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Research Article

Technologies in the Classroom: Catalysts for Change and Potential Obstacles

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Abstract

This article examined how digital and socioeconomic gaps affect the implementation of technologies in education. Unequal access to these tools influences academic performance, especially among low-income students. Studies highlight that students from higher-income families have easier access to devices and the internet, which enhances their educational outcomes. In contrast, those in disadvantaged contexts face limitations that affect their learning. Furthermore, the adaptation of Information and Communication Technologies (ICTs) has fostered innovative methodologies such as the flipped classroom, which promotes collaborative learning. However, resistance to change, especially among older educators, hinders their adoption. A lack of teacher training and adequate resources perpetuate these inequalities. The research specifically addresses the digital divide through multiple perspectives, including device accessibility, connectivity infrastructure, and digital competency development among students and teachers. Our findings indicate that the implementation of ICTs in educational settings varies significantly between urban and rural areas, with rural communities experiencing pronounced disadvantages in technological infrastructure. These disparities are further amplified by socioeconomic factors, as evidenced by research showing that low-income households have significantly less internet access compared to middle and high-income households. The study also explores pedagogical innovations enabled by ICTs, such as constructivist and connectivist approaches that promote student autonomy and active knowledge construction. However, our analysis reveals that these innovations are not equally accessible across different socioeconomic contexts, potentially exacerbating existing educational inequalities. Age-related resistance to technological adoption among educators represents another significant barrier, with research showing that teachers over 50 years old demonstrate greater reluctance to incorporate ICTs into their teaching methods. This research contributes to the ongoing discourse on educational technology by highlighting the complex interplay between technological implementation, socioeconomic factors, and pedagogical practices. In conclusion, although ICTs have the potential to improve educational quality and promote equity, digital and economic gaps limit their impact. It is essential to design inclusive policies and strengthen teacher training to ensure equitable access to digital resources and opportunities for all students, regardless of their socioeconomic background or geographical location.

Keywords

ICT, Education, Inequality, Academic Performance, Flipped Classroom

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1. Introduction

In the digital age, ICTs have profoundly transformed education, improving access to information and the quality of learning. Currently, ICTs in school learning are essential and widely recognized. They are considered a resource that significantly enriches the educational process, and their adoption has influenced educational systems at all levels [1]. However, in developing countries like Peru, the implementation of ICTs faces barriers in the digital divide, which limits equitable access to devices and connectivity, especially in rural areas. Despite government efforts, inequalities persist, and a comprehensive approach is necessary to ensure inclusive education that trains both students and teachers in the proper use of digital tools [2, 3].

Therefore, this article seeks to identify: how do digital and socioeconomic gaps affect the implementation and effectiveness of technologies in the classroom? The digitalization of education not only presents challenges, such as growing concerns about privacy and data protection or the widening digital divide, but also transforms educational management and the assessment of student competencies [4]. Addressing these inequalities is crucial to ensure that all students have equitable opportunities. There are various strategies to mitigate these problems, such as teacher training and the development of flipped classrooms. Ignoring these gaps perpetuates educational inequality and limits the potential of many students. By ensuring equal access to technology, we promote a more fair, inclusive, and high-quality education for all.

The objective of this research is to examine how digital and socioeconomic gaps affect the implementation and effectiveness of technologies in the student environment. This analysis seeks the main obstacles faced by students in vulnerable contexts, especially in vulnerable areas, in order to propose solutions that promote inclusive education. Furthermore, it is hoped to develop strategies that allow for improved access to devices, the internet, and teacher training, to ensure that all students enjoy the same learning opportunities in a digital environment. Likewise, it is observed that some teachers are reluctant to change their teaching methods, either due to personal beliefs or distrust of new technologies, which represents an additional obstacle in the integration of technologies.

The hypothesis is based on the premise that inequalities in access to technology generate a large educational integration gap that disadvantages students from less advantaged socioeconomic backgrounds. In countries like Peru, the lack of devices and connectivity, along with insufficient teacher training, limits the potential of technologies in education. Therefore, it is necessary to implement action plans that address these inequalities, promoting equitable access to technological tools and ensuring that both students and teachers are equipped to make the most of the opportunities they provide.

