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THE ROLE OF DIGITAL TECHNOLOGIES IN ENSURING THE INCLUSIVITY OF DISTANCE EDUCATION

EL PAPEL DE LAS TECNOLOGÍAS DIGITALES PARA GARANTIZAR LA INCLUSIVIDAD DE LA EDUCACIÓN A DISTANCIA

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ABSTRACT

The main purpose of this research is an examination of the ways in which digital technologies are enabling inclusivity in distance education, and, more specifically, how assistive technology can help bridge accessibility gaps for students with diverse learning needs. The research demonstrates the increasing relevance of distance education, and specifically comments on the situation caused by global phenomena, such as the COVID-19 pandemic that drove the transition to online learning. There are, however, real challenges in ensuring that students with disabilities and other learning barriers are appropriately supported in the sudden shift to digital education. This research assesses the barriers to adoption of inclusive digital education by analyzing secondary data from case studies, government reports and academic literature that identify financial, technological, and policy-related bottlenecks. In addition, it examines current initiatives and practices from Ukraine, the USA, the UK, Kenya, German, India, Canada, Australia, Brazil and Japan for integrating assistive technologies in online learning environments. The study closes with recommendations for policymakers, educators, and technologists to increase accessibility via investments in assistive tools, professional development, and new policy. The goal is for the findings to inform future efforts to build a more equitable and inclusive digital education landscape.

Keywords:

Inclusive education, distance education, assistive technologies, digital accessibility, educational technology, online learning, policy recommendations.

RESUMEN

El objetivo principal de esta investigación es examinar las formas en que las tecnologías digitales están posibilitando la inclusión en la educación a distancia y, más específicamente, cómo la tecnología de asistencia puede ayudar a cerrar las brechas de accesibilidad para estudiantes con diversas necesidades de aprendizaje. La investigación demuestra la creciente relevancia de la educación a distancia y, específicamente, comenta la situación causada por fenómenos globales, como la pandemia de COVID-19, que impulsó la transición al aprendizaje en línea. Sin embargo, existen desafíos reales para garantizar

que los estudiantes con discapacidades y otras barreras de aprendizaje reciban el apoyo adecuado en el cambio repentino a la educación digital. Esta investigación evalúa las barreras para la adopción de la educación digital inclusiva mediante el análisis de datos secundarios de estudios de casos, informes gubernamentales y literatura académica que identifican cuellos de botella financieros, tecnológicos y relacionados con las políticas. Además, examina las iniciativas y prácticas actuales de Ucrania, Estados Unidos, el Reino Unido, Kenia, Alemania, India, Canadá, Australia, Brasil y Japón para integrar tecnologías de asistencia en entornos de aprendizaje en línea. El estudio concluye con recomendaciones para que los responsables de las políticas, los educadores y los tecnólogos aumenten la accesibilidad mediante inversiones en herramientas de asistencia, desarrollo profesional y nuevas políticas. El objetivo es que los hallazgos sirvan de base para futuros esfuerzos encaminados a construir un panorama educativo digital más equitativo e inclusivo.

Palabras clave:

Educación inclusiva, educación a distancia, tecnologías de asistencia, accesibilidad digital, tecnología educativa, aprendizaje en línea, recomendaciones de políticas.

INTRODUCTION

Over the past few years, the worldwide education sector has rapidly evolved because of the fast development of digital technologies (Wang et al., 2020). As distance education becomes more important, especially during the COVID-19 pandemic, educational systems have needed to evolve to adapt. During the pandemic all over the world, schools and universities had to change the way of traditional teaching in the classroom to teaching online platforms, which increased the accessibility of education for a wider range of students. But this transition brought with it a host of pitfalls, specifically concerning access and inclusion for all students - specifically those with disabilities or those who otherwise encounter barriers to learning.

Whenever education grows digital, the urgency to integrate becomes more vital. In traditional education environment, students with diverse needs, for example students with physical disability, learning difficulty and other conditions that prevent them from being understanding with traditional teaching methods are left behind.

Although distance education can be flexible and reach a variety of students, without purposeful and intentional design of digital tools and resources for a range of learning needs, it also exacerbates existing inequalities. Screen readers, speech to text software, and adaptive learning platforms have become invaluable assistive technologies serving to bridge that gap and ensure that all students - regardless of their abilities - can access quality education in a digital environment.

