


THE PROCESS OF DIGITAL TRANSFORMATION IN EDUCATION DURING THE COVID-19 PANDEMIC

Israel Barrutia Barreto^A, Rosa Marlene Sanchez Sanchez^B, Walter Sanchez Sanchez^C, Olger Huamani Jordan^D, Jose Daniel Borja Escalante^E



| ARTICLE INFO | ABSTRACT |
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| <p>Article history:</p> <p>Received 09 June 2023</p> <p>Accepted 07 September 2023</p> | <p>Purpose: This document seeks to delve into the digital transformation of education during the COVID-19 pandemic, aiming to provide a comprehensive understanding of this evolving phenomenon's purpose and significance.</p> |
| <p>Keywords:</p> <p>Education; Pandemic; Virtual; Post-COVID-19.</p> | <p>Design/Methodology/Approach: The research approach undertaken is characterized by a non-experimental, documentary, exploratory, and descriptive study methodology, which involves an extensive examination of existing literature and data to gain insights into the digital transformation in education during the pandemic.</p> |
|  | <p>Findings: The study's key findings revolve around the consensus in existing literature regarding the swift acceleration of the transformation of education from traditional face-to-face classes to virtual learning environments. It also highlights the implications of this transformation, particularly in reshaping teaching models and advocating for a hybrid approach encompassing both face-to-face and virtual learning.</p> <p>Research, Practical & Social implications: The implications of this research extend to informing educational institutions about the need for digital adaptation, guiding policymakers in supporting adaptable learning models, and empowering educators with a deeper understanding of the changing educational landscape. Moreover, it considers the broader societal impact, including equity and access issues in education.</p> <p>Originality/Value: This research is unique in its contribution to understanding the profound impact of the COVID-19 pandemic on education. It emphasizes the significance of adaptability and hybrid learning models while providing a foundation for future educational research and policy development.</p> <p>Doi: https://doi.org/10.26668/businessreview/2023.v8i9.3770</p> |

O PROCESSO DE TRANSFORMAÇÃO DIGITAL NA EDUCAÇÃO DURANTE A PANDEMIA DA COVID-19

RESUMO

Objetivo: Este documento procura aprofundar a transformação digital da educação durante a pandemia da COVID-19, com o objectivo de fornecer uma compreensão abrangente do propósito e significado deste fenómeno em evolução.

Desenho/Metodologia/Abordagem: A abordagem de investigação empreendida é caracterizada por uma metodologia de estudo não experimental, documental, exploratória e descritiva, que envolve um exame extensivo

^A Doctor in Administration. Facultad de Administración, Universidad Nacional Federico Villarreal. Peru.

E-mail: ibarrutia@unfv.edu.pe Orcid: <https://orcid.org/0000-0002-5728-0651>

^B Doctor in Law. Facultad de Derecho, Universidad Nacional Federico Villarreal. Peru.

E-mail: rsanchez@unfv.edu.pe Orcid: <https://orcid.org/0000-0002-3434-3293>

^C Doctor in Law. Facultad de Derecho, Universidad Nacional Federico Villarreal. Peru.

E-mail: wsanchez@unfv.edu.pe Orcid: <https://orcid.org/0009-0000-7917-2769>

^D Master in Educational Administration. Facultad de Educación, Universidad Nacional Federico Villarreal. Peru.

E-mail: ohuaman@unfv.edu.pe Orcid: <https://orcid.org/0000-0001-8377-8018>

^E Doctor in Education. Facultad de Educación, Universidad Nacional Federico Villarreal. Peru.

E-mail: jborja@unfv.edu.pe Orcid: <https://orcid.org/0000-0001-9011-0358>

da literatura e dos dados existentes para obter insights sobre a transformação digital na educação durante a pandemia.

Constatações: As principais conclusões do estudo giram em torno do consenso na literatura existente sobre a rápida aceleração da transformação da educação de aulas presenciais tradicionais para ambientes de aprendizagem virtuais. Também destaca as implicações desta transformação, particularmente na remodelação dos modelos de ensino e na defesa de uma abordagem híbrida que abranja tanto a aprendizagem presencial como a virtual.

Implicações de investigação, Práticas e Sociais: As implicações desta investigação estendem-se à informação das instituições educativas sobre a necessidade de adaptação digital, orientando os decisores políticos no apoio a modelos de aprendizagem adaptativos e capacitando os educadores com uma compreensão mais profunda do cenário educativo em mudança. Além disso, considera o impacto social mais amplo, incluindo questões de equidade e acesso à educação.

