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Development and Validation of Virtual Reality Scenarios to Improve Disability Awareness among Museum Employees

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Abstract: To improve inclusion of persons with disabilities (PWD), it is important to create suitable physical and social environments. This can be done by improving awareness about disability, specifically for employees working in the service and cultural sectors. Virtual reality (VR) simulation can be advantageous by providing an engaging experience highlighting physical accessibility issues, as well as social interactions with virtual avatars. This study's objective was to validate the content of two disability awareness VR scenarios in museum employees and individuals with disabilities in terms of perceived usefulness. Five PWD and seven museum employees experienced two VR scenarios illustrating a museum visit for a person with low vision or using a wheelchair. The scenarios consisted of different scenes such as finding an accessible entrance and interacting with virtual employees. Participants were interviewed about their experience, with questions related to the realism of the scenarios and their perceived usefulness. Four main themes were identified specifically: emotions, experience, usefulness, and realism. Our scenarios were seen as useful in describing social and physical barriers experienced by PWD. VR can be a valid tool to promote disability awareness among employees in a sociocultural setting, representing a step towards the inclusion of PWD.

Keywords: disability awareness; virtual reality; museum; employee training; visual impairments; motor impairments

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1. Introduction

The social inclusion of individuals with physical and visual impairments holds significant importance globally, considering their substantial population. Contrary to common misconceptions, impairment does not inherently equate to disability if the environment is conducive to their needs [1]. Hence, the creation of physically and socially suitable environments is pivotal for the integration of persons with disabilities (PWD) into society. However, the presence of accessibility barriers often leads to feelings of frustration, anger, resignation, and exclusion among PWD [2]. Two fundamental requirements stand out as essential for achieving inclusive access: necessary infrastructural adjustments and increased public awareness [3]. While infrastructural changes are imperative, it is equally crucial to address societal attitudes and perceptions towards disability. In this context, ableism refers to the discrimination, prejudice, and social exclusion experienced by individuals based on their disability status. It is a form of oppression that privileges able-bodied individuals and devalues and marginalizes people with disabilities. Ableism can manifest in various ways, including physical and architectural barriers, negative attitudes and stereotypes, lack of accessibility and accommodations, unequal opportunities, and systemic barriers that limit the full participation and inclusion of individuals with disabilities in society. Ableism perpetuates inequality and reinforces the notion that disability is a problem or a deficit, rather than recognizing the diversity and value of all individuals, regardless of their

abilities [4,5]. Because of ableism, individuals without disabilities struggle to empathize with the stigmatizing challenges faced by people with disabilities due to environmental inaccessibility [6,7].

There are several programs that aim to simulate barriers and challenges that PWD encounter in educational environments [6,8,9] For example, the utilization of assistive devices like wheelchairs and crutches to simulate mobility disability is widely common in disability simulation programs across numerous educational environments [10,11]. The purpose of mobility disability simulation programs is to address "ableist" attitudes toward people with disabilities, increase awareness and understanding of disabilities, promote social inclusion, reduce stereotypes and discrimination, challenge preexisting stereotypes and behaviors, facilitate negotiations with environmental barriers, promote empathetic understanding of stigmatizing experiences, foster empathy and advocacy for disability rights, and promote a barrier-free and inclusive society [6,8,9,12,13]. Results from these simulations indicate that participants' emotional reactions, such as fear, anger, frustration, and embarrassment, are like those reported by people with disabilities [13–16]. The experience of participants encountering these challenges emphasizes their harmful behaviors toward PWD and encourages them to employ more respectful behavior [9,14,17–19].

However, feelings of pity and sympathy are adverse effects of these programs. The focus on environmental barriers in these programs can reinforce the idea that disabilities are abnormal and minority statuses. This can lead to the belief that difficulties faced by those with disabilities are solely because of their disability. These experiences might make people think that living with a mobility disability is sad and hopeless and that those with such disabilities are always suffering. As a result, participants might avoid interacting with people who have mobility disabilities or avoid addressing accessibility issues [15,20–23].

