Accessibility Analysis in a Natural Park in Medellín-Colombia: The Perception of Population with Visual Impairments (PVI)

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ABSTRACT

Social inclusion encompasses many components, including accessibility in natural spaces for tourism. Population with visual impairments (PVI) demand real options to experience tourism independently. This study analyzes the perceptions of PVI regarding accessibility in a natural park in Medellín, Colombia. It seeks to identify physical, technological, and attitudinal barriers that affect their experience as tourists. Through a qualitative approach based on ethnography and semi-structured interviews, testimonies and direct observations were collected and then processed using tools such as empathy maps. The results reveal deficiencies in infrastructure, signage, wayfinding technologies, and staff training. Based on the analysis, recommendations are proposed to improve accessibility conditions and foster the autonomy of PVI in ecotourism contexts. This work is part of a macro-project funded by the "Alianza 4U" and constitutes a key input for the design of inclusive experiences in the country's natural spaces.

1. INTRODUCTION

Accessibility in natural spaces is a fundamental aspect to ensure the inclusion of all people, regardless of their physical or sensory needs. In this context, natural parks must have adequate conditions that allow people with visual impairments to fully enjoy their surroundings and activities. However, the infrastructure and services in many parks still present barriers that limit their access and experience.

The Natural Park under observation is in Medellín, which is a key ecotourism destination in Colombia. Despite its efforts to offer inclusive experiences, it is necessary to evaluate the extent to which its facilities, signage, and resources allow for the effective participation of people with visual impairments.

This study analyzes the accessibility of a Natural Park in Medellín-Colombia from the perspective of people with visual impairments. By exploring their perceptions, it seeks to identify the main barriers and opportunities for improvement to ensure more equitable access. The research provides valuable information for designing strategies that promote inclusion and accessibility in natural and tourist areas.

A qualitative approach was followed, combining ethnography and semi-structured interviews to capture relevant information. Data were then processed using empathy maps, and finally, a series of recommendations was generated.

Finally, through qualitative analysis, it was possible to identify accessibility issues that participants with visual impairments face when interacting in natural parks and propose recommendations to address the identified difficulties. The insights from this work are useful for continuing a macro-project funded by the "Alianza 4U" in Colombia.

The remainder of the article is organized as follows: the next section presents a conceptual framework that includes some key definitions, followed by a background survey. Section 3 presents the methods used. This is followed by some relevant results (Section 4). The final sections include the conclusions and acknowledgments.

2. CONCEPTUAL FRAMEWORK

Below is a summary of the main concepts underlying the research and the background to accessibility studies in natural parks.

2.1 Theoretical framework

There are different types of disabilities, each with its own characteristics and challenges: visual, hearing, intellectual, physical or motor, or multiple [1].

Visual impairment occurs when a person's vision is impaired, affecting the performance of daily activities. There are two levels: blindness and low vision. Blindness refers to a total or near-complete loss of vision, in which a person has little or no functional vision. Low vision refers to significant visual impairment that cannot be fully corrected with glasses,

contact lenses, medications, or surgery and may require visual aids or adaptive strategies to perform tasks [1].

On the other hand, the term accessibility refers to the ability of all people, regardless of their physical or mental condition, to access and use the services and environments around them independently. Universal accessibility is a condition, a right, that guarantees equal opportunities for all, especially for people with disabilities [2].

Furthermore, accessible tourism seeks to ensure that all people, including those with disabilities, can enjoy tourism experiences without limitations. In the context of natural parks, this involves the implementation of accessible trails, Braille signage, and audio guidance systems, among other strategies.

Moreover, accessible tourism is governed by various standards [3] that guarantee inclusion in natural spaces as follows. The UN Convention on the Rights of Persons with Disabilities (2006) establishes accessibility as a fundamental right, requiring measures to guarantee it in tourist spaces. ISO 21902:2021 provides guidelines on the design and management of accessible destinations, while ISO 21542:2011 establishes technical requirements for accessibility in infrastructure [4]. The World Tourism Organization promotes the implementation of accessible infrastructure and assistive technologies, such as audio guides and Braille maps [5]. In the United States, the ADA defines standards for trails, signage, and accessible transportation in national parks. In Europe, EN 17210:2021 regulates accessibility in tourist spaces, and the European Accessibility Directive requires inclusive tourism services. In Colombia, Law 361 of 1997 protects the rights of persons with disabilities, while the Colombian Technical Standard NTC 5643 establishes specific guidelines for accessibility in tourism. In the case of natural parks in Medellín, these standards involve adapting trails, providing accessible signage, providing maps in adapted formats, and training staff to assist people with visual impairments.

