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Challenges and Realities of Virtual Education in Amazonian, Rural and Insular Areas of Ecuador

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Virtual education in rural areas is essential to provide access to quality educational resources, overcome geographical barriers and promote equity, allowing the development of skills in a digital environment. In Ecuador, despite current policies and regulations, significant limitations persist in the adequate implementation and generalization of virtual education. The objective of this study was to identify the main challenges and realities of virtual education in Amazonian, rural and insular areas of Ecuador. A documentary and bibliographic research was carried out, based on a systematic review of publications using the PRISMA methodology. Twenty research studies were selected to form the analysis matrix, based on the defined criteria. Six grouping categories were obtained for the selected works, which made it possible to identify and bibliographically support the results. The main challenges and realities identified were: the digital divide and inequality in access to technology; teacher training and digital illiteracy; the impact of the pandemic and the need for innovation in education; public policies and digital inclusion; the efficient use of ICTs in the educational process and contextualized digital culture and competencies.

Keywords: virtual education, digital divide, general education, higher education, digital illiteracy.

1. Introduction

The implementation of virtual education in rural or hard-to-reach areas is essential to reduce educational gaps and promote equity in access to knowledge. Through digital platforms, quality training can be offered to students who would otherwise be limited by a lack of educational infrastructure and a shortage of teaching resources. In addition, virtual education allows students to develop technological skills, improve their autonomy in learning, and access up-to-date content (Carrete-Marín & Domingo-Peñafiel, 2023; Safdar et al., 2022).

The Ecuadorian government has undertaken various efforts to promote virtual education as a key tool for educational development at all levels of education. The main objective of the "Draft Reformatory Organic Law for the Promotion and Strengthening of Virtual Education in Higher Education" is to promote and strengthen the virtual modality in Ecuadorian higher education, guaranteeing equitable access, quality and relevance of technical and technological

training. The project highlights the importance of information and communication technologies as fundamental tools to ensure the continuity of teaching. In addition, it seeks to promote educational innovation and research in the digital field, contributing to the comprehensive development of Ecuadorian society in a globalized and digitized environment (National Assembly Republic of Ecuador, 2024).

Similarly, the Ministry of Education (MinEduc) published the Digital Educational Agenda 2021-2025, which establishes a series of strategies divided into two fundamental axes. Axis 1: Digital Learning focuses on the implementation of training models in Learning and Knowledge Technologies (TAC), the training of teachers in technological and techno-pedagogical skills, and the design of pedagogical models for digital classrooms. In addition, it promotes the application of STEAM methodologies, the management of digital resources, and access to digital environments for the entire educational community, along with the creation of indicators that allow digital learning to be evaluated (Ministry of Education, 2021).

The second axis, related to literacy and digital citizenship, focuses on the definition of essential digital skills, the development of digital literacy training models, and the promotion of digital citizenship through awareness-raising and training programs. It also includes the integration of digital citizenship into the national curriculum and the evaluation of its implementation. These strategies seek to guarantee comprehensive learning and the development of digital skills, ensuring equitable participation in the educational digital transformation. The implementation of actions in the digital learning axis specifically proposes that at least 45% of the educational institutions of the National Education System carry out the seven actions identified for direct implementation by 2025 (MinEduc, 2021).

The fulfillment of the goal of the digital agenda, however, does not imply the representativeness of rural regions in the proposed figures. Regions affected by geographical gaps, such as the Amazon, also have specific regulations focused on their integral and digital development. Such is the case of the Organic Law for the Comprehensive Planning of the Amazonian Special Territorial Circumscription, which establishes a framework for the sustainable development of the Amazon region of Ecuador, relevant to the development of virtual education in several key aspects. Article 4, paragraph j), states that the purpose is "To strengthen the education system at all levels, especially higher education, and to guarantee access for the Amazonian population, in accordance with local demand, reinforces the commitment to guarantee equitable access to quality education, promoting social justice and the inclusion of marginalized groups, aligned with the principles of equity and sustainable development of the region" (AN, 2018).

However, the existence of these regulations provides the legal framework for the development of virtual education, but does not guarantee its effective development. The limitations and inequities that constitute historical realities for these regions require greater efforts to achieve this purpose. In terms of technological gaps, according to DataReportal (2024) the main limitations of connectivity and access to the internet in Ecuador in 2024 include a penetration of 83.6%, which leaves out 16.4% of the population, that is, approximately 3 million people who do not use the internet. Although social media is widely used by 69.2% of the population, coverage does not ensure that all individuals have equal or continuous access to these platforms. According to Lara-Castro & De Souza (2023), despite being the largest province in

Ecuador, Pastaza (located in the Amazon region) has one of the worst internet access infrastructures. 41% of those surveyed only access satellite internet, 40% by cable, and 10% by cellular connection. This generates high connection costs, which represent up to 17% of the basic salary, and many can only access it sporadically.