Among various aspects of life, leisure activities play a significant role in shaping public perceptions and attitudes towards individuals with disabilities. Museums, as cultural hubs, offer spaces for leisure and education, yet they often fall short of accommodating the diverse needs of visitors with disabilities [24]. This problem highlights the need to raise awareness about disability among employees of such social and professional establishments who may encounter PWD, with the aim of improving their social inclusion.

The AQLPH (Association Québécoise pour le Loisir des Personnes Handicapées), a community organization in Québec, Canada, offers employee training to increase awareness of the barriers experienced by PWD and teach appropriate behavior. A key component of their training program involves the trainees experiencing physical barriers by trying wheelchairs or donning vision-limiting glasses in different contexts. This short simulation training is bracketed between briefing and debriefing sessions to avoid amplifying negative stereotypes about disability [6,25]; this is followed by training on inclusive attitudes and behaviors for service employees towards PWD. The simulation training, however, can be time consuming and requires cumbersome equipment. The AQLPH has been looking for an alternative solution to provide it, such as a virtual reality (VR) application.

VR and interactive technologies have emerged as powerful tools for promoting empathy, with immersive virtual experiences designed to evoke perspective-taking and increased understanding of diverse perspectives [26]. VR can offer users immersive and interactive environments that elicit feelings of presence and allow for vivid experiences from alternative perspectives [27]. Unlike traditional media, VR perspective-taking tasks require fewer mental resources, as participants solely focus on acting within the digitally rendered environment, thereby enhancing accuracy and methodological control [28]. Moreover, embodied cognition theory suggests that physical movement within virtual environments can enhance cognitive performance and foster empathy by providing additional spatial information [29].

Several studies have demonstrated the effectiveness of VR perspective-taking, also called 'embodiment', in reducing prejudice and increasing prosocial behaviors towards outgroup members [30–32]. Furthermore, embodying alternative perspectives, such as those of individuals with different characteristics, has been shown to mitigate biases and

increase self–nature overlap, suggesting potential applications in promoting empathy and environmental consciousness [27]. Despite the promising outcomes, existing research on VR perspective-taking is limited by small sample sizes and lack of demographic diversity, being primarily conducted in laboratory settings [33]. Therefore, further empirical evidence is warranted to validate the efficacy of VR perspective-taking in promoting empathy and prosocial behaviors towards diverse populations in real-world contexts.

Our approach to raising awareness by using VR stands out because we go beyond merely exposing users to physical barriers; we also incorporate social interactions through virtual reality (VR). Unlike traditional simulation training, which typically concentrates solely on physical obstacles, our method integrates both physical and social challenges. For instance, users not only encounter inaccessible spaces but also experience how others interact with them due to their perceived disability.

Moreover, our application specifically targets training for museum employees to cultivate appropriate attitudes. By immersing users in VR environments where they encounter various perspectives and attitudes, we aim to enhance their understanding of inclusivity and sensitivity toward visitors with disabilities. This approach allows employees to experience firsthand the impact of different attitudes on individuals with disabilities, fostering empathy and guiding them towards more inclusive behaviors.

Thus, the specific aim of this study was to evaluate the validity of our VR disability awareness scenarios in terms of realism, potential usefulness, and ease of use for PWD and museum employees. This paper aims to explore the potential of VR as a tool to raise public awareness about the challenges faced by individuals with physical and visual impairments. By leveraging VR technology, we seek to bridge the gap between societal perceptions and the lived experiences of PWD, fostering a more inclusive and empathetic society.

