

Information and Communication Technologies and their impact on people with visual disabilities

Las Tecnologías de la Información y la Comunicación y su impacto en las personas con discapacidad visual

Tecnologias da informação e da comunicação e seu impacto nas pessoas com deficiência visual

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Abstract

Technology is positioned as an invaluable ally in improving the quality of life of people with visual disabilities, by providing a variety of tools and resources that facilitate access to information, communication, learning and working more independent and effective. The objective of this article is to systematize the theoretical references related to Information and Communication Technologies and their impact on people with visual disabilities, through a bibliographic study. For this purpose, a qualitative methodology was used and descriptive research was developed, based on the bibliographic review and the application of various scientific methods, such as analysis-synthesis, inductive-deductive and the hermeneutic method. The results obtained by the students and teachers involved in the research project "Prototype of ultrasonic cane for people with visual disabilities of the TES" revealed a notable situation in the country: the scarcity of studies related to technology and its impact on people with visual disabilities. Likewise, the crucial importance of continuing to develop and perfect Information and Communication Technologies (ICT) was highlighted with the purpose of guaranteeing complete and equitable inclusion of people with visual disabilities in all spheres of life.

Keywords: Technology, innovation, visual disability, cane

Resumen

La tecnología se posiciona como una aliada invaluable en la mejora de la calidad de vida de las personas con discapacidad visual, al proporcionar una variedad de herramientas y recursos que facilitan

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el acceso a la información, la comunicación, el aprendizaje y el trabajo de manera más independiente y efectiva. El presente artículo tiene como objetivo sistematizar los referentes teóricos relacionados con las Tecnologías de la Información y la Comunicación y su impacto en las personas con discapacidad visual, a través de un estudio bibliográfico. Para ello, se empleó una metodología cualitativa y se desarrolló una investigación de tipo descriptiva, basada en la revisión bibliográfica y la aplicación de diversos métodos científicos, como el análisis-síntesis, el inductivo-deductivo y el método hermenéutico. Los resultados obtenidos por los estudiantes y docentes involucrados en el proyecto de investigación "Prototipo de bastón ultrasónico para personas con discapacidad visual del TES" revelaron una situación notable en el país: la escasez de estudios relacionados con la tecnología y su impacto en las personas con discapacidad visual. Asimismo, se resaltó la importancia crucial de continuar desarrollando y perfeccionando las Tecnologías de la Información y la Comunicación (TIC) con el propósito de garantizar una inclusión completa y equitativa de las personas con discapacidad visual en todas las esferas de la vida.

Palabras clave: Tecnología, innovación, discapacidad visual, bastón.

Resumo

A tecnologia posiciona-se como um aliado inestimável na melhoria da qualidade de vida das pessoas com deficiência visual, ao disponibilizar uma variedade de ferramentas e recursos que facilitam o acesso à informação, à comunicação, à aprendizagem e ao trabalho de uma forma mais autónoma e eficaz. O objetivo deste artigo é sistematizar os referenciais teóricos relacionados com as Tecnologias de Informação e Comunicação e o seu impacto nas pessoas com deficiência visual, através de um estudo bibliográfico. Para o efeito, utilizou-se uma metodologia qualitativa e desenvolveu-se uma investigação de tipo descritivo, baseada na revisão bibliográfica e na aplicação de diferentes métodos científicos, tais como o método de análise-síntese, o indutivo-dedutivo e o hermenéutico. Os resultados obtidos pelos alunos e professores envolvidos no projeto de investigação "Protótipo de uma bengala ultra-sónica para pessoas com deficiência visual do TES" revelaram uma situação marcante no país: a escassez de estudos relacionados com a tecnologia e o seu impacto nas pessoas com

deficiência visual. Destacou também a importância crucial de um maior desenvolvimento e aperfeiçoamento das Tecnologias de Informação e Comunicação (TIC), de modo a garantir a inclusão plena e igualitária das pessoas com deficiência visual em todas as esferas da vida.

Palavras-chave: Tecnologia, inovação, deficiência visual, bengala.

INTRODUCTION

People with visual impairment, lacking the sense of sight, tend to develop and enhance other senses, such as hearing, touch and smell, as a way to compensate for the absence of vision. This adaptation process allows them to function in their environment and perform daily tasks effectively.