According to the statistical analysis of Ponce et al. (2023), in the last three years there has been a significant increase in local Internet traffic in Ecuador, mainly driven by accelerated digitalization during the pandemic, with an increase of 93.16%. But at the same time, this highlighted the need to strengthen Internet infrastructure, especially in rural areas, improve connectivity and use technologies that optimize the end-user experience and reduce transmission costs to guarantee full access in the most remote areas. Likewise, according to bulletin number three of the UNAE Observatory, during the pandemic, access to connectivity and preparation for virtual classes presented serious limitations for both students and teachers. Although most students had some connectivity and some teachers were prepared, 35% of schoolchildren did not have access to the Internet and 27% of teachers were not trained for virtual teaching (Loaiza Sánchez & Arias Sinchi, 2023).

This report shows that only 20% of students and 27% of teachers were able to face virtual classes without significant difficulties. They also identified that "the institutions that until now do not have internet, a means of communication with family representatives and an educational platform are mostly located in rural areas and in the Amazon region" (p. 14). In addition, the post-pandemic data revealed a significant loss of learning, especially in the first educational levels and in areas such as Language and Literature and Natural Sciences, which could be verified with the results of the "Being a student 2022" test, which denotes a limited and deficient use of virtual environments.

These problems highlight the need to identify the main limitations faced by the full development of virtual education in rural areas, islands and the Ecuadorian Amazon, where technological gaps apparently lead to educational inequities. Observation also made by Cuesta Ormaza & Chamorro Benavides (2022), who state that virtual education faces serious difficulties, when students come from disadvantaged socioeconomic contexts, which reduces their access to the technological resources necessary to maintain quality education and to this is added the fact that schools are located in rural areas with limited internet coverage, which aggravates the problem of the digital divide in the educational field.

The present study aims, therefore, to identify the main challenges and realities of virtual education in Amazonian, rural and island areas of Ecuador, based on a review of the specialized literature. It is intended to provide categories that characterize this problem from the grouping of scientific results of references in the field of virtual education research in Ecuador and its most vulnerable areas.

2. MATERIALS AND METHODS

The research carried out is classified as exploratory, as it seeks to identify specific problems related to virtual education and digital literacy in rural and vulnerable areas of Ecuador. It is descriptive in nature, detailing the digital divides in these areas and exploring a little-researched context, providing a basis for future studies. In addition, it is a cross-sectional

study, since it collects data at a specific time without monitoring over time. As for the data collection, it is documentary and bibliographic, based on an exhaustive review of previous studies.

To carry out the analysis of the main challenges and realities of virtual education in the Amazonian, rural and island areas of Ecuador, the PRISMA methodology (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) was applied. This methodology has established itself as a valuable tool in the systematic review of scientific literature, as it guarantees a transparent and reproducible process in the selection and analysis of studies. Its main advantages include the ability to reduce bias when assessing the quality of the available evidence and the possibility of synthesizing large volumes of information in a structured way, thus facilitating the identification of common patterns and the generation of new categories of analysis (Page et al., 2021). These characteristics make it ideal for addressing complex problems such as those presented by virtual education in the most vulnerable contexts of the country.

Steps to apply the PRISMA methodology in the systematic review.

1. Source Identification and Selection

The first phase will consist of the exhaustive search for specialized literature related to virtual education in Amazonian, rural and island areas of Ecuador. Academic databases such as Scopus, Web of Science, IEEE and Google Scholar will be used. The search included articles published between 2019 and 2024, in English and Spanish, with key terms such as: Ecuador; virtual education, digital literacy, rural and digital divide.

2. Inclusion and Exclusion Criteria

To ensure the quality and relevance of the selected studies, the following criteria were applied:

- Inclusion: studies that analyze the implementation, challenges, or benefits of virtual education in the aforementioned areas, scientific reviews that address issues of the digital divide, and articles that offer a focus on virtual teaching policies or methodologies for rural and vulnerable environments.

- Exclusion: studies contextualized exclusively in urban areas or on topics not directly related to virtual education; studies whose methodology is not based on empirical evidence or systematic reviews.

3. Selection Process

- Phase 1: Initial search. A first search was carried out using the selected keywords. This phase included reviewing titles and abstracts of found articles to eliminate duplicates and irrelevant papers.

