THE SHIFT TO THE 5.0 REVOLUTION: THE CHALLENGES OF PUBLIC EDUCATION IN COSTA RICA

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ABSTRACT

Objective: The objective of this qualitative, exploratory, and descriptive study was to understand the causes and effects contributing to a specific phenomenon.

Theoretical Framework: The study is contextualized within the realm of virtual education and digital transformation, emphasizing the need for a more active and dynamic approach in state support for students.

Method: In-depth interviews and a bibliometric review were employed to identify key factors and comprehend the phenomenon under investigation.

Result: It was found that students demand more active and dynamic state support, with measurable objectives, in line with the online teaching model and digital transformation goals.

Discussion: It was concluded that the success of virtual education requires an agile, flexible, and dynamic teaching model that aligns with national objectives.

Research Implications: This study suggests the need for reforms in virtual education to align with national digital transformation goals. Additionally, it underscores the importance of a more dynamic and measurable approach in state support for students.

Originality/Value: The combination of qualitative methods and bibliometric review provides a unique perspective on the challenges and opportunities in virtual education, representing a significant contribution to both academia and educational policies.

Keywords: Accessibility, Secondary Education, Online Learning, Digital Transformation, Technology.

A TRANSIÇÃO PARA A REVOLUÇÃO 5.0: OS DESAFIOS DA EDUCAÇÃO PÚBLICA NA COSTA RICA

RESUMO

Objetivo: O objetivo deste estudo qualitativo, exploratório e descritivo foi compreender as causas e efeitos que contribuem para um fenômeno específico.

Referencial Teórico: O estudo é contextualizado dentro do âmbito da educação virtual e da transformação digital, enfatizando a necessidade de uma abordagem mais ativa e dinâmica no apoio estatal aos estudantes.

Método: Foram utilizadas entrevistas em profundidade e uma revisão bibliométrica para identificar os principais fatores e compreender o fenômeno em questão.

Resultado: Verificou-se que os estudantes demandam um apoio estatal mais ativo e dinâmico, com objetivos mensuráveis, em consonância com o modelo de ensino online e os objetivos de transformação digital.

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Discussão: Concluiu-se que o sucesso da educação virtual requer um modelo de ensino ágil, flexível e dinâmico que esteja alinhado com os objetivos nacionais.

Implicações da Pesquisa: Este estudo sugere a necessidade de reformas na educação virtual para se alinhar com os objetivos nacionais de transformação digital. Além disso, destaca a importância de uma abordagem mais dinâmica e mensurável no apoio estatal aos estudantes.

Originalidade/Valor: A combinação de métodos qualitativos e revisão bibliométrica proporciona uma perspectiva única sobre os desafios e oportunidades na educação virtual, representando uma contribuição significativa tanto para a academia quanto para as políticas educacionais.


LA TRANSICIÓN A LA REVOLUCIÓN 5.0: LOS DESAFÍOS DE LA EDUCACIÓN PÚBLICA EN COSTA RICA

RESUMEN

Objetivo: El objetivo de este estudio cualitativo, exploratorio y descriptivo fue comprender las causas y efectos que contribuyen a un fenómeno específico.

Marco Teórico: Se contextualiza el estudio dentro del ámbito de la educación virtual y la transformación digital, destacando la necesidad de un enfoque más activo y dinámico en el apoyo estatal para los estudiantes.

Método: Se emplearon entrevistas en profundidad y una revisión bibliométrica para identificar los factores clave y comprender el fenómeno en cuestión.

Resultado: Se encontró que los estudiantes demandan un apoyo estatal más activo y dinámico, con objetivos medibles, en consonancia con el modelo de enseñanza en línea y los objetivos de transformación digital.

Discusión: Se concluyó que para el éxito de la educación virtual se requiere un modelo de enseñanza ágil, flexible y dinámico que cumpla con los objetivos nacionales.

Implicaciones de la Investigación: Este estudio sugiere la necesidad de reformas en la educación virtual para alinearse con las metas nacionales de transformación digital. Además, destaca la importancia de un enfoque más dinámico y medible en el apoyo estatal a los estudiantes.

Originalidad/Valor: La combinación de métodos cualitativos y la revisión bibliométrica aporta una perspectiva única sobre los desafíos y oportunidades en la educación virtual, lo que representa una contribución significativa tanto para la academia como para las políticas educativas.

Palabras clave: Accesibilidad, Educación Secundaria, Aprendizaje en Línea, Transformación Digital, Tecnología.