Originalidade/Valor: Esta investigação é única na sua contribuição para a compreensão do profundo impacto da pandemia da COVID-19 na educação. Enfatiza a importância da adaptabilidade e dos modelos de aprendizagem híbridos, ao mesmo tempo que fornece uma base para futuras pesquisas educacionais e desenvolvimento de políticas.

Palavras-chave: Educação, Pandemia, Virtual, Pós-COVID-19.

EL PROCESO DE TRANSFORMACIÓN DIGITAL EN LA EDUCACIÓN DURANTE LA PANDEMIA COVID-19

RESUMEN

Propósito: Este documento busca profundizar en la transformación digital de la educación durante la pandemia de COVID-19, con el objetivo de brindar una comprensión integral del propósito y la importancia de este fenómeno en evolución.

Diseño/Metodología/Enfoque: El enfoque de investigación empleado se caracteriza por una metodología de estudio no experimental, documental, exploratoria y descriptiva, que implica un examen extenso de la literatura y los datos existentes para obtener información sobre la transformación digital en la educación durante la pandemia.

Hallazgos: Los hallazgos clave del estudio giran en torno al consenso en la literatura existente sobre la rápida aceleración de la transformación de la educación de clases tradicionales cara a cara a entornos de aprendizaje virtual. También destaca las implicaciones de esta transformación, particularmente en la remodelación de los modelos de enseñanza y la promoción de un enfoque híbrido que abarque el aprendizaje presencial y virtual.

Investigación, Implicaciones prácticas y Sociales: Las implicaciones de esta investigación se extienden a informar a las instituciones educativas sobre la necesidad de adaptación digital, guiar a los formuladores de políticas para que apoyen modelos de aprendizaje adaptables y empoderar a los educadores con una comprensión más profunda del cambiante panorama educativo. Además, considera el impacto social más amplio, incluidas las cuestiones de equidad y acceso a la educación.

Originalidad/Valor: Esta investigación es única en su contribución a comprender el profundo impacto de la pandemia de COVID-19 en la educación. Enfatiza la importancia de la adaptabilidad y los modelos de aprendizaje híbrido, al tiempo que proporciona una base para futuras investigaciones educativas y desarrollo de políticas.

Palabras clave: Educación, Pandemia, Virtual, Post-COVID-19.

INTRODUCTION

On March 11, 2020, The Who declared as a pandemic the new disease originated at Wuhan, China, and in less than 3 months, it spread almost worldwide. The instant effect of the pandemic was the significant disruption of almost all human activities. Likewise, the rapid spread of this new virus caused two types of concomitant situations: on one side, the sanitary crisis, which affected millions of people, either by infection and suffering effects in health or by the deaths due to lack of information about specific treatments for the disease. On the other

side, the productive and economic social crisis linked to the imbalance between supply and demand results from the effects of the pandemic spread and the measures to face it. In this sense, the coordination of general policies and specific strategies trying to stop the spread of the disease worldwide was unflinching (Blackman *et al.*, 2020).

As a principal strategy, the governments worldwide, following the WHO recommendations (WHO, 2020), implemented several measures: the closure of work and education centers, remote working, suspension of domestic and international movement (land and air), among others. Thus, to control the virus spread, almost all the countries closed the education centers, affecting 90 % of the student population worldwide (WHO, 2020). The backdrop in this unexpected drama worldwide, governments, organizations, and institutions of the tertiary sector have implemented multiple political alternatives to face the contingency and continue with the academic activities seriously affected. Different reports show the multiple approaches and disagreements related to three things: how and what to teach (the activities and the workload of teachers and professors); where to teach (what type of environments, applications, methodologies, and teaching tools); and what type of effects are developing regarding the equity of education (Zhang *et al.*, 2020). Most countries had managed their efforts to the deployment of technology as a tool in virtual learning. The researches worldwide show the persistent deficiencies in the infrastructure of telecommunication; environment; hardware and software; lack of training or inexperience of teaching staff; the unclear and contradictory information from plan organizers and managers; proposals to consider against the social asymmetry; the complex familiar environment of students; among others. (Oluwatimilehin *et al.*, 2021).

