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PAPER

Strengths and Challenges in Teaching and Learning in Education with the Use of Information and Communication Technologies

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ABSTRACT

The purpose of this paper is to explore the existing scientific literature on the assets and difficulties in teaching and learning processes through the implementation of information and communication technologies (ICT) in education. The study employed a qualitative methodology with a hermeneutic approach across three stages: (1) identification of the research problem; (2) collection of 50 relevant publications from various databases that contributed to the topic; and (3) a reflective analysis of the importance of implementing ICT in teaching and learning. The findings pointed out five emerging themes: 1. The digital divide in Latin America, 2. The challenges of ICT integration, 3. Digital competencies and skills, 4. The impact of technology on education, and 5. Public policies. Findings show a high degree of digital inequality between different sectors of society and a substantial disparity at the household and educational center levels in terms of both access to and the use of ICTs. Most teachers either know little about new technologies or do not have suitable training to use these technologies in their classrooms. This situation prevents students from acquiring technological tools and building up digital skills that would enhance their learning process, access to higher education, and employment opportunities. It finally confirms an exceptionally intricate and persistently unequal digital divide in Latin America that affects rural and low-income populations by restricting them from accessing educational and labor market opportunities, underscoring the need for effective public policies to promote equitable access to ICTs and teacher training.

KEYWORDS

digital divide, digital competencies, digital skills, and technological tools

1 INTRODUCTION

Information and communication technologies (ICT) comprise a collection of technological tools and resources that enable the creation, storage, exchange, and management of information. The term ICT was first introduced in the 1990s

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by Jean-Claude Guédon, a French economist and academic, and has since further spread, particularly in educational and technological contexts. According to [1], ICTs are essential in education because they ease access to information as well as develop new forms of teaching and learning in different contexts [2]. The definitions of ICTs vary in literature. For example, [3] defines them as a set of tools and resources enabling the creation, storage, exchange, and management of information through digital media, while [4] describes them as technologies that support the communication and dissemination of information, which thereby changes the methodologies for teaching and learning.

A key challenge today is the incorporation of ICT in the fast-changing world of technology. The UNESCO Global Education Monitoring [5] report holds that the last two decades have seen tremendous growth in digital tool use—such as educational applications and online platforms. These are technologies through which a wide array of resources facilitates information management [6] and have spread to all sectors of society, including education, which has much improved on its methods of teaching [7]. Such provide inspiring materials that help to make content meaningful to learners. This trend towards more active learning is emphasized with technological tools that enable teachers to create new educational experiences rich in critical thinking and collaboration, as per the findings presented by [8].

Within the Latin American framework, various challenges converge that limit the implementation of ICTs within education effectively. [1] indicated that the lack of adequate infrastructure and quality Internet access in rural areas constitutes an impediment. [8] Complete the picture by saying that insufficient teacher training, among other factors, makes institutional support contribute to change resistance and the underutilization of ICTs. Although some countries have started to measure connectivity in rural areas [9], scanty internet coverage and limited access to computers are still problems that persist. Besides, improper preparation and low morale of teachers impede robust inculcation of state-of-the-art technologies such as virtual reality and artificial intelligence into the academic framework [10], [11].

In a society that is being digitized more and more, unequal access to ICT has caused digital illiteracy [12], this being manifested both in people's difficulties adapting to new technologies and in the insufficiency of autonomous digital competencies such as the development of critical thinking and the ability to interpret relevant online information [13]. All of this happens because, especially in rural areas, people know less about technological advances and have less access to all the digital tools needed [14], [15].

Technological advances, especially in ICTs, have transformed the economy and brought down inequality by making possible new business practices and democratizing access to education [16], [17]. In addition, digitalization and such technologies as artificial intelligence and blockchain have opened novel employment opportunities requiring high-level digital skills but rather empowered marginalized individuals and communities to take part in the global economy and foster entrepreneurship. Moreover, the availability of technological instruments has also improved the quality of education, thus closing the educational and economic gap [7]. Therefore, in such a dynamic environment, the integration of ICT in education is fundamental to answer the rising demand for technological skills [18], [5].

Based on these considerations, the integration of ICTs into primary and secondary education has the potential to revolutionize educational practice and enable teachers to create more meaningful and personalized learning experiences [19], [8]. This helps implement active approaches that promote student engagement [20], essential for developing the basic digital skills required for students' future careers and for bridging the digital divide, as proposed in MinTIC's Digital Agenda for Colombia

2022–2026. However, the successful implementation of ICTs faces significant challenges, such as the lack of clear pedagogical approaches and appropriate methodological design, which can limit their effectiveness in the classroom [7].