2. Materials and Methods

2.1. Development of VR Scenarios

The study commenced with a review of the existing literature focusing on accessibility challenges encountered by individuals with disabilities in museum settings. This literature review provided foundational insights into prevalent barriers and issues faced by people with disabilities during museum visits, encompassing both physical and sensory impediments. Some examples of these hindering factors are haptic unavailability, limited or incomprehensible oral information, too-high reception counters or exhibition objects, use of glass doors (for people with low-vision), and narrow paths or paths in the wrong direction for wheelchair users [34–36]. Following the literature review, semi-structured interviews were conducted with four individuals working within museums in Quebec and actively involved in facilitating access for people with disabilities. These interviews aimed to gather firsthand experiences and perspectives regarding accessibility challenges and potential areas for improvement within museum environments. Interviews were conducted in either English or French, with questions designed to explore participants' observations, experiences, and suggestions for enhancing accessibility.

Data gathered from interviews, combined with insights from the literature review, were analyzed to identify key challenges faced by PWD in museum settings. These challenges ranged from physical obstacles such as inaccessible ramps and high counters to communication barriers and inadequate informational resources. Here are some of the challenges identified during data collection, which were then used in the development of disability awareness scenarios:

1- Barriers experienced by persons with low vision:

- Lack of audio guide
- Lack of haptic access
- Lack of Braille information on elevator buttons
- Limited or incomprehensible oral information
- Presence of glass doors
- Small fonts/low-contrast text

- Limited information offered to visually impaired people
- Lack of lighting control to differentiate places and visibilities
- Lack of appropriate sound/navigation system

2- Barriers experienced by persons with physical impairments:

- Inaccessible elevator push buttons
- Unclearly signposted route
- Too-high reception counter
- Art exhibits placed too high
- No logical arrangement of places
- Presence of steps, staircases, steep slopes, or uneven paths
- Wrong drop-off location for PWD in front of museum

3- Other barriers/challenges:

- Being ignored while speaking to staff
- Unawareness/unavailability of staff
- Inaccurate information provided by staff

Based on the identified challenges, two distinct scenarios were developed for the VR application: one focusing on barriers experienced by wheelchair users and the other addressing issues relevant to individuals with low vision. These scenarios were designed to simulate real-life experiences of PWD navigating museum environments, incorporating elements such as inaccessible pathways, unclear signage, and interactions with museum staff.

The VR scenarios were developed using the Unity 3D game engine specifically tailored for the Oculus Quest 2 head-mounted display (HMD). This HMD was chosen for its portability, standalone functionality, ease of use, and minimal hardware requirements, ensuring accessibility and usability for a diverse range of users.

2.2. Participants

Following the development of VR scenarios, validation was conducted by individuals representing both PWD and professionals experienced in museum accessibility. To be included in the study, PWD needed to be individuals with a motor disability using a wheelchair or individuals with a visual impairment. Museum employees could be included in the study if they had at least 2 years of experience working in accessibility or in the accompaniment of PWD in a museum. All participants provided their informed consent, as approved by the IRB of Université du Québec à Trois-Rivières.

2.3. Task

Participants sat on a chair, donned the HMD, were provided with a single hand controller, and engaged sequentially in each of the two VR experiences. Participants first learned, through a short tutorial, how to navigate inside our VR application and how to interact with the objects/characters. The application was designed to be easy to use: participants could look around each scene and interact with virtual objects and avatars through the use of a virtual pointer, controlled by moving and clicking the hand controller. When a scene was completed, participants were automatically teleported to the next one. Those with a visual impairment were guided through the scenes by a researcher, if needed, and oral descriptions of the scenes were provided.

We developed two VR scenarios. The first one addressed 'potential' barriers, including environmental and social barriers, experienced by people with motor or physical impairments and the other addressed potential experiences by people with low vision. Both scenarios start with a scene inside a taxi where the participant embodies the PWD, on their way to an interesting museum. Inside the taxi, the user has a conversation with a friend about this museum. This conversation serves as a starting point for the challenges (physical or social interaction barriers) that the participant will experience. The conversation, and all other conversations with avatars within the scenarios, took place inside the VR environment.