INTRODUCTION

Starting from a scenario of uncertainty, a series of questions arise that make us think beyond what happens in an educational center, entering the deepest spheres of the academic sphere of a nation. Undoubtedly, we are at a turning point where a series of concerns arise, such as who
is prepared to face the challenge of a pandemic, those who have managed to travel several years in the digital world, or those who are just starting?

Since the onset of the global crisis, students worldwide have had to deal with a series of obstacles, moving to an online learning modality. Among the challenges, some of them minor or major, have been characterized by the scarcity of resources and the urgent need to update educational programs to the work dynamics of the future. It is here where teachers, students, authorities, and parents must adapt to a world where virtual learning is necessary.

According to this paradigm, UIT (2021) identified that 37% of the world's population (2.9 billion people) lacks access to the Internet. This connectivity gap presents a discouraging scenario for students around the world, with higher levels of resonance in developing countries and vulnerable situations. Based on this context, a barrier is built in the advancement of future generations, restricting their path towards a world where education will increasingly constitute the basis for professional stability and a higher quality of life, and this problem is not alien to Costa Rica. The study presented by CEPAL-UNESCO (2020) highlights that the digital divide is caused by the lack of government investment and the social inequalities that have been dragging on for years.

Consequently, the transition to virtuality is seen as a challenge of unprecedented magnitude in addressing the pressing need to reformulate and adapt the educational methodology to respond to the needs of the student environment. In such an environment, questions still need to be addressed, such as a) What underlying factors have perpetuated the connectivity deficiency at national and international levels? B) Could the lack of sound governance, lack of focus on teaching, or underutilization of Information Technology (IT) influence the present global situation, and c) What factors have led to the current global situation? The above seeks safe navigation in the learning process in the digital transformation era. Amid this scenario, the research question to be answered starts from the following: How has the pandemic affected connectivity in Costa Rican public secondary education?

The main objective will be to expose the affectation experienced by students in public schools in Costa Rica, starting from connectivity during the virtual classes adopted in response to the COVID-19 pandemic, delving into the technological challenges that this new educational dynamic required from students, both current and future. Seeking to address this issue scientifically, guidelines were established to identify the affected areas with their respective sequels and to reflect experiences in other countries to understand whether existing educational practices have been modified. Finally, to validate the relevance and impact of technology in the academic context through in-depth interviews in the field of study.
2 LITERATURE REVIEW

The Internet is a network of networks (Castells, 2010). In general, access to cyberspace provides valuable support for information, communication, business, and leisure, as previously highlighted, but why is it not also used in education? The Internet has somehow come to provide opportunities and, in turn, transform itself according to people's innovations and needs. Ultimately, the idea of technology is to facilitate the routine tasks of human beings (González, 2018). However, with the new reality of COVID-19, it has become a bewilderment both in the world and for Costa Rica; a standstill that simply could not be given taking into account the different activities that are performed and contribute as a whole in society since life and the economy cannot stop (Swissinfo, 2022).

The UIT (2021) highlights that, due to contingency measures at the time of the spread of the virus, connectivity increased by more than 10% only in the first year of the pandemic, and assumed that it was the most significant annual increase in a decade. However, discouragingly, globally, the people counted who had the opportunity of connectivity could maintain an Internet connection, but infrequently, through shared devices or with limited speeds, in addition to the other part that does not have this privilege, 96%, highlighting the developing countries (IWS, 2021).

This digitally excluded part includes marginalized populations due to poverty, illiteracy, limited resource access, knowledge deficit, and digital skills. Hence, a connectivity gap provides a bottleneck for other people in the digital progress (UIT, 2021). Thus, what is the relevance of the intersection of technology or connectivity with education? First, it is estimated that, on average, people mainly use cell phones to be able to interact with the Internet in different ways, and it is in constant change; for example, in 2019 alone, it was estimated that 4390 million people spent connected an average of 6 hours and 42 minutes a day, of which, much of it is used for social networking and e-commerce (We-Are-Social, 2020). In contrast to 2020, the year in which, precisely, most countries were affected by the pandemic, the flow of Internet users increased to 4540 million people online, which is an Internet penetration of 60% (We-Are-Social, 2019).

Despite the latter, approximately 3.2 billion people in the world are disconnected (We-Are-Social, 2020), so, in terms of education, COVID-19 has reminded us that the worst possible scenario can be presented due to inequalities regarding Internet access, thus generating digital divides, since 463 million students, that is, one-third of the Costa Rican population, do not have access for online learning (UNESCO, 2021). Figure 1 shows the Venn diagram representing...
The intersection of technology and education, showing how connectivity and digital divides affect students and society in general (Heberle et al., 2015).