The CONPES 3975 report of 2019 stresses the need to develop curricular guidelines that integrate ICTs in a coherent manner with institutional educational projects to prepare students for the fourth industrial revolution and its demands [21]. Furthermore, UNESCO warns that many technological initiatives in education lack clear objectives and an educational rationale to support their implementation, which limits their impact on learning [22]. This raises the question: what are the strengths and challenges in teaching and learning processes through the use of ICT in education? Therefore, it is essential to explore academic publications on the successes and difficulties in educational processes, as this facilitates the identification and theoretical analysis, allowing relevant contributions to be made to the area of study.

2 METHOD

This paper was developed using a qualitative methodology with a hermeneutic approach, taking ideas from authors such as [23], who delves into the interpretation of meaning in historical contexts; [24], who analyzes the interpretation of language and texts; and [25], who applies hermeneutic principles to interpret data, aiming for a deeper understanding of the phenomena under study.

Following the stages described by [25], as shown in Figure 1, the central problem of the study was identified. In the second stage, relevant publications that contributed to the understanding of the topic were reviewed. Finally, a reflection was made on the importance of implementing ICT in teaching and learning.

The hermeneutic design facilitated the extraction of relevant findings from the research to generate a deeper understanding of reality. The first phase focused on identifying the strengths and challenges in the teaching and learning processes when implementing ICTs, addressing issues such as technological and pedagogical barriers that impact ICTs efficacy in education.

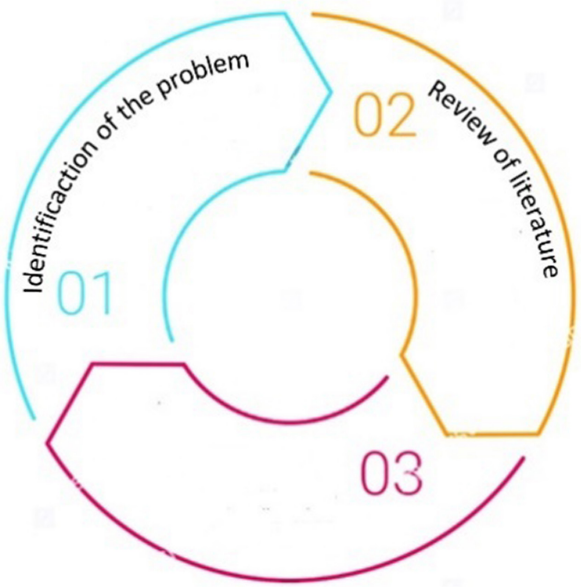

Fig. 1. Stages of the hermeneutic approach. Developed by the authors, based on the stages described by Cárcamo (2005)

In the second phase, a literature search was conducted in several databases, including Scopus, ResearchGate, SciELO, Redalyc, ScienceDirect, and online resources. The focus was on the category "Advantages and challenges in the teaching-learning process through the implementation of ICTs", as well as on the technological and pedagogical barriers that affect the effectiveness of ICTs in education. Relevant publications were selected for the analysis based on the inclusion criteria: articles published between 2017 and 2024 in English or Spanish, with a focus on education in Latin America. In addition, exclusion criteria were developed, including texts in languages other than English and Spanish, texts using quantitative methods, and texts not related to ICTs in education.

In the final phase, an analysis of the selected articles was performed, culminating in a reflection on the importance of implementing ICT in education. The evaluation considered findings on how technologies could enhance or complicate teaching and learning processes.

3 RESULTS

Following the stages of the hermeneutic approach and conducting a literature review, institutional documents, theses, and scientific articles on the strengths and challenges in the teaching and learning processes through the implementation of ICTs and the technological and pedagogical barriers that affect the effectiveness of ICTs in education were reviewed. These were found in different databases, as shown in Table 1, where 50 articles were selected: 11 were institutional documents, 16 in the Scopus database, 8 were in ResearchGate, 5 were in Redalyc, 6 were in Scielo and 1 was in ScienceDirect, in addition, 3 doctoral theses were consulted in order to carry out the analysis in light of the categories proposed.

Table 1. Types of documents and sources consulted for the exploration of scientific literature

Type of Document	Database and/or Sources	Quantity
Scientific papers	Scopus	16
	ResearchGate	8
	Redalyc	5
	Scielo	6
	ScienceDirect	1
Institutional documents	Web	11
PhD Thesis	Institutional repositories	3
Total		50

The information extracted from the scientific articles was categorized and summarized into five emerging subcategories, as illustrated in Figure 2.

