THE *O GRUPO DO LEÃO VR*: FOSTERING ACCESSIBILITY, DRAMA AND TECHNO-EDUCATION WITH BLIND AND PARTIALLY SIGHTED PEOPLE IN THE MUSEU NACIONAL DE ARTE CONTEMPORÂNEA IN PORTUGAL

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ABSTRACT

This article examines how drama activities and computer technology acts as an effective bridge of mediation between the artwork and the visually impaired audience. Museums are essential for connecting visitors to history and culture, as they act as a reflection of the social past and present. It is necessary for the institution itself to reconsider its museographic strategies, offering inclusive multimodal experiences. The text presents the findings of the exploratory project *O Grupo do Leão: Explorando a Inclusão das Pessoas com Deficiência Visual em Museus Através de Uma Experiência Virtual Imersiva*, developed at the Museu de Arte Contemporânea do Lisboa (Portugal) between November 2022 and February 2023. The methodology, objectives, procedures/materials used, and conclusions obtained from the interviews with the participants are detailed, focusing on the integration of the sense of touch as an effective museographic strategy for visitors who are blind and partially sighted.

Keywords: Accessibility; Effective inclusion; Virtual reality; Museums; Visual impairment.

1. INTRODUCTION

Santiago Sipán (2022, p. 1) stresses that "museums not only show the past of different cultures throughout history, but also the present of the society to which they belong". Art, with its ability to channel emotions and foster critical appreciation, plays a vital role in the temporal and contextual connection of the visitor. However, the museum-institution still faces challenges when it comes to the inclusion of visually impaired people (a group that is often marginalized in these spaces).

According to data from the World Health Organization (2011), it is estimated that there are 2.5 million individuals with vision impairment and around 24 million with low vision (the most dominant of our senses). In a significant move towards inclusion, in 2009, the European Union and its nationals adopted the *UN Convention on the Human Rights of Persons with Disabilities*, setting standards in terms of equality, non-discrimination, and access to culture. In 2015, the UN developed the 2030 Agenda and its "Sustainable Development Goals", including the promotion of universal access to safe and disability-friendly public areas. In 2021, the *Strategy on the Rights of Persons with Disabilities 2021-2030* completes the integration of persons with disabilities (European Parliament, 2021).

People who are blind and partially sighted use senses other than sight to experience the world and understand their environment. It is incorrect to assume that these users lack experience or knowledge comparable to subjects without this condition (Edelstein, 2022, pp. 196-198). The relationship between blindness and creativity is associated with previous experiences, memory, reasoning, or internal motivation (Arias et al., 2016, pp. 60-66). Within the museum field, inclusion becomes a complex concept and is often misunderstood. It is crucial to consider the diversity of audiences, as well as the need for "practical-theoretical-effective" knowledge based on unconventional experiences that enhance the human capacity to feel the art object (De la Jara, 2022, p. 97).

In the 21st century, it is essential that museums become spaces of multimodal communication accessible to diverse audiences. Museology and museography must guarantee equal participation and access in the cultural sphere from both a cognitive and emotional perspective.

Although there are some technological tools already created for the assistance of blind people in the museum environment, there are still restrictions linked to the rest of the senses other than sight (such as the prohibition of touch in many museums) that hinder the experience. Cecilia Rafie (2022, p. 138) points out that there have been debates over the last decades on how to make this space more accessible, recognizing the importance of considering the individual expectations and needs of each subject in any strategy linked to accessibility. In a world with such a considerable number of people who are blind and partially sighted, adapting these cultural spaces becomes a priority.

The curatorship of museum content has the duty to overcome barriers and reflect the diversity of the society we live in, as well as to

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establish efficient accessibility policies, including the development of adapted standards and protocols (Ayukawa, 2021, pp. 3-9). Despite the challenge this presents, given that art has traditionally focused on the visual and auditory senses, there is an ongoing effort to incorporate touch into art experiences. It is essential that museums seek ways to establish dialogues with their diverse audiences and offer multiple channels of information, creating an environment that enhances universal experiences and allows all visitors to connect intimately with the artwork in question.

Portugal, in 2022, launched the *Strategy for the Promotion of Accessibility and Inclusion in Museums, Monuments and Palaces 2021-2025* (Dispatch no. 2016/2022) promoting accessibility and inclusion practices in cultural sites, relying on technological tools to facilitate access to collections. In this regard, and within the framework of this strategy, this work reflects, from both a theoretical and practical approach, and from an academic-scientific viewpoint, the results obtained after the implementation of the *O Grupo do Leão VR* prototype at the Museu Nacional de Arte Contemporânea, in Lisbon, in 2023.

