

Impact of technology on education: Challenges and opportunities for learning in the Digital Age

Claudia Marcela Durán Chinchilla¹; Alveiro Alonso Rosado Gómez²; Martin Humberto Casadiegos Santa³

Universidad Francisco de Paula Santander, Colombia

In the New Era of education, technology has blossomed as an effective tool that promises to evolve and democratize access to knowledge. However, this metamorphosis has also brought to light the relentless technological divide, which threatens to exacerbate existing socioeconomic differences. Inequality in access to technology can lead to significant disparities in educational opportunities, particularly affecting disadvantaged and rural communities.

Keywords: Teaching-learning, Technology, Education, Digital Age.

DOI: 10.5281/zenodo.14601711

¹ Graduate in Linguistics and Literature, Specialist in Teaching Practice, Master in Pedagogy and PhD in Education. Contact: cmduranch@ufpso.edu.co

² Specialist in IT project management and Master in Software Management, Application and Development. Contact: aaosadog@ufpso.edu.co

³ Lawyer, Human Rights Specialist and Master in Public Law. Contact: mhcasadiegos@ufpso.edu.co

1. INTRODUCTION

In a world that is developing in direct relation to technological innovations, where the management of information becomes an essential place for decision-making, both individually and communally, the presence of a gap that breaks with the equality that nature grants us by the simple fact of being human beings is almost natural. This discrepancy in the management of information, induced primarily by communication accessibility to it, is called the digital divide. The digital divide is part of a cycle that belongs to educational and economic differences, acting as both origin and effect depending on the point of view taken. It has become a concept that reflects the social differences existing in the technological world.

Technology has revolutionized many aspects of our daily lives, and education is no exception. In the digital age, technological tools provide unprecedented opportunities to improve access to and quality of education. However, this evolution has also revealed a deep technological divide that can exacerbate pre-existing socioeconomic discordances. Digital equity thus becomes a crucial challenge to ensure that all students, regardless of their socioeconomic background, enjoy access to the same educational opportunities.

In this sense, technological impacts have established a new and different social reality, with numerous emerging changes in political, social, and economic institutions, fundamentally in the educational field. One of the most notable factors in this change has been the digital divide, which refers to the difference, distance, or separation between countries, institutions, societies, individuals, or groups of individuals in terms of access and use of Information and Communication Technologies [1] In such a way, the digital divide not only reflects differences in the technological infrastructure but also in the capacity of individuals to use these tools effectively.

When we talk about the digital divide, we are referring to the distance between those who can make effective use of information and communication tools and those who cannot do so because they are elderly, disabled, illiterate, technologically illiterate, or people with economic limitations or in a marginal situation [2]. Similarly, the digital divide has been defined as the incompatibility between individuals, households, businesses, and geographic areas at different socioeconomic levels concerning their opportunities to access ICTs and their use for a wide variety of activities [3].

For [4] the digital divide refers to the inequality of possibilities to access information, knowledge, and education through new technologies; in the same way, it refers to the lack of access to the network and the various tools found in it, as well as the discrepancies that this context causes, therefore, it could be said that the digital divide is the social distance that separates those who have access to information and communication technologies (ICT) from those who do not.

From the point of view of [5], access to technology is a process of appropriation that consists of several basic stages. First, motivational access, which is related to the interest and affinity for the new technology, is revealed by social, cultural, mental, and psychological factors. Second, physical or material access, is linked to the availability of hardware, software, applications, networks, and the use of ICT and its applications. Third, access to digital literacy refers to the education necessary to obtain digital skills. Finally, use refers to the significant opportunities to apply these technologies.

However, thinking that everyone is connected to the Internet is a myth, since the reality is that not everyone has access to this technology, and not everyone will have the possibility of connecting in the medium term. This may mean that, instead of benefiting the democratization and extension of education, it is promoting the exclusion of those people who, due to their economic resources or the area in which they live, cannot access these new tools. This is where the so-called digital divide comes into action.

When explaining the digital divide, we find two major trends that we could consider hard and soft [6]. Within the line that we could call soft, it is indicated that the problem to be solved is simply one of telecommunications and computer technology infrastructures. On the other hand, there is another harder and more realistic view, which assumes that the problem is a consequence of the social and economic

inequality that exists in capitalist society. This inequality not only separates countries by the quality of education and medical services but also by the degree of use they can make of ICT.