This research is aimed at studying how the digital technologies can improve the inclusiveness of the distance education. In particular, it seeks to investigate if and how assistive technologies can be included in online learning platforms conducted on students with different need. This research examines the challenges and possibilities pertinent to the utilization of digital tools in inclusive education including the financial, technical and policy related barriers hindering widespread uptake of digital tools. This study analyzes case studies from countries like Ukraine, the United States and a few European and African countries to provide useful insights into how distance education can be best practiced whilst being inclusive.

This research has the objectives to analyze the key factors that determine the integration of assistive technologies in online learning environments, to assess their inclusivity policies and initiatives and to provide useful suggestions for policymakers, educators and technologists to improve accessibility of digital education. The study then focused on a problem statement of the digital divide and financial, infrastructural and pedagogical challenges that hamper the ability of many educational institutions to provide equal learning opportunities for all students. The research seeks to address the need for practice-based evidence which is emerging to inform future policy and practice on inclusive distance education as it relates to the growing body of knowledge on inclusive education.

Digital technology in distance education has been transformational in receiving learning to all students, regardless of their diverse needs. Transition to online education was expedited by the COVID-19 pandemic revealing the need for inclusive educational practices. In this literature review, the authors explore key themes in the role of digital technologies for inclusive education using recent research to illustrate challenges, opportunities and the necessity of inclusivity in the digital learning environment.

In his article, Bashir et al. (2021), discusses how the COVID19 pandemic brought about a rapid move to online learning which future implications for higher education courses especially in biosciences. Accessing online learning involved flexibility for some students, but was difficult for those with disabilities. If institutions are not intentional about integrating assistive technologies and building in accessibility features into online platforms, the shift to online learning makes inclusivity even more difficult to achieve, argue the authors.

The authors Al Lily et al. (2020), also study distance learning as a response to pandemics, however, their focus is in the Arab cultures and the problems that students and

teachers experienced during the COVID-19 pandemic. The research of this kind highlights the absolute necessity of incorporation of inclusive teaching techniques in areas with limited access to technology, by providing culturally relevant and accessible online learning tools that help involve all students in the process of education.

According to Padmanabhanunni & Pretorius (2023), examine the psychological implications of tacher burnout during the pandemic that impaired including education. According to the study, teacher burnout serves as an obstacle preventing teachers from providing effective distance education as teachers had too many duties to adapt to online teaching and meet the demands of different learners at the same time. Such a burnout will translate to degeneration in the quality of education offered to students especially the ones who need special attention.

According to Koldovskiy (2024), suggests a transdisciplinary way of improving the quality of education under conditions of digital transformation. The study suggests integrating different academic disciplines to complete more inclusive digital education models. Through this approach, institutions can implement more flexible and accessible systems to meet the specific needs of all students, those with disabilities, and from marginalized groups.

In addition, Panda (2020), learning management systems (LMS), which are effective in the current educational context is proposed for students with special educational needs. LMS platforms certainly create a centralized environment for learning, yet as Panda points out, Panda understands the importance of creating an LMS that is designed with a wide range of disabilities and learning styles in mind. It involves fusion of the assistive technologies and making the platform itself user friendly and accessible.

Online exam supervision technologies are touted by Coghlan et al. (2021), as increasingly common in digital education, and these are ethically problematic. Although these technologies were intended to protect academic integrity, they can function as barriers to students with disabilities, many of whom need additional time or accommodation during testing. The authors reason that digital exams should not disadvantage some groups of students (particularly those who may struggle with the surveillance aspects of online assessments) and argue for ethical guidelines to address this.

In their study on gamification in e learning, both before and over pandemic, Burlacu et al. (2023), examine how (2023) evaluate how gamification in e learning. Gamification has been proven to increase levels of student engagement, and it has enormous potential for excluding students also, especially learners with learning disabilities. However, the study proves that gamified learning environments can work quite well for making learning more interactive and more engaging, as long as the gamification is designed to suit different learning styles and levels.

The educational value of virtual reality (VR) apps to improve the learning experience is also explored by Cherner & Halpin (2021). VR empowers inclusivity through immersive learning experiences that benefit students with disabilities to interact with content in ways that is hard to achieve through traditional means. Though, as the authors observe, VR tools are expensive for schools to purchase and teachers to train in, and this may prevent VR from enabling inclusivity more widely.