2. ON MUSEUMS, ACCESSIBILITY, AND NEW TECHNOLOGIES IN PORTUGAL

The article *Visiting Museums from the Perspective of Visually Impaired Visitors: Experiences and Accessibility Resources in Portuguese Museums* (2021) analyses the Portuguese museum context and the problems or limitations experienced by people who are blind and partially sighted. This study shows how these visitors often depend on companions to access the content intellectually. In addition, the lack of tactile resources or the complexity of the representations themselves make designing inclusive tools quite complicated. The absence of an inclusive approach that addresses these specific needs to ensure a satisfactory experience implies, to a large extent, an inadequate orientation of the blind and partially sighted user in the environment. The main challenge of museography today is to design multimodal resources that consider aspects such as interaction, perception, interpretation, and accessibility in a feasible way. The combination of traditional methods such as Braille or large print signage, together with computer technology, becomes fundamental in the construction of complete experiences that improve access to culture for this group.

In order to access the "Portuguese museum accessibility map" in the framework of the *O Grupo do Leão VR* project, and in relation to people who are blind and partially sighted, a questionnaire was drawn up and sent to 35 national museums and 32 municipal museums. Responses were obtained from only 25 museums in total. It is remarkable that only 12% of these museums were contemporary art museums compared to 40% which were historical. 72% claimed to have accessible infrastructure for people who are blind and partially sighted, mentioning elements such as ramps, audio guides or Braille signage. However, some highlighted the economic and structural limitations (especially in historic buildings)

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to make the necessary adaptations. 60% of the museums surveyed have adapted content but face challenges in terms of resources and professional training. Despite the fact that 76% value technology positively as a tool for visual understanding at museum level, only 44% have knowledge of the specific needs of this group, and therefore their staff are not adequately trained. Although 96% believe they understand the limitations faced by these users during their visits, much remains to be done. Finally, the majority are very positive about the inclusion of advanced technologies (XR) in the museum environment, but express caution and lack of knowledge about their concrete benefits in the short and medium term.

Also, 72% of the centers surveyed have photogrammetrized at least a part of their collection (between 1 and 5 pieces). All see digitization as beneficial for increasing the accessibility of their collections to people who are blind and partially sighted to varying degrees but continue to emphasize monetary and training constraints. In short, although the importance of training staff and effectively adapting the museography to this type of public is recognised, it is still difficult to have the appropriate means for this to happen correctly in the medium term.

3. O GRUPO DO LEÃO VR

3.1. OBJECTIVES

The main objective of this exploratory project, which lasted 6 months, was to create knowledge about the concept of museum accessibility and people who are blind and partially sighted. It also consists of different areas of research, training, and promotion, focused on the application of 3D computational technologies. This process seeks a more effective inclusion of this group in the context of the museum-institution and its contents. To this end specific lines of action were outlined, which are indicated below:

- To consider the qualities of immersion, interaction, and participation inherent to virtual reality (3D computer technology) as a bridge between the artistic work and the visually impaired public, promoting the use of this type of tools as intermediaries in the aesthetic and formal artistic experience.
- Investigate the value and advantages of virtualizing artistic and cultural heritage and how it can be appreciated using senses other than sight. This includes the creation, implementation, and testing of immersive narratives in situ, working with groups with such disabilities.
- To invite the blind and partially sighted population to immerse themselves in different types of plastic experiences using a technological prototype under development with the intention of motivating the visitors who are blind and partially sighted, facilitating authentic interaction with the museum object.

https://doi.org/10.34632/jsta.2024.15896

• To explore the mechanical-haptic functionalities (touch) and the transcoding of visual languages (de-visualizing access to art) with special emphasis on the work *O Grupo do Leão* (1885) by Columbano Bordalo Pinheiro and promoting the inclusion of visually impaired people to varying degrees.
• To contribute to the strategic plan of IHA (Instituto de História da Arte, FCSH-NOVA, Universidade Nova de Lisbo) and University of Málaga new lines of exploration that improve the quality of life of these groups in vulnerable situations through specialized, cross-cutting, quality research.

3.2. METHODOLOGY AND MATERIALS

A participatory methodology was used to achieve the goals set. It allowed the groups of people involved to cooperate, express, and represent themselves from authentic and personal perspectives. As this group of people who are blind and partially sighted is generally considered as a "new public" or "non-visitor" to museums, the work plan took on a diversified direction. The creative, self-expressive and abstract experiences of the people involved in the practical process were valued, prioritizing not only the results, but the process itself.

To facilitate collaboration between researchers, a shared workspace was established on Google Drive. An access point, through which they could access and contribute in real time to the completion of the project. The work plan was divided into several specific stages, following prior research. During the first stage (November 2022 to February 2023), meetings were organized in which discussions were held on the existing literature related to 19th century art, especially the painting *O Grupo do Leão*. To this, the exploration of museum issues, accessibility and inclusion was added as a key element.