2. Materials and Methods

2.1. Theoretical Framework

ICTs play a fundamental role in education, promoting meaningful learning by facilitating the acquisition of cognitive, social and operational skills. According to Puicañ [5], the use of ICTs improves learning by 77.18%, underscoring their positive impact on education. By offering interactive and accessible tools, such as online study platforms and educational apps, ICTs enable students and teachers to optimize the educational process, fostering greater understanding and long-term knowledge retention. However, it is also valuable to consider the challenges that may arise, such as technological dependence and access gaps, which raises the question of whether they are truly catalysts for change or new obstacles to learning.

For an in-depth analysis of key elements related to ICT and the development of ethical values, Ventura et al. [6] suggest that historical-logical methods are particularly useful. These methods allow for the examination of students' trajectories and backgrounds, both inside and outside the classroom, in relation to their use of ICT. Furthermore, they facilitate the identification of the consequences of the appropriate handling of technologies and digital elements, as well as the assessment of whether they are used responsibly. This analysis is fundamental to understanding how ICT can influence students' ethical development.

2.2. Methods

This work is based on a constructivist philosophical framework, which emphasizes that knowledge is constructed through contextual and meaningful experiences. Following Hernández [7], who mentions that this perspective fosters a unique experience in the student learning process, which adjusts to the way they best assimilate and construct their own knowledge. From this perspective, the use of digital tools in the classroom allows students to take an active role in directing their own learning, promoting a personalized and unique experience that breaks with the traditional teaching model centered on paper and pencil. Furthermore, the work is enriched by the principles of connectivism, proposed by George Siemens, which emerged in complex societies and inserted in globalized economies.

This theory focuses on how learning occurs in networks and is structured by the connections students form through technologies [8]. It provides a key perspective for understanding how ICTs not only provide instant access to a vast universe of information but also foster student autonomy in the active construction of their knowledge.

The proposed design is based on a case study, as described by Andreoli and Lorenzen [9], where they mention that this

case study allows for an in-depth and detailed exploration of complex phenomena in real-life contexts, which is suitable for investigating the implementation of technologies in the classroom, emphasizing that technology should not be approached as a simple technological novelty, but as a global strategy that challenges education to rethink and adjust its approaches to meet the needs of an increasingly interconnected and interactive world. The method used is inductive, according to Gómez et al. [10], in their study conducted in Mexico, which indicates that the inductive method allows for the development of theories based on observation and the analysis of the collected data, which is essential for understanding how digital and socioeconomic gaps affect the effectiveness of educational technologies.

In this study, observation confirms all the identified emerging categories and how the digital divide positively impacts students and teachers. The study focuses on identifying catalysts for change in the use of ICTs in educational contexts, especially in developing countries like Peru. Epistemologically, from a constructivist perspective, where knowledge is constructed through interaction and experience, and from a connectivist perspective, which emphasizes the connection between information nodes in the digital age, addressing the improvement of technologies within the educational context will serve as catalysts for change. However, digital and socioeconomic divides can have a significant impact on the implementation and effectiveness of these technologies in the classroom. These become obstacles to overcome, creating the dilemma of whether ICTs truly help us improve or intensify the barriers that currently exist.

3. Results

3.1. Digital Gaps in the Classroom

In recent years, ICTs have become an essential part of our daily activities, transforming multiple aspects of modern life. Their rapid spread is advancing by leaps and bounds, and their integration into the educational field has meant a significant improvement in access to information, personalized learning, and interactivity in classrooms, adapting to the needs and learning styles of each student. However, the use of ICTs in education is not a new phenomenon. This is evidenced by the 1,874 academic articles published on the topic between 1996 and September 2022, reflecting how digitalization, globalization, and the information society have profoundly impacted education and teaching-learning methodologies [11].

Despite their benefits, unequal access to these technologies, coupled with differences in the digital skills of students and teachers, has created significant gaps that limit the potential of ICTs in many educational contexts, especially in rural or low-income areas. This panorama reveals a worrying reality, as accessibility to these tools remains a considerable barrier for the majority of the world's population. As society becomes more digital, developing digital skills becomes a mandatory requirement for both learning and labor and social inclusion [12]. Therefore, it is essential to thoroughly analyze how these factors influence learning and how these inequalities can be reduced to ensure equitable education in the digital age, promoting digital literacy that encompasses all sectors of the population.

3.1.1. Access to Technological Devices

Access to technological devices such as computers, tablets, and internet access is essential for educational and social development, and is therefore fundamental to today's education. However, this access remains unequal across all contexts, perpetuating social inequalities and limiting learning opportunities, especially for the most vulnerable communities.