These visions, as we can imagine, imply different approaches to addressing and solving it. One approach states that by universalizing access to the Internet, everything else will be resolved and the digital distance, the gap, between people and countries will be reduced. While, from the other perspective, since the digital gap is a consequence of social inequality, either this is attacked or all the measures adopted to extend the networks will continue to benefit only one group, and indirectly the same gap will continue to widen. To a certain extent, we could say that the digital gap is a direct consequence of the existing socio-economic gap between countries, regions, institutions, and people.

2. EDUCATIONAL DIGITAL DIVIDE

Since the earliest times, human beings have linked progress with the development of technology. The generation, application, and transfer of technological concepts have granted competitive supremacy in economic, material, and cultural terms to social groups that hold political and economic power and have known how to take advantage of technological development to their advantage.

On the other hand, other marginal social groups, both in urban and, above all, rural areas, have not benefited from this knowledge, remaining behind the progress achieved by the former. This has generated a technological gap between both groups.

A current version of this technological discrepancy is the digital divide. This concept is closely linked to the limitations in access to ICT by large sectors of the population [7]. This situation leads to the stratification of society based on the transition to new technologies and the use made of them. In other words, segmentations are created between those who have access to these technologies and those who cannot access them or are even unaware of their existence.

In recent years, technological advances have founded a true digital revolution, giving rise to a new context distinguished as the Information and Knowledge Society (IKS). In this society, both access and use as well as the generation of information are promoted on a global scale in an almost immediate and synchronous manner. These transformations are implementing changes in all areas of life, making it essential to ensure that citizens assume technology training, which supports the exclusion of new elements of divergence between societies of the world and between women and men, becoming an opportunity to generate equality, as indicated in the Sustainable Development Goals 2030 [8].

Information and communication technologies have become an integral part of the common language in educational institutions at all levels, in large, medium, and small cities around the world. Today, students in large and medium-sized cities do not consider taking subjects such as computer science, computational models, or programming to be new. Unlike previous generations, they see it as an obligation imposed by the educational institution, and therefore, something commonplace. This situation is noticeable since the younger generations were born during the rise of these technologies and have grown up in parallel with their continuous advance.

In the educational context, the digital divide refers to the problems of use and appropriation of technologies, determined by the lack of skills and knowledge regarding the use of these tools both in daily life and, in the case of teachers, in the didactic task, in that sense, it is essential to have competent teachers not only in disciplinary content of the subjects they teach, but also in pedagogical knowledge, so in this regard, [9] highlight the need to accommodate the curricula to these requirements, originating teaching and learning models that take into account an appropriate inclusion of technologies in educational processes.

From the students' point of view, institutions must guarantee digital inclusion, fulfilling two fundamental objectives: on the one hand, providing students with the skills and abilities necessary to access and use these technologies; on the other, ensuring that public authorities implement the necessary policies so that populations have the necessary resources for this access, so this process, in the current scenario, is

unfinished, and puts at risk of social exclusion all those who, on the one hand, do not have access to digital media and, on the other, those who do not have the essential skills to be in tune with the current world.

From the above point of view, education is a determining factor in the development of a country, and nowadays it is impossible to think of education without the use of different technological tools. Nowadays, it is not just a closed place where master classes are given; countless technological tools are needed to make the learning process more dynamic and meet the needs of individuals, communities, and society in general. In short, the educational digital gap can be summarized as shown in Table 1.