Questionnaires were sent to all Portuguese national and municipal museums to better understand how they work with the inclusion of people with disabilities in these spaces. Didactic materials were created for the stipulated sessions and a virtual reality prototype was prepared. During this last phase, multiple meetings were held with different associations and partners dedicated to the group

• First stage of the project (planning and preparation): between 1 November 2022 and 10 February 2023. The team coordinated activities and meetings (face-to-face and virtual) with the different members of the research team. The objectives were to study the literature related to the painting to be digitized and accessibility in museums, to send surveys to Portuguese museums to find out how they dealt with the inclusion of disabled people in their facilities, the development of educational resources focused on the painting by Columbano Bordalo Pinheiro (digital twin), the testing of the prototype in virtual reality with the support of Opossum Studios Virtual Builders (responsible for the design of the tool) and the

Journal of Science and Technology of the Arts, vol. 16, n. 2 (2024): pp. 109-130 https://doi.org/10.34632/jsta.2024.15896

meeting with the partners to organize the project to proceed in the framework of the MNAC, to collect the necessary equipment and costumes.
• The first part of the project was focused on developing exploratory sessions in the context of the museum with groups of blind and partly sighted people. Guided visits and previous mediation activities were carried out to explain the painting and its characteristics, both formal and aesthetic, following the theatrical dramatization of the painting that would later be explored through virtual reality.

We worked with the virtual prototype during sessions three and four. The photogrammetric 3D model of the painting *O Grupo do Leão* was previously obtained and processed during a pre-doctoral research stay in 2021 (Martins & Crespillo, 2023). These sessions aimed to foster creativity and abstract thinking by combining art and technology.

• All the sessions took place at the Museu Nacional de Arte Contemporânea, in Lisbon (MNAC) directed by Emília Ferreira. A total of 20 participants who are blind and partially sighted from the blindness association - *Associação Promotora de Emprego de Deficientes Visuais APEDV*, and the company specialized in cultural accessibility - *Locus Acesso* (both Portuguese) participated in these sessions. The main aim of these sessions was to collect the different testimonies of the participants, taking notes, conducting during the session open interviews, presentations, as well as obtaining individual and group testimonies regarding:

- Creative, art-historical awareness and plastic experience
- Level of autonomy and self-expression in relation to painting
- Attitudes towards the exploration of the prototype and its testing in the museum field
- Level of inclusion and awareness of participants

The sessions one and two aimed to create points of proximity between the research team and the participants who are blind and partially sighted, introducing discussion topics related to inclusion and accessibility in museums. Some comments were clear about the impact that museums can have on the inclusion of blind and partly sighted people in society. One of the participants mentioned that museums provide a reality that is not available in other sectors of society, such as in the media: “by getting to know art, we gain a good general culture, we can insert ourselves into everyday discussions”. However, some comments considered the need for museums to have professionals with specific training in the area of accessibility and technical resources available to accommodate blind and partially sighted people. One of the participants suggested that museum studies students should be taught how to work with the blind and partially sighted audiences, aiming to explore specific and very important subjects such as, for example, audio description. A testimony

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Journal of Science and Technology of the Arts, vol. 16, n. 2 (2024): pp. 109-130

from another participant about a previous museum visit highlighted the lack of knowledge that museum professionals have in communicating their exhibitions to blind and partially sighted visitors: “I asked the lady who worked in the museum why there was no one to explain the artworks for the blind audience and she said: - I thought those explanations in Braille were enough for you, forgive my ignorance”. She asked what could be improved and ended up describing that bust of a sculpture and let me touch a few things.” Also, they considered that not all blind and partially sighted people like art and maybe because they are a minority audience, unfairly, museums have not invested financially in attracting blind and partially sighted audiences.

They mentioned, as well, that the disbelief in the abilities of people who are blind and partially sighted by the non-disabled people is one of the key aspects for their exclusion: “people think my life is a disgrace. Today, we are in the 21st century, and people still think that we can’t do anything, that we can’t use a computer…”.

On the other hand, these sessions also intended to present the painting “O Grupo do Leão” through detailed verbal descriptions and drama activities, facilitating the subsequent exploration of the virtual reality prototype.