Since World War II, the educational offering has increased steadily; however, the pandemic and the guidelines derived from governments imposed an unprecedented and untimely change: face-to-face classes should become virtual classes. Notwithstanding the differences and limitations, the present situation emphasized the necessity of taking directives to mitigate the pandemic effects in education. The Chinese government took the first intervention; an initiative called “suspending classes without stopping learning” was launched by China to continue the teaching-learning process during the coronavirus pandemic without disruptions (Zhang *et al.*, 2020). Huang *et al.* (2020) suggest that the approaches to face and deal with the present educational problems must focus on the production and escalation improvement of educational computing. In that sense, they propose to prevail the equipment of hardware, and skills and training to teachers and students, preferring the standardization of

education at home so that teachers have online training, thus supporting the educational research to all students, including those with particular needs (difficulties in virtual learning.)

A report submitted by UNESCO (2020) suggests that the entities involved in education should find alternative ways of learning for children, teenagers, and young adults who had to be away from educational centers; all of this makes necessary the launching of equivalence and "bridge" programs accredited and approved by the government to shape a submission of flexible learning in formal and informal environments during a state of emergency (Huang et al., 2020). In this context, the use of ICT induces teaching staff to train to meet a generation that, in one way or the other, facing asymmetries and imbalances, had already been exploring the world of new technologies. Ali (2018) revealed strong relationships between students and ICT, being the context and the perceptions mentioned the amalgam that provided the necessary encouragement to the strategies' implementation of virtual classes.

At this time, there is a combination of unique elements managing the range of concomitant variables referred to the growing importance of digital connectivity via the internet in all productive, distribution, and service sectors, and the crisis triggered by the COVID-19 (Ríos, 2020). Of this conjunction of factors, from different sectors of society, several ideas have emerged from the necessity of reinventing and implementing more developed dynamics in solutions to the challenges in sectors such as economy, trade, politics, entertainment, and, particularly, education. All problems and challenges not resolved yet, and those pending in Latin America education, become more complex with the pandemic spread; some topics such as growth without quality, inequality in education access and achievements, progressive loss of government expenditure on education, among others.

Analysing the pandemic effects and offering recommendations to governments and higher education institutions, UNESCO (2020) and International Institute for Higher Education in Latin America and the Caribbean — IESALC (2020) state that: a) there is no planned and organised dynamic to extensively and intensively use in classes and assistance, and monitoring costs and resources to ensure the possibility to continue with the training schemes; b) those who did not have opportunities of quality, continuity, and ICT use are at the mercy of the dissociation of educational formation and learning process, giving rise to more possibilities of abandonment of the education system; c) in Latin America and the Caribbean, there is a necessity of changing the good-quality interconnection offers, stability in service, affordable costs and prices, and availability of mobile network coverage, in which the average of interconnected homes does not exceed 50 %; d) this situation involves an opportunity to guide

the efforts of educational institutions and offer solutions about technology so that students and teachers can access platforms, content, courses, among others; e) at least; 25 % of university students will be removed from the programs as a result of the use and availability situation of educational resources of teleinformatics; and f) they suggest all the actors be prepared for the reopening of higher education institutions and focus on activities considered less important. These activities involve the following: programs of health monitoring and support, adjustment of calendars, the contribution for pandemic mitigation, and moving from the extempore planning and approach of health emergency to the planning and the preparation to reopening in a recessive scenario with cuts in public investment in education. In this sense, the challenge around education is attending pedagogical, economic, and socioemotional demands of those who experience greater difficulties in continuing their training, now in a non-traditional modality (IESALC, 2020).

The different international multilateral agencies made various comments about how the pandemic has affected education. Firstly, the estimations made by the World Bank (2020b) and UN (2020) indicate that it is an unprecedented event that has a double impact on education: a) the closure of educational institutes, and b) effects result from the economic recession that will have a long-term impact; even, combined with the difficulties caused by the promptness of the countries' appropriate response to face the crisis. On the other side, early data analysed by ECLAC (2020) states that the impacts will have several costs in the human capital accumulation, its formation, and the development and well-being perspectives. In summary, the crisis generated in education can be in the following ways: a) high educational costs and impacts on health, translated into terms of learning disruption, reduction in the feeling of belonging to the school, an increase of inequalities on education, among others; b) impacts in educational supply and demand; and c) the long-term effects will increase the already fragile situation on education worldwide, contributing to the reduction of human capital, increasing inequalities in learning, among others. Despite all effects and severe consequences unavoidable, ECLAC (2020) believes that if the governments' response is prompted, with adequate planning and programming, the crisis can become an opportunity to change the educational systems into systems with higher resilience; inclusiveness; and efficiency.