However, despite these developed abilities, blind people constantly face a series of difficulties that limit their active participation in the development of society. The lack of physical and digital accessibility in public spaces, such as streets, buildings and websites, hinders their mobility and access to information. In addition, discrimination and social stigma can limit their opportunities for education, employment and participation in social and cultural activities.

Architectural and technological barriers, as well as a lack of awareness and sensitivity on the part of society in general, contribute to the exclusion and marginalization of blind people. These difficulties not only affect their quality of life and well-being, but also represent a loss for society as a whole, depriving it of the potential and contributions that these people could make if they were given the necessary support and inclusion.

According to data obtained from CONADIS, there are 476,360 people with disabilities in the country, and with visual impairment there are 55,246 people registered, which is equivalent to 11.60% of this population (Ecuador, Ministry of Public Health, 2023). Hence the importance and timeliness of this study developed by students and teachers of the Higher Technology career in Networks and Telecommunications of TES in the city of Guayaquil, which aims to systematize the theoretical references related to Information and Communication Technologies and their impact on people with visual impairment, through a bibliographic study.

Technology has revolutionized digital accessibility, allowing visually impaired people to access online information through screen readers, voice recognition software and tactile devices. These tools convert digital text into speech or Braille, allowing them to read

emails, browse web pages and access electronic documents with ease.

In addition, technological devices such as smartphones and tablets have facilitated communication and social interaction for people with visual impairments. Built-in accessibility applications and features, such as screen readers and voice recognition systems, allow them to send text messages, make phone calls and access social networks autonomously. In the workplace, technology has opened up new opportunities for people with visual impairments, allowing them to access remote jobs, use assistive work software and adapt the work environment to their specific needs.

One of the crucial tools for blind people is the cane, as it provides them with independence, safety and autonomy in their daily movement. This tactile device, widely used by visually impaired people, offers a number of significant benefits that justify its importance in their daily lives.

The cane acts as an obstacle detection tool, allowing blind people to explore and navigate their environment more safely. By using the cane, they can detect obstacles such as steps, curbs, street furniture and people, which helps them avoid accidents and gives them confidence in their mobility.

It also provides them with tactile information about the texture and surface of the ground, allowing them to better interpret their surroundings and make informed decisions about their route of travel. Another important aspect is that the cane is a universally recognized symbol of visual impairment, which helps to raise community awareness of the presence of blind people in public space. This can facilitate social interaction and collaboration between visually impaired and non-visually impaired people, promoting inclusion and mutual respect.

To better understand the importance and significance of the cane used by blind people, it is essential to explore its historical origins and its evolution over time. The cane for the blind, also known as the white cane or guide cane, has a rich and varied history that reflects society's evolution toward greater awareness and understanding of the needs of people with visual impairments.

The earliest records of canes for the blind date back to ancient Greece and Rome, where sticks or poles were used as support tools for the visually impaired. However, these devices were rudimentary and lacked the tactile and obstacle detection features that modern canes have.

The real breakthrough in the development of the cane for the blind occurred in the 19th century, with the invention of the white cane by British photographer James Biggs in 1921. Biggs, who lost his sight due to an automobile accident, painted his cane white to make it more visible to drivers and avoid accidents. This innovation ushered in a new era in mobility and safety for the blind.

However, the registration of the white cane for people who are blind or visually impaired is attributed to American George A. Benham, who developed this innovative assistive tool in the 1920s (IMO Foundation, 2017). Benham devised the white cane as a way to improve the mobility and safety of visually impaired people in public and road environments. One of the highlights of his design was the addition of a red lower end.

The inclusion of a red end on the white cane served a practical and vital purpose: to alert pedestrians and drivers to the presence of a visually impaired person using the cane. This visually striking detail served as a clear signal for other individuals to recognize and respect the space of the visually impaired person, allowing them safe passage and facilitating their mobility in public spaces and urban areas.

Benham's innovation marked a significant milestone in the history of assistance for the visually impaired, as it provided a recognizable and universally accepted symbol indicating the need for consideration and caution on the part of others. Over the years, the white cane has become a symbol of independence, autonomy and respect for visually impaired people around the world and continues to be instrumental in improving the quality of life and inclusion of this community. Its design and functionality have been further refined with technological advances, such as the incorporation of sensors and satellite navigation devices, which improve the accuracy and effectiveness of the cane as a mobility tool.

The cane not only guides and improves the mobility of visually impaired people; it also allows society to identify the presence of a blind person and his or her type of disability; for example, the white cane is used by blind people; the green cane is used by people with low vision; and the red and white cane is used by people who, despite being blind, are hearing impaired.