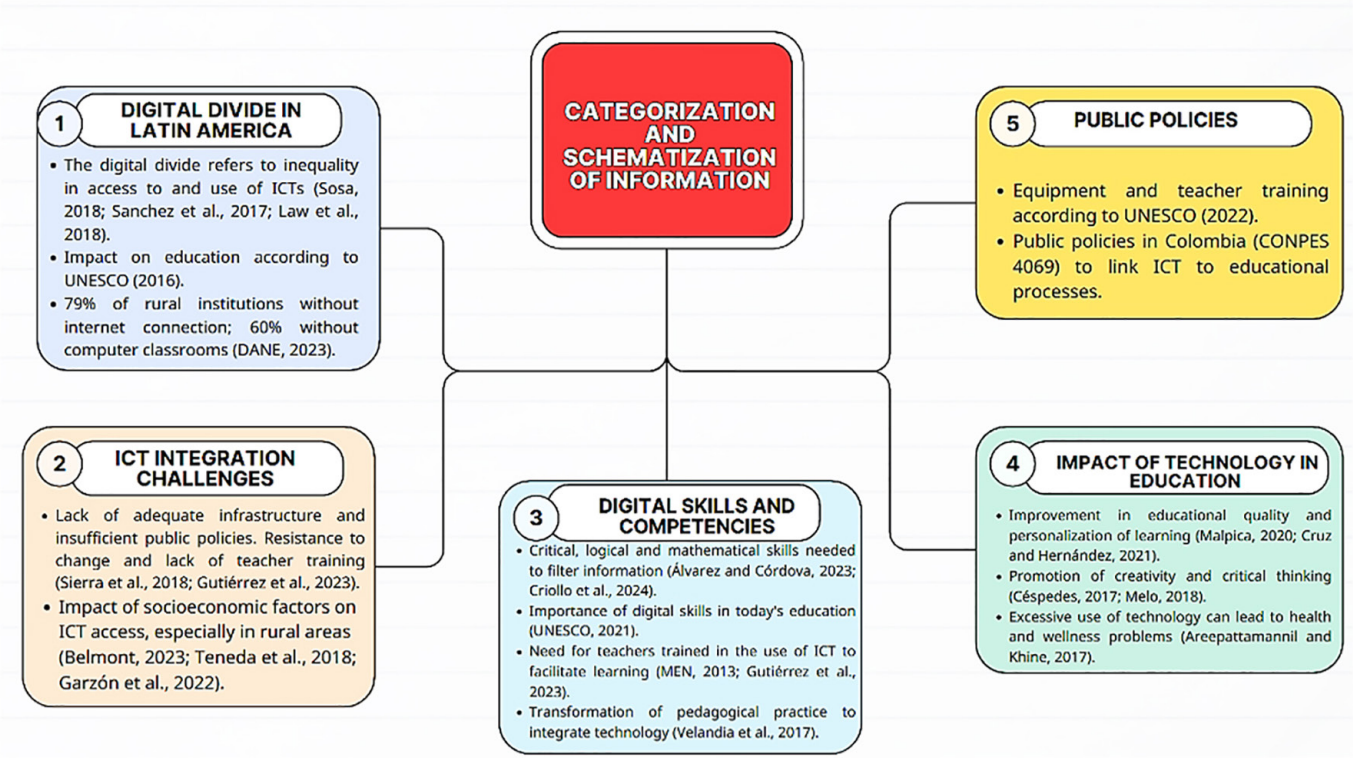

Fig. 2. Categorization and schematization of information extracted from scientific articles (Developed by the author)

4 DISCUSSION

Based on the findings and the identified subcategories, the analysis for each is presented below.

4.1 Digital divide in Latin America

The digital divide is an unequal phenomenon that reflects the disparity between access to and use of ICTs. The above analysis of articles vividly demonstrates that the gap continues to exist in different strata of society [10], [26], [27]. According to UNESCO, this version of the digital divide refers to the unequal access and usage of ICTs between different groups of people, which greatly influences education. The study conducted by IICA, the Inter-American Development Bank, and Microsoft (2022), [26], demonstrates that 71% of the urban population has Internet access, while less than 37% of the rural population has this access. This disparity demonstrates not only variations in terms of location but also economic imbalances, according to the Economic Commission for Latin America and the Caribbean [28], which indicates stark contrasts in Internet availability among households of differing socioeconomic statuses. The unequal access to digital tools and proper education means that some students and institutions possess all the necessary resources while others are neglected.