In effect, through verbal descriptions associated with key questions and answers, participants got to know formal notions regarding the painting, namely its size, technique, chromatic stain, type of brushstroke, schematic organization of the figures – positioning, expressive attitude, clothes, and accessories used. Conceptually, ideas related to the history of art were introduced, mentioning the importance of painting in the Portuguese historical-artistic context, including its production context. In this sense, discussions were developed between the participants and the research team around the innovative nature of the painting, about the characters represented and their meaning in the cultural context of the time and possible technical influences that contributed to the production of the painting. In this aspect, some participants highlighted not only the importance of having quality descriptions in mediated activities for people who are blind and partially sighted, but also the importance of telling stories about museum objects: “I like the descriptions if they are well done. But I like knowing the stories, yes!” Likewise, another participant mentioned that the use of touch sense is important, although quality descriptions can overcome this resource, particularly if they are detailed and offer intellectual contents. Drawing on a previous experience of visiting an exhibition, he said: “For me, touching the works is important, but I often delight with just the intellectual reflection of the artworks. Once, I visited an abstract painting exhibition (...) and what seduced me were the texts that accompanied the works, not so much the descriptions because some of them [works] were very simple.

The intellectual conception behind them pleased me a lot. I particularly like museums where figurative art predominates, and I like the descriptions (...) with great details”.

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Figure 1. First session moment, exploring the painting with the participants © Seed-project photos, 2023.

The second key moment of the exploratory sessions aimed to develop a drama activity in order to recreating the painting scene. To do this, each participant was invited to represent a character present in the painting. Some props that contextualized the scenic space were also made available, such as a table and some chairs, a white tablecloth, beer glasses, and an A3-sized notebook (to simulate the art magazine present in the painting). Another relevant aspect for the development of this scenic recreation was the collaboration of the Teatro Nacional de S. Carlos, which provided, on loan, clothing, and accessories from the period, demonstrating the importance of establishing partnerships in accessibility projects between academia and civil society cultural institutions. Participants were invited to recreate the scene, placing themselves in the same position as the characters in the painting and expressing the same attitude. With this action, participants were able to obtain more reliable information on the way the characters were represented, facilitating the connection with the next stage of exploring the virtual reality prototype.

The feedback from the participants was very positive, some of them even considered this activity more important compared to the first part, dedicated to the descriptions of the paintings: “This thing about staging the work, dressing and undressing, knowing the position of the characters, it’s very different from audio description… memory is different.” “I prefer this to audio description!” Another participant also mentioned the importance of “feeling” the painting through staging: “dressing like the characters made us enter the work, because describing it is one thing, feeling it is another!”.

The sessions three and four aimed to explore the VR haptic prototype through the indirect-haptic touch (glove), in order to facilitate the conceptualization of the painting through the construction of abstract images. The procedure was the same as in the "direct touch" sessions, in which the painting, its context and its importance as a period document were explored in the form of a participatory workshop, making use of

Journal of Science and Technology of the Arts, vol. 16, n. 2 (2024): pp. 109-130 https://doi.org/10.34632/jsta.2024.15896



Figure 2. Second session moment, dramatization of the painting with the participants © Seed-project photos, 2023.

materials with different textures, shapes, sizes, etc., and facilitating their interpretation conditioned by the imagination. In this way, the three-dimensional work is placed in a museum environment that emulates the space where the real painting is located.

The interest in providing tactile and auditory experiences for the subjects is the first step towards obtaining comparative data on the prototype and its level of stimulation or aesthetic-plastic development of the subject based on their real needs (possibilities), interests and expectations, sensory capacity for learning (more or less limited), knowledge of concepts (sequencing), level of autonomy, motivation, involvement, general cooperation between users and appropriateness/ timing of the experiences in terms of assimilation of new content.

A specific space was made available for the development of exploratory sessions three and four with the virtual reality prototype. The hardware to be used was initially lent by the *Laboratório de Reabilitação Psicossocial de Porto*. However, several problems were experienced due to the haptic glove model (which turned out to be an older version than expected).

This drawback meant that, during the first technology session, we were only able to show how the vibration by mechanoreceptors of the gloves worked. However, the experience was not bad, because they saw its potential as a means of plastic expression. However, we were not able to put the prototype into operation due to the lack of functionality (software) of the borrowed hardware.

Nevertheless, an interesting exercise was done with the group of participants, before putting the gloves on each of them. Emília Ferreira had a conversation with the group members about the experience of using headphones in museum settings or cultural visits.

In this case, they focused on the "Quinta Regaleira" which offered simple resources such as "*QR codes*" at the entrances that provided information related to what was to be visited. It was mentioned that one of

https://doi.org/10.34632/jsta.2024.15896

the main problems in this area is precisely the lack of funding and human resources in general. Audio description by itself does not guarantee an accurate knowledge of what is represented. The difference between audio description and scenographic representation was discussed (as had been done previously in sessions one, two and three) as some people prefer the immersive approach to audio description alone, as interest may be lost. At this point, virtual reality offers kinesthesia and thus not only audio description, but also gestural immersion and alternative sensory information making use of other senses more developed in visually impaired people.