Likewise, the ECLAC (2020) considers 3 stages in public politics planning to reverse the negative effects of this crisis: 1) combating the pandemic, as has been in the first year; 2) learning continuity management, and 3) the stage of improvement and acceleration learning. The first stage has been signed by the responses of each country to face the sudden institutions'

closure, prioritizing health, security, and student learning, without forgetting the components of the educational system. In the second stage, simultaneously with the ease of the confinement measures, social distancing, and mitigation of the pandemic, it should be ensured that various institutions safely organize the process of reopening, keeping in mind to ensure as least desertion as possible and the education recovering. The third stage oriented to accelerate learning provides the opportunity to rebuild the education systems to be more equitable and robust, and promote efficient approaches to reduce the gaps in education. It includes innovations that efficiently use communication technologies to support and develop distance learning systems; moreover, incorporate technology for the early detection of possible cases of school desertion, adequacy of pedagogical programs, study plans adapted to the right level, and the promotion of the material and socioemotional support to parents, teachers, and students.

The last stage pointed by the ECLAC (2020) is the concept of the utmost importance of digital transformation. In the pandemic and post-pandemic context, digital transformation is a crucial process; since it suggests the integration of digital solutions in common life, especially in education. Likewise, it intends to enhance traditional solutions and open up opportunities for innovation and approaches that can revolutionize the perception of how things are made. One of the principal objects of the digital transformation process is the improvement of business processes to meet clients' demands through the intensive and extensive use of technology and the involved data. In the field of education, in this approach, teachers, students, and education staff would be the target consumer; in that way, the pair student-teacher will benefit from digital transformation (Goldin & Katz, 2008). Likewise, the purpose of the digital transformation process must include, but not be limited to providing a wide range of virtual learning options, using technology in the classroom, and monitoring the learning process, allowing students to use mobiles or web applications in their learning process, and the virtual classes' enablement. In that sense, this document aimed to explore and describe the process of digital transformation in education during the COVID-19 pandemic.

METHODOLOGY

A non-experimental, documentary, exploratory and descriptive study. This study involves the complexities associated with the concomitant relationships between the variables: distance or online learning, quarantine, and social distancing in the COVID-19 pandemic. Between 2020 and 2021, a systematic review of published studies was made, trying to interpret more than giving added aspects. Also, rigorous qualitative methods are used for the synthesis

of the existing qualitative studies. The study applied the exploratory approach of the systematic literature review proposed by Kitchenham (2004).

RESULTS

Global Context

According to the OMS data, at the end of August 2021, it was reported 219 million confirmed cases of COVID-19, 4.55 million deaths, and 213 countries affected by the virus. In this context of constant evolution, the most important measures taken worldwide have been containment and mitigation of the virus spread. In the case of education, the vast majority of governments have opted for the closure of education centers, and they have focused on learning use and online education. New York University in Shanghai and Duke University in Kunshan are emblematic cases because they gave examples of the short-term and efficient adjustment and adaptation of services and educational products with digital technology. However, most educational institutions had to adapt to vertiginous paces and depend on the virus spread in all countries. Consequently, the digital divide has been unfathomable; on one side, several students suffered minor disruptions in the continuity of their studies; while, others had extended periods of waiting and adaptation to the implementation of those solutions (UNESCO, 2020; ECLAC, 2020; World Bank, 2020a).

The pandemic revealed that most countries and institutions lack resources and digital capital. Accordingly, the measures of virtual education implementation face the obstacles of improvisation, weakness of the communication infrastructure, lack of training, and weak development of ICT competencies between students and teachers. Considering that social distancing is as essential as the quarantine in the fight against the COVID-19, the general trend worldwide was to use digital systems in all educational activities (courses, tests, researches, among others). At the level of secondary and primary education, the responsibility of making the change and the creation of platforms, resources, and solutions felt on the ministries or entities responsible for managing those education sectors (Czerniewicz, 2020). In the light of the analysis of the events, the change was unavoidable; since the spread and seriousness of the pandemic demanded it to the people's health security. In that sense, the response to the challenges of the COVID-19 pandemic has forced organizations of the service sector, especially education, to rapidly adapt to the practices promoted by the technology of information and communication with severe limitations (Carroll & Conboy, 2020), expecting that the digital transformation continues increasing with the pandemic evolution and post-pandemic.