Table 1. Educational digital gaps

Digital divide	Cause	Consequence
Internet access	<ul style="list-style-type: none"> ▪ Insufficient infrastructure in rural and remote areas ▪ High costs of internet services. ▪ Socioeconomic inequality. 	<ul style="list-style-type: none"> ▪ Limited access to online educational resources. ▪ Increase in educational inequality. ▪ Less participation in digital academic activities.
Device Availability	<ul style="list-style-type: none"> ▪ Lack of financial resources to purchase devices. ▪ Insufficient public policies. ▪ Dependency on shared devices. 	<ul style="list-style-type: none"> ▪ Reduction in usage time per student. ▪ Difficulties in developing technological skills. ▪ Increase in academic backwardness
Training and Competencies	<ul style="list-style-type: none"> ▪ Lack of teacher training programs in ICT. ▪ Inequality in the quality of technological training between urban and rural schools. 	<ul style="list-style-type: none"> ▪ Teachers with poor technological skills. ▪ Outdated teaching methods. ▪ Student demotivation due to non-interactive methods.
Educational Content and Resources	<ul style="list-style-type: none"> ▪ Lack of digital content in local languages and contexts. ▪ Unequal distribution of digital resources between public and private schools. 	<ul style="list-style-type: none"> ▪ Less relevance and applicability of educational content. ▪ Gap in educational quality between different regions and types of schools.
Home Connectivity	<ul style="list-style-type: none"> ▪ Low internet penetration in low-income households. ▪ Lack of policies to facilitate domestic access to the Internet 	<ul style="list-style-type: none"> ▪ Limitations on doing homework and studying at home. ▪ Inequality in remote learning. ▪ Increase in school dropouts.
Policies and Regulations	<ul style="list-style-type: none"> ▪ Absence of inclusive educational policies in ICT. ▪ Insufficient investment in technological infrastructure. ▪ Uneven implementation of policies. 	<ul style="list-style-type: none"> ▪ Increase in the educational gap between regions. ▪ Lack of preparation of students for the modern labor market

Digital gaps in education are a reflection of broader economic, social, and political inequalities. Addressing them requires a comprehensive approach that includes infrastructure transformations, inclusive public policies, and training programs for both students and teachers. Only through a concerted effort can equitable and accessible education be achieved, preparing future generations for the challenges of the digital world.

3. REFLECTIONS ON INEQUALITY IN ACCESS TO TECHNOLOGY AND EQUITABLE EDUCATION

That we are all on the net and that it is becoming an element of welfare and social equality for all people, as argued by one of the gurus of the Information Society, [10], is a fallacy. The reality is that the gap between rich and poor countries at the beginning of the 21st century is greater than that which occurred in the previous century. As pointed out [11], the reports on Human Rights carried out since 1990 by the UN indicate remarkable data regarding how society is gradually developing more unequally. Recognizing that the index of Internet and ICT worldwide is successively increasing, one cannot fail to recognize that the degree of sagacity of the same in different countries is quite different. In that sense, it is not necessary to be an expert analyst to realize that the separation is perfectly marked by the economic conditions of the country.

From the above perspective, in the digital age, access to technology has become a transcendental factor for educational and professional development. However, this reality has also revealed an alarming inequality: the technological gap. This gap refers not only to the availability of devices and internet connection but also to the ability to use them effectively. Inequality in access to technology can exacerbate socioeconomic differences in various ways.

First, lack of access to technology prevents students from disadvantaged communities from having the same learning circumstances as their more advantaged peers. In a world where information and educational resources are increasingly available online, those without access to the internet or appropriate devices are left behind. This situation creates a vicious cycle: lack of access to technology leads to lower academic performance, which in turn limits future employment circumstances and perpetuates poverty.

Second, the technology gap also affects individuals' ability to acquire essential digital skills in the modern labor market. Digital literacy is critical in virtually every industry, and those who do not have access to technology from an early age are at a competitive disadvantage. This disparity can lead to further economic polarization, where the highest-paying jobs are available only to those with advanced technological skills.

To address these inequities and ensure equitable education, several measures need to be implemented. First, governments and international organizations must work to provide universal access to high-speed internet. Initiatives such as installing free Wi-Fi hotspots in marginalized rural and urban areas can be a significant step towards bridging the digital divide.

Furthermore, it is crucial to invest in technological infrastructure in schools. This includes not only providing devices such as computers and tablets but also ensuring that educational institutions have the technical support necessary to maintain and effectively use this technology. Continuing training programs for teachers in the use of digital tools are also essential to maximize the positive impact of technology in the classroom.

Another important measure is the creation of digital inclusion programs that offer free training in technological skills to disadvantaged communities. These programs can help close the knowledge gap and equip individuals with the necessary skills for success in the 21st century.

Finally, public policies must focus on digital equity, ensuring that technological initiatives consider the specific needs of the most vulnerable populations. This includes designing and implementing educational strategies that integrate technology in an inclusive and accessible way for all students, regardless of their socioeconomic status.