- Phase 2: Full-text review. The shortlisted studies were evaluated in their entirety to ensure compliance with the inclusion criteria.

- Phase 3: Quality assessment. The criterion of researchers not committed to this study was used to evaluate the methodological validity of the selected articles, which discarded those with significant limitations in their design or methodology.

4. Data Extraction and Grouping

The data were organized into a matrix that included:

- Author and year of publication.
- Objective of the research
- Type of item.
- Type of education
- Main challenges and realities of virtual education identified in the study.
- Proposed solution or main conclusion of the study

By pooling scientific results, common patterns and categories in the studies reviewed were identified. These categories served to develop a framework of analysis on the main challenges and realities of virtual education in the Amazonian, rural and island areas of Ecuador.

3. RESULTS AND DISCUSSION

To apply the PRISMA methodology to the filtering process of the 729 initial results obtained, the previously established steps were followed. During the different phases, studies were discarded based on the inclusion and exclusion criteria, until a total of 20 articles were selected for systematization. In the initial phase, an exhaustive search was carried out in academic databases using the defined keywords and the selected time range, which generated a total of 729 results. Subsequently, 124 duplicate studies in different databases were eliminated, reducing the number of articles to 605. Next, in the review of titles and abstracts, 497 studies that were not directly related to virtual education in Amazonian, rural or island areas of Ecuador were discarded, leaving 108 articles.

In the review of the full text of these 108 studies, 57 that did not meet the inclusion criteria were eliminated, such as those focused on urban areas or with inadequate methodologies, leaving 51 articles eligible. Finally, after an evaluation of methodological quality by independent evaluators, they eliminated 31 articles due to significant limitations in the design, data analysis or relevance of the results, selecting a total of 20 studies for systematization, which are presented in the matrix of Table 1. This process ensured the relevance and quality of the scientific evidence reviewed.

Table 1.Matrix of selected articles

Author	Authors' Objective	Item Type	Type of Education	Challenges and realities identified	Main conclusion
González Cabrera & Ugalde (2019)	To analyze the socio-political and regulatory context and projects around media and digital literacy in Ecuador.	Revision	Secondary and higher education	Little preparation of students and teachers in media and digital literacy, despite investment in this area.	Implement a continuous program to improve media and digital literacy, in collaboration between government, academia and citizens, to reduce

					inequalities.
Apolo et al. (2020)	Identify the challenges and gaps that government entities in Ecuador must face to link education and technology.	Qualitative	General Education	Results of the National Development Plans focused on figures without delving into comprehensive management. Lack of contextualized pedagogy and limited teacher motivation.	Propose a comprehensive long-term management that includes a pedagogical design based on the experiences of teachers, accompaniment and motivation for training in digital mediation.
Vivanco-Saraguro (2020)	To examine educational inequalities exacerbated by the use of telematics resources during the COVID-19 pandemic.	Descriptive	Public and Rural Education	Educational gaps among students, particularly in rural and low-income sectors, widened with teleeducation.	Review of educational policies to mitigate inequalities and support students from the most disadvantaged sectors through better technological and pedagogical resources.
Albán Defilippi et al. (2021)	To analyze the relationship between digital illiteracy and income inequality in Ecuador between 2008 and 2019.	Quantitative	Technological and Labor Education	Low connectivity and digital illiteracy, which limits job opportunities and increases income inequality.	Improve connectivity and promote digital literacy to reduce inequalities in access to employment, relying on specific data to implement effective policies.
Asencio et al. (2021)	To analyze the role of the teacher in digital literacy in education in the twenty-first century.	Descriptive	General Education	Insufficient technological literacy of students due to the lack of teacher training and unprepared conditions for the implementation of digital technologies.	Continuous training of teachers in technological skills, promoting spaces for constructive dialogue and autonomous learning.
Benites-Sigcho & Fiallos (2021)	To diagnose didactic strategies to overcome the difficulties of the digital divide in teaching-learning in a single-teacher school in Ecuador.	Case Study	Single-teacher basic education	Shortcomings in the educational applicability of digital skills among students.	A significant digital divide between teachers and students is not detected; however, it is suggested to work on the applicability of digital competencies in the educational context.