Some examples of simulated physical barriers were, for motor disability:

- Presence of non-accessible stairs at the main entrance (Figure 1)
- Difficulty in finding the accessible entrance, simulated by requiring the user to find the sign that shows the appropriate direction. This is made more obvious after unsuccessful attempts (Figure 2).
- Automatic doors that open toward the wheelchair, requiring the user to move backward to let the door open
- Reception counter and art pieces installed too high for a wheelchair user to properly see (Figure 3)
- Elevator push buttons not reachable for manual wheelchair users



Figure 1. Staircase at main entrance.



Figure 2. Difficult-to-find access point signs.

The barriers experienced by persons with low-vision disabilities (the participant's vision was reduced in VR by obscuring and blurring the visual output) included:

- Low lighting inside the exhibition room (Figure 4)
- Hard-to-read art descriptions, using low-contrast and small fonts (Figure 5)
- Most artifacts lacking adequate audio description
- Presence of a glass door (Figure 6)
- Lack of brail information on elevator push buttons

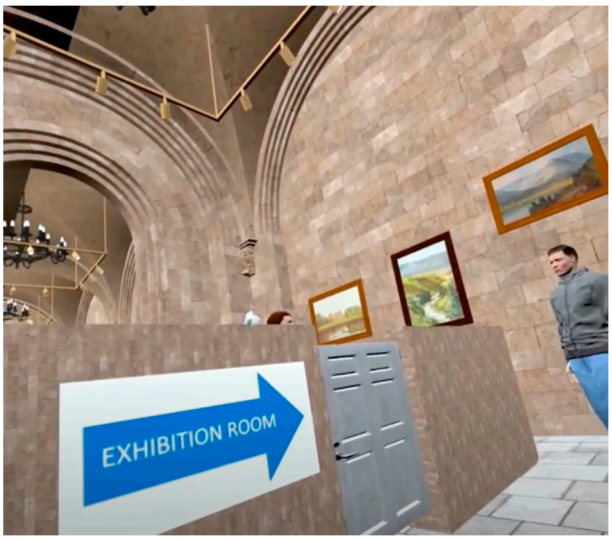


Figure 3. The reception counter is too high.

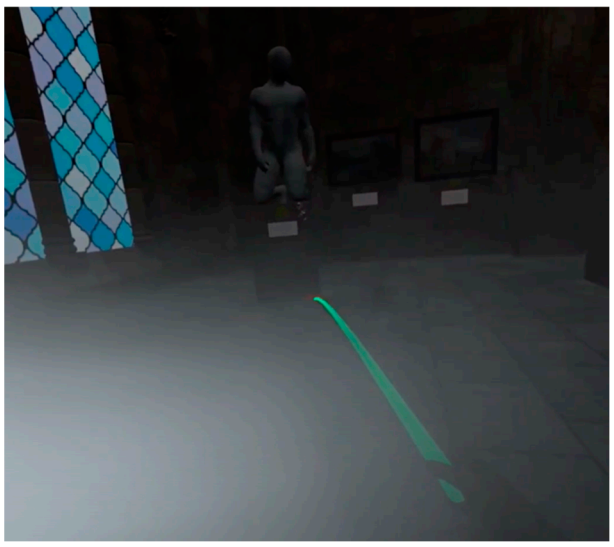


Figure 4. Exhibition room with poor lighting.

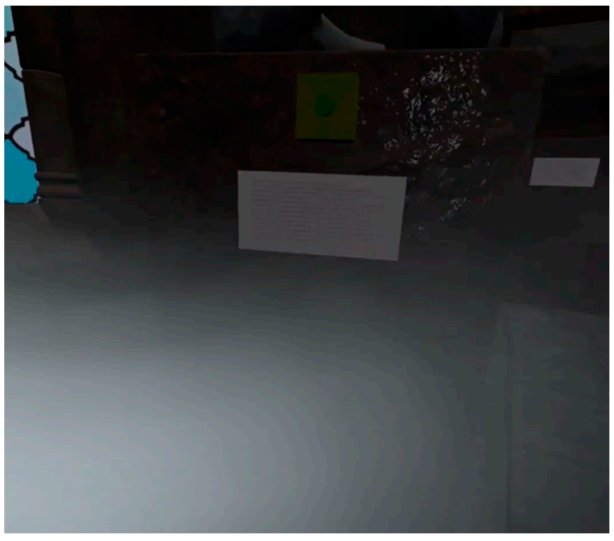


Figure 5. Hard-to-read art descriptions.