By the year 2022, DANE [29], stated that only 32.2% of rural households in Colombia will have internet access compared to 67.5% of urban households. It not only reproduces educational inequalities but also restricts employment and social

opportunities for those lacking access to technology. The widest gap hits marginalized communities, especially low-income and rural ones; this affects personal development first and, later, impacts social cohesion and economic growth in the country. But the gaps in digital also give chances for new ideas and shifts. Ruling bodies and groups can act to help more people online, like extending web networks in lacking areas, offering training for online skills, and sharing easy-to-read content. In this case, learning has a key part; giving folks the tools they need to use the digital space can change lives and create fresh paths.

4.2 Information and communication technologies integration challenges

The provision of adequate infrastructure, particularly high-speed internet connections and access to devices, is grossly lacking, which undermines the digital divide further. Among learners, those from low-income families stand out as facing extra challenges in accessing learning in a meaningful and relevant way due to the lack of these resources. As per UNESCO [30], socioeconomic factors greatly influence the integration of ICTs into people's lives, and a significant proportion of individuals lacking Internet and technological tool access reside in rural areas. This has engendered conditions for digital illiteracy [12], [14], [15]. The [29] report of Colombia verifies that 79% of educational institutions in the rural area do not have internet access, and nearly 60% do not have computer laboratories, unlike 9.3% and 14.7% in the urban area, respectively. Such blatant inequalities prohibit access to education.

The incorporation of ICTs in education has its own set of gigantic challenges. As per the research conducted by [15], most of the teachers are underqualified to integrate technological instruments into their teaching approaches, and therefore, this may lead to the insubstantial use of ICTs. For a positive impact, continuous training and support for educators in the use of these tools is essential to ensure that they apply the technology pedagogically.

Pedagogy needs to be changed too. This is a process that involves not only making technology a part of teaching but also changing and thinking afresh about how teaching and learning take place [1], ICTs use should promote active and collaborative learning [19], [31], making students play an active role in the educational process. Hence, there must be a different type of mind-setting with the educators and the learners as new forms of interaction and learning take place.

Lastly, the assessment of the impact of ICT on learning remains a prime challenge. Most learning institutions do not have any clear indicators that would facilitate the measurement of the effectiveness of all those technological tools implemented [19], [32]. Without evaluation, it is impossible to ascertain what practices are working and what needs to be changed. In this sense, the TPACK framework [19], [33] has proved to be very useful since it makes teachers reflect on the crossing of pedagogical, technological, and content knowledge in assessing the use of ICT in the classroom. With such integration of these three components, teachers can determine not only which technologies will be most effective in delivering content but also how those tools might be used instructively to improve student learning [34]. It is, therefore, very important to create evaluation frameworks that will permit institutions to analyze the impact of ICT on learning and to make ongoing improvements, in view of the complex interactions that TPACK stresses in educational practice.

4.3 Digital competencies and skills

There is a great disparity between households and educational centers in accessing and utilizing ICTs. Most institutions have very poor technological equipment, reflected in an insufficient number of student devices and internet classrooms. Many students lack the required computer tools, as there is no Internet connection nor adequate technological resources in most schools [35]. According to the DANE survey, only 37.9% of households have a desktop, laptop, or tablet nationwide, with a greater percentage in urban areas (46.3%) than in rural areas (9.7%). The absence of this access not only limits learning opportunities but also reproduces educational inequality. Along with access to technological tools, developing the students' skills in filtering and processing the information they receive is also crucial.

Analytic skills are needed by students, as stated by [2], [11], for properly judging the validity and relevance of information. Such skills would help distinguish trustworthy sources from untrustworthy ones. Also, data and graph representation require reading and spatial skills. It is very true that digital skills and competencies have become a fundamental part of the modern world, where technology has integrated almost all aspects of daily life, work, and education to a significant degree. [19] states that knowing how to navigate, use, and create technological tools is not merely a desirable competency but an essential one for success in personal and professional domains.

However, these competencies do not just address the usage of devices or software applications but include other skills such as the evaluation of information, effective communication in digital environments, collaboration in an online setting, and privacy and security protection [10]. Despite the importance of these skills, there are still massive gaps in access to them. Many people, especially from disadvantaged communities, lack access to technology and thus the opportunity to acquire digital skills [29].

This inequality does not only limit their possibilities of joining the digital economy but also perpetuates social and economic inequalities. Fast tech growth keeps pushing on the need to update digital skills; what matters now can soon be old news, needing a steady effort to learn and change [32]. So, schools and companies must back a culture of all-time learning, where updating digital skills is key. This will not just help the person but will also help in building a more solid and strong workforce. Digital skills cannot be left to the individual; there must be support from institutions, both educational and in the workplace. An encouraging environment for innovative and collaborative learning is necessary for skill development. Companies and educational institutions can put into place continuous training programs that go beyond merely teaching employees, teachers, or students how to use digital tools but also critically enhance thinking and creativity.