**Figure 1**

*The intersection of technology and education: connectivity and digital divides*

In Figure 1, sets A and B represent technology and education, respectively; the meeting of both shows how technology is integrated into the educational environment, validating the lack of technological access as the central element that leads to digital divides in education (Heberle et al., 2015). Successively, in the learning processes, mobile devices, specifically smartphones and tablets are necessary tools to access online educational resources because their portability and connectivity allow learning anywhere and anytime, making acquiring knowledge more flexible (Cabero-Almenara, 2017).

On the other hand, access to education through online platforms has taken teaching to another level, enabling access to and use of resources democratizing learning without detriment to geographical barriers, as stated by Gómez-Gallardo and Macedo-Buleje (2010). However, despite advances in the integration of technology in learning processes, digital divides are still present (CEPAL, 2022). The lack of access to devices and their respective connectivity, especially in low-income communities, increases inequality in the online learning (Villalobos-Solís, 2020).

Throughout history, Costa Rica has reiterated its commitment to education as a central axis of development; despite this, the pandemic has unveiled risks to the fulfillment of the rights of students and even the achievement of the Sustainable Development Goals since 60% of them...
The Shift to the 5.0 Revolution: The Challenges of Public Education in Costa Rica

during the pandemic had access to the educational platform; At the same time, the rest continued the distance learning process by means such as WhatsApp, offline and printed digital resources (SUTEL, 2022).

In addition, only 34% of students have equipment and full connectivity, 29% have limited access to both, and the remaining to neither (UNICEF, 2021). Therefore, a reinvention is also needed in education, since it is part of a basic basket of essential services; with the development of skills such as IT, for consistent competition, since there is a danger of falling behind, which brings lags and consequences in the future of students and, at the same time, the development of the country (UNESCO, 2020); this problem is part of everyone, and institutions must intervene, since education is the basis of progress (Barrero-Rivera, 2015).

Likewise, in Costa Rica, despite being in good numbers concerning connectivity compared to the rest of Central America, areas far from the central area have serious connectivity problems. According to Cordero-Pérez (2018), there are several cantons where the situation should be attacked more forcefully: "Zarcero is the canton with the greatest mobile telephony problems with service based on second-generation (2G) Global System for Mobile (GSM) technology, which is used for simple phone calls". Additionally, areas such as San Carlos, San Ramón, Montes de Oro in Puntarenas, and Matina in Limón, i.e., most of them are rural areas, where students are affected when trying to access virtual education (Villalobos-Solís, 2020).

On the other hand, Costa Rica has been in the first places in terms of international indexes on digitization in countries due to factors such as connectivity in homes; however, according to the National Household Survey (ENAHO, 2022), there are 218 thousand disconnected households. Of the total number of these, more than 50% are in this condition due to digital literacy, i.e., a perceived deficit of knowledge and skills in digital competencies. Meanwhile, 38% of the disconnection is due to economic conditions (Úbeda et al., 2020).

Among the main reasons for these gaps is digital illiteracy, as mentioned above, since, of the households that are disconnected, 50% is for this reason, that is, people who do not have any knowledge about the use of technological (Espinoza-Freire et al., 2018). In addition, PROSIC (2021) mentions: "the impact of different socioeconomic variables that affect the probability of a household accessing the Internet. Some of these contemplate the economic income, whether it is a household with how many older adults inhabit, the educational level, among others".

Also, there is a massive gap in several points, from rural areas with less income, quality of service, and devices from where it is accessed. According to the National Household Survey
(ENAHO, 2022), access is mainly from mobile devices, unlike in urban areas where at least a third is from mobile devices (Sunkel et al., 2014). Thus, it can be observed that the digital divide is vast and complex, integrating various factors and mainly encloses a: "series of inequalities of the digital era" (PROSIC, 2021). Furthermore, it can be said that education is, according to PROSIC (2021): "a fundamental part of the use of information and its transformation into knowledge."

By May 2020, 535 thousand students in the country did not have connectivity in their homes, of which 210 thousand were in poverty, so it is evident that the education system is in crisis and that this did not detonate from the pandemic but deepened the problem that existed before (MEP, 2020, 2021; Públicas, 2020). In addition, it is evident that, as a result of this situation, several actors were affected, such as teachers, parents, and, mainly, students, due to this lack of connectivity to engage in virtual classes through the platform that the Ministerio de Educación Pública (MEP) provided, which was Microsoft Teams, together with the lack of knowledge in the use of tools for education from home, taking into account that it leaves aside the traditional method of blackboard, notebooks and pens and urges the panorama to a more technological use where the execution is carried out digitally (Cordero-Parra, 2021).