Regarding visual impairment, the World Health Organization (WHO, 2001) states that there are four levels of visual acuity: normal vision, moderate visual impairment, severe visual impairment and blindness. Similarly, it states that in the world there are approximately 253 million people with visual impairment: 36

million with blindness and 217 million with moderate to severe visual impairment; cited by (Basantes, Guerra, Naranjo, & Ibadango, 2018).

According to data obtained from CONADIS, in the country there are 476,360 people with disabilities, and with visual impairment there are 55,246 people censused which is equivalent to 11.60% of this population; in the province of Guayas people with visual impairment respond to 10.04 % of the population and in the canton Guayaquil 10.15% (Ecuador, Sistema Nacional de Información, 2023).

In order to better understand the object of study of this research, it is necessary to conceptualize the term visual disability which, according to the National Council for the Promotion of Education is: "A condition that directly affects the perception of visual impairment:

A condition that directly affects the perception of images in total or partial form. Sight is a global sense that allows us to identify at a distance and at the same time objects already known or presented to us for the first time (Mexico, Consejo Nacional de Fomento Educativo, 2010).

The Consejo Nacional de Fomento Educativo considers that there is visual disability when there is a significant decrease in visual acuity even with the use of glasses, or a significant decrease in the visual field. Visual acuity is the ability of a subject to perceive with clarity and sharpness the shape and form of objects at a certain distance. People with normal visual acuity have a vision of 20/20: the numerator refers to the distance at which the test is performed, and the denominator to the size of the optotype of figures or letters used by the ophthalmologist to evaluate vision (Mexico, Consejo Nacional de Fomento Educativo, 2010).

For its part, the Chilean Ministry of Education defines visual impairment as:

The difficulty presented by some people to participate in activities of daily life, which arises as a consequence of the interaction between a specific difficulty related to a decrease or loss of visual functions and the barriers present in the context in which the person develops (cited by (Ulloa & Ulloa, 2019).

The Regulation to the Organic Law on Disabilities in Ecuador, in its Art. 1. defines Person with disability:

Any person who as a consequence of one or more physical, mental, intellectual or sensory impairments, regardless of the cause that would have originated it sees permanently restricted their biological, psychological and associative capacity to exercise one or more

essential activities of daily living in a proportion equivalent to thirty percent (30%) of disability duly qualified by the National Health Authority (Ecuador, National Assembly, 2020).

According to (Ministry of Public Health of Ecuador, 2018), Visual Impairment:

It encompasses functional and/or structural, irreversible and irrecoverable impairments, limitations and restrictions in the vision system, structures and functions associated with the visual sense. It is an alteration of visual acuity, visual field, ocular motility, color vision and depth.

After these reflections, the authors of the present study consider that visual impairment is a condition that encompasses a wide range of visual limitations, ranging from a partial decrease to a total loss of vision. This condition is assessed by various parameters that help determine the degree and nature of visual impairment in each individual. Some of these parameters include visual field, reading ability at different distances (both near and far) and light perception. In contrast, blindness is an extreme form of visual impairment in which the person experiences a total loss of visual function. This means that the person cannot perceive light or shapes and therefore cannot see objects, colors or visual details. Blindness involves a complete absence of vision and can occur congenitally or acquired throughout life due to various medical conditions or injuries.

It is important to understand that visual impairment is a broad spectrum ranging from total blindness to varying degrees of reduced vision. Each individual with visual impairment may experience their condition uniquely, with different visual needs and abilities. Therefore, it is critical to recognize and respect the diversity within the visually impaired community by providing appropriate support and resources based on each person's individual needs.

Regarding the barriers faced by people with visual impairment, according to the Ministry of Education of Chile (2016) cited by (Ulloa & Ulloa, 2019) are of various types, among the most frequent can be noted:

- Absence of auditory signals that replace visual information.
- Absence of Braille or audio literature in public libraries.
- Absence of alternative writing systems.

The active participation of people with visual impairment in the use of ICTs is not only important, but fundamental to promote inclusion and avoid social exclusion; this approach should focus on the needs and perspectives of people with visual impairment in the design and development of technological innovations.

This means that technologies must be designed in a way that adapts to the specific needs of people with visual impairment, facilitating their access and independent use. In addition, participation fosters a sense of empowerment and autonomy among people with visual impairment.