Figure 6. Glass door.

Both scenarios also included simulated social interaction barriers such as:

- When the user asks a question to the receptionist, the receptionist addresses the friend instead of directly responding to the user.
- The museum employee uses a very slow cadence and loud voice when talking to the user.
- When the user asks two museum employees about the directions to the elevator, contradictory and confusing answers are provided.

2.4. Interviews

Following the VR experience, semi-structured interviews, lasting between twenty and forty minutes, were conducted with participants in either English or French. One or two researchers were present at the interviews. These interviews explored participants' perceptions of the tool's realism and usefulness and their overall impressions of the VR disability awareness tool. They were conducted with an interview guide with questions such as: "What characteristics in the virtual environment struck you?" and "How realistic do you think the tasks and activities of these scenarios are?" The interview questions were based on the technology acceptance model [37], exploring concepts such as perceived usefulness and ease of use, and on a short feedback questionnaire [38] which explores emotions, presence, and realism in virtual reality tasks. Open-ended questions were used to gather information about the degree of realism, potential usefulness, and overall ease of use of the VR disability awareness tool.

2.5. Data Analysis

Interviews were audio-recorded and then transcribed verbatim. Interview data were analyzed through a constant comparison approach [39]. This is an inductive approach where information (quotes from participants) is assigned to categories. As the analysis progresses through the interview data, the set of categories is constantly adjusted and refined. The analysis was undertaken by two co-authors (PA and USAR). Three interviews were first read and reviewed to get an idea of the common themes and patterns and develop an initial code book or set of categories. Then, the remaining interviews were reviewed by either PA or USAR; new categories or the adjustment of existing categories were discussed between the two researchers. When appropriate, we noted the VR scenario (motor or visual impairment) as well as the scene corresponding to each statement.

2.6. Trustworthiness

We established several processes to ensure trustworthiness and rigor in our data collection and analysis. First, during our interviews, we focused on developing a trusting relationship with the participants by explaining the study's objectives, answering their questions, and explaining how their confidentiality would be maintained [40]. To ensure rigor, the coding and theme classification process was verified by two researchers, who discussed any disagreement until a consensus was reached.

3. Results

3.1. Participants

Five PWD and seven persons with experience in museum accessibility participated in the study. For the PWD, three had motor disabilities and two had visual impairments. The participants with museum experience included one person who worked in a firm specializing in the creation of accessible museum exhibits, as well as six employees from four different museums, in positions such as accessibility expert or employee manager.

3.2. Themes

Four main themes, including 18 subthemes, were identified from the analysis of the interview data (Table 1). The first was 'Emotions', which included both negative (frustration, confusion) and positive (empathy) emotions experienced by participants in the VR scenarios. The second theme was 'Experience', or how the VR scenarios matched the participants' lived or professional experience. The third theme, 'Usefulness', described how the VR scenarios could be used within the scope of teaching appropriate interactions with persons with disabilities and to increase awareness. In the fourth theme, 'Realism', participants explained how the VR scenarios presented a realistic rendition of accessibility/inaccessibility and of interactions with museum employees. In addition, participants made suggestions on how the VR scenarios could be improved or extended.

Table 1. Themes and subthemes identified by thematic analysis.