Charro & Maya (2021)	To analyze the capacity of schools and technological resources in teachers and students for distance learning during the pandemic.	Case Study	Basic and secondary education	Inequality in access to technological resources between different socioeconomic groups, affecting learning.	Improve connectivity and provide resources for distance education, addressing differences between socioeconomic segments.
López et al. (2021)	Examine the challenges and proposals that students faced during the pandemic to improve the quality of higher education.	Descriptive	Higher education	Limitations in connections and devices, perception of incomplete learning, lack of interaction and active participation in classes.	Promote mobile learning, strengthen digital skills, adapt learning to students' realities, and link emerging theories such as connectivism
Guzmán et al. (2022)	To promote the development of ICT in early education in Ecuador to promote the cognitive, motor, linguistic and social development of children.	Document review	Early education	Lack of total integration of ICT in early education, deficiencies in the availability of the Internet and teaching management of ICT.	Ensure the availability of the Internet in all educational spaces and train teachers in the use of ICT for its correct integration into the teaching-learning process.
Iñiguez Apolo et al. (2022)	To analyze the situation of virtual education in rural areas of Ecuador, based on a bibliographic study and a content analysis on access to technological resources.	Literature review	Rural Education	Lack of technological infrastructure and connectivity in rural areas, leading to an imbalance in education between urban and rural areas.	Establish "infocentres" and community computers, as well as promote the political will of the authorities to improve technological infrastructure in rural areas.
Lara (2022)	To analyze digital competencies according to the educational culture of Sumak Kawsay in Ecuador and the country's educational legislation.	Qualitative (Hermeneutical)	Education in general	Difficulty in defining digital skills and a technological policy that is inconsistent with the constitutional norm and the cultural context.	Incorporate a pedagogy that discusses the role of technology and ecological awareness, as well as cultural and social meanings, adapting technology to Ecuadorian regulations.
Moreno & Zamora (2022)	To analyze the potential of radio schools in Ecuador as an educational alternative for sectors	Qualitative	Rural Education	Unequal access to virtual education due to historical difficulties of injustice and the lack of technological infrastructure in vulnerable	Using radio schools as an option to respond to the lack of virtual access,

	with connection limitations during the pandemic.			communities.	although it is not the definitive solution to the deficiencies of the education system.
Acosta Jaramillo et al. (2023)	To analyze the implications of face-to-face and virtual education in the Ecuadorian context.	Systematic review	Education in general	Virtual education has accentuated inequalities, affecting students, teachers, and families with technological and economic limitations, making it difficult to access and remain in the education system.	Teacher training to develop digital skills in both teachers and students and access to their own technological infrastructure by educational institutions
Albuja Loachamin et al. (2023)	To analyze technological inequalities in education in Ecuador, highlighting the digital educational gap at different educational levels.	Systematic review	Basic and Higher Education	Significant disparities in access to technology, affecting different levels of education, and socioeconomic challenges that perpetuate the digital divide.	Evaluate the proposed strategies and simultaneously address socioeconomic and technological challenges to close the educational gap.
de la Cruz-Campos et al. (2023)	To learn about the institutions involved and the proposals to reduce the digital divide in Ecuador.	Systematic review	General Education	Persistent digital divide, lack of synergy between the public, private and social sectors.	Generate collaboration between the public, private and social sectors, guaranteeing access to ICTs and inclusive policies at all levels of government.
Jadán et al. (2023)	To identify the difficulties of access to technology in Ecuadorian students and their impact on academic performance.	Case Study	Basic education	Difficulties accessing technological resources and a stable connection, which affects academic performance and online participation.	Coordinated implementation of solutions that promote inclusion and technological readiness, providing equal opportunities in access to technology.
Pegalajar Palomino & Rodríguez Torres (2023)	To analyze the level of mastery of digital skills of university students in Ecuador.	Descriptive	Higher education	Difficulties in the development and adaptation of technological materials and in the creation of digital content, with differences between genders and areas of study.	Make decisions to improve the planning and acquisition of digital skills, especially for students of Intercultural Bilingual Education, in favor of better teacher professional development.

Hernández et al. (2024)	Investigate the integration of educational technology into basic education in Ecuador and understand its impacts and challenges.	Mixed (qualitative and quantitative)	Basic education	Lack of technological infrastructure in educational institutions, lack of teacher training and inequality in access to devices and connectivity.	Strengthen teacher training and improve technological infrastructure in schools. Addressing equity in access to technology for effective classroom integration
Mena Hernández et al. (2024)	To investigate the integration of educational technology in basic education classrooms in Ecuador, and the challenges and impact that this entails.	Mixed (Qualitative and Quantitative)	Basic education	Lack of technological infrastructure and teacher training in many educational institutions, as well as inequities in access to devices and connectivity.	Strengthen teacher training and improve technological infrastructure to ensure effective integration of technology, also addressing inequities in access.
Suarez-Ávila (2024)	To describe the implications of collaborative learning and online assessment as tools for rural teachers in Ecuador.	Documentary research	Rural Education	Teacher training in rural areas is insufficient to guarantee quality education.	Collaborative learning and online assessment are opportunities to enrich the educational experience, foster inclusion, and offer education tailored to rural needs.