This conceptual framework will serve as the basis for analyzing accessibility in a Natural Park, allowing us to assess how existing elements impact the experience of people with visual impairments.

2.2 Related work

Accessibility in recreational spaces and natural settings has been examined from multiple perspectives in scientific literature and field projects. Previous studies have focused on the barriers faced by people with visual impairments in tourist destinations and strategies to enhance their experience. Along these lines, specific initiatives have already been proposed to facilitate access for those with reduced mobility or other permanent limitations. A prominent example is the United States Access Pass: a free, lifetime pass available to citizens or permanent residents who, through a medical report, prove a permanent disability (not necessarily 100%), which allows entry to more than 2,000 recreational areas managed by six federal [6].

Internationally, various programs and policies demonstrate sustained efforts to integrate accessibility into natural areas, national parks, and recreational destinations, considering it both a fundamental right and a component of sustainable tourism. In the United States, the Access Pass program facilitates access for people with disabilities to thousands of federally managed recreational sites and is linked to the National Park Service's physical and informational

accessibility guidelines [1]. In Europe, initiatives led by the European Network for Accessible Tourism (ENAT) and European Union programs have documented "accessible destinations" and natural parks that combine adapted trails, tactile and braille signage, alternative information formats, and systematic evaluation mechanisms [7]. Parks Canada's accessibility activities incorporate specific measures to identify and eliminate barriers in protected areas, linking accessibility to the daily management of sites and conservation goals, including a list of multiple activities to be carried out in its various parks [8]. In Australia and New Zealand, "accessibility for all abilities" strategies promote accessible routes, support teams, and detailed guidance on conditions in national parks [9].

Recent research in Asia and Europe reinforces these trends through the use of technological and perceptual models. For instance, multimodal transport analyses applied to Chengdu's park system have shown how transport accessibility directly affects inclusion in recreational areas [4], while perceptual frameworks such as the Park Dual-modal Perception (PDP) model have helped interpret differences between objective and perceived accessibility [10]. Furthermore, large-scale analyses of accessible tourism information have identified the need for consistent, transparent data about accessibility across destinations. Together, these studies provide a data-driven and international perspective on inclusive tourism development. Furthermore, experiences in Thailand and other countries in Asia and Latin America align with UN Tourism Guidelines on Accessible Tourism, introducing self-assessment tools, staff training, and improved access to information for travelers with disabilities [11, 12]. Taken together, these initiatives illustrate a global trend toward more inclusive natural environments, while also revealing persistent shortcomings in the implementation, monitoring, and systematic inclusion of the perspectives of visitors with visual impairments in the design and evaluation of services.

Several studies have evaluated the effectiveness of accessible trails and tactile signage in natural parks, highlighting the importance of universal design and assistive technology. For example, research in national parks in Spain and the United States has shown that the combination of audio guides, haptic maps, and Braille signage significantly improves the orientation and mobility of people with visual impairments [5, 13].

Despite accessibility advancements implemented by recreational parks like Walt Disney World, challenges persist in the experience of visitors with disabilities. Although Disney offers services such as the Disability Access Service (DAS) to facilitate access to attractions, there is criticism regarding the lack of effective feedback systems that allow users to express their specific experiences and needs. For example, some visitors have noted that recent changes to DAS policies have limited access for people with certain physical disabilities, and that there is no clear mechanism for providing comments or suggestions regarding these services [2, 11].

In contrast, in Colombia, many natural parks lack structured accessibility services and lack feedback systems or user-centered approaches. This lack of accessibility makes it difficult to identify and address barriers faced by people with visual impairments, limiting their full inclusion in tourism activities. Implementing mechanisms that collect and analyze the perceptions of these visitors is essential for developing strategies that improve accessibility and the quality of the tourism experience for all [12].

In Colombia, studies on accessible tourism are still limited, although some initiatives have explored the adaptation of cultural and recreational spaces. Recent projects have analyzed the implementation of accessible infrastructure in museums and urban spaces, but there are few specific analyses of natural parks. Recent studies have explored the use of data-driven methods to analyze accessibility in recreational spaces. For instance, GIS-based evaluations have been applied to measure spatial accessibility in urban parks, demonstrating how data can reveal inequities in park distribution and entry conditions [7]. Similarly, multiscale models integrating GIS and space syntax have been used to assess accessibility in Xi'an, China, offering a comprehensive approach to understand how physical and cognitive barriers interact in natural areas [8]. These findings reinforce the importance of incorporating spatial and data-driven analysis in the study of inclusive tourism and accessibility in natural parks. The Colombian Technical Standard NTC 5643 [14] establishes guidelines for accessibility in tourism, but its application in natural settings remains a challenge.