On the other hand, the situation of teachers is similar because the pedagogical model had a similar impact to that of students, where teachers needed the skills to work in a virtual teaching environment. After all, the traditional way consisted of books or printable (Nivela-Cornejo et al., 2021). These competencies, while advancing, require more sophistication because there was a low appropriation of the use of technological tools. However, these competencies should have been on track or in the process of being resolved to innovate in the training process and the updating of technologies in teachers to have been able to assume, through a strategy, the abrupt emergence (López-Corral & Acuña-Meléndrez, 2020). Also, another weakness is found in the universities that prepare teachers, who do not integrate methodological strategies that attract students to be participatory in classes; even so, it should be recognized that the country does not maintain a learning culture, unlike others such as Germany, where students are connected and participatory (Torres, 2006). In the first instance, according to PROSIC (2021), the different variables in terms of the socioeconomic situation regarding the probability of a household having access to the Internet depend on economic income, the head of household, the number of older adults, level of education, and others. Therefore, it is possible to determine that, in homes with a more significant presence of people with educational assistance, there is a greater probability of having electronic tools, such as a
computer, a laptop, or at least a cell phone and Internet, than in households where there is no education of any kind (Chanto-Espinoza & Loáiciga-Gutiérrez, 2022).

The country's economic situation has not been the best, especially during the pandemic, worsened by unemployment; such circumstances affect vulnerable populations with less education (Villela-Cortés & Contreras-Islas, 2021). At the same time, this affects educational exclusion because students drop out of school to start working in the (Echeita, 2013). In fact, by 2020, 18 thousand students were excluded; by 2021, 10 thousand rejoined, but the remaining 8 thousand dropped out. Hence, the situation worsens more with different factors that involve the problem, which will worsen if actions are not taken because they will represent an absence of the right to education and a gap in knowledge towards the future with the labor force that high school youth will face (Rico-Martínez, 2022).

What is essential is that the gaps are understood holistically since it is not only about the difference in access to equipment but also about the skills to take advantage of these resources, which are unequal among students, teachers, and family members in the virtual learning process (Tapia-Salinas et al., 2020). Thus, policies should be focused on more egalitarian access that recognizes the different dimensions of inequalities to be resolved (CEPAL-UNESCO, 2020).

Thus, the use or early teaching on the use of technologies is a way to counteract these gaps so that tools can be provided in the educational centers of the country for the motivation of digital skills; which, if it had been so, the impact would have been reduced for successful online learning during pandemic (Mancilla-Vela et al., 2020). From the above mentioned, it can be established that it needs to be exploited in the best way for the benefit, especially in education, the area on which this article focuses.

But what are technologies all about, how are they applied today, and what is the outlook of these technologies on education? Information technologies are digital tools that help to manage, administer, and exchange information by analyzing, processing, and presenting it to perform daily tasks more efficiently, both work and educational or personal, on electronic devices such as cell phones, computers, tablets, among others (ULatina, 2020).

Applied technology is the clear difference between a developed and developing society; the key is to teach how to learn, which will last throughout life, and not only to transmit information (Hernández-Requena, 2008). In this way, they are motivated to create knowledge, select, value, use, discard, and be critical through technologies (Monteagudo-Fernández et al., 2020). This strategy allows the so-called online learning, i.e., learning through digital tools that facilitate learning at any time and place, so that the center of the experience is the student.
because they must also learn to self-manage their education, choosing how, when, and the pace of their study (Cohen, 2022).

Consequently, it is much more flexible for the student and generates more significant benefits. However, there are different types for its execution, and it is essential to emphasize that there must be a relationship with the person who (Palacino-Rodríguez, 2007). They must be a guide, not only a work reviewer; they must learn and teach with the students' contributions. There must be interaction through forums, chats, and dynamic activities, synchronous or asynchronous, among others, since the opposite would be the delivery of massive open online courses (Tabares, 2022).

Indeed, online learning is the future, but now it is the present about the use of information technologies for successful development in education and for the next close step in students' lives: the working life (Ascencio-Ojeda et al., 2016). These impact employment because it is a job-creating industry and a tool that allows workers to access new forms of work in a new and more flexible way (WB, 2013). In turn, companies are increasingly implementing them to train their employees to streamline processes and expand reach since the traditional way can be slower depending on factors such as schedule or transportation (Colman, 2021).

In addition, for those with access to appropriate technology, online learning is more effective in several ways (Lemke, 2006). Some studies show that, on average, students retain 25% to 60% more documents when studying online, compared to only 8% to 10% in the classroom, mainly because students can learn online faster (Cofré et al., 2010).

Online learning requires 40% to 60% less study time than in a traditional classroom because students can learn at their own pace, go back and reread, skip, or speed up concepts as they wish, so it is another plus for digital competencies from early education (Li & Lalani, 2020).