As can be seen, most of the selected studies were published between 2021 and 2024, reflecting an increase in attention to issues related to virtual education and digital literacy in Ecuador, especially after the COVID-19 pandemic. The types of research are varied, highlighting qualitative and quantitative approaches, case studies and systematic reviews. This range of methods evidences an exhaustive exploration of the subject from different perspectives, although qualitative and descriptive studies predominate, aimed at understanding specific contexts and educational challenges.

The main objectives of the selected research are aimed at analyzing inequalities in education and access to technology in Ecuador. In general, it seeks to identify the main challenges faced by educational institutions and students, and to propose strategies to overcome the digital divide, with a particular focus on rural areas and vulnerable contexts. Six categories were identified that will contribute to the analysis of these challenges and realities, which are described below based on the contributions of each research included.

1. Digital Divide and Inequality in Access to Technology

The digital divide in rural and marginalized areas of Ecuador is presented as one of the main challenges for educational equity, as evidenced by various studies. Jadán et al. (2023) underscore the insufficient access to technological resources by students of the Margarita

Ponce Gangotena Educational Unit, which has a direct impact on their academic performance. In this context, the lack of suitable devices and poor internet connection hinder effective participation in distance education activities. These deficiencies reflect not only a lack of infrastructure, but also socioeconomic constraints that exacerbate inequalities in learning.

Similarly, Vivanco-Saraguro (2020) highlights the impact of the COVID-19 pandemic, where the transition to virtual education deepened pre-existing inequalities. The study shows that low-income students, particularly those living in rural areas, experienced greater difficulties, due to the lack of adequate technologies and limited academic support at home. This situation is more critical in homes where parents have low levels of education, further limiting school accompaniment and perpetuating educational inequalities.

On the other hand, Iñiguez Apolo et al. (2022) and Lara (2022) analyze the impact of the absence of technological infrastructure in rural areas of Ecuador, underlining how the lack of connectivity prevents the effective development of virtual teaching modalities. The technological precariousness in these areas not only compromises access to e-learning, but also limits educational and professional development opportunities for students. According to these authors, the imbalance in access to technologies between urban and rural areas perpetuates structural inequalities, disproportionately affecting the most vulnerable communities.

In a complementary approach, Benites-Sigcho and Fiallos (2021) delve into the case of a single-teacher school, where, despite the digital skills acquired by teachers, the technological gap remains a significant obstacle. Despite the effort and dedication of teachers to integrate technological tools into the teaching process, the lack of resources and connectivity makes it impossible to completely overcome this gap. This analysis reinforces the imperative need for a more robust and equitable technological infrastructure, which allows students to access quality education, regardless of their geographical location or socioeconomic level.

Studies agree that the digital divide in Ecuador is not only a problem of technological infrastructure, but is deeply intertwined with socioeconomic and educational factors. Deficiencies in access to technological resources and connectivity in rural areas severely limit students' ability to participate in digital learning, thus exacerbating structural inequalities in the country. Therefore, it is essential to design public policies that not only guarantee access to technology, but also address the underlying socioeconomic conditions that perpetuate this gap.

2. Teacher Training and Digital Illiteracy

Digital illiteracy in Ecuador and the lack of technological skills among teachers have been pointed out as critical factors in various studies. Apolo et al. (2020) highlighted the need to train teachers not only in the basic use of technologies, but also in contextualized pedagogical design for digital environments. The research pointed out that, although progress has been made in the provision of technological infrastructure, the challenge lay in the lack of preparation of teachers to effectively integrate these tools into their teaching practices.

The focus focused on the importance of providing pedagogical support that allows teachers not only to adapt to technologies, but also to use them as tools that promote meaningful learning. This coincides with what was stated by Acosta Jaramillo et al. (2023), who

highlighted the need to train teachers for the development, both of their own digital skills, and those of their students, along with the increase in access to their own technological infrastructure by educational institutions.

Asencio et al. (2021) reinforced this view by stating that students' digital literacy depended heavily on the digital skills of their teachers. This study showed that the lack of systematic and continuous training limited the ability of educators to create effective learning environments in virtual environments. According to the authors, the lack of advanced technological skills and the lack of permanent training programs reduced students' opportunities to develop technological competencies, which perpetuated digital illiteracy in the new generations. The study underlined the need to incorporate technological training into initial teacher training programs and their in-service updating.