Motivated by the same idea, Yamani (2021), suggests a conceptual framework for integrating gamification in e-learning systems, based on some instructional design models. In this framework, need for paying attention to diverse learning needs and disabilities in designing gamified e learning experience is brought. Yamani said that keeping this point in mind, gamification could promote engagement, motivation, and increasing levels of inclusivity by offering numerous avenues in which students can engage with content based on their level of cognitive strength.

A number of several key themes in the literature are revealed on the role of digital technologies for the inclusive distance education. First, online learning is flexible; however, to promote inclusiveness in online learning, assistive technologies must be embedded in the learning platform and the platform must be accessible. According to (Bashir et al., 2021; Al Lily et al., 2020), it is necessary to consider technology access disparities around the region and the cultural factors of the GCC that influence learning experiences. Additionally, teacher burnout, as characterized by Padmanabhanunni & Pretorius (2023), is still a pressing obstacle to delivering high quality inclusive education with a focus on the need for specialized professional development and support.

According to Tserklevych et al. (2021), virtual museum spaces provide an innovative space for student research practice through the use of interactive, accessible and immersive learning environments. The authors argue that in these digital spaces, students are able to explore and analyze the complex topics we work with in ways that were never possible using traditional methods. Also according to Tserklevych et al. (2021), by including such technologies within educational practices, gaps in the access and participation to learning can be more easily bridged - a goal many educators who want to increase access to learning opportunities have.

In this vein, the idea of transdisciplinary approaches – as introduced by Koldovskiy (2024), – presents a promising

method for making educational models more inclusive. According to Panda (2020), when a learning management system is designed to support diverse learners, it can provide important support services being accessible and adaptable. However, Coghlan et al. (2021), emphasize the ethical considerations regarding surveillance across online assessments, to avoid disadvantage for students with disabilities.

Lastly, gamification and virtual reality have great potential in relationship to enhancing engagement and accessibility of online education; however, they need to be implemented taking into account various learning needs. In the words of (Burlacu et al., 2023; Cherner & Halpin, 2021), and other authors, VR immersive technology and gamified learning environments can make inclusive, more interesting and interaction learning experiences for all students possible.

Finally, to integrate digital technologies in education inclusively, accessibly, and relevant culturally. Taken together, the studies reviewed here indicate that successful digital education spaces require collaborations between educators, policymakers, and technologists so that digital education systems will serve a variety of learners well.

MATERIALS AND METHODS

The role of digital technologies in promoting inclusivity in distance education was explored within the scope of this research by means of a secondary data analysis approach. The sources of data include government reports, academic articles, case studies, policy documents and international initiatives in assistive technologies for learning. According to sources relevance to the research questions and to be a source of insights on how digital technology is integrated for inclusive education in various countries and places, these sources were chosen. In the research case studies from the countries that had different approaches to inclusive education – Ukraine, USA, UK, Kenya, German, India, Canada, Australia, Brazil and Japan – are analyzed in particular. Using publicly available reports on government funding programs, public private partnerships, and innovative policies that seek to improve the accessibility of digital education tools, these case studies were drawn.

Furthermore, an analysis of the relevant academic literature was done to understand the key trends and challenges of adopting assistive technology tools in distance learning. Journal and conference articles focusing on educational technology, inclusivity, and digital divide were selected as it is relevant. The analyzed data was qualitatively analyzed to identify common patterns and challenges peculiar to integrating the application of digital technologies for inclusive education programs in various countries. Exploring the financial, technological and policy related barriers and opportunities with respect to advancing inclusive distance education, this analysis furnishes a comprehensive understanding of the same.

RESULTS AND DISCUSSION

Fostering inclusivity in education has found digital technologies both as core enablers and as barrier removers for the different types of existing and emerging learner needs. An important category is assistive technology which is use for students that have disabilities or have some other special educational needs (Padmanabhanunni & Pretorius, 2023). Visually or hearing-impaired learners can more easily learn by using tools like screen readers and speech to text software. Students with hearing impairments can remain engaged with closed captioning, and those with physical impairments can input to digital platforms using alternative input devices, for examples adaptive keyboards or eye tracking systems. Therefore, these technologies fill gaps too, thus making learning available to a wider audience.