Due to the events that began with the pandemic worldwide, all countries were affected, including their student population. Therefore, this comparison is based on contingency plans, management, and interaction between the regulatory body, students, and their families during the school process in the pandemic (Yela-Pantoja et al., 2021). Next, the stated objectives will review how other countries handled the situation described in this conversation.

An exciting aspect to review is how the pandemic was handled and documented in other countries. UNESCO (2020) highlighted that in Chile, face-to-face classes were suspended in March 2020, the president foreseeing a possible global catastrophe, indicated to the education organizations to start developing contingency plans for what could be the beginning of a pandemic and withdraw students from face-to-face classes; being the Ministry of Education in
charge of providing students with two virtual platforms of totally free access; which learn online
(which covered all levels of schooling) and school digital library (it is providing to all people
more than 10 thousand free books); Chile continued with the programs to provide food to
students and their families in rural areas, printing the necessary documents for each student, in
addition to documents to support the understanding of the subjects, with this they covered what
are the most essential points to be resolved, the country never stopped teaching classes or
providing support to their students (UNESCO, 2020).

According to MEGT (2020), Guatemala managed the situation by closing the
educational institutions and organizing its resources to be able to cover the entire student
population in the best way in the least amount of time; unlike Chile, there was no contingency
plan created in advance, it is also necessary to take into account the socioeconomic factor
present in the territory, which greatly limited the access to information and the means of
communication that could be used, as well as the capacities of the government to solve the new
and growing problem brought by the pandemic; it was proposed to reach the majority of the
population through two programs broadcast on television and radio, in addition to encouraging
reading through social networks such as Facebook and other means to continue learning,
communication was based on WhatsApp and email for access to teachers and further
consultations; additionally, everything that was available at the time and with the resources they
had at their disposal was done (MEGT, 2020).

Whereas, in Costa Rica, there was no contingency plan but a pandemic response plan,
as in the rest of the world, it was decided to close face-to-face classes and adopt virtuality; the
country presented its courses at the beginning through Zoom and interactive television
programs on national channels; as the pandemic progressed, the Ministerio de Educación
Pública (MEP) made a massive effort to bring connectivity to most of the territories so that
students would not have connectivity problems (MEP, 2021).

As part of the comparison, it is possible to observe that Chile did an exceptional job by
deciding to make a contingency and prevention plan against the repercussions of the pandemic.
With the present limitations, including the lack of connectivity and communication, Guatemala
provided information with physical documents so that everyone could access education in
search of a more feasible and accurate solution to the pandemic. For its part, Costa Rica decided
to suspend all classes for a short period while a plan to counteract the pandemic's effects could
be implemented. It is noted that most countries should develop contingency plans and planning
schemes for possible disasters of this nature.
3 RESEARCH METHODOLOGY

The research adopted a qualitative approach to develop the object of study and identify relationships and regularities among its components (Creswell & Poth, 2018). In addition, it incorporated a subcategory within the descriptive approach, allowing the exploration of specific properties and characteristics of the object of study associated with the affectation of connectivity in public secondary education during the pandemic in Costa Rica (Hernández-Sampieri & Torres, 2018).

The research takes as its starting point an exploratory approach to model the underlying causes of the affectation of connectivity in public secondary education. This approach was guided by the epistemological perspective of constructionism (Rockmore, 2005), whose objective was to detail the factors involved in depth. Furthermore, it assumed that technologies could positively impact connectivity and online learning, accelerating the development of virtual education.

The categorization of the factors considered the guidelines proposed by Hurtado (2000), according to the context of a qualitative study. The categories of analysis were constructed throughout the research process, starting from the generality, responding to the research question that addressed the causes of the affectation of connectivity in education. The primary tool for data collection was the in-depth interview, following the methodological orientation of Hernández-Sampieri et al. (2017).

The unit of analysis referred to identifying the factors that conditioned online learning. The sample of this research consisted of 92 high school students from schools located in two different regions of Costa Rica for the year 2021.

To validate the findings obtained, a documentary review was carried out. Barrantes (2016) highlights that the technique allows for verifying documentary assets such as reports, case studies, and other relevant documents. In this case, the documentary review focused on examining assets and studies that addressed the impact of connectivity on online learning in school education, taking into consideration online databases such as Business Source Complete, EBSCOhost, Emerald, ScienceDirect, Scopus, Pro-Quest Central and Web of Science, in addition to online resources of authors, experts, and communities.