For their part, González Cabrera and Ugalde (2019) analyzed media literacy in Ecuador and observed that, despite advances in public policies and access to technologies, the average level of digital skills in both students and teachers remained in a medium range. This finding highlighted the need to improve not only access to technological tools, but also the quality and depth of technological training for teachers. The study argued that, without adequate training in the use of digital media and technological literacy, teachers' ability to guide students in a complex media environment remained limited.

In the field of higher education, Pegalajar Palomino and Rodríguez Torres (2023) addressed the digital skills of university students, finding that, although they prioritized research and information management, they presented significant difficulties in the creation of digital content. This deficit reflected a lack of comprehensive training in technological skills, which limited their ability to adapt to the new challenges of the digital environment. The study also revealed that gaps in digital skills disproportionately affected students in certain careers, such as Intercultural Bilingual Education, which highlighted the importance of designing differentiated training strategies according to the specific needs of different groups of students.

Overall, the research reviewed agreed that digital illiteracy in Ecuador was not only related to access to technologies, but also to the urgent need for more robust and contextualized teacher training. The lack of digital skills in educators stood as a fundamental barrier to the full digital literacy of students, both in basic and higher education. Public policies and educational programs should focus on the creation of continuous technological training opportunities for teachers, thus promoting a more inclusive teaching-learning process aligned with the demands of the twenty-first century.

3. Impact of the Pandemic and the Need for Innovation in Education

The COVID-19 pandemic marked a turning point in the adoption of educational technologies, accelerating the transition to virtual environments. López et al. (2021) showed that the health crisis forced higher education institutions in Ecuador to incorporate technologies into their teaching processes quickly and without adequate planning. Although this situation allowed academic continuity to be maintained, it also revealed deep inequalities in access to devices and connectivity. The lack of technological infrastructure, particularly in rural and marginal areas, widened the digital divide between students from different socioeconomic strata, affecting their academic performance. This research pointed out that

education policies were not prepared to face a crisis of this magnitude, which exacerbated the existing shortcomings.

For their part, Charro and Maya (2021) analyzed the difficulties experienced by students and teachers during the pandemic. The authors highlighted that the lack of technological skills in many teachers, added to the scarcity of technological resources among students, significantly affected the teaching-learning process. Students with limited access to the internet or adequate devices faced additional barriers, while teachers were forced to quickly adapt their methods without prior training in the use of digital tools. This context highlighted the urgent need to improve teacher training in technological skills, as well as to implement policies that guarantee more equitable access to educational technologies.

Moreno and Zamora (2022) investigated an innovative solution to address technological barriers in rural areas through the implementation of radio schools. In regions where internet connectivity is limited or non-existent, this alternative allowed students to continue their studies through radio broadcasts. Although not considered a definitive solution, the authors concluded that this strategy offered a viable option for mitigating educational exclusion in rural communities during the pandemic. However, they stressed that the effectiveness of this method depended to a large extent on the commitment of local authorities and the ability to adapt educational content to this format.

Regarding the search for innovative pedagogical methods, Suárez-Ávila (2024) addressed the impact of collaborative learning and online assessment on rural education. This study explored how these strategies could enrich the educational experience in areas with technological limitations, promoting the inclusion of students from rural communities in more participatory educational processes. The findings indicated that collaborative learning, combined with remote assessment, offered a significant opportunity to improve educational quality in these areas. Suárez-Ávila stressed that these methodologies made it possible to adapt teaching to local realities, strengthening the interaction between students and teachers and creating a more dynamic and contextualized learning environment.

Taken together, these studies reflected that the pandemic not only accelerated the adoption of educational technologies, but also exposed structural limitations and inequalities in access to digital education. The crisis highlighted the need to innovate in pedagogical approaches, ensuring that education policies include flexible and accessible strategies for all sectors of the population, especially the most vulnerable. The integration of emerging technologies, together with methodologies adapted to rural and marginal contexts, was presented as a path towards a more inclusive and equitable education in Ecuador.

4. Public Policies and Digital Inclusion

Public policies aimed at reducing the digital divide in Ecuador have played a central role in efforts to ensure more equitable education. De la Cruz-Campos et al. (2023) conducted a comprehensive analysis of how digital inclusion policies should comprehensively address existing technological exclusions in the country. The authors proposed the creation of synergies between public, private and social sectors, suggesting that intersectoral collaboration would be essential to overcome inequalities in access to and use of information and communication technologies (ICTs). This approach, according to the study, would make it

possible to generate more inclusive policies, which would not only improve technological infrastructure, but also ensure adequate training for users and guarantee efficient management of resources.