The World Economic Forum has identified 10 technology trends that, from its point of view, are eminent to face the pandemic and possible similar outbreaks in the future, including distance education (Xiao & Fan, 2020). Moreover, among these trends, there are digital and automation components that pretend to become physical contact services into technology services. These trends promise to have a wide range of possibilities of process improvement, optimization, and efficiency. Likewise, the crucial point is associated with the complication of digital technology adoption, which tends to meet with the adjustment processes and resistance that take time to its complete implementation, disregarding those cases in which the available resources and digital capital are insignificant.

Finally, Andersen *et al.* (2020) notice the so-called Digital Sclerosis arose from the immature technology implementation, characterized by the stiffening of service provision, reduction in innovation possibilities, and the failure to respond to the changes in demand. It incites the careful monitoring of implementation and the evolution of digital education; besides that, digital education has a methodical design, development, and deployment; since its initial adoption has been rapid, sudden, and no-planning during the pandemic evolution.

Trends in Education as a Result of the Pandemic

Since the pandemic burst, private and public sectors have promoted and provided educational content combined with teachers' contributions worldwide. In most cases, the contents are contextual; some cost and others are free. The two principal trends in education directly related to the spread of the COVID-19 pandemic and the phenomenon of digital transformation are the increasing innovations in educational technologies and the expansion of digital education. In the case of the first trend that refers to expansion, development, and innovation in educational technologies, the literature shows that virtual education was the most appropriate solution because most governments worldwide closed their education centers (Bedenlier *et al.*, 2021). The learning content was accessible through communication technologies, distance education, and educational technologies (EdTech), so, thanks to the pandemic, the education field has a challenge and an opportunity to the innovation and the adoption of technologies that have emerged and developed before the advent of the internet as a social phenomenon.

The EdTechs have shown a high level of innovation; because they have progressed with the deployment of new computing devices, such as cell phones, tablets, and the increased digitalization of texts and teaching material. On their own, these tools do not improve the

efficiency or the effects in learning, much less modify the education; because they existed before the pandemic in education. Another innovation of the EdTechs is the so-called Learning Management System (LMS), which is a software that companies use to manage, document, and monitor the courses and programs of online training; this software was created at the end of the last century. The LMSs are widely used in the field of education, existing platforms with low cost and even free. The reasons for its use were evident: they have improved the efficiency in the preparation of learning, educational courses management, and the communication between teacher and students; also, they have social networking features in which teachers, students, parents, and guardians interact as it was a social media (Kant *et al.*, 2021).

Likewise, the LMS technology can improve the efficiency of learning material and methodology in education; most of them have software applications that work on smartphones. Researches made in Japan; at the beginning of the LMS use; show that the employ of educational applications based on cell phones or other devices improved the interaction between teacher and students (Nakane, 2005). Another innovation in the EdTechs is the use of Artificial Intelligence as an education tool; these collect data about performance, evolution, and comprehension level in students, these are analysed and provide suggestions and recommendations to improve them. In this way, for the sectors that maintain that personalized education is the ideal one, these advances give the opportunity of education for individual students, this should improve the effects of education (Setiawan *et al.*, 2021). Combined with the LMS, the so-called approach Observe, Orient, Decide, Act (OODA) is a loop of feedback (Silvander & Angelin, 2019); this approach has its basis on the idea that computing devices provide educational content generating the data that are used, if it is required, as a new entrance to adequate and improve those contents through the repetitive use of the feedback loop.

The second trend in the context of distance education expansion as a result of the pandemic was the exploration and application of distance learning methods on an unprecedented scale. Notwithstanding the practices of distance education existed a long time before the COVID-19 pandemic, they were not widespread; since most learning activities were made in the classroom. In a short period, distance education became usual, and they reached various places depending on the connectivity and infrastructure. Therefore, the distance learning is based on interactivity with diverse modalities that involve platforms, collaborative learning, tutorial, and education guided by teachers. There are two predominant modalities of distance learning based on the internet:

Recorded online classes

The courses widely used are the so-called Massive Open Online Courses (MOOCs). The MOOCs are online platforms that provide free courses, allowing students to learn in a self-paced manner and personalize their studies. The flexibility of MOOCs comes from ubiquity; a person can take courses anywhere at any time. In general, these courses are available for high education, but there are no alternatives adapted to the study plan of primary education. Due to the conditions of the technology evolution, the different or improved versions of MOOCs could be the basis for people who want to learn new skills while working, can do it (Torres-Toukoumidis *et al.*, 2021).