In Colombia, various studies have been conducted on accessibility in tourist areas. Some of them can be summarized as follows:

a) Diagnosis and proposal for accessibility in tourist museums in Manizales: This study evaluated accessibility in museums in Manizales and proposed actions to improve the inclusion of people with disabilities [15].

b) Analysis of accessible tourism in Colombia: This research analyzed the characteristics of accessible tourism in the country, based on aspects of universal design, and found that 69% of cities do not offer tourism products focused on this population [16].

c) Strengthening universal accessibility in Colombia's tourist attractions: This project, promoted by the Ministry of Commerce, Industry and Tourism in partnership with the National Tourism Fund (FONTUR) and the Ibero-American Council for Accessible Design, City and Construction (CIDCCA), seeks to implement universal design through a self-diagnosis tool to identify the current state of the tourist services offered [17].

d) Several government actors (Ministry of Commerce, Industry, and Tourism, FONTUR, and CIDCCA) are leading a project aimed at strengthening universal accessibility in tourist attractions. The goal is to address 178 destinations in Colombia's 32 departments. Training for more than 1,600 industry stakeholders on inclusion and accessibility is also planned [12].

These studies reflect a growing interest in improving accessibility in Colombian tourism spaces; however, significant challenges remain in achieving full inclusion. This paper contributes to the existing literature by focusing on the perceptions of people with visual impairments regarding accessibility in a Natural Park in Medellín-Colombia. Unlike previous research, which has addressed accessibility primarily from a regulatory or architectural perspective and primarily focused on physical disability, this proposal incorporates a qualitative perspective based on user experience, allowing for the identification of specific barriers and opportunities for improvement in a local context.

Based on the review above, although Colombia has accessibility regulations and some studies focused on museums and urban destinations, a significant gap persists between existing regulations and their effective

implementation, especially in natural tourism spaces. Research on accessibility in natural parks is scarce, and even more limited is the specific attention paid to the experience of people with visual impairments in these settings. In this context, this research aims to answer the following question: How can a Natural Park in Medellín-Colombia become an accessible space for people with visual impairments, and how do they perceive their experience when visiting it?

The problem arises from the lack of specific diagnostics that assess accessibility in Colombian natural spaces, as well as the need to analyze not only the available infrastructure but also the training of staff to adequately serve people with visual impairments. Furthermore, the goal is to understand how users perceive the effectiveness and usability of the services and resources offered, understanding that the accessibility experience goes beyond physical aspects and must consider sensory, cognitive, and emotional elements. Thus, this research aims to close the gap between regulatory provisions and practical reality in natural parks, providing empirical evidence to guide future improvements in tourism inclusion.

3. METHODS

This study follows a qualitative research approach. Data was collected through fieldwork, with a group of professors and students from the "Information Systems with Social Impact" program at EAFIT University, along with a selected sample of visually impaired people (four in total) at various levels (blindness, low vision). Participants were recruited using snowball sampling; the first person contacted recommended other visually impaired people to participate in the experience, and so on. It is worth mentioning that all participants are affiliated with the WAIMA Foundation.

Among the inclusion criteria for sample selection were people aged 25-55 with visual impairments. All participants reside in Medellín (6 in total). Besides, 50% were women and 50% were men. 100% received a government subsidy for their disability. However, 50% of them were employed in jobs where they had to support and educate other people with disabilities. The intervention included several activities, as shown in Table 1.

Table 1. Activities for the intervention

Time	Activity
7:00	Departure from the meeting point to a Natural Park in Medellín-Colombia
7:15	Icebreaker activity during the trip: each person mentioned their name, expectation, hobby, or interesting fact
8:30	Arrival at the park, registration, introduction to the guides, start of the visit
9:00	Hiking, interaction in the adventure zone, lunch with the study group, which included travel in special vehicles for people with disabilities
14:00	Return to Medellín

During their interaction in the park, the students and teachers from the group followed a predefined observation protocol and recorded details associated with the interaction of people with visual impairments in spaces such as restaurants, restrooms, trails, and attractions, seeking to identify strengths and weaknesses. At the beginning of the tour, each participant with a disability had an assigned student responsible for

always conducting ethnographic observations and providing support when needed. To reinforce the observation, the Think-aloud method was used; as the participants walked through the park, the research team inquired about the challenges and strengths they encountered during their visit to each space (Figure 1).