The other crucial feature entails adaptive learning platforms that stand as customizable content to suit an individual's learning preference and requirement (Wang et al., 2020). They employ artificial intelligence and machine learning to alter lesson difficulty, pacing and way of presentation depending on how a student progresses and requires. By this way, this method does not only increase engagement but it also guarantees that learners will receive the specific support they need in order to accomplish better, despite their abilities or difficulties.

However, it is equally important to follow accessibility standards in the educational technology tools. According to the Web Content Accessibility Guidelines guidelines, platforms are created with inclusivity in mind - they use things like keyboard navigation, turn on contrast settings, and apply text size adjustments. When you follow these standards, all learners can use the educational content (even those using assistive devices or alternative interaction methods).

The latter includes assistive technologies, adaptive learning platforms, and observation of accessibility standards to support an inclusive digital education, thereby availing of an equal opportunity for learning across all backgrounds.

The sudden transition to a distance education has revealed substantial disparities in digital technology access that are crucial for the effective learning. The technical barriers to them completing secondary education in underserved areas are among the most pressing. Unavailability of devices and fast internet amounts to huge disparities in provision of education, rendering many learners unable to join education activities. These problems not only prevent students' success in education but also increase the gulf

between sections of rural and urban populations and between sections of different socio-economic class. The barriers to accessing education and maximizing the potential of digital learning platforms must be addressed in a equitable manner in order to have equitable access to education (Table 1).

Table 1. Technical barriers (limited access to devices or high-speed internet in underserved areas).

№	Barrier	Description	Impact	Possible solutions
1.	Limited access to devices	Many students lack access to personal computers, tablets, or smartphones required for online learning.	Excludes learners from participating in distance education and hinders engagement in digital classrooms.	Government or institutional programs to provide subsidized or donated devices to underserved communities.
2.	High-speed internet access	Remote and rural areas often face poor internet connectivity or lack affordable high-speed internet options.	Creates challenges in accessing real-time lessons, downloading materials, or engaging in interactive content.	Expansion of broadband infrastructure, affordable internet plans, and initiatives like community Wi-Fi zones.

Source: Own elaboration

Technical barriers to distance education can be categorized into two main issues: To be lacking access to devices and a poor internet connection (Padmanabhanunni & Pretorius, 2023). Yet many students, especially in rural or low-income areas, do not have access to their own personal devices like laptops, tablets, or smart phones, which are so key for engaging in online courses. Because of this lack of access, students are forced to use shared resources, which causes conflicts about how to schedule, and ultimately, students are unable to learn as much as they should. Additionally, the problem is compounded by insufficient Internet infrastructure in rural and underserved areas. Slow or unreliable internet also prevents real time participation in virtual classes, in time download of educational materials authored in rich multimedia, something that has become an important part of modern education. Together these barriers reduce the inclusiveness and performance of distance education systems.

Government usually tries to overcome these challenges through subsidy of devices or its setup of community computer labs (Wang et al., 2020). Likewise, broadband infrastructure expansion programs or affordable internet packages for a greater number of people have also been a success in increasing access to connectivity. But their success will require continuous investment and policy support, and a partnership between public and private sector. If no measures are put in place, then technical barriers will cease to allow for such inclusivity and accessibility of distance education.

Major barriers exist in the form of technical barriers such as limited access to devices and the high cost of internet capability. These problems significantly handicap learners in underserved areas often already existing educational inequities, and the ultimate effects of their inheritance will also be considerable. Therefore, the resolution needs to be tackled using a multi-faceted approach for infrastructure development, distribution of devices, and provision of the affordable connectivity. Policies to accelerate the bridging of the digital divide must be jointly implemented by stakeholders (governments, educational institutions and private companies). If we defeat these pitfalls then distance education can truly be an inclusive and effective medium of learning for all students.

Inclusivity in education hinges mainly on the deployment of assistive technologies in inclusion of disabled students in the learning environment. However, they are faced by a major barrier - lack of training, and awareness of requirements among educators (Burlacu et al., 2023). A lot of teachers don't know the tools that exist or they just don't have the skill to implement them into their teaching practices. Limited understanding of the students with disabilities, means it is difficult to develop truly inclusive and supportive educational experiences for all students. It is imperative that we close these training and awareness gaps to realize the complete capabilities afforded by assistive technologies in education (Table 2).