4.4 Impact of technology on education

The COVID-19 crisis has greatly hastened the shift to digital in many areas—education, health, and working from home. As [36] notes there has been a big surge in using the internet at home during this time, which leads to more growth of online learning and opens up new chances for education. The fast use of ICT tools shows the 21st-century standard for basic skills, as UNESCO (2021) suggested, where problem-solving, good communication, and decision-making are key to adjusting and succeeding in a changing tech world.

The educational landscape has been fundamentally transformed by ICT, and students have reached a very sensitive stage in their studies and personal life. A report from [22] suggests that the use of ICTs in teaching not only enhances information accessibility but also promotes a more dynamic and participative style of learning. For young learners, starting to build essential skills and forming their academic identity that can impact their future profession, this is especially critical.

One of the most important impacts ICTs have on education is personalized learning. Digital platforms and online learning resources enable content and teaching strategies to be adapted to the individual needs of students. Such an approach is consistent with constructivist learning theory [19]. This customization allows educators to implement more flexible, student-centered teaching approaches that increase engagement and motivation.

The impact of ICT on students' social and emotional development is another important aspect. While digital tools can help facilitate collaboration and peer-to-peer communication, they can also bring issues of cyberbullying and social anxiety [12]. Schools need to run courses that make student ICT users responsible for their actions and understand the importance of digital communications being empathic to help create a healthy and safe school environment.

4.5 Public policies

The integration of ICTs into education requires not only the innovation of teaching methods but also a rich policy framework that would back the change. Educational policies should acknowledge the fundamental presence of ICTs in learning and teaching and provide guidelines for their effective implementation in class. According to [37] and [38], public policies need to become diversified into 21st-century needs and ensure all students have technological tools and training to use those tools effectively. A great part of this policy is continuous teacher training. As [15] points out, most teachers do not have enough training to use technology in their teaching. So, public policies should have programs to help train teachers on digital tools and ways to use active and group learning. This kind of approach would not just make teaching better but also help teachers be change-makers in their communities.

The public policies should also include the digital divide that is entrenched in most communities. [29] argues that unequal access to technology belittles learning opportunities for students in secondary education, hence continuing the cycle of social and economic inequality. Education policies should comprise approaches that guarantee all students, regardless of their socioeconomic status, access to technological devices and internet connectivity. This would not only facilitate easier learning but also contribute toward equal educational opportunities. Responsible promotion of ICTs ought to be another important public policy. [12] mentions emerging issues in the digital environment that affect students, which are cyberbullying and social anxiety. Among them, education policies should incorporate curricula that inform young people about ethical practices in technology use and digital communication's empathic importance and how to respond when they find themselves involved in a cyberbullying case.

This will protect students' emotional health and contribute to an environmentally friendly school atmosphere. Lastly, it is equally important that public policies foster cooperation among various sectors, which include government, academia, and the private sector. As stated by [22], the participation of all these stakeholders is fundamental in creating an educational system that responds to the actual requirements

of contemporary society. Public-private partnerships can augment resources and introduce new methods for enhancing public education and improving the quality of learning.

5 CONCLUSIONS

The studies analyzed demonstrate a complex and persistent digital divide in Latin America, reflected in inequalities in access to and use of ICT. This gap disproportionately affects rural and low-income communities; not only does it limit access to education, but also to employment and other social opportunities. The absence of adequate infrastructure and poorly trained teachers further exacerbates this situation, preventing most students from meaningfully participating in a learning process tailored to their needs.

Yet, the review pinpointed significant holes in the research. Above and beyond the vast literature on the technical and pedagogical impediments that undermine the efficacy of technologies, there is a lack of concrete interventions that can meaningfully close those gaps. In addition, the assessment of the impact of ICTs on learning is less than ideal, which stalls the development of education policies based on evidence.

This review is very important because it highlights the challenges teachers and learners encounter when trying to use ICTs in teaching and learning as well as brings to the fore problems and opportunities that arise with the introduction of ICTs. The education sector is critical in this regard since it involves imparting digital skills to people and enhancing their inclusion today. Thus, the research shall focus on promoting public policies that ensure equal access to ICTs and training for teachers, considering the technologies' fast pace of development and influence over education, hence preparing the students to fit into a changing labor market. The academic rigor of this paper shall thus pave the way for other research work and policy recommendations while reiterating that the digital divide and integration of ICTs into education be continued, with access to technology being one among several critical tools for equity and social development in the 21st century.

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