According to (Basantes, Guerra, Naranjo, & Ibadango, 2018) Information and Communication Technologies (ICT) for the benefit of people with visual impairment are wide and diverse, electronic Braille, text to audio converters, printers for the Braille system among others are available; however, when they are used in isolation and independently from the rest of curricular components (objectives, strategies, contents...) the results are not as expected and the failure of the teaching-learning process is evident.

In summary, technological advances, such as the Internet of Things (IoT), have revolutionized the way in which visually impaired people interact with the world around them, contributing significantly to improving their quality of life. The Internet of Things is based on the interconnection of physical objects through the Internet, allowing these devices to communicate with each other and with users. This technology offers a number of specific benefits for visually impaired people, such as: improved accessibility, greater independence, personal safety, and access to information.

MATERIALS AND METHODS

The research follows a qualitative methodology, because its purpose is to perform a deeper analysis of technology and its contribution to people with visual impairment, based on the literature consulted.

It is a descriptive type of research, because the authors seek to analyze, clarify and explain the behavior of the phenomenon under study: the impact of technology on the improvement of the quality of life of people with visual impairment; with the objective is to obtain a detailed and systematic understanding of this topic, through the literature review, which allows to examine comprehensively the relationship between technology and improvements in the quality of life of this specific group of people.

Various scientific methods are applied in the research, such as the analysis-synthesis, the inductive method, and the hermeneutic method, which allows the authors to assume a critical position in relation to ICTs and their contribution to visually impaired people in Ecuador, from the selected literature.

Interventions:

The research follows the steps of a literature review research, which are explained below:

The first step is the literature search, 35 sources related to ICT and its contribution to people with visual impairment are located, available on the Internet and in bibliographic databases such as: Dialnet, Digitalia, Esboco, E-Libro, Scopus, Scielo, Redalyc, among others.

Inclusion criteria are established in the research to delimit the relevant sources for the research, such as:

- Publication date: the selected studies are in the time interval: 2018-2024.
- Context: studies developed in Ecuador are selected.
- Type of research: original studies are selected, generally indexed articles, documents and legal regulations.
- Language: All selected studies are published in Spanish.
- Key words: Technology, innovation, visual impairment, cane.

Of the 35 sources located, only 11 have been included in the research, selected on the basis of established inclusion criteria. These sources were chosen for their ability to provide a deeper understanding of the issues related to Information and Communication Technologies (ICT) and their impact on the lives of people with visual impairment.

Finally, an exhaustive analysis of the information obtained from the selected sources is carried out. This analysis aims to identify the significant contributions made in these studies in relation to Information and Communication Technologies and their impact on the lives of people with visual impairment. A critical and reflective stance is adopted to objectively evaluate the relevance of the findings and their applicability in practice. This process of deep reflection allows not only to better understand the problem in question, but also to generate innovative ideas and proposals to improve the quality of life and inclusion of visually impaired people in the digital era.

RESULTS

As a result of the bibliographic review, it was found that in Ecuador there are few studies related to the problem under investigation. The researches located are outdated; however, it is considered relevant to refer to authors such as:

(Sánchez & Armijo, 2018) who, in their study expose the various Information and Communication Technologies (ICT) accessible to students with visual impairment. By considering that ICTs generate significant changes in the environment of those who use them, they

highlight their potential to facilitate access to education, especially for social groups conditioned by various barriers, as is the case of people with visual impairment. ICTs, according to these authors, constitute effective tools to overcome the learning challenges faced daily by these students, allowing them to use them regardless of their personal or contextual limitations. The research focuses on exploring various tools and software designed specifically for the visually impaired.

The main findings highlight the effectiveness of applying both individual and collective strategies to address the challenges of students with visual impairment, as well as fostering collaborative group work and effective content management. This contributed to improving both individual and group performance of these students, strengthening their learning process.

Corroborating that ICT not only allows the development of social and experiential skills among students with visual impairment, but also involves them more in their learning process and improves their academic performance. This study highlights the transformative potential of ICTs in educational inclusion and empowerment of people with visual impairment.

On the other hand, (Basantes, Guerra, Naranjo, & Ibadango, 2018) conducted a study on the implementation of screen readers with the purpose of strengthening the learning process of blind people in the Imbabura Special Popular Education Center and the Technical University of the North, located in Ibarra. During the research, the authors explored the learning styles of blind people, the factors that influence their educational process and the impact of the use of screen readers, such as JAWS and NVDA, on their learning conditions.