Figure 1. Park visits

After the park visit, each participant with a disability was asked to generate a short report highlighting positive aspects and areas for improvement regarding the park facilities and the treatment provided by guides and other personnel involved in the experience.

They (6 in total) were also interviewed, with subsequent transcripts. The same student in charge of each participant with a disability conducted each interview. They were asked about the level of safety the people with disabilities felt when visiting the park. They were also asked whether the minimum accessibility standards were met to guarantee the independence these individuals so desperately demand, and whether they could enjoy the facilities without asking for assistance.

The results were transcribed using the Google Speech-to-Text tool from the collected material; each transcribed interview was manually reviewed to correct inconsistencies. The automatic transcription took an average of 2.5 to 3.5 hours for each interview, and the manual review took approximately 30 minutes.

To analyze the interviews, qualitative analysis techniques were used, including open and axial coding, thematic analysis, and affinity diagrams. Two in-person sessions were held with the participation of a researcher, a software developer, and three students from the information systems with social impact program. Each session lasted approximately two hours. The procedure for the first session was as follows:

1) The researcher reviewed the project and session objectives.
2) The team began identifying relevant aspects (codes) related to the interaction of people with visual impairments in natural parks, including challenges, problems, possible solutions, and useful tools to fill the gaps.

The principal researcher then generated an affinity diagram using the codes extracted in the first session, identifying relevant categories. Atlassian's Miro tool was used to generate codes and affinity diagrams.

4. RESULTS

Table 2 presents results obtained from the analysis of the fieldwork conducted as part of the project. Students and professors from EAFIT university and four PVIs participated in this visit.

Based on the in-person visit to Natural Park, the logbook, observations made, and interviews with individuals with visual impairments, it was possible to identify the specific needs of this population within the park environment. This process enabled a comprehensive and well-founded understanding of the factors that impact accessibility and inclusion. As a result of this methodology, four main categories were defined that group together key aspects for moving toward a more accessible experience in the park.

Category 1, Park Infrastructure, highlights the need for additional physical and technological elements to ensure universal accessibility. Category 2, Culture and Training for Accessibility and Inclusion, emphasizes the importance of training park staff on issues related to visual impairment.

Category 3, movement and interaction within and outside the park, focuses on the conditions that affect mobility both within and access to the park. Category 4, Inclusive and Accessible Design for Tourism Spaces, emphasizes the importance of periodically involving people with disabilities in conducting interim validations of routes, spaces, and all other proposed elements within the park. This constant interaction connects people with special needs and avoids making assumptions based on ignorance of different realities. The qualitative analysis also identified accessibility issues that participants with visual impairments face when visiting natural parks as tourists. Table 3 presents a set of guidelines for designing technology to improve the user experience for people with visual impairments. It also provides some recommendations for natural park staff to prepare for these special needs.

Table 2. Affinity diagram

Category 1: Park Infrastructure	
Physical infrastructure	**Technological infrastructure**
-Many of the spaces/buildings/bathrooms inside the parks do not meet the urban planning standards required by the government and regulatory bodies. -Lack of appropriate tools for PWDs to navigate the park without having to request outside support. This increases the risk of potential accidents. -Restrictions on the use of basic facilities (bathrooms, restaurants) by PVI, this problem is also observed in people with reduced mobility. -Obstacles on paths and traffic areas (e.g., trash cans on the sidewalk, poorly located poles). -Visual contrasts and appropriate lighting in different environments. -Basic signage at strategic points in the park, which does not include options for guiding people with visual impairments.	-Transiting for PWDs within the park is difficult because there is no technological support for guidance. -In addition to the limited physical infrastructure for PWDs, there is also no information technology that can bridge this gap. -The available information technology is not compatible with screen readers, which are the means used by PVI to interact with applications.

Category 2: Culture and Training for Accessibility and Inclusion	
Tourist guide	**Respectful and dignified treatment**
-The guides demonstrate a willingness to support, but lack specific training in visual impairment. -People with disabilities face difficulties in receiving clear, detailed, and accessible information during tours. -There are no established protocols for the proper care of visitors with visual impairments.	-Some employees exhibit fear when referring to or interacting with PVI. -There is a complete lack of knowledge of standards for treatment and interaction with PVI. -Some employees, in their eagerness to be supportive, automatically intervene to help, without first asking the person if they require assistance.