Themes	Subthemes	Themes	Subthemes
Emotions	Anger Empathy Frustration Hurt Surprise Unwelcomed	Usefulness	Accessibility Awareness Criticism Immersion and presence Learning Teaching skills
Experience	Lived experience Work/professional experience Solutions	Realism	Accessibility/inaccessibility Overall experience Museum environment Social interactions

3.3. Emotions

In the interviews, participants described emotions they experienced while engaged in the VR scenarios. These mostly included negative emotions related to the interactions with the virtual characters in the two scenarios. Most participants described feelings of frustration directed at the virtual characters, which were emphasized in both the visual and motor scenarios. The scene, in both scenarios, where a virtual museum employee directly addresses the friend instead of the participant, was seen as frustrating. In addition, the lack of accessibility was often seen as frustrating, as one museum participant (M06) explained:

> *Also, we see at the beginning in the first scenario with the person in a wheelchair how complicated it is to get into the museum. If I did that, then I felt like I was doing something wrong, because maybe I pressed a button I shouldn't have. But in the end, I realized*

afterwards that yes, I think the script is done on purpose, to show how difficult it is for some people to get into museums when they are not accessible.

Some participants described feeling angry, hurt, or unwelcomed. As one participant with visual impairments explained (P01):

I felt unwelcome. I was like, "What am I doing here, it's not worth being here because I can't enjoy the activity."

Many participants reported feelings of surprise at the reactions of some of the virtual employees or at the lack of accessibility in some of the scenes, such as in the inadequate audio description of the museum exhibit for persons with visual impairments.

Many museum participants experienced feelings of empathy with the VR scenarios. They described how the scenes and interactions made them imagine the challenges experienced by persons with disabilities visiting locations that are not entirely accessible.

3.4. Experience

All participants described how the VR scenes matched their lived experience. PWD could relate to their overall experience with museums and other cultural institutions. For the museum participants, the VR scenes were linked with their work experience.

In terms of lived experiences, PWD explained how they often encounter museums and other locations with poor accessibility such as that depicted in our VR scenarios (obstacles, unclear directions, audio guide for persons with visual impairments not describing the actual art piece. They also describe how the attitudes of the virtual characters matched their own experiences. As one participant with a visual impairment (P05) explained:

People are just kind of afraid. That's the thing. They don't want to engage because they don't understand. And they're afraid, or it's just it's not their job. Like, "what are you doing here alone?" kind of stuff. Like, oh, "you need to bring your own guide" kind of stuff.

Museum participants described how the VR scenarios matched their own experience working towards improving accessibility in museums, or in the training they had received or were providing for the accompaniment of PWD in the cultural sector. One participant (M03) mentioned:

In any case, that's one of the things that needs to be conveyed in training, and that's that you speak directly to people. It's true, you have to speak slowly or very distinctly, particularly for people with sensory impairments. The staff may not know how to address them. And so, a blind person will be spoken to very loudly.

Participants also proposed various solutions based on their own experiences and knowledge about disability awareness and accessibility. In terms of accessibility, solutions included developing a museum itinerary for PWD, creating specific audio descriptions for persons with visual impairments, educating art commissioners in terms of accessibility, and having lower counters for persons working at the museum's reception. In terms of disability awareness, participants proposed educating staff about the needs of PWD and about how to offer help and that the museum could provide a guide. For example, one participant with a motor disability explained (P02):

Often the typical sentence is: "Do you need help?" Before you even do anything there, "do you need help?" And then after that it's: "How can I help you?"