Lack of access to appropriate technologies negatively impacts the education of students from low-income families. A study by Afzal et al. [13] indicates that low-income households have significantly less internet access compared to those with middle and high incomes. This socioeconomic digital inequality further complicates access to educational resources for students from disadvantaged backgrounds, generating a cycle of educational disadvantage that can persist throughout their lives, perpetuating social inequality. To address this problem, it is essential to provide adequate training on the use of educational technologies and foster confidence in them. This requires ongoing support for educators and students to improve their digital competency. Collaboration between educators, families, and the private sector is key to bridging the digital divide. It is also essential to adapt instructional methodologies and tailor learning to address the unique needs of digital environments [14].

It is vital to implement public policies that improve technological infrastructure and ensure its proper use in the educational field, adapting to the needs of teachers and students. Educational administrators must continue to innovate in their learning models using available technological resources in order to increase academic levels, as mentioned in research by Jerry Chih -Yuan, et al. [15], which shows that the proper use of technology by students increases their academic performance results. In addition, it is key to guarantee adequate digital connectivity that facilitates access to virtual education and helps reduce this existing digital divide [16].

3.1.2. Digital Skills of Teachers and Students

The diversity of ICTs is key to education and the goal of optimizing teaching and learning. This diversity encompasses different skill levels and combinations, allowing both teachers and students to experience personal and professional growth [17].

According to the Spanish Ministry of Education and Vocational Training [18], citing the National Institute of Educational Technologies and Teacher Training (2021),

students are expected to achieve five objectives by the end of basic education. These objectives are in line with the five competency areas defined by the European Digital Competence Framework for Citizenship, which establishes five key areas: information and data management, interaction and collaboration in digital environments, production of digital content, protection in the digital sphere, and the ability to solve problems related to the use of technology. To achieve these objectives, teacher participation is key. Pozos and Tejada [19] have defined a series of essential digital competences for this profile. The priority falls on the teacher as a reflective professional, capable of using ICT strategically not only in the classroom but in all their work contexts. This approach promotes a critical and contextualized use of technology, which favors student learning and professional development, thus ensuring adequate attention to diversity.

This personal growth occurs through the implementation of different methodologies in various areas. As can be seen in the following examples, Gómez and Herranz [20] propose that both teachers and students use a methodology that combines quantitative and qualitative approaches in their studies without modifying the variables in the process. They suggest creating surveys specifically designed for the situation, collecting sociological and lexical data from participants, and analyzing and evaluating responses using available ICTs. Furthermore, they highlight the importance of activating exercises that, through appropriate stimuli, promote free association and allow for the observation of patterns in responses, thus contributing to the collection of relevant statistical data. King et al., for their part, [21] analyze the implementation of ICTs in the training process in economics and administration in higher education.

To this end, they propose a methodological approach focused on the search and bibliometric analysis of relevant articles. This process should include the identification of key publications, the construction of academic collaboration networks, and the analysis of the main lines of research. They also suggest the use of tools such as Excel and Vosviewer to analyze patterns and trends, as well as the evaluation of relevant keywords that guide personal and academic development in these areas. Finally, we have Puicañ o. [5], who conducted a study on the impact of ICT tools on the acquisition of meaningful knowledge. The methods he proposes include a strong collaborative orientation, meaning teachers should integrate ICT into their teaching practices in a way that facilitates the connection between the new information obtained and students' existing knowledge, enabling them to construct their own knowledge.

Thanks to the studies conducted, it can be said that the use of ICTs in education goes beyond reducing technological inequalities, but also enhances the personal and professional development of teachers and students. It is essential to adopt methodologies that adapt to the diverse skills present in the classroom, ensuring that both teachers and students are equipped to overcome the challenges that may arise in the future [22].

3.2. Socioeconomic Impact of Technological Implementation

The socioeconomic impact of technological implementation is a highly relevant topic today and has been the subject of various debates and studies in recent decades. The integration of new technologies not only represents an opportunity for economic and social progress but also introduces complex challenges in various sectors. In education, for example, the inclusion of digital technologies improves the quality of learning, diversifies teaching methods, and expands access to high-quality, customizable educational resources tailored to students' individual needs. However, unequal access to these technologies highlights the digital divide, especially in low-income communities, and resistance to change persists in some educational institutions, hindering their effective implementation [23, 24].