Inequality in access to technology is a significant challenge that can exacerbate existing socioeconomic differences. However, through a combination of universal access, adequate infrastructure, ongoing training, and equitable public policies, it is possible to mitigate this gap and promote fairer and more accessible education for all. By doing so, we will not only be preparing future generations for a digital world but also fostering a more equitable and inclusive society.

On the other hand, it is important to note that on the Internet we come across an abundance of information, which is very different from knowledge. The latter requires cognitive reworking and accommodation by the user. In this regard, the digital divide is not only a question of technical access and training capacity, but also, although related to the latter, a linguistic one. The situation is that English dominates the network, and as the language of the empire, the most novel, updated, and attractive places from a scientific point of view are in that language [12].

Likewise, another relevant aspect is the one related to the radical classification between digital natives and emigrants, where some are experts in the use of ICT and others are novices, because technological developments are being carried out more by those classified as emigrants than by natives; the difference cannot be made by taking age as an element alone, but other parameters are already beginning to be considered, such as how we interact and construct messages with technologies, and here again, emigrants make more complex uses than natives; and many times they establish categories to indicate something that we do not fully understand [13].

What can be overlooked is that there is a clear divergence in how each person accesses technology and the cognitive structures they possess as a result of their interaction with different technologies and symbolic

systems. Native speakers may be more multitaskers, are used to working with an overload of information, tend to be active interlocutors, and present themselves as producers. However, they also have problems with the cognitive skills of attention and concentration [14].

4. IMPORTANCE OF ADDRESSING THE DIGITAL DIVIDE IN EDUCATION

The digital divide in education is a critical challenge facing the entire world. In an increasingly interconnected and technology-dependent world, the ability to access and use digital tools has become a conclusive factor for academic and professional success [15]. Addressing this gap is not only a matter of social justice but an imperative need to ensure the equitable and sustainable development of our societies [16].

4.1 Impact on access to information

Access to the Internet and technological devices grants students access to a vast amount of information and educational resources. Without this connectivity, students in rural areas and segregated communities are left behind, unable to benefit from online learning materials, digital libraries, and learning platforms. This lack of access perpetuates the discrepancy in the quality of education received and limits opportunities for autonomous and continuous learning [17].

4.2 Development of technological skills

In the digital age, technological skills are essential for almost every profession. By failing to address the digital divide, we risk leaving a large part of the population without the skills needed to participate in the modern labor market [18]. Learners who lack regular access to devices and the internet have fewer opportunities to develop skills in programming, data analysis, and the use of specialized software – skills that are increasingly in demand [19].

4.3 Teacher training and teaching methods

Teachers play a vital role in integrating ICTs into the classroom. However, many teachers lack the appropriate training to use these tools effectively [20]. Addressing the digital divide also involves investing in teacher training, ensuring that all teachers, regardless of their location, can implement innovative teaching methods adapted to the needs of the 21st century.

4.4 Equity and Social Justice

The digital divide exacerbates existing inequalities. Students from low-income families, rural communities, and marginalized groups are the most affected. Without access to the same educational opportunities as their more advantaged peers, these students face additional barriers to achieving their potential. Addressing the digital divide is therefore a matter of social justice and fairness, ensuring that all students have the same opportunities to succeed [21].

4.5 Preparing for the future

The future of work is inextricably linked to technology. Innovations in artificial intelligence, robotics, and other technological areas are transforming entire industries. [22] Preparing students for this future requires equitable access to technology from an early age. Only then will they be able to develop the skills necessary to adapt and thrive in an ever-changing work environment?

5. CONCLUSIONS

The digital divide in education is a tangled problem that requires multifaceted solutions. Governments, educational institutions, and the private sector must work together to ensure that all students have access to the Internet, appropriate devices, and quality technological training. Doing so will not only foster equity and social justice but will also prepare future generations to face and take advantage of the opportunities

of the digital world. Only through a joint and sustained effort can we close the digital divide and ensure a more equitable and prosperous future for all.

In short, the digital divide in education is a complex problem that can only be addressed with a coordinated global strategy. It is not so much about access to the internet and devices as it is about the infrastructure that will enable every student, everywhere and of any socioeconomic level, to participate in the digital revolution.