Table 2. Training and awareness (lack of teacher preparedness to use and integrate assistive technologies).

№	Aspect	Description	Impact	Possible solutions
1.	Lack of teacher preparedness	Many educators are unfamiliar with assistive technologies and their application in digital classrooms.	Reduces the effectiveness of these tools, limiting their potential to support inclusive learning.	Conducting regular professional development programs focusing on assistive technology integration.
2.	Integration challenges	Teachers struggle to incorporate assistive tools into curricula effectively.	Leads to underutilization of technology and missed opportunities for enhancing accessibility.	Providing step-by-step guides, lesson templates, and practical examples for using assistive tools.

3.	Awareness gaps	Limited understanding of the specific needs of students with disabilities among educators.	Results in inadequate customization of teaching strategies to meet diverse learner needs.	Organizing workshops or seminars to raise awareness of diverse learner needs and inclusive practices.

Source: Own elaboration

Several interrelated factors, however, are responsible for the lack of teacher preparedness to use and integrate assistive technologies (Bao, 2020). Second, they first do not provide the educators with adequate professional development or training for using these tools. Without hands on experience or guidance, these technologies can be terrifying or irrelevant to their teaching contexts. The effect is underutilization, leading students relying on such tools to go without the support they require.

In addition, if teachers know assistive technologies, they might have problems incorporating them in their curricula. Time and expertise for developing learning plans that will incorporate these tools as necessary components are lacking; however, the work load is heavy and the resources limited. Moreover, it is a matter of fact that many do not know the needs of students with disability so they add to the problem. If educators are not armed with the ways to identify or address these needs, they may inadvertently shut out students from having engagement in digital learning environments.

The efforts towards addressing these challenges usually consist of targeted professional development programs (Burlacu et al., 2023). This involves building technical skill, offering practical examples of tool integration and how they relate to building and empowering others, as well as pushing for inclusivity on dev teams. Educators can be empowered to become confident and effective users of assistive technology, leveraging workshops, certifications and peer mentoring to enable that to happen and enable them to recognize these tools for what they can do to support diverse learners.

A big barrier to successful use of assistive technologies in education is lack of teacher training and awareness. However, this gap inhibits the capacity of these tools to promote inclusivity and to address the variety of needs of learners. The comprehensive solving of this issue comes in the form of professional development programs, practical resources for curriculum integration, and initiatives to enhance understanding of student needs (Bao, 2020). Stakeholders must then equip teachers with the needed skills and knowledge to deploy assistive technologies effectively to promote a more inclusive and equitable learning environment for all students.

The adoption of digital technologies in achieving inclusivity in education is limited by financial constraints. Specialized tools uniquely designed to enable support for learners with disabilities (a) assistive software, (b) adaptive devices, and (c) access features are so expensive. These represent an expense that is prohibitive to schools, particularly in underserved areas with constrained budgets. This means that many institutions are unable to secure the required technologies, therefore students don't have the means they need to succeed in a digital learning environment (Reuge et al., 2021).

Additionally, what makes it worse is the never-ending expense of maintaining and updating these technologies. Assistive tools are updated regularly (thus remaining compatible with changing platforms) and may need specialized technical support on some devices. The repetitive cost, as well, adds another financial burden on educational institutions and discourages their use even on schools having the fund to buy the capital.

Tackling these financial barriers will take a multi-faceted approach. Government funding and grants can be used to help subsidize the cost of assistive technologies (either for purchase by the school or a learner, or both). Reducing costs can also be achieved through partnerships with private companies and nonprofit organizations to help lower costs through donations and discounted pricing programs (Bao, 2020). Enhancing the development of open source and low cost assistive solutions would allow these tools to be available to a wider community.

Thanks to the alleviation of financial constraints, stakeholders can guarantee access to all kinds of learners, regardless of their socio-economic background, to specialized tools towards inclusivity. The creation of equitable and accessible educational settings that enable all students to achieve their full potential necessitates this investment (Reuge et al., 2021).

The worldwide inclusion of assistive technologies in education systems is confirming a growing commitment to inclusion. Although the acquisition, maintenance, and upgrade of these specialized tools are critically constrained by the associated financial realities. Targeted programs have been implemented in various countries and regions to address these challenges, and make use of government funding, nonprofit partnerships and innovative policies. Through analysis of real-world examples, we can derive these strategies and learn key lessons about solving for financial barriers to inclusive education. Table 3 shows the real-world initiatives that attempted to solve financial issue in assistive technologies to integrate with education systems, they have tried several things, and here can be seen the results.