People who are not blind or partially sighted use the sense of sight as the main channel of information acquisition by 90% (Jagošová & Hlušì, 2022, pp. 5-10). In contrast, those without a normative range of vision experience the world differently. Each person who is blind and partially sighted may have different sensory dominance and cognitive abilities that influence their artistic perception, and this makes it necessary to emphasize the concept of inclusive education in the framework of the museum, with the aim of making its works accessible to this group, including a wide range of conditions and physiological degrees they rely on, and with which they learn, understand and process information from their direct environment: specific stimuli such as sounds or touch.

In this regard, and for the subsequent technological sessions, researcher (Martins & Crespillo, 2023) used her own equipment: *Manus x Haptic VR Gloves*, *HTC Vive Pro* stereoscopic VR glasses and a *Lenovo Legion* laptop with *Manus Core*, *Steam* and *Vive Port* software (equipment brought specifically from Spain).



Figure 3. Emilia Ferreira in conversation with participants © Seed-project photos, 2023.

A sound catalogue (audio guide elements) was created to be implemented in the VR model. For its development, certain historical-artistic information on the painting itself was considered: title and author of the work *O Grupo do Leão*, date and period in which it is framed, technique and the place where it is exhibited. Great emphasis was placed on the contextual framework of the work (Portuguese realism or naturalism) so that the participants would

Journal of Science and Technology of the Arts, vol. 16, n. 2 (2024): pp. 109-130 https://doi.org/10.34632/jsta.2024.15896



Figure 4 . Hardware and software used © Seed-project photos, 2023.

understand and know the artistic and cultural reality of the painting, in relation to the project's objectives of inclusion and democratization of content. As a complement, a piece of piano music from the 19th century is played at the beginning of the experience. More specifically, the *5 Portuguese Rhapsodies* by José Vianna da Motta, which places them sensorially, and through their hearing, in the environment represented by the painting[1].

Through the use of *Unreal Engine 5* software, each painted character was assigned a sound description, which was activated by placing the fingers on them. The *force feedback* was previously programmed by Gabriel Ruiz Gonzálvez (C.E.O. of Opossum Studios Virtual Builders) through the use of *Blueprints*, and to the extent that these allowed for functionality: the vibration range of the MANUS X Haptic Prime was framed in values between 0 and 1, allowing the user to interact in a three-dimensional digital environment, almost as if they were in contact with the real object.

The haptic feedback of the *hardware* is designed to complete virtual experiences by emulating the perception of specific objects, in our case, the Columbine painting. Simultaneously the mechano-receptive vibration stimulated the phalanges of the participants establishing continuous feedback. Henrique Pinto, Ribeiro Cristino, José Malhoa, Alberto de Oliveira, Silva Porto, António Ramalho, Manuel Fidalgo, Moura Girão, Rafael Y Columbano Bordhalo, Antonio Monteiro, Cipriano Martins and Rodrigues Vieira presented individualised audios with information on position, facial qualities, and clothing. The columns that framed the scene, as well as the table and the elements on it, are also made explicit through vibration and specific sounds, as well as the festive atmosphere of the room itself (glass of glass, bubbling of beer, crowd talking, etc.).

The stereoscopic glasses used, in this case, are used as a means of positioning in the controlled environment set up and defined in the framework of the museum, through the optical sensors. This allows users to focus on a specific position, avoiding the loss of the three-dimensional

1 On this occasion the colours were not encoded by means of sounds, as the chromatic range of the painting was not very diverse (ochre chiaroscuro, beiges, greys, browns, etc., with poorly defined lines). In short, figurative constructions by means of vaguely wide-ranging spots and shades, complex to translate in a non-visual way.

https://doi.org/10.34632/jsta.2024.15896

object in the space where the painting is digitally placed. They cannot visualise the place of the experience, but they can listen to instructions on the position of the painting and on how to reach it until they touch it, start to perceive the relative haptic vibration, and activate the audios previously recorded by the project team. For this task, the prototype had a very simple operation, based on the movement of the user's own hands (the reading of the pictorial environment is done from the center to the sides):

- Right hand: the surface of the painting was touched, and the vibration mechanoreceptors were activated (each character had a different programmed vibration intensity). The empty areas of figures did not vibrate in order to generate in the user the sensation of information emptiness in those areas.
- Left hand: activated, by closing and opening the fist, placed on the right hand, the audio description of the character selected on each occasion. It was switched off by touching any of the other characters.



Figure 5. Instructions for participants © Own Authoring, 2023.

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Figure 6. One of the participants testing the prototype at the MNAC, © Seed-project photos, 2023.