There is a wide range of these courses on the Internet that Universities use. Chuang y Ho (2016) described the effects of the phenomena EdX of MIT and Harvard University; through this platform, people receive a certificate after completing and passing the course. Between 2016 and 2021, they found that the number of registered people constantly increased; however, just 5.5 % of 2.4 million registered people had received the certificate during that period. Other studies maintain similar results: completion rates are between 2.3 % and 19.5 % for an average of 6.5 % (Chuang & Ho, 2016). In that sense, the researches of Chuang & Ho (2016) and Reich & Ruipérez-Valiente (2019) show that the types and tools of distance education do not guarantee the full use of the online education content.

Interactive and live online courses

The other trend, which education centers used most until now (UNESCO, 2020), is interactive online learning, especially virtual conferences such as broadcasting or streaming. Unlike the MOOCs that most of them are pre-recorded and based on asynchronous learning; these courses use the synchronous learning method in which students can participate in real-time, promoting bidirectional communication and encouraging students to participate, ask in real-time, and discuss the activity with teachers, even if they are in remote or physical places. In general, these courses have specific periods of study and depend on each education center; for that reason, they do not have an education curriculum developed by other centers (Bedenlier *et al.*, 2021).

Limits in the Digital Transformation of Education

The COVID-19 pandemic has generated several concerns in education that international forums have expressed in different ways (UNESCO, 2020; ECLAC, 2020; World Bank,

2020b), mainly for the suspension of classes and the closure of education centers, even with a virtual alternative to continue with education. However, virtual transformation in education generates concerns about its haste implementation in the education system, causing uncertainty in the results. The most important trends in this area are: (1) education inequality arose from the so-called digital divide; (2) the lack and deficit of motivation management in teachers, students, and parents; and (3) the possible negative impact of computing devices — such as computers, tablets, and smartphones— in education. Likewise, not all of these concerns arose from the pandemic; some arose from the pre-pandemic:

1. The recent concept of the digital divide refers to the inequality in society between people who can access education using ICT and those who can partially access education or not. The reports in the pre-pandemic show that this digital divide exists not only between rich and poor countries but also in regions of the same country (Nicolau et al., 2020). To provide technology solutions in the education field, it is necessary having a suitable infrastructure of telecommunication and informatics. Likewise, the universalization of equipment and high-quality connectivity is the precondition for students and teachers to access the technology potentials. In other words, if the access to digital infrastructure dot not improve, the advance and digital transformation in virtual education will increase the gaps of existing inequality (Neidhöfer et al., 2021).

2. The deficit and lack of motivation management. According to various experts, virtual education will be the prevalent learning method that will replace traditional education in the short term. However, the effect of distance education on learning success and education is not still clearly defined; the education effects of online and interactive classes are relatively new, and there is no guarantee that students completely took advantage of the resources and contents, so this is an open research area (Reich & Ruipérez, 2019). Ito *et al.* (2019) found that the EdTechs do not motivate learning since the increase in technology use does not guarantee that learning expectations impact self-esteem levels and motivation to succeed; consequently, despite having suitable and high-quality education resources, the motivation in most students disappears.

3. The negative impact of computing equipment uses, the provision of equipment, and quality connectivity are the premises for distance education and the access platforms with learning content. However, researchers, teachers, parents, and authorities worry about how students, especially minor children, use computing devices. Studies previous

to the pandemic show that students admit that, although computing devices are sources of entertainment, they use them considering that the relation cost/benefit is favorable for them (Kay & Lauricella, 2011; Ito et al., 2019). The report of the OECD (2015) found that there were no significant differences in the improvement of reading, sciences, or maths skills between students who invested in ICT and those students of other countries who did not make that investment.