The results obtained revealed that the use of screen readers facilitates access to information, promotes autonomy in communication and enables visually impaired people to effectively handle new digital materials. In this way, techno-pedagogy promotes the construction and development of educational equity and inclusion, thus contributing to the integration of vulnerable groups in the educational environment.

In their study (Cruz, Pinargote, Demera, Vera, & Mosquera, 2018), they propose a system that provides guidance to students with visual impairment regarding the obstacles present in their journey within the Technical University of Manabí. The research is based on the reports of accidents occurred during the displacement of these students inside and outside the university campus. To achieve their

objective, the authors thoroughly analyzed the warning systems and technologies currently in use, through a detailed study of national and international practices. The study detailed the tools and technologies used in the proposed solution, including methodologies, technologies for tracking the movement of people, software, programming languages, among other relevant aspects. This analysis allowed an efficient and fast implementation of the proposed system, which is based on RFID (Radio Frequency Identification) technology.

The most outstanding result of this research is the remarkable improvement in the quality of life of the 32 visually impaired students of the university. This translates into a significant reduction of accidents both inside and outside the institution, which evidences the positive and tangible impact of the developed solution on the welfare and safety of this group of students.

In contrast (Zuñiga, Córdova, Velázquez, & Castro, 2020), in their study focused on improving the quality of life of blind people through the creation of a technological prototype of electronic glasses. This device is designed to allow blind people to move safely in their environment, avoiding possible accidents. The authors conducted a comprehensive analysis of the mobility of blind people during their movements, in order to identify the difficulties they face in their mobility. They used a variety of research methods to gather information and validate their proposal.

The results obtained in this study revealed significant changes in the lives of blind people when using the proposed electronic glasses. These glasses, adapted to their needs, contributed to reducing accidents caused by obstacles in their environment, giving users the confidence to move around independently. This increase in autonomy and safety motivated blind people to incorporate the use of electronic glasses in their daily lives.

Another study conducted in the country was carried out by (Idrovo, 2023), who conducted an ethnographic research with blind people associated with the Society of Non-Sighted People of Azuay (SONVA) between 2011 and 2020 in the city of Cuenca, Ecuador. The purpose of this study was to understand how blind people perceive and experience the notion of time through their daily routines and rhythms. According to the author, although these rhythms and temporalities may be influenced by dominant global norms, contextual conditions and the personal experience of blindness add nuances to the way time is perceived and experienced. This challenges some of the conventional narratives that simplify

and homogenize the conception of time. The study contributes to the debate around the anthropology of time by analyzing situated individual experiences, and highlights the importance of exploring disabilities from less researched subjective perspectives, such as the perception of time.

The finding derived from the literature review reveals a remarkable situation in the country, the scarcity of studies related to technology and its impact on people with visual impairment.

The literature review developed in this study allows the authors to present the following results:

First, there is a significant gap in knowledge and research in this specific field. The lack of studies dedicated to technology and its application to improve the quality of life of people with visual impairment suggests a lack of attention and resources directed towards this particular population.

Furthermore, this situation highlights the urgent need to broaden the spectrum of research in the country to address the specific needs and challenges of people with visual impairment.

Technology plays a crucial role in the daily lives of people with visual impairment, from assistive devices to accessibility applications, so it is imperative to better understand how these tools can be leveraged to improve their quality of life.

The paucity of studies also highlights the importance of fostering collaboration between academic institutions, civil society organizations and the private sector to drive research and development of innovative and effective technological solutions for people with visual impairment in Ecuador.

CONCLUSIONS

The exhaustive review of the selected literature has allowed the authors not only to acquire a better understanding of the problems related to Information and Communication Technologies (ICT) and their impact on visually impaired people in Ecuador, but also to generate innovative ideas and concrete proposals to improve their quality of life and promote their inclusion in the digital era.

In the literature reviewed, the importance of continuing the development and improvement of Information and Communication Technologies for the purpose of ensuring full and equitable inclusion of visually impaired persons in all aspects of their lives is emphasized.

Although the information related to the cane is scarce in the sources consulted, its invaluable usefulness in the lives of visually impaired

people has been confirmed, as it contributes significantly to improve their mobility, safety, and autonomy. It is imperative to recognize the importance of perfecting this tool through technological innovation.

The few studies identified highlight the urgency of adopting a more focused and collaborative approach to address this significant problem to improve the quality of life of this vulnerable community.

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