The search was limited to articles, papers, blogs, and official websites in English and Spanish. This discussion reinforced the documentary review with empirical evidence that supported the evolution and trend of technology in virtual education in the digital era.
4 RESULTS AND DISCUSSION

The results obtained in this section take as a central point the findings through the in-depth interviews conducted using a questionnaire applied to the 92 interviewed students in two Costa Rica regions. Initially, the closed questions were analyzed using absolute frequency distribution. The contrast of the most common words and phrases gives room to the causes that affected connectivity during the Costa Rican public secondary education pandemic. Table 1 presents the results obtained to determine the location of students in online learning mode in the selected sample.

Table 1

<table>
<thead>
<tr>
<th>Location</th>
<th>Number of people</th>
<th>Percentage of representation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gran Area Metropolitana (GAM)</td>
<td>52</td>
<td>56.5%</td>
</tr>
<tr>
<td>Zona Rural</td>
<td>40</td>
<td>43.5%</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on the results obtained

The results indicate that students in the Greater Metropolitan Area have the highest impact, with 56.5%, which shows more significant access to connectivity in this geographic location. In contrast, in rural areas, the results are lower. Santodomingo (2021) states that in areas where skilled labor is abundant, technology needs to be used more, which is why its use is not encouraged within the family. Table 2 shows the results obtained concerning evaluating the impact of geographic location on online learning.

Table 2

<table>
<thead>
<tr>
<th>Adequate knowledge of the handling of technology</th>
<th>Number of people</th>
<th>Percentage of representation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gran Area Metropolitana</td>
<td>62</td>
<td>67.3%</td>
</tr>
<tr>
<td>Zona Rural</td>
<td>30</td>
<td>24.7%</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on the results obtained

An interesting aspect to highlight in Table 2 is that students in the Greater Metropolitan Area previously knew about using technology to carry out online learning (67.3%). In contrast, students in rural areas needed to gain knowledge or training in using technology. Figueroa (2021); Rojas (2000) agree that the lack of access and support to the student population during the pandemic caused an increase in school dropouts. Table 3 presents a similar analysis.
associated with the quality of the educational centers' technology infrastructure during the pandemic.

**Table 3**

*Quality of the technological infrastructure in times of pandemics*

<table>
<thead>
<tr>
<th>Did the educational center have adequate technological infrastructure for online learning?</th>
<th>Number of people who answered YES</th>
<th>Percentage of representation (%)</th>
<th>Number of people who answered NO</th>
<th>Percentage of representation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gran Área Metropolitana</td>
<td>40</td>
<td>43.4%</td>
<td>17</td>
<td>18.5%</td>
</tr>
<tr>
<td>Zona Rural</td>
<td>25</td>
<td>27.2%</td>
<td>10</td>
<td>10.9%</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on the results obtained

As shown in Table 3, both rural areas agreed that the quality of the technological infrastructure in times of pandemic needed to be improved, which impacted the teaching processes in online learning. Therefore, an appropriate physical environment equipped with modern classrooms and up-to-date technology contributes significantly to enriching learning. Consequently, it not only impacts academic performance significantly but also impacts the integral development of the educational community as a whole (Marciniak & Gairín-Sallán, 2018). Table 4 presents the results associated with the Internet connection quality for online learning in different geographical locations.

**Table 4**

*Quality of Internet connection for online learning*

<table>
<thead>
<tr>
<th>Did the student have a stable, quality Internet connection for online learning?</th>
<th>Number of people who answered YES</th>
<th>Percentage of representation (%)</th>
<th>Number of people who answered NO</th>
<th>Percentage of representation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gran Area Metropolitana</td>
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<td>10.9%</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on the results obtained

The results in Table 4 indicate that the student's perception of online learning coincides with the quality of the technological infrastructure. Consequently, from the student's perspective, this area is the same and the perceived service could be higher. Table 5 presents the results associated with the instructor's level of preparedness to deliver an online learning model during the pandemic.
Table 5

*Teacher knowledge in the online learning model*

<table>
<thead>
<tr>
<th>Do you think the teacher had the knowledge, experience, and expertise to deliver online learning?</th>
<th>Number of people who answered YES</th>
<th>Percentage of representation (%)</th>
<th>Number of people who answered NO</th>
<th>Percentage of representation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gran Área Metropolitana</td>
<td>10</td>
<td>10.8%</td>
<td>27</td>
<td>29.3%</td>
</tr>
<tr>
<td>Zona Rural</td>
<td>8</td>
<td>8.6%</td>
<td>47</td>
<td>51.3%</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on the results obtained

In the results of Table 5, the interviewees also agreed that the teaching staff did not have the necessary training, experience, and expertise to carry out an online learning model. However, when evaluating the open-ended questions of the questionnaire, the interviewees agreed that the teaching staff tried to learn how to use technology to avoid dropping out of school, although they emphasized that communication between teacher and student was affected due to the emergence of feelings of loneliness and individualism characteristic of online learning (Acuña Acuña, E. G. 2023).