DISCUSSION AND CONCLUSIONS

In 2020-2021, the education field spent two transcendental events: the spread of the COVID-19 pandemic and the education transformation due to the indefectible necessity of implementing digital technologies as a strategy to continue with the education process. The exponential growth of the population that uses ICT opened up the possibilities of implementation of online learning in the last 30 years, making a qualitative leap in its application due to the pandemic scenario. The present trends in tools and platforms of online learning depend on the Learning management system (LMS), Massive Open Online Courses (MOOCs), videoconferences such as broadcasting or streaming, several types of educational applications, and supporting technology. All of this shows the potentials of implementing and consolidating the new method to deal with the learning process.

The literature agrees that education evolution, from face-to-face classes to virtual classes, had an early boost due to the pandemic. The result shows that each actor (teachers, students, centers, CEOs, and parents) faced- and faces- many obstacles in the adaptation process of this new stage. The obstacles urge centers and governments to provide coordinated and consensual alternatives to activate the required resources to remove barriers in the transformation of education, which will result in a reshaping of the teaching models and the adaptation to new paradigms. Thus, the significance of the transformation of education and the adaptation to remote learning and virtual education demand studies that make it possible to find the impact of this type of education resulting from the cause that incited the adaptation to the education system.

Return to normal for education centers worldwide is uncertain (ECLAC, 2020). In this scenario, the purpose of the transformation of the education system progress as the available technological tools are incorporated to implement the process of educational disruption that promotes resilience and new ways of thinking, making, and creating. In the post-pandemic scenario, education will emerge with an unprecedented experience in asymmetric

universalization processes in virtual classes, which demand planning for the disruptive education era. In the perspective of digital transformation, it is insufficient that organizations and government entities pronounce alignments to alternative calendars and use technology and tools of teleinformatics to promote different types of virtual education. In this way, it is essential to accompany this initiative with policies oriented to close gaps in technological and physical infrastructure, services, resources, equipment, development of competencies of teachers and students, and innovation process in the creation of the courses. All of this is oriented to mitigate the evident digital divide during the pandemic in a heterogeneous, unequal, and combined environment and situation.

A widespread argument in the literature formulates that notwithstanding all efforts of teachers to make maximum use of tools, students are those who will be most affected by the digital divide expansion, which particularly aggravates in regions with problems of electricity supply, lack of mobile devices, or with cell phones but not internet, whether due to high prices, or lack of quality service (Romero-Rodríguez et al., 2020). Likewise, there are considerable differences in the accessibility and quality of teachers in public and private education centers (Budi et al., 2020; Arora & Srinivasan, 2020; Qian-Hui, 2020). Combined with this, studies show that; if the integration of technologies, communication, and participation between teachers and students is not good, the learning process becomes an activity focused on the teacher-instructor-tutor and not on the student (García et al., 2015). In the same vein, Moorhouse (2020) identified the trend towards courses digitalization in the adaptation process of teachers to virtuality; without being trained to do it.

The limitations that arose from the COVID-19 containment do not yet provide the evaluation and monitoring metrics of the impact in virtual education and the dynamic of the transformation processes from face-to-face to the virtual model; therefore, Chang et al. (2020) suggest the advance of field investigations that compare both types of education. In that context, it prevails the questions that try to respond if there are aspects that remote education does not solve, for example, the attitudes and movements expressed by the students in a face-to-face course, the understanding difficulties of topics may not be as critical as in a face-to-face class, among other elements that form a group of criticisms discussed by those who are not sure about the appropriate and widespread use of remote courses (Lall & Singh, 2020).

During the pandemic, remote education has been essential; however, digital education is far from replacing traditional face-to-face learning. The most meritorious trend is the guidance in a parallel environment since it is still necessary to evaluate all the experiences of

this social experiment at a no planning, global, and massive scale, in a way that leads to ensure that bidirectional communication between teacher and student that is typical in classrooms and assure this scenario in a digital version of learning. In summary, it is necessary to clarify how the technology intervention and the efforts to solve the pernicious digital divide (Boeren et al., 2020) will be solved or mitigated, considering that these should be fundamental to the development of society.

The COVID-19 pandemic marked the period of radical changes in many aspects of human life where the pass from face-to-face to virtual era is still considered a syncretic process in which remote learning (based on technology) constitutes a complement without replacing the bidirectional and face-to-face learning process. For the moment, remote or distance education has eclipsed the face-to-face one, demanding trends of automatization and innovation, which do not result in the unfailling face-to-face education in the short or medium-term arising from the remarkable asymmetries.

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