Category 3: Movement and Interaction Inside and Outside the Park		
Multi-format visitor maps and agendas	**Visitor center**	**Means of transport**
-Park maps and activity schedules are in a single format that is not accessible. -The information available at the park entrance and on digital channels is neither multi-format nor accessible.	-The orientation spaces were not designed for people with special needs. -There are no additional strategies to offer autonomous and meaningful interaction for PVI. -The facilities do not meet the sensory and communication accessibility standards required for a tourist space.	-Transportation is not adapted to facilitate access to the park from different parts of the city by people with disabilities. -There is transportation inside the park for wheelchair users, but there are no adaptations for other types of disabilities.

Category 4: Inclusive and Accessible Design for Tourism Spaces		
Interactive spaces	**Feedback from the PVI**	**Inclusive signage**
-Areas with flora and fauna lack the means to help people with disabilities learn about and enjoy the variety, as well as recognize its ecological importance. -The guides prepare their speeches during the tours without any adjustments to special needs. -The adventure and risk areas are not designed to be accessible to people with limited mobility, and park staff are wary of allowing this type of population to experience them because of how dangerous it can be if not properly designed.	-There are no accessible mechanisms for visitors to leave suggestions and comments. -There are no validation tours of services and infrastructure with PVI that could indicate necessary improvements throughout the fleet. -There are no regular interactions that allow PVI to participate and make suggestions to facilitate their interaction in these spaces and thus evolve toward truly inclusive spaces.	The design of pedestrian paths is not designed for PVI, beyond having tactile guides in some of them, but without compliance with standards for their construction. -The signage is unclear and is located at points that are difficult for the PVI to access.

Table 3. Design guides for immersive experiences in natural parks for PVI and recommendations for staff

Problem: Infrastructure that does not Meet Accessibility Standards (Urban Planning, Bathrooms, Buildings)	
Design guides for physical infrastructure	**Guides for park staff**
Participatory technical diagnosis on accessibility issues, combining audiences (experts, people with disabilities). This could be based on NTC 6047 and Decree 1538 of 2005. Progressive adaptation of basic facilities: Wide doors and accessible handles, toilets with grab bars, restaurant sinks and tables at appropriate heights. Visual and tactile contrast: Use contrasting colors on door edges, floors, and steps. Incorporate tactile flooring in crossings and waiting areas.	Train staff in basic accessibility regulations (such as NTC 6047 and Decree 1538 of 2005), focusing on how these regulations apply to park spaces. Raise awareness about the importance of accessible infrastructure for the autonomy and dignity of people with visual impairments. Provide training in the recognition of common physical barriers and in channeling reports to teams responsible for maintenance and adaptation. Promote a proactive approach to guiding visitors in the proper use of routes, restrooms, and accessible spaces, without resorting to paternalistic behavior.
Problem: Lack of Accessible Technologies that Support the Orientation and Autonomous Experience of People with Visual Impairments	
Design guides for physical infrastructure	**Guides for park staff**
Develop mobile applications with voice navigation and screen reader support. Implement audible signaling at key points along the route.	Train staff in the use and operation of accessible technologies (apps, audible signals, assistive devices).