Table 3. Real-world initiatives that address financial constraints in integrating assistive technologies into education systems.

№	Country	Case	Description	Impact/outcome	Challenges addressed
1.	Ukraine	Government digital accessibility program	Government-funded initiative to provide assistive tools and subsidize devices for schools in rural areas.	Enabled over 1,000 schools to equip classrooms with basic assistive technologies.	Addressed the high cost of specialized tools and resource allocation in underserved areas.
2.	USA	Individuals with disabilities education act (IDEA) funding	Federal grants provided to schools to support inclusive education, including purchasing assistive technologies.	Increased availability of screen readers and speech-to-text devices in public schools.	Mitigated high costs through dedicated federal funding.
3.	India	Sugamya Bharat Abhiyan (Accessible India campaign)	Government initiative promoting digital accessibility in schools and public spaces.	Facilitated the deployment of affordable text-to-speech and screen magnification tools in schools.	Focused on making assistive technologies affordable for low-income regions.
4.	UK	Tech for all program	Charitable initiative providing free assistive technology devices to children with disabilities.	Distributed 10,000 devices to eligible students, enhancing accessibility in education.	Tackled financial barriers through donations and partnerships.
5.	Canada	Inclusive education for students with disabilities project	Provincial funding for inclusive classrooms, with a focus on adaptive devices and teacher training.	Increased teacher proficiency in using assistive tools and improved accessibility for students.	Combined financial and training support to address resource limitations.
6.	Germany	Digitalpakt Schule (Digital pact for schools)	Federal program investing €5 billion to enhance digital infrastructure and tools in schools.	Funded the purchase of assistive technologies, benefiting students with disabilities nationwide.	Focused on long-term digital inclusion through substantial financial investment.
7.	Australia	National disability strategy digital inclusion initiative	Comprehensive plan to integrate assistive technology into educational frameworks.	Provided schools with financial support for specialized tools, increasing accessibility for learners.	Reduced cost barriers through government-backed subsidies.
8.	Kenya	Assistive technology for schools' program	Collaboration between nonprofits and the Ministry of Education to provide low-cost tools for inclusive education.	Delivered 5,000 affordable Braille devices and audio tools to underserved schools.	Overcame financial barriers with affordable and sustainable solutions.
9.	Brazil	Accessible education initiative	State-led program focusing on equipping public schools with assistive technologies for inclusive learning.	Ensured access to adaptive devices for students with disabilities in urban and rural areas.	Tackled affordability issues through targeted government investment.
10.	Japan	Inclusive school development program	Local government grants for purchasing assistive technologies for special-needs schools.	Expanded the use of advanced tools like eye-tracking devices and personalized learning software.	Reduced financial constraints through regional-level funding programs

Source: authors development using World Bank (2020); and Sahay et al. (2020).

The analysis of financial initiatives for integrating assistive technologies in education reveals critical strategies for overcoming cost barriers (Table 4).

Table 4. Effectiveness of the strategies and identification key lessons for addressing financial barriers to inclusive education.

№	Key insights	Evidence from cases	Analysis
1.	Government funding is crucial	Examples: Ukraine's Digital Accessibility Program, US IDEA funding, Germany's DigitalPakt Schule.	Substantial government investment directly improves access to assistive tools and infrastructure.
2.	Public-private partnerships are effective	Examples: Kenya's Assistive Technology for Schools Program, UK's Tech for All Program.	Collaboration between governments, nonprofits, and private entities can amplify resources and reach.
3.	Targeted local initiatives show impact	Examples: Japan's Inclusive School Development Program, Brazil's Accessible Education Initiative.	Regional and localized funding ensures that solutions are tailored to specific community needs.
4.	Cost-effective solutions are vital	Examples: Kenya's low-cost Braille devices, India's Accessible India Campaign.	Affordability and sustainability are key to scaling assistive technologies in low-resource settings.
5.	Teacher training is complementary	Examples: Canada's Inclusive Education Project, Australia's Digital Inclusion Initiative.	Financial support coupled with teacher training ensures proper utilization of assistive tools.