3.5. Usefulness

Almost all participants agreed that the VR scenarios would be useful in teaching disability awareness to museum staff, as well as concepts related to accessibility. Participants discussed how the VR scenarios could serve as a basis to discuss issues related to accessibility, such as how to create more accessible descriptions of the art pieces, create an accessible exhibition, or improve signage. In terms of disability awareness, many agreed

that the VR scenarios would constitute an excellent ice-breaking activity prior to more formal instruction. However, participants also indicated that the VR activity was by itself quite convincing. One museum participant (M06) indicated:

> *Yes, I think so. I think that's relevant. It wasn't too long, it was clear, we understand the points. I thought it was good.*

Participants also thought that the VR activity would be useful when teaching museum employees new skills on attitudes and on how to interact with PWD. As explained by one museum participant (M03):

> *I think it can be a good introduction to something more. This is clearly not enough for education and training. I tend to think it's good to experience it in real life too, but it's still a good tool.*

Many participants appreciated the sense of immersion provided by the HMD, explaining that this contributed to the richness of the experience and that it may please a younger crowd. For example, one museum employee (M03) said:

> *I think it's a technological experience that lets you live . . . that puts yourself in someone else's shoes, and it's relatively effective.*

On the other hand, a few participants had reservations about the VR scenarios. One PWD explained that the scenarios may exaggerate difficulties, which could be counterproductive. Likewise, one museum participant explained that staff that may eventually experience the scenarios could feel confused about what to do or not to do and suggested adding a disclaimer at the beginning.

3.6. Realism

Most participants agreed that the VR scenarios were realistic in terms of how the accessibility issues in the museum environment and the social interactions were portrayed. Participants felt that the overall experience was realistic. Their impressions were of having lived, for a short while, the experience of a person with a visual or a motor disability visiting a museum.

In terms of accessibility, participants acknowledged the realism of the convoluted path required to reach the wheelchair-accessible entrance or to find the elevators inside the museum. They also found the lack of accessibility in the exhibit room to be realistic (placement of art pieces, lighting, audio descriptions). In the words of museum participant (M05):

> *Yeah, I think art is strategically placed at our eye level when we're standing, so in that sense, it's not very accessible.*

Participants, mostly PWD, also commented positively on how the interactions with the virtual employees were portrayed. Many commented on how they have often encountered staff, in museums and elsewhere, that talk loudly or slowly when not needed or do not address them directly. As one participant with a visual impairment explained (P05):

> *Yes, it's really funny, because, since I spent years working with disability organizations. I was seen as the attendant to this person. So, staff were talking to me and not to my boss, my boss was using a wheelchair. Staff should not have been talking with me, they should have been talking with her. And I've seen it again and again and again.*

Some participants also expressed criticism that aspects of the VR scenarios could be improved. For example, one museum participant and one PWD were surprised that the elevator did not have automatic verbal announcements, which has been a norm for quite a while now. One participant with a motor disability thought that the VR activity represented a worst-case scenario that one would not experience in a single museum, but agreed this was a good approach in terms of a disability awareness training tool.

3.7. Suggestions

In terms of suggestions, participants suggested adding an entirely new scenario focusing on the experience of a person with a hearing disability. In terms of the physical environment and accessibility, some participants proposed adding text below the art pieces with a small font that is difficult to read. There were also suggestions of adding a poorly adapted bathroom scene, although other participants also noted that the lack of physical accessibility was already sufficiently conveyed in the scenarios. Some also suggested that the scenario should start with planning of the trip to illustrate possible transportation-related barriers. In terms of social interactions, some participants proposed adding some positive interaction with the virtual employees, such as, for example, having a virtual employee provide correct directions after the participant had gone the wrong way. Others suggested adding a scene where a virtual character provides help without having been asked for it, which is seen as intrusive and unwanted. As one participant with a visual impairment described (P05):

> *And there's the last, but not least, usual suspect: it is people making decisions for me. Just kind of: "no, no let me take you there" like.*

4. Discussion

In this study, PWD and museum employees experienced two VR scenarios in which they embodied a person with a physical or visual impairment visiting a museum, with scenes focusing on social interactions with virtual employees and on accessibility issues. Participants, overall, had positive impressions of the VR scenarios and agreed that these would be useful in the context of a training program for disability awareness for museum employees. They also agreed that the social and physical barriers depicted in the scenarios were realistic and matched their lived experiences in museums and other locations. Participants also described the negative emotions they felt while being confronted with these barriers.