Use GPS systems or Bluetooth devices to guide visitors within the park. Ensure basic connectivity (Wi-Fi or local network) for the operation of accessible digital tools. Include touch technology or interactive devices in sensory stations.	Promote familiarity with digital tools used by people with visual impairments, such as screen readers and voice commands. Provide initial support to visitors who wish to use the park's applications or devices, respecting their autonomy. Report failures or technological maintenance needs in a timely manner to ensure service continuity.
Problem: Guides Lack Specific Training to Assist People with Visual Impairments, which Affects the Quality of the Experience	
Design guidelines for the park experience	**Guides for park staff**
Design guided tours with detailed verbal descriptions that integrate sensory references (sound, texture, temperature, smell). This requires preparing detailed scripts or narratives to ensure that all tour guides communicate the same message, creating similar experiences for visitors. Include tactile stations with replicas or natural elements from the park.	Train guides in inclusive communication and audio description techniques. Promote empathy without falling into condescending attitudes. Encourage the use of open-ended questions to identify the visitor's specific needs.
Problem: Lack of Awareness Leading to Inappropriate or Overly Condescending Treatment of PVI, Affecting Their Experience and Autonomy	
Design guidelines for dignified treatment	**Guides for park staff**
Create safe spaces where all people can participate without prejudice or exclusion. Design experiences that do not depend on constant assistance from third parties, promoting autonomy. Incorporate elements that reinforce equality and recognition of functional diversity.	Raise awareness among staff about the rights of persons with disabilities and the inclusion approach. Teach respectful interaction protocols: always ask before helping, speak directly to the person, avoid infantilizing. Include attention to diversity as part of continuing basic training.
Problem: Information is not Available in Accessible Formats for PVI	
Design guides for multi-format maps and visitor agendas	**Guides for park staff**
Create and print relief maps and agendas in audio and digital formats compatible with screen readers. Place this information at strategic access points and on the park's website. Include tactile representations of trails, key points, and amenities.	Provide training in the use and delivery of accessible maps. Provide clear and detailed information on the content of the available resources. Be prepared to guide visitors using alternative formats.
Problem: Lack of Adapted Guidance and Accessible Resources from the Park Entrance	
Design guidelines for the visitor center	**Guides for park staff**
Design an accessible point of care with assistive devices, tactile signage, and audio. Create an initial orientation space that allows you to learn the route, using sensory and technological elements. Ensure that all information materials are available in accessible formats.	Offer inclusive care from the moment you enter, tailored to the visitor's communication needs. Offer assistive devices work and know how to explain them. Promote an attitude of active listening and availability.
Problem: Transportation Inside and Outside the Park is not Adapted for Users with Visual Impairments	
Design guides for means of transport	**Guides for park staff**
Equip vehicles with tactile signaling, audible warnings, and identifiable seats. This will ensure a comprehensive, inclusive experience. Coordinate accessible routes from key points in the city to the park. Design the internal transport service.	Train drivers and assistants on caring for people with visual impairments. Provide support only when required and allow the visitor to indicate their preferences. Periodically check that the transport is adapted and in good condition.
Problem: Lack of Accessible Sensory Experiences that Allow Exploration of the Environment	
Design guides for interactive spaces	**Guides for park staff**
Create sensory stations with natural elements that can be touched, smelled, or heard. Incorporate devices that reproduce sounds of park species upon contact. Design experiences that don't rely exclusively on sight to convey information or generate enjoyment.	Know how sensory elements work and know how to guide them verbally if necessary. Promote the autonomous use of these spaces without unnecessary intervention. Encourage free exploration while respecting the visitor's timing and interaction methods.
Problem: There are no Accessible Channels for PQRS by PVI	
Design guidelines for feedback from the PVI	**Guides for park staff**
Enable accessible channels for collecting suggestions: Braille drop-off boxes, oral surveys, accessible digital forms. Integrate these mechanisms into the route to facilitate their spontaneous use. Ensure that feedback is truly taken into account for continuous improvement.	Actively invite people with visual impairments to share their opinions. Know how to record or channel suggestions received verbally. Value feedback as an input for institutional learning.
Problem: Signage Lacks Tactile, Auditory, or High-Contrast Elements	
Design guidelines for inclusive signage	**Guides for park staff**
Install multi-sensory signage (tactile, high-contrast visual, and audible) at key points. Use consistent codes throughout the park to promote recognition. Incorporate tactile floors to guide movements and warn of changes or risks.	Recognize the types of accessible signage available and know how to explain them if required. Periodically check that the signage is in good condition and correctly located. Avoid physical obstructions that make it difficult to read the signs by touch or sight.

5. CONCLUSIONS

This paper presented a qualitative study on the perceptions of accessibility in natural parks among people with visual impairments. Using a qualitative approach that combines on-site observation and semi-structured interviews, the study identified the main barriers and opportunities for improvement to ensure more equitable access to these types of recreational spaces.

The research provides valuable insights for designing strategies that promote inclusion and accessibility in natural and tourist settings. In summary, the identified problems include: inadequate park infrastructure (both physical and technological), lack of accessibility and inclusion training for staff, limited movement and interaction within and outside the park, and a deficiency in inclusive and accessible design for tourist spaces.