6.	Innovative policies Expand access	Examples: Brazil's state-led initiatives, UK's focus on free device distribution.	Creative approaches like device donations and subsidized programs increase the availability of tools.

Source: Own elaboration

Finally, government funding becomes a cornerstone and makes it possible to purchase large amounts of tools on a large scale, and develop infrastructure. Impact is enhanced through public private partnerships by bringing resources and expertise together in one location, and targeted local initiatives for specific community needs. Furthermore, scaling access in resource constrained settings requires cost effective and sustainable solutions such as affordable devices and open source technologies.

But crucially, this financial support needs to be matched with teacher training so that assistive technologies are used effectively. The potential for increasing access to inclusive tools is illustrated by the demonstration of an introduction of innovative policies such as subsidized programs and device donation schemes. Through a multi-faceted approach involving funding, collaboration and policy innovation, stakeholders can do much to reduce the strangle hold of financial constraints, thereby contributing to building inclusive and equitable education systems in the entire world.

Digital technologies are being hailed for their potential to increase inclusivity and improve learning outcomes, and nowhere is this more apparent than following the COVID-19 pandemic which accelerated the use of online education. The research which is carried out currently emphasizes the significance of digital tools in the creation of more inclusive learning environments. The transition to digital platforms has created opportunities for reskilling and upskilling the workforce necessary to respond to the demands of Industry 4.0. Offer personalized learning experiences to individual students, fostering inclusion through the use of these digital tools.

While digital technologies are seen as inclusive, challenges remain, however. For instance, in a study by Reuge et al. (2021), online education was proved to be taken up almost universally during the COVID-19 pandemic, but was demonstrated to be plagued by digital readiness and accessibility discrepancies between regions. At the same time, the digital divide was made worse by the pandemic - and especially for students who come from marginalized communities and who didn't have enough access to technology. There was a clear discrepancy in learning outcomes of students at both institutions, and this discrepancy had a negative effect on these students, suggests that while digital platforms should have potential for great success, the level of success will depend on equitable access to resources.

Bao also (2020), conducted a case study at Peking University, further corroborating the challenges to do with implementing online teaching in higher education settings. Still, Bao found that, even if the university reacted quickly to shift to online learning, not all students had access to digital learning, especially if they couldn't afford a device or had an unreliable internet connection. This reinforces current research that promoting inclusive opportunities for using technology in digital education cannot be restricted to merely supplying technology, but must also address broader infrastructural issues.

Some of the areas where implemented digital tools outperform traditional methods are: Traditional face to face teaching often is constrained by the limitations of the physical classroom although digital technologies can support more flexible learning environments. Emergency remote teaching (as applied in the midst of the pandemic) was not a perfect substitute for old methods, yet provided a chance to try the online learning (Hodges et al., 2020). Traditionally teaching methods fail to compare in terms of flexibility and scalability of digital platforms, namely to reach a broad audience and adjust to varied learning demands.

Furthermore, the integration of learning management systems (LMS) has been demonstrated capable of improving the learning experience, as students can access content as fast as they are comfortable with, this being favorable for students with special educational needs. As the Panda (2020), mentions, accessibility features like text to speech tools and customize interface can be part of LMS platforms to make learning more inclusive.

The research however, as observed by Lythreatis et al. (2022), reveals rising acute danger posed by the growing digital divide, warning that although digital tools present great advantages, they could also further perpetuate inequalities especially in under resourced regions. The findings that school closures during the pandemic entailed disproportionate exclusion of children from low income families from school, and consequently from online education (Van Lancker & Parolin, 2020) have further amplified this gap.

To maximize the benefits of digital technologies for inclusive education, several recommendations can be made for policymakers and educators:

1. Limited access to technology has long been identified by (Van Lancker & Parolin, 2020; Lythreatis et al., 2022), as vital to facilitating equitable access. To change this, governments and institutions must invest in infrastructure, including access to internet (especially in underserved communities) and low-cost devices. Finally, digital divide can be solved by specific policies that provide resources for disadvantaged students.

2. With attention to teacher burnout, as presented by Padmanabhanunni & Pretorius (2023), there are, however, still major challenges. To use digital tools in inclusive education, educators require an adequate training and support. For instance, there are professional development programs for digital teaching that cover not just digital teaching technicalities, but also pedagogical approaches that are inclusive, and able to respond to diverse learner needs.