For their part, Apolo et al. (2020) emphasized that it is not enough to create technological platforms if they are not supported by comprehensive educational policies that take into account the social and cultural characteristics of the country. The study highlighted that teachers, as key actors in the digital teaching-learning process, required contextualized training adapted to local realities. In addition, they underlined the need to design pedagogical policies that offer constant support and accompaniment to educators, in order to maximize the potential of technologies in education. The implementation of successful policies had to consider not only technological access, but also the pedagogical and cultural preparation of the actors involved.

Albán Defilippi et al. (2021) analyzed the implementation of the Digital Education Agenda in Ecuador, highlighting that, although the government had promoted various initiatives to promote digital inclusion, these had not been sufficient to close the gaps in their entirety. While some progress had been made in urban areas, access to technologies remained limited in rural and peripheral areas, where internet connectivity and technological infrastructure were poor. The authors agreed that public policies should focus not only on the provision of infrastructure, but also on the creation of inclusive educational environments that promote technological equity at all levels of education.

Likewise, Albán Defilippi et al. (2021) pointed out that, despite the policies already implemented, significant inequalities continued to exist that mainly affected students in rural areas. The authors recommended the creation of specific programs that prioritize connectivity in these areas, proposing strategies based on cooperation between local and national actors.

In summary, the studies reviewed agreed that public policies for digital inclusion in Ecuador had made significant progress, but significant challenges remained, particularly in rural areas. The digital divide is not only limited to the lack of access to technologies, but also includes the lack of digital skills and the mismatch between educational policies and the socio-cultural realities of the country. To achieve true digital inclusion, policies must adopt a comprehensive approach that encompasses infrastructure, training and pedagogical support, with the collaboration of multiple sectors and actors at the national and local levels.

5. Efficient use of ICT in the Educational Process

The integration of Information and Communication Technologies (ICT) in the field of education has been recognized as a crucial element for the modernization of education systems, especially in contexts such as Ecuador's. Guzmán et al. (2022) analyzed the impact of ICT on early education, highlighting that its inclusion required a comprehensive approach that encompassed not only technological infrastructure, but also teacher training, the development of clear educational policies, and the effective incorporation of ICT into the school curriculum. The study stressed that, in order to optimize the use of these technologies, it was essential that teachers receive continuous training and that curricula be adapted to integrate ICT as essential pedagogical tools. This approach, according to the authors, would allow not only an appropriate use of technologies, but also their use to improve teaching-

learning processes, with special emphasis on the development of digital skills in students from an early age.

In a broader context, Hernández et al. (2024) examined the use of ICT in basic education, noting that while a large number of teachers had begun to incorporate technologies into their classrooms, they still faced significant challenges. The research revealed that most teachers lacked adequate technological training, which limited their ability to effectively integrate ICT into their teaching methodologies. This problem was compounded by a lack of equitable access to technological devices, creating a disparity between students who could take full advantage of digital tools and those who were excluded because they did not have the necessary resources. The study emphasized that the implementation of ICT in the classroom could not be considered successful if the aspects of teacher training and the provision of technological infrastructure were not addressed together.

Mena Hernández et al. (2024) expanded on this analysis by examining the technological infrastructure in Ecuadorian schools. Their findings indicated that many educational institutions, especially in rural and peri-urban areas, did not have the basic technological resources to implement ICT-based educational programs. This lack not only affected the quality of learning, but also limited students' opportunities to develop digital skills, essential in the contemporary world. The study highlighted that lack of internet access, insufficient devices and inadequate infrastructure were critical barriers to the full use of ICTs in the educational process. To overcome these limitations, the authors recommended a substantial increase in public and private investment in infrastructure, accompanied by policies that promote equitable access to technology in all schools in the country.

The studies reviewed agreed that the efficiency of ICTs in the educational process depended on several interrelated factors, including teacher training, the availability of adequate technological infrastructure, and the creation of educational policies that would guarantee a sustainable implementation of these technologies. Continuous training of teachers was identified as an urgent need, given that their mastery of technological tools would determine the effectiveness with which ICTs would be integrated into pedagogical activities. In addition, the researchers highlighted the importance of closing ICT access gaps, as inequality in the availability of technological resources continued to perpetuate educational differences between students from different regions and socioeconomic levels.