Figure 7. One of the participants testing the prototype at the MNAC, © Seed-project photos, 2023.



Figure 8. One of the participants testing the prototype at the MNAC, © Seed-project photos, 2023.

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It became fundamental for the project team to know the range of access to the painting and the handling of the interface by the participants through touch and hearing. In these terms, the subsequent questionnaire delved into various categories of analysis related to the usefulness of these virtual tools in terms of the museum experiences of visually impaired people (considering what was expressed in the first non-technological exploratory sessions):

- Level of usefulness of the prototype
- Level of ease/difficulty of use of the prototype
- Level of shape recognition in the framework of painting through prototyping
- Quality level of sounds and information implemented in the prototype.
- Overall satisfaction level after first contact with the prototype
- Level of integration of the subject in the prototype experience
- Level of stimulation of alternative senses to vision through prototyping



Figure 9. Interview with participants © Seed-project photos, 2023.

All these sessions, like the previous ones, were recorded and processed. The interviews were also transcribed and transferred to a joint drive with which to work and draw conclusions regarding the initially proposed objectives.

• The third stage (analysis of collected data and results): efforts were concentrated on the compilation and study of the data obtained, with the aim of reflecting on different aspects related to the perception and artistic awareness of these people in the museum environment, their reaction to the tool/resource, as well as the different perceptions expressed in terms of accessibility and inclusion. Based on these data, work is being carried out to improve the prototype.

Journal of Science and Technology of the Arts, vol. 16, n. 2 (2024): pp. 109-130 https://doi.org/10.34632/jsta.2024.15896

From a human diversity perspective, the self-perception of the 'self' in the environment is largely forged through interaction and experience of the external world. A person does it differently: they construct internal images based on an abstraction of the knowledge acquired by these processes of interaction and experience, transcending the visual (Zarur, 2023, pp. 137-149). Looking at art implies a genuine connection with emotions and thoughts. Likewise, a visually impaired person, not being dependent on vision, appreciates and understands the visual manifestation in a different way using his or her own independent abilities and skills. They also have a greatly enhanced sense of proprioception and kinesthesia.

This methodology, therefore, sought to deepen the understanding of essential aspects such as the creation of mediation tools and the development of interpretative content, related to current museology and museography. The "digital humanities" are taken as a catalyst for innovation and change, to improve and enhance the quality of life of these groups in vulnerable situations, with respect to access to general culture in art museums and other institutions. From an art-historical and transdisciplinary perspective, this proposal focuses on the evaluation of the accessibility, functionality, and innovative character of "accessible technological resources". It also fosters an environment that supports diversity and studies on the inclusion of visually impaired people in the museum environment.

4. RESULTS

The interviews took place at the Museu Nacional de Arte Contemporânea, in Lisbon, after the exploratory activities and the testing of the technological-virtual prototype. The proposal of a scenographic recreation of the painting where the participants had to position themselves as the characters described was a challenge. However, this exercise allowed them to assess the spatial place of those depicted in a real environment, based on the creation of mental images, which helped them to orient themselves face to face with the "digital twin" (virtual) of the painting, since the museum itself does not allow them to touch the works (a way of acquiring sensory and direct awareness of the external reality). According to the interviews carried out, there is a general perception that visual art museums are not for people who are blind and partially sighted, and, for this reason, many have never been able to visit them.

Several interviewees started visiting museums at an early age, others are starting to take an interest now. They see it possible to work in a museum if there are appropriate adaptations and believe that they can contribute with ideas for this. Although they do not know all the spaces in the museum environment, they move autonomously and with ease, they say that they can adapt easily to new spaces. They also feel that society still has misconceptions and prejudices about what blind people can experience in front of a work of art (negative comments about their innate abilities in everyday environments, etc.). They stress the importance of

https://doi.org/10.34632/jsta.2024.15896

blind and partially sighted people visiting museums and then sharing their experiences to raise awareness.

It is important to make adaptations in museums; it is important, they say, to offer a general culture in order to integrate the collective in the daily discussions that arise from the artistic field. Describing an exhibition does not validate the experience as such. Accessibility remains a challenge and there is often a lack of information and investment. In addition, there is a misperception of sensory capacity around people who are blind and partially sighted. There is a call for adaptation and awareness-raising with the intention of attracting a wider and more diverse audience, as well as more training for museum staff.

Several of the interviewees indicated that they enjoyed visiting museums, and that this activity was very much appreciated by them. While audio descriptions and tactile resources are essential elements for appreciating the visit from a non-visual perspective, they commented, the range of resources needs to be broadened so that accessibility is increased, and the visit is enriched. They point out that there are museums that offer fantastic experiences in this sense, but they are a minority (at least in Portugal).