There is a strong need for governments to work with educational and private organizations in implementing a holistic approach to address this challenge. Governments must lead efforts by creating public policies that ensure equal access to technology and the development of digital skills from an early age. Of course, schools must also play a role in shifting teaching paradigms to make better use of technology and ensure that all students are well-positioned for the 21st century. The role of the private sector can once again be with materials, technology, and training that complement rather than duplicate the work of the public sector.

It is not enough to provide students with devices and connectivity; technological training for both students and teachers must be ongoing. Technology evolves, and unless the necessary training continues as well, the digital divide will continue to widen, potentially leaving some students at a disadvantage even within an increasingly cutting-edge digital educational environment.

Closing the digital divide will not only have an immediate equalizing and social justice-promoting effect but also a massive long-term impact. An inclusive digital education will train students of future generations to take on and make the best use of the opportunities of the globalized world in terms of a more competent and flexible workforce. This, in turn, will foster economic growth and help reduce inequality in society.

The promise of closing the digital divide must be fulfilled over time. Work cannot be done in isolation or within a limited time horizon on an ever-evolving problem. Only through persistent and malleable work as technology and society itself progresses can we hope to realize a more equitable and prosperous future for all individuals in society.

Finally, the digital divide is a problem that we must all be willing to work on. Such cooperation, across all spheres of society, will not only allow us to close this gap but will also strengthen the field of inclusive, equitable education that is relevant to the challenges of the digital age. In the process, we will be able to build a tomorrow in which everyone has the opportunity to prosper, without exception.

REFERENCES

- [1] Garzón A. et al. (2022). Estudio de la brecha digital y el proceso de enseñanza- aprendizaje en Ecuador - Caso De Estudio: Universidad Técnica De Machala. *Revista Angolana de Ciencias* 4(2,) 1-22.
- [2] Guzman J. (2008). Estudiantes universitarios: Entre la brecha digital y el aprendizaje. *Apertura* 8(8), 21-33.
- [3] OECD. (2001). Understanding the digital divide. Organization for Economic Co-operation and Development.
- [4] Almenara J. (2014). Reflexiones sobre la brecha digital y la educación: Siguiendo el debate. *Inmanencia* 4(2), 14-46.
- [5] Van D. (2006). Digital divide research, achievements, and shortcomings. *Poetics* 34(4-5), 221-235.
- [6] Sánchez G. (2019). El digital business, transformación digital de las empresas: evolución de las competencias digitales del talento humano. Universidad Cooperativa de Colombia.
- [7] Segurajáuregui L. y Rojas F. (2008). La brecha digital y su influencia en la educación para la sustentabilidad. *Revista del Centro de Investigación de la Universidad La Salle* 8(29), 69-79.
- [8] ONU. (2017). Informe de los Objetivos de Desarrollo Sostenibles. Recovered: <https://unstats.un.org/SDGs/report/2017/>
- [9] McGarr O. y McDonagh A. (2019). Digital Competence in Teacher Education. Recovered: <https://dicte.oslomet.no/>.
- [10] Negroponte N. (1995). El mundo digital. Ediciones B.
- [11] Tezanos J. (2001). La sociedad dividida. Estructuras de clases y desigualdades en la sociedad tecnológica. Biblioteca Nueva.
- [12] Watson R. (2011). Mentes del futuro. ¿Está cambiando la era digital nuestras mentes? Viceversa.
- [13] Carr N. (2011). ¿Qué está haciendo Internet con nuestras mentes superficiales? Taurus.
- [14] Carr N. (2014). Atrapados. Cómo las máquinas se apoderan de nuestras vidas. Taurus.
- [15] García C. (2004). Diferentes, desiguales y desconectados: Mapas de la interculturalidad. Gedisa.
- [16] Warschaue M. (2004). Technology and Social Inclusion: Rethinking the Digital Divide. MIT Press.
- [17] Castells M. (1996). The Rise of the Network Society. Blackwell Publishing.
- [18] Livingstone, S. (2012). Children, risk, and safety on the internet: Research and policy challenges in comparative perspective. Policy Press.
- [19] Selwyn M. (2010). Schools and schooling in the digital age: A critical analysis. Routledge.
- [20] Roblyer M. y Doering, A. (2014). Integrating Educational Technology into Teaching. Pearson.
- [21] Warschauer M. (2003). Technology and Social Inclusion: Rethinking the Digital Divide. MIT Press.
- [22] Schwab K. (2017). The Fourth Industrial Revolution. Crown Business.