When contrasted with international experiences, the four categories identified in this study: Park Infrastructure, Culture and Training for Accessibility and Inclusion, Movement and Interaction within and outside the park and Inclusive and Accessible Design for Tourism Spaces; reveal a pattern consistent with, but less consolidated than, advances reported in other regions. Cases such as Arona and other European accessible destinations illustrate how sustained local policies, collaboration with Disabled People's Organizations (DPOs), and integrated "tourism for all" plans translate into concrete improvements in infrastructure, signage, and support services, alongside monitoring instruments to evaluate user experience [1-3]. Empirical studies in Italian protected areas show that the systematic integration of universal design criteria, staff training, and assessment tools into park management is feasible when accessibility is treated as a cross-cutting governance priority rather than as isolated interventions [4]. Likewise, federal instruments such as the U.S. Access Pass and the strategies of Parks Canada, as well as "all abilities access" programs in Australian parks, demonstrate that regulatory frameworks and national or regional policies can expand access rights and promote the progressive adaptation of trails, facilities, and information systems [5, 6, 11-13]. However, across these contexts, the literature consistently reports gaps in multisensory accessibility (audio, tactile, Braille resources), uneven quality and updating of online information, and insufficient participation of people with disabilities in the design and evaluation of services—limitations that mirror the barriers documented in the Natural Park studied here [3, 4, 14].

Experiences in Thailand and other Asian and Latin American destinations, together with the guidelines of UN Tourism, reinforce the idea that accessibility in natural spaces must be understood simultaneously as a rights-based obligation and as a strategic dimension of sustainable and competitive tourism [14, 15]. Measures such as accessible routes, user manuals, improved public transport connectivity, and self-assessment tools for operators converge on three key elements that are also central to our findings:

(i) infrastructure and mobility solutions that support independent navigation.

(ii) continuous training and cultural change within institutions.

(iii) mechanisms for ongoing co-design, feedback, and evaluation with people with disabilities.

In this broader panorama, the Medellín Natural Park case is emblematic of emerging destinations where regulations exist and isolated actions are being developed, but where institutionalization, monitoring systems, and structured participation of visually impaired visitors remain incipient. Our qualitative results, particularly the emphasis on staff training, multimodal information, accessible routes to and within the park, and periodic validation of proposals with users, align with international best practices while highlighting the urgent need to move from normative compliance and sporadic adaptations to integrated governance models that embed accessibility into planning, daily management, and long-term evaluation of natural parks.

The following are proposed as possible solutions:

1) The barriers are not only technological but also attitudinal: prejudices or lack of knowledge about the autonomy of people with visual impairments persist. The availability of accessible resources does not guarantee their use unless accompanied by an inclusive institutional culture.

2) Accessibility must be addressed from the beginning of all processes, and continuous validation must be carried out with the involved population. If it is done as a later addition, it leads to unnecessary reprocessing and errors.

3) Gradual actions must be undertaken to equip the park's physical infrastructure with essential elements, such as doors, bathrooms, tables, and sinks, in accordance with NTC 6047 and Decree 1538. Additionally, use contrasting colors and tactile floors to facilitate orientation.

4) It is urgent to train staff in accessibility regulations, barrier detection, accessible technologies, and digital tools. The goal is to promote respectful, autonomous, and non-patronizing treatment of people with disabilities and to provide adapted care from the moment they enter the park.

5) In terms of technological and information infrastructure, it is necessary to design and implement computer applications that support audio signage, orientation, and maps in multi-format, as well as written and audio guides.

6) Design an accessible visitor center that fosters autonomy and enables inclusive experiences recognizing functional diversity.

7) Adapt transportation systems with tactile and audible signage and accessible routes and train drivers and attendants to provide respectful and autonomous service.

8) Create sensory stations featuring natural elements that allow individuals to touch, smell, or listen to them.

9) Enable accessible channels for petitions, claims, and complaints, including braille mailboxes, oral surveys, and digital forms.

All the above proposals emphasize that whenever commitments are made, the most important factor is to support them with strong culturalization, awareness-raising, and training strategies.

Beyond the diagnostic perspective, these findings have practical implications for different stakeholders. For policymakers, they highlight the need to integrate accessibility standards into local and national tourism development plans, ensuring that inclusion becomes a measurable policy outcome. For park administrators, the results can serve as a roadmap to design and implement inclusive management plans, allocate resources effectively, and strengthen partnerships with disability organizations. For training and education programs, these insights can inform the creation of curricula and workshops aimed at developing skills in accessible tourism, inclusive communication, and universal design.

Ultimately, applying these recommendations could

contribute to transforming natural parks into genuinely inclusive spaces that promote social participation, equal opportunity, and respect for diversity—core principles for sustainable development and human rights.