New technologies, namely virtual reality, offer enormous potential to enhance the artistic experience in cases where the visitor is visually impaired. However, they say, it must be implemented and designed carefully for it to be effective. The description of the artwork before using the virtual reality equipment was, they said, very useful and improved the approach to the object materialization. There is great interest and curiosity, on the part of the interviewees, to find out how this technology can enhance their experience, and proposals such as these are viewed positively, as well as being considered valuable contributions. There is a general desire, we are told, to continue to develop more projects of this kind focused on accessibility for the collective of people who are blind and partially sighted.

For all of them, this visit and proposal was a positive experience, as it allowed them to appreciate the painting in a different way (de-visualized) and to learn from it in an interactive way. The descriptions added to the virtual experience allowed them to imagine and understand the painting itself. The technology used and the descriptions provided impressed them, and being able to touch a piece allowed, they say, a richer and more complete experience. In addition, they say that the description of the piece is fundamental to assessing it correctly or incorrectly. In this respect, it is not a matter of "just" visiting a museum, but of understanding, even if only in an accompanied way, the context of a work or exhibition.

Each blind and partially sighted person has different backgrounds and cultural perspectives, which may influence the way they interact in museum environment. Initially, they say, they encountered initial difficulties in getting to grips with the virtual reality equipment: adaptation of the physical space, as it was very small, the way in which the descriptions were activated, sometimes with some delay, the lack of

https://doi.org/10.34632/jsta.2024.15896

precision of the vibration in front of the figures. These problems prevented the formation of a clear mental image of the painting, even though the description of the images was good, and details were given about the position of the figures. However, the existence of empty spaces in the digital model of the painting, together with the previous description, helped them to understand why no mechano-haptic vibrations were felt in certain places.

Therefore, some improvements are suggested by the participants, so that the prototype can be further developed and useful:

- The descriptions regarding the painting in the prototype were quite good and the previous staging brought them into the work. This is interesting, since they talk about immersion, and so they indicate that "describing is one thing and feeling is another". In fact, they were very much in line with the first non-technological sessions.
- The virtual reality prototype (hardware and software) increases the autonomy of blind people when experiencing the painting. They therefore indicate that it takes more time to try out the tool and, in fact, they comment "if I had been alone, it would have taken me longer, but I would get a more or less comprehensive view of what is represented in the painting".
- The exploratory sessions of the painting, especially the one in which they dressed up as the characters in the painting while occupying their place in space, helped them a lot in terms of the subsequent use of the prototype. These sessions allowed them to know what position each person occupied in the scene, as well as how they were dressed. By having a broader knowledge of the play, it was much easier to explore the prototype.
- The prototype completed the representation previously scenographed by the participants, as well as the descriptions. They indicated that it was easy to get used to the virtual experience as they "knew the painting". Perhaps the most difficult part was holding their arms and hands up (although this was because it was the first time they had used it).
- The prototype can be refined over time (making it easier to gesture to access information). One of the main problems was space, which was too limited to move around freely. However, on the other hand, it would have been important to place limiting marks on the floor to know where it started and where it ended, as the painting was large and there were many figures to identify. Also, the description of these characters is not immediate, so they sometimes overlapped with each other (an element to be improved).
- The vibration worked clearly, although it was necessary to wait until the previous description was finished before starting to feel the next figure. In this sense, the waiting time complicated the specific approach to the elements. However, it is interesting that they say that, as there was vibration in contrast to the empty areas, they knew that there was going to be another figure or element there.

https://doi.org/10.34632/jsta.2024.15896

- The range of vibration was not very wide (due to the limitations of the equipment itself) and this made it difficult, to some extent, to construct an accurate sequence of the image. Added to this was the need for the description to stop when changing figure. However, both elements allowed for a notion of the work itself, which would have been quite complicated without this combination of tactile and sound resources.
- The previous sessions greatly facilitated the experience with the prototype, as the painting had been worked on previously and they knew what was behind the vibrations and the descriptions that sounded in unison. In fact, from both elements, they started to work on the mental image (abstract image) using their own imagination.
- Although the perception of space is important for people with disabilities and the equipment provides the participants with the kinesthesia of the body through gestures, it still needs to be perfected: cables make autonomy difficult and in such a small space it is necessary to be aware of any movement.