Finally, Table 6 presents the results of the leading causes identified by the students that affected the student's ability to connect in the online learning model.

Table 6

*Causes affecting the ability to connect to online learning*

<table>
<thead>
<tr>
<th>Cause</th>
<th>Number of people</th>
<th>Percentage of representation (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Economic problems</td>
<td>55</td>
<td>38.00%</td>
</tr>
<tr>
<td>Lack of uncertainty management</td>
<td>30</td>
<td>32.60%</td>
</tr>
<tr>
<td>Family problems</td>
<td>20</td>
<td>21.73%</td>
</tr>
<tr>
<td>Lack of interest in classes</td>
<td>7</td>
<td>7.67%</td>
</tr>
</tbody>
</table>

Source: Own elaboration based on the results obtained

The results show that economic problems, the lack of adequate management of uncertainty, and family problems during the pandemic significantly affected the ability of public sector students to connect to the online modality. Jiménez et al. (2016) highlight that technology is an input that helps institutions to reduce school dropout since it allows streamlining the educational process through the incorporation of the virtual education model, which helps students not to travel to academic centers, but at the same time streamlines communication between teacher and student through agile and simple communication platforms, thus allowing the teacher to offer more dynamic, simple classes according to the needs of the participant.

An important aspect to highlight in the identified causes is that they emphasize the multifaceted nature of the challenges faced by students during the pandemic, with the need for...
comprehensive support from the state, business, and society. Reuge et al. (2021) highlight in their work the need to effectively implement solutions to ensure the success of distance learning, the implications for equity, mitigation of learning loss, and notions around improved reopening, with their conclusion being to leverage the innovative solutions generated by the crisis response to make education systems more resilient while reinforcing the focus on equity and inclusion so that pre-existing disparities are not exacerbated in the future (Acuña Acuña, E. G. 2022).

While Stanistreet et al. (2020) highlight the understanding of ideas, experiences, reflections, warnings, and visions of the future that can help us to face, make sense of, and overcome the pandemic, the central aspect they highlight is the construction of a society capable of addressing these issues, characterized by a renewed interest in solidarity, within and between states, and between people.

To conclude with the present section, it is pertinent to establish a debate on the backlash of digital transformation in education and the role of parents to collaborate in this. Therefore, to address these challenges, it is crucial to develop strategies that ensure equitable access to technology, provide educators with adequate training, and offer comprehensive support mechanisms to students (Acuñar, EGA 2024).

5 CONCLUSIONS

The research provides a comprehensive view of the challenges and opportunities that the COVID-19 pandemic has presented for education in Costa Rica, supported by Cruz-Barrionuevo (2020). It highlights how the crisis prompted individuals, students, and teachers to reinvent themselves, acquiring new skills in information technology to contribute to education. The authors Corral-Ollero and de Juan Fernández (2021) pointed out that education will never be the same since information technologies will play a central role in overcoming the different fears associated with blended learning. Therefore, it is essential to conceive the pandemic as an opportunity to transform and correct the deficiencies in education that benefit students in the current century.

Similarly, Valero-Cedeño et al. (2020) state that the roles of educational actors have changed after the pandemic, turning parents into mediators of online learning. However, it is recognized that people in vulnerable economic situations face challenges, motivating teachers and parents to establish strategies to reduce the impact of distance education. At this point, the family emerges as a fundamental link for continuous learning in the context of the pandemic, as referred to by Hurtado-Talavera (2020). The main challenge for teachers is to rethink
methodological strategies that adapt to diverse realities and educational contexts,
accompanying students and their families in this process. The academic community had to
adapt to distance education, especially in innovation and creativity, as Field Fernández et al.
(2020) suggested. In this sense, the lack of equitable access to technology is a significant
challenge that underlines the need to ensure the quality of online education despite the
infrastructure limitations present (Valero-Cedeño et al., 2020).

Therefore, economic, social, and emotional aspects must be addressed, as evidenced by
the findings of Fernández et al. (2020). Online education is not the solution for everyone,
especially in the case of practical and technical disciplines that demand face-to-face and
practical experiences in actual laboratories. At this point, the Costa Rican government should
focus its efforts on strengthening resources and capacities for education in the most vulnerable
areas. In conclusion, the pandemic has prompted the educational community to adapt and
transform itself. While information technologies will play a significant role in education, equity
of access and quality of education must remain critical priorities. The crisis has underscored the
importance of collaboration among teachers, parents, students, and authorities to meet the
challenges and take advantage of the opportunities this situation has presented for the future of
education in Costa Rica.