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REFERENCES

[1] Goodley, D. (2024). Disability Studies: An Interdisciplinary Introduction. SAGE Publications Ltd.

[2] Zawawi, Z.A., Kamarudin, H., Khalid, M.K.A., Narotama, M.R. (2023). Accessibility and Universal Design in the Built Environment: A Bibliometric Analysis. UiTM Press, Universiti Teknologi MARA. https://doi.org/10.24191/myse.v11i3.3914

[3] Selanon, P., Chuangchai, W. (2023). Improving accessibility to urban green spaces for people with disabilities: A modified universal design approach. Journal of Planning Literature, 39(1): 79-83. https://doi.org/10.1177/08854122231212662

[4] Selanon, P., Puggioni, F., Dejnirattisai, S. (2024). An inclusive park design based on a research process: A case study of Thammasat Water Sport Center, Pathum Thani, Thailand. Buildings, 14(6): 1669. https://doi.org/10.3390/buildings14061669

[5] Holloway, L., Marriott, K., Butler, M., Reinders, S. (2025). 3D printed maps and icons for inclusion: Testing in the wild by people who are blind or have low vision. arXiv preprint arXiv:2501.09204. https://doi.org/10.48550/ARXIV.2501.09204

[6] National Park Service. (2024). America the Beautiful—the National Parks and Federal Recreational Lands Pass. https://www.nps.gov/planyourvisit/passes.htm#america-the-beautiful-passes.

[7] Jia, Q., Syed Mahdzar, S.S., Khaidzir, K.A.M., Lim, Y.W. (2025). Spatial structure and accessibility of urban parks: A multi-scale integration of GIS and space syntax in Xi'an. Frontiers of Architectural Research. https://doi.org/10.1016/j.foar.2025.09.010

[8] Zhang, Z., Ma, G., Lin, X., Dai, H. (2023). Accessibility in a multiple transport mode urban park based on the "D-D" model: A case study in Park City, Chengdu. Cities, 134: 104191. https://doi.org/10.1016/j.cities.2023.104191

[9] Zhao, X., Lu, Y., Huang, W., Lin, G. (2024). Assessing and interpreting perceived park accessibility, usability and attractiveness through texts and images from social media. Sustainable Cities and Society, 112: 105619. https://doi.org/10.1016/j.scs.2024.105619

[10] Domínguez Vila, T., Darcy, S. (2025). Beyond technical website compliance: Identifying and assessing accessible tourism value chain information content on national tourism organisation websites. Tourism Management Perspectives, 55: 101332. https://doi.org/10.1016/j.tmp.2024.101332

[11] SFGATE. (2025). Disney sued for alleged discrimination after changes to disability service. https://www.sfgate.com/disneyland/article/disney-sued-discrimination-disability-service-20168308.php.

[12] Comercio Industria y Turismo. (2025). The Ministry of Commerce, Industry and Tourism, Fontur and Cidcca lead strategy to improve tourism accessibility in Colombia. https://www.mincit.gov.co/prensa/noticias/turismo/estrategia-mejora-accesibilidad-turistica-colombia.

[13] Gual, J., Puyuelo, M., Lloverás, J., Merino, L. (2011). Universal design and visual impairment: Tactile products for heritage access. In Proceedings of the 18th International Conference on Engineering Design (ICED 11), pp. 155-164.

[14] ICONTEC. Norma técnica colombiana NTC 5643: [Título oficial de la norma]. Instituto Colombiano de Normas Técnicas y Certificación (ICONTEC).

[15] Dayra Tatiana, P.T., Elian Sofia, M.A. (2021). Proyecto de investigación diagnóstico y propuesta de accesibilidad en museos turísticos para Colombia, caso de estudio ciudad de Manizales. Trabajo de grado. Universidad Católica de Manizales. https://repositorio.ucm.edu.co/handle/10839/3342.

[16] Martinez Bernett, O., Bru Porto, C.A. (2024). Analysis of accessible tourism in Colombia. Ciencia Latina, 7(6): 8975-8991. https://doi.org/10.37811/cl_rcm.v7i6.11000

[17] FONTUR. (2025). The ministry of commerce, industry and tourism, FONTUR and CIDCCA lead strategy to improve tourist accessibility in Colombia. https://fontur.com.co/es/comunicados/el-ministerio-de-comercio-industria-y-turismo-fontur-y-el-cidcca-lideran-estrategia.