In conclusion, the successful integration of ICT in Ecuadorian education required a systemic approach, which considered not only the provision of resources, but also the constant training and support of teachers, as well as the creation of a regulatory environment that would ensure equity in access to technology. Together, these elements would maximize the benefits of ICT and contribute to improving the quality of education in the country.

6. Contextualized Digital Culture and Skills

The contextualization of digital competences in the Ecuadorian cultural framework was presented as a key topic in the studies by Lara (2022) and Albuja Loachamin et al. (2023). Both studies agreed that the simple adoption of technologies in education was not enough if the specific social, cultural and political contexts of the country were not taken into account. Lara (2022), through an analysis of the educational culture of Sumak Kawsay, proposed an

approach that integrated principles of sustainability, equity, and respect for cultural diversity in the digital teaching and learning process. This approach sought to align digital competencies with Ecuadorian constitutional values, promoting an education that was not only technologically competent, but also reflected the realities and needs of rural and Amazonian communities.

Lara suggested that the adoption of digital skills should go beyond simple technological literacy, to include a critical understanding of the social and cultural impact of technologies on the lives of local communities. In this sense, he proposed a pedagogy that considered technology not only as a technical tool, but as a means to strengthen relationships between individuals and their environment, respecting traditional ways of life and ancestral knowledge. This approach, based on Sumak Kawsay, moved away from Western models of technological education, advocating for an integration that respected the cultural particularities of Ecuador.

For their part, Albuja Loachamin et al. (2023) delved into the importance of contextualizing digital competencies in rural education, stressing that the adoption of technologies in these areas should be aligned with the cultural, social, and economic characteristics of communities. In their analysis, they highlighted that access to technology in itself did not guarantee learning success if it did not take into account how students and teachers in these areas interacted with technologies. Digital skills, according to their study, had to be adapted to the ways of life and community dynamics of the Amazon and rural regions, where technological resources were limited and traditional forms of teaching continued to have a significant weight.

Albuja Loachamin et al. (2023) also pointed out that educational programs designed for the integration of ICTs in these areas required an intercultural approach that allows students to develop technological skills without losing the link with their cultural identity. This approach should include specific training for teachers, not only in the use of technologies, but also in how they could be used to strengthen community ties and respect for the natural environment. The inclusion of digital skills, from this perspective, was not only limited to technical skills, but also encompassed an ethical and cultural dimension, promoting the responsible and conscious use of technologies in harmony with local values.

Together, both studies provided a critical and enriching vision on the importance of contextualizing digital competencies in the Ecuadorian education system. Rather than imposing a single model of digital literacy, they proposed an integration that respected cultural particularities and promoted a more meaningful interaction between technology, community, and education. This approach not only responded to the country's technological needs, but also strengthened the social and cultural values that are part of Ecuadorian identity, particularly in rural and Amazonian regions. The adoption of this model could contribute to a more inclusive, equitable and relevant education for the most vulnerable communities in Ecuador.

4. CONCLUSIONS

Through legislation, the creation of public policies, and the implementation of curricular reforms, the Ecuadorian government has demonstrated recognition of the need to adapt the education system to the demands of the digital age. These initiatives aim not only to improve access to education by reducing associated gaps, but also to ensure that students acquire digital

skills, expanding learning opportunities, especially in hard-to-reach geographical areas. However, this institutional movement requires scientific-methodological, socio-cultural and financial complements for its effective implementation, from the identification of the socioeconomic and technological gaps that affect certain regions and population sectors.

In virtual education in Ecuador, one of the main challenges is the digital divide and inequality in access to technology, which significantly affects rural areas and the most vulnerable populations. Limited connectivity and lack of technological resources hinder equity in access to educational opportunities. In addition, teacher training and digital illiteracy represent another key obstacle, as many educators lack the necessary skills to efficiently use technologies in their pedagogical practices, which exacerbates the difficulties in virtual teaching. These challenges were exacerbated during the pandemic, which evidenced the urgent need for innovation in education to face emergency contexts.

On the other hand, the formulation of inclusive public policies that promote digital literacy and equitable access to technology is essential to close the existing gap. A key challenge is also to improve the efficiency of ICT in the educational process, ensuring that technological tools are not only used, but effectively integrated to optimize learning. Finally, virtual education in Ecuador faces the challenge of integrating contextualized digital culture and competencies, where technological tools and pedagogy must be aligned with the sociocultural realities of the country, guaranteeing a more inclusive and effective education. This reflects the need to design continuous training strategies that address these problems from a contextualized approach. Therefore, new technologies and methodologies must be developed for digital literacy, virtual education, the development of interactive education programs, training and comprehensive training in vulnerable areas of Ecuador.

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