Globally, the speed of technological change has the potential to drive sustainable development through the efficient use of resources and job creation in emerging sectors. However, it also poses significant challenges for local economies, which must quickly adapt to changes in the labor market, particularly in sectors vulnerable to automation and digitalization, where the replacement of traditional jobs with advanced technologies is a latent threat [25]. In Peru, technological implementation presents a landscape of opportunities and challenges that must be managed through inclusive and sustainable policies, especially in critical areas such as education, health, and the economy, with the aim of maximizing their benefits and mitigating negative impacts to achieve equitable and resilient development.

3.2.1. Socioeconomic Factors and Their Relationship with Access to Technology

In the current educational context, access to technology has become a key factor for the development of skills and competencies in students. However, this access is not equitable, as it is often conditioned by various socioeconomic factors that influence families' ability to integrate technological resources into their students' educational environment. Various studies clearly reflect this inequality. Starting with research on the impact of socioeconomic classes on internet use for learning in Europe and Korea, it is observed that adolescents from families with greater economic resources have easier access to devices and a stable connection, which significantly improves their educational outcomes [26].

In contrast, students from low- income families, such as those in the city of Surabaya, where poverty rose to 15,000 in 2020, face severe limitations that hinder their participation in online learning environments [27]. Other studies, such as those by Maya et al [28], reinforce these ideas about digital divides and how they persist today, highlighting the challenges faced by people with limited resources in

accessing these learning methods. Therefore, the socioeconomic status of families significantly influences young people's learning and academic performance. The influence of families, regardless of their social class, has been and continues to be key to students' academic success.

3.2.2. Effect of Uneven Implementation on Academic Outcomes

The implementation of educational technologies has transformed learning, but unequal access to them negatively impacts academic performance, especially in low-income communities nationally and internationally. According to Flores et al., [29] the lack of internet and technological tools limits not only educational opportunities but also the social development of those without access to ICTs. In the academic field, a study presented by Fuentes et al. [30] shows that the use of digital tools between 2020 and 2022 significantly improved the academic performance of fifth-grade secondary school students compared to 2018 and 2019, when ICTs were not used. Another study by Garc á et al. [31] analyzes the use of search engines, wikis, and podcasts by 1,488 Spanish adolescents, demonstrating that these tools improve academic performance in Science, Mathematics, and Language, especially among women and younger students.

Inequality in access to educational technologies continues to this day, preserving limitations on learning and development. Improving this access is essential to equalizing opportunities and enhancing academic performance nationally and internationally. It is crucial to ensure that all students receive the support they need to thrive in their educational institution, with the necessary means to achieve the optimal learning that is truly expected of them.

3.3. Pedagogical Innovations Through ICT

ICTs have revolutionized the educational field, providing new opportunities for inclusion and pedagogical innovation. By facilitating access to a wide variety of educational resources, these technologies have opened doors to personalizing learning, promoting active student participation, and fostering greater interactivity in the classroom. However, the implementation of these technologies also poses significant challenges that, in some cases, can exacerbate preexisting inequalities in the education system. According to Gonz ález et al. [32], the effective integration of ICTs in education can be a key driver for educational inclusion, but this requires adequate planning and ongoing training for both teachers and students, ensuring that all involved benefit equitably.

Romero also [33] highlights that the lack of access to technology and adequate digital skills can significantly limit the positive impact of ICTs, especially in emergency contexts such as mandatory social isolation during the COVID-19 pandemic. This scenario highlighted how inequalities in the availability of digital tools affected many students, who were unable to fully participate in the educational process. To maximize the inclusive potential of ICTs, it is crucial to guarantee their accessibility, provide adequate teacher training, and ensure their effective integration into daily pedagogical practices. This involves considering factors such as the available technological infrastructure, the design of accessible content for all students, and the continuous evaluation of their effectiveness in the educational context. In short, although ICTs have enormous potential to promote inclusion, their success depends on careful, equitable, and sustainable implementation that eliminates existing barriers and ensures all students can benefit from these tools.

3.3.1. Possible Exclusionary Effects of ICTs

ICTs can have exclusionary effects, especially for students from socioeconomic disadvantages or those with limited digital skills, exacerbating the digital divide and hindering equal participation [34]. Several studies have highlighted how socioeconomic inequality negatively influences the development of digital skills from an early age. For example, research conducted in Germany reveals that children from low-socioeconomic status families have significant gaps in ICT-related skills, comparable to the differences observed in "hard" skills such as math or science; furthermore, these disparities persist into secondary school [35].