They all participated with particular curiosity, interested to see how the prototype could help them to perceive the work of art, as well as to improve their understanding of it. Thus, they suggested improvements such as the delimitation of the environment of experience. However, it seems that the initial description of the painting allowed many to visualize it in their mind while using the equipment, showing that virtual reality, together with the right preparations, can offer a valuable experience for them (although there is room for improvement). Although many projects may not be useful for everyone immediately, the efforts made, and the continuation of the project will benefit the visually impaired in the long term. In fact, different types of vibration (ranges) are suggested to indicate the various elements of the picture located in space. In this respect, they highlight the previous information sessions (scenography) and hope for improvements in the prototype so that it can offer a clearer understanding of the works. In fact, they believe that with more time and practice, they themselves could become more familiar with the equipment and get a clearer picture of the information in the painting without the need for prior descriptions. Vibrations to varying degrees (already built in) are noticeable, although not to the extent necessary for the benefit to be direct for now.

5. DISCUSSION

The *O Grupo do Leão VR* project studied and analyzed the impact and possibility of artistic- cultural virtualization and its implementation as an accessible tool in the museum. The implementation of previous, complementary, and experimental activities focused on the painting itself (exploitation and participation of groups of visually impaired people) provided certain very useful theoretical and practical results: the

https://doi.org/10.34632/jsta.2024.15896

development of accessible content was deepened, addressing the digital humanities as an axis of innovation and interpretation of heritage.

From the sessions and interviews conducted, it is evident that the participating users see potential in the use of virtual reality to enhance their experience and understanding of works of art, although there is still room for improvement. The descriptions provided by the device were rated positively, although the range of vibrations generated some uncertainty as to their ability to form a concrete metal image of the painting. The initial description helped to understand the spaces occupied by figures and other elements, as well as the voids. Curiosity and interest in this assistive technology motivated participants to take part in the project. However, the need for refinements to the prototype was highlighted with the incorporation of a more differentiated range of vibrations, the definition of a larger physical space of interaction with signs on the floor to allow for more intuitive interaction, as well as the promotion of projects as a way to encourage more people to visit museums, highlighting the social impact and potential of these initiatives in their daily lives.

6. CONCLUSIONS

Assistive computer technologies have proven to be essential for disabled people, especially the blind and partially sighted, giving them greater autonomy and reducing their sense of isolation. For museums to be truly inclusive, they must implement these tools, giving importance to tactile perception and other forms of non-visual interaction. Barriers are not only physical, but also cognitive and sensory. Overcoming them is essential for the collective to have a full cultural experience.

Real inclusion in the cultural sphere, particularly in museums, is an urgent need. A major obstacle is the lack of training of museum staff in the use of these tools. It is essential to invest in this aspect, as well as in the development of technological tools that promote inclusion and democratize access to museum content. In this sense, extended realities (XR) play a crucial role in the creation of much richer and multi-sensory experiences, adapted to our current diverse society. It is vital, on the other hand, that visual impairment is understood, not as a limitation, but as a condition that requires other forms of interaction and artistic participation.

Most blind and partially sighted people perceive the world in a unique way (with individual variations in sensory dominance and cognitive abilities). This greatly influences their artistic perception. It therefore becomes necessary to adopt a holistic and inclusive approach to museum education to ensure that works are accessible, considering this variety of ways in which they process information and the space in which they do so (self-perception).

Virtual reality (VR) technology can improve accessibility for this group in the museum environment. Inclusive visits stand out for the importance they give to sound descriptions, but they still leave aside the kinesthesia of the body with which the blind or visually impaired subject explores and constructs the world. The previous exploratory (non-

https://doi.org/10.34632/jsta.2024.15896

technological) activities in the form of a workshop help to establish a link with the picture, which subsequently facilitates the use of a prototype such as the one presented, which offers them the same information designed in another way, with which they can "see" the picture, constructing mental images by making use of their own imagination.

Among the challenges we find are the improvement of the prototype (vibration range and description support in connivance with the changes of mechanoreceptive information) and the deployment of resources that deepen the knowledge of the physical space of the experience (marks on the floor to establish the limits of the virtual environment itself), as well as more time spent with the tool, in order to achieve a complete aesthetic-formal perception of the works. All of this, making use of bodily kinesthesia, memory, imagination, and the alternative senses that are more acute in the case of blind people: touch and hearing.

In this sense, it is very important to continue with the research and implementation of this type of tools from the perspective of Art History and Digital Humanities. The development of technological projects such as this one, which encourage blind and partially sighted people not only to visit museums, but also to participate in them, should also be promoted. Museums should be committed to real and effective accessibility in their facilities, considering and evaluating the resources available to them in order to improve access and create a democratic and plural socio-cultural environment (something which is still an unresolved issue).

Therefore, although while there has been an increase in research on assistive computing technologies in the last decades, there is still a lack of research on how they enhance the knowledge acquisition process of blind people in alternative interactive and semantic environments that incorporate the kinesthesia of the body as the predominant sense. The *O Grupo do Leão VR* is just the beginning.

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