6 FUTURE LINES OF RESEARCH

The conclusions drawn from the previous section point the way to several lines of
research to broaden and deepen the understanding of the challenges and opportunities presented
by the pandemic in the educational context of Costa Rica. These lines of research are essential
to guide future studies that impact the quality of education in the country:

1. **Equity in technological access and connectivity:** Since the lack of equitable access to
technology affects the quality of online education, it is crucial to continue researching
how to close the digital divide between urban and rural areas. Analysis studies
associated with government programs and strategies to ensure that all students have
access to quality Internet devices and connectivity, thus addressing educational
inequality;

2. **Teacher training in technology:** Research how to improve teacher training and
education in educational technology, exploring professional development methods that
allow educators to adapt to virtual pedagogical mediation processes effectively;

3. **Emotional and social impact of online learning:** Explore in depth how online learning
affects students’ emotional well-being and social interactions, enabling the development of strategies to mitigate student loneliness and isolation as appropriate;

4. **Technology infrastructure and quality of education**: Future studies could examine the relationship between the quality of technology infrastructure in schools and student academic performance. Research in this area could guide policies and decisions to improve the technological infrastructure in educational institutions;

5. **Educational innovation and teaching methods**: deepen research that examines effective pedagogical practices in online education, including content design, student-teacher interaction, and digital tools;

6. **Impact of collaboration among educational stakeholders**: Collaboration among policymakers, students, and parents is essential to address online education's challenges. Future research will examine how these collaborations impact student achievement, engagement, and educational quality in virtual environments;

7. **Technological Innovations for Education**: The constant emergence of new technologies provides opportunities to improve online education. Future studies could investigate the impact of virtual reality, artificial intelligence, and gamification on online learning, evaluating their effectiveness and benefits.

These proposals refer to fundamental pillars to address the challenges and opportunities that online education in Costa Rica has presented due to the pandemic. These future studies will not only contribute to a deeper understanding of the existing problems. Still, they will also provide facts and data for policy and educational decision-making to strengthen the country's educational system in a constantly evolving digital environment.

**REFERENCES**


Ascencio-Ojeda, P., Garay-Aguilar, M., & Seguic-Zeran, E. (2016). Formación inicial docente (FID) y tecnologías de la información y comunicación (TIC) en la Universidad de
To the 5.0 Revolution: The Challenges of Public Education in Costa Rica


Corral-Olleo, D., & de Juan Fernández, J. (2021). La educación al descubierto tras la pandemia...


The Shift to the 5.0 Revolution: The Challenges of Public Education in Costa Rica


Hernández-Sampieri, R., & Torres, C. P. M. (2018). Metodología de la investigación (Vol. 4). Interamericana, México. https://d1wqtxts1xzle7.cloudfront.net/38911499/Sampieri-libre.pdf?144343652=&response-content-disposition=inline%3B+filename%3DSampieri.pdf&Expires=1688486202&Signature=cEqtpZeXOI689ujUFapX-WYO60EN6ybmdm9D8TBBKqoE5nqrz4R0Zoy2-SmEfv-eSA6b0XX3dTneE7zRYhiaOv-Psbt5UjVJtPHVEe3bMSNNI2d3OZQ7-2sQvJ-LkChNg8NAloZMvY6Yx-11hLFlimHtyT2mbahEskso73ygIkC4m1evUREUFQpZx54x5YPcgm--TqVpusk9O789JF-8QxAq3RazW7Xtra3Zrh9SqMza-YaN0wZC-us-U33tMuot1Z-8WHiKarnnU993g-TC6Xd5I6gip90QPBEIZL8TT0ujwXRKNAyWV6vEznTmjgOdKzpoEi12vR1Dcnmq__&Key-Pair-Id=APKAJLOHF5GGLRBBV4ZA


Hurtado, J. (2000). Metodología de la Investigación Holística (E. F. Sypal, Ed. Vol. 3). Instituto Universitario de Tecnología Caripito. https://www.academia.edu/8813831/Hurtado_J_Metodolog%C3%ADa_de_Investigaci%C3%B3n_Hol%C3%ADstica_Secciones_Escogidas_1


Rico-Martínez, L. (2022). Vulneración del derecho a la educación de los niños, las niñas y los adolescentes por ausencia del servicio de Internet en casa en medio de la pandemia causada por el COVID-19: Colombia. https://repository.ucatolica.edu.co/server/api/core/bitstreams/876a22c9-6e90-4723-8aee-43e02f989c6f/content