It is essential to recognize that digital exclusion is not limited solely to access to technological devices. This concept also encompasses aspects such as motivation, available social support, and differences in the effective use of digital tools. As mentioned earlier in this chapter, family income is a determining factor in the level of perceived digital skills. Likewise, the studies conducted by Gazi and Abdur [36] They reveal how online learning practices had different outcomes during the pandemic, exacerbating or aggravating this educational disparity. Thanks to the reviewed studies, we can conclude that the potential exclusionary effects of ICTs do not only relate to the lack of access to devices, but also to differences in motivation, social support, and technology use.

3.3.2. Adaptation of Teaching Methods to ICT

The adaptation of teaching methods to ICT has given rise to new methodologies such as the flipped classroom and technology-assisted collaborative education. Globalization has generated economic, social, and cultural changes that have transformed people's lives, including the teaching-learning processes. In this context, the flipped classroom emerges as an innovative option to foster teamwork and cooperative learning [37]. According to Espinoza et al. [38], regarding the use of ICT, younger teachers are eager to employ these tools. Teachers between 30 and 40 years old still have a desire to learn, but feel demotivated and prefer to postpone studying. Teachers between 40 and 50 years old also express interest in learning, but family and work responsibilities prevent them from doing so. Those aged 50 to 60 tend to reject the use of ICTs in the classroom, arguing that

they are too old to learn, while teachers over 60 justify their reluctance by considering that it is not worth learning something new if they are already close to retirement. This reveals a degree of resistance to innovation and acquiring technological skills, largely leaving the use of these resources to young people.

Similarly, Arias and Torres' research [39] addressed the use of digital technologies and the flipped classroom in teachers' pedagogical practices in another academic context. The results showed that, although many teachers have a positive perception of digital technologies and some actually use them, their use is not widespread. Furthermore, some teachers are unfamiliar with the flipped classroom, while others consider it important but feel limited in its implementation. Despite these challenges, it is clear that the integration of ICTs in higher education has transformed educational methodology, favoring a constructivist and collaborative approach. According to Mohamed and Mohamed [40], hybrid education offers flexibility and personalization, although it also presents challenges for educators when adapting to new tools and methodologies, such as the flipped classroom. Ultimately, this integration is key to modernizing education and training professionals fit for a technological society. Recognizing the differences in teachers' willingness to learn how to use these methods, it is concluded that it is appropriate to provide them with opportunities to explore these tools, seeking maximum benefit not only for teachers and students, but for education in general.

4. Conclusions

In conclusion, digital divides in the classroom have been established through access to technological devices, technological infrastructure, and the digital skills of teachers and students. This inequality, which emerges in more disadvantaged contexts, perpetuates social differences and limits the potential for many students to adapt to the demands of a digitalized society. Only with a comprehensive approach can we guarantee an education in which students have the opportunity to develop digital skills that allow them to fully integrate into society.

Furthermore, the socioeconomic impact of technological implementation in education is fundamental, as socioeconomic factors directly influence access to and use of technological tools, affecting unequal implementation and accentuating disparities in academic outcomes. It is crucial that educational policies address and promote equitable access to technology, improving infrastructure so that all students can develop without socioeconomic limitations in educational environments.

Ultimately, the implementation of ICTs in education offers great opportunities for pedagogical innovation and inclusion; however, significant inequalities persist. The lack of access and digital skills, especially among low-income students, limits the potential of these tools. To overcome these obstacles, it is necessary to promote accessibility, train teachers, and promote effective use of ICTs. Only through inclusive public policies and a comprehensive approach can equitable access to technology be guaranteed, ensuring that all students fully benefit from digital tools.

In short, the implementation of ICTs in education presents significant opportunities to improve learning and promote equity. However, digital and socioeconomic gaps remain significant obstacles limiting this transformative potential. To overcome these barriers, it is essential to implement inclusive public policies and adequately train teachers. An integrative approach is needed that promotes equitable access to technology and ensures that all students have the opportunity to fully benefit from the benefits of digital tools. Only in this way can we achieve a more just and equitable education capable of meeting the challenges of the digital age and enhancing the social and educational development of all students.

Abbreviations

ICT	Information and Communication Technologies
UNESCO	United Nations Educational, Scientific and Cultural Organization

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Jury Medina: Conceptualization, Data curation, Formal analysis, Supervision, Writing (review and editing)

Carmen Astocondor: Resources, Software, Research, Methodology, Visualization

Hubert Huamani: Supervision, Funding, Validation, Writing (original draft), Project administration

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Data Availability Statement

The data supporting the outcome of this research have been presented in this manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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