3. Digital learning platforms should be inclusive, meaning that assistive technologies should be integrated to make sure the learning processes are truly inclusive. According to Panda (2020), site and platform designs should be accessible for all, to provide screen readers, subtitles and alternative material to content. On top of that, gamification and virtual reality, presented by Burlacu et al. (2023), can be useful to induce students with disabilities. To provide a more interactive and accessible learning experience they should be incorporated into digital learning systems.

4. The authors (Loades et al., 2020; Brooks et al., 2020), do not overlook the psychological impact of online learning and social isolation. Mental health support services for students should be a part of every educational institution when it comes to students who are negatively challenged by the isolation in the online learning environments. Digital learning frameworks should be designed to promote social connectedness and peer support.

5. The authors Al Lily et al. (2020), highlighted the requirement of culturally meaningful educational practices, especially in communities with various student representatives. When designing digital education systems, educational stakeholders have to bear in mind their cultural context, such that they also incorporate and accommodate different learning styles and culturally diverse perspectives.

The ability of digital technologies to enhance inclusivity in education is high, if access disparities are addressed, teachers are sufficiently well prepared and students are supported. Through aligned digital education initiatives with inclusive policies and practices, we can build more equitable learning environments for all students.

As a result of this research findings, the following key recommendations have been made for enhancing the digital technologies for inclusive distance education. However, it is vital for governments to remain invested, and invest more, in assistive technologies for them to become a reality for learners in underserved schools. Targeted funding programs and subsidies will help lower the cost of specialized devices and software to achieve this. Moreover, public private partnerships should be reinforced because cooperation between governments, nonprofits, and technology companies could reduce costs and make more assistive technology available.

Also, low cost, sustainable assistive technologies have to be developed. Providing open source tools and affordable devices, we can broaden accessibility, especially in the low-income regions. Policies should also be introduced to make these technologies part of school's educators' and schools' ongoing professional development. Financing alone will not allow assistive technologies to properly integrate into classrooms and help educators meet the needs of their learners, so training must be offered as well.

Finally, adopting innovative strategy like donation of devices, subsidies and long funding strategies will guarantee provision of technology to all. By targeting both financing and infrastructural barriers, these strategies can guarantee that all learners with equal opportunities to succeed in a digital learning environment, every learner can have the opportunity to succeed, regardless of his or her abilities. Together, these efforts can make distance education much more inclusive, even, and allow for an equitable education experience all around the world for students.

CONCLUSIONS

In education, the bringing in of digital technologies has the potential to change education environments, and make them more inclusive and accessible to all students irrespective of their abilities. Several important findings are highlighted by the research as impacting the critical role of financial support, government initiatives and public private partnerships in addressing barriers to inclusive distance education. Around the globe, governments have funded a great step in assistive technologies, especially to Ukraine, the United States and Germany that have invested so highly to infrastructure and particular tools. These are investments that are critical to enabling schools, especially in underserved areas, to offer education that is accessible. Furthermore, public private partnerships have been found to multiplicatively increase resources, in Kenya and in the UK where nonprofits and private companies team up with governments to get assistive technology into schools.

However, financial constraints are not enough to ensure inclusivity distance education. Vital in terms of their

affordability, sustainability and long-term viability are these technologies. The scaling can only start at low costs, low cost solutions like affordable braille devices, and open source software to begin with. In addition, teacher training to be considered as an adjunct effort to make possible the educational practitioner integrating these resources into their practice as an educational practitioner. Canada and Australia have been very successful with offering professional development and financial support to teachers in order for them to have what it takes to use assistive technologies.

In the future of inclusive distance education, innovation will be the force behind improving the accessibility. Now it falls to policymakers, educators and technologists to collaborate further in breaking down financial and logistical barriers. Investment in both development of affordable technologies and infrastructure to support it is ongoing. Furthermore, keeping no student behind the wheel, innovative policies including subsidized programs and device donation scheme will be adopted.

Finally, future of inclusive distance education involves integrated investment financially, technologically, and the continuous support to the educators. These challenges must be met proactively by policymakers, educators and technologists, specifically and inclusively, for the benefit of our learners of all abilities. By adopting this approach, we will be building a more equitable and accessible educational landscape towards our future generations.

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