Our research achieved its primary aim, in that our results validated the VR scenarios' perceived usefulness and realism. Thus, it also answered the needs of our community partner, the AQLPH, who intends to use the VR scenarios in their disability awareness training program directed at service employees. In that context, the VR scenarios will be employed as an icebreaker, where participants will receive instructions about the activity and will then try either of the scenarios (motor or visual disability). Participants will be debriefed to discuss their experience, and, following this, they will receive more formal training about accessibility and interactions with PWD.

4.1. Embodiement in VR

Our results also support other research, illustrating how VR can be employed as an immersive tool to facilitate the understanding of viewpoints other than one's own. This could be facilitated by the use of embodiment in VR, where participants experience a sense of ownership of the virtual avatar through a visual representation of the hands or other parts of the body. For example, studies have shown that immersive VR scenarios with embodiment can reduce racial and gender bias [32,41,42]. Other authors indicated that the use of immersive VR using an HMD is better at reducing implicit bias towards PWD than a non-immersive desktop application and that embodiment plays a significant role [43]. In our experiment, participants received visual cues of the avatar's lower extremities (for the motor disabilities scenario) and hands (both scenarios) and therefore experienced embodiment in an immersive VR environment. These characteristics of our VR scenarios (immersion and embodiment) may explain why our participants largely expressed positive impressions about our VR application and its potential in increasing disability awareness in future users. Indeed, some of our participants clearly indicated being in "someone else's shoes" contributed to the experience of the VR scenarios and facilitated their understanding of the needs of PWD.

4.2. Negative Emotions in Disability Simulaions

Various authors have cautioned against the effects of negative emotions in simulation studies, which can exacerbate biases. This has been observed in 'real' disability simulation studies, where participants experience moving in a wheelchair or don glasses that limit their vision. While a meta-analysis showed that such simulation programs do reduce biases and improve conception of social inclusion for PWD at follow-up [25], some authors also indicate that these programs can increase anxiety, confusion, and helplessness postsimulation [13]. Such programs have been critiqued for providing a "bad and sad" experience of disability [44]. Immersive VR simulation scenarios have also been shown to actually increase biases and negative emotions, depending on the context. For example, implicit racial bias increased in a VR simulation depicting aggressive or violent scenarios [45]. Debriefing following the simulation, where participants are allowed time to express their emotions following an unfamiliar experience, is seen as crucial to reduce these possibly negative impacts [25]. In our research, participants understood that the VR scenarios would be used in the context of a complete disability awareness training session and agreed on the importance of providing debriefing time. Some participants expressed concerns about the impact of negative emotions, and one suggested adding clear briefing indications to prepare potential participants for the experience.

4.3. Simulation of Physical and Social Environments in VR

Lastly, our VR scenarios may have differed from real disability simulations on one important point. Indeed, real disability simulations place the focus on the lack of accessibility and on the disability itself. In our VR scenarios, the focus was on the social interactions with the virtual characters, representing museum employees. This is more in line with the use of a social model of disability, which some have advocated for in the use of simulation for disability awareness [6]. It remains to be seen, however, if focusing on the social rather than on the physical environment can improve disability awareness while avoiding negative emotions about disability.

4.4. Limitations

One of the limitations in this study is that we did not include participants who were recent museum employees. Our sample only included museum employees with experience in accessibility and in service to PWD. Including more junior employees, to whom the disability awareness training program will be offered, may have afforded a different perspective. For data analysis, no specific methodological paradigm was determined a priori. However, several processes were used to ensure the qualitative data collection and analysis were robust, transparent, and trustworthy, such as developing a trusting relationship between the interviewer and interviewees and obtaining a consensus between two researchers for coding and theme classification. Another limitation is that, although participants in our study understood that the VR scenarios would be included in a more complete disability awareness training program, they did not have access to the content of that program. This could have affected their opinions on the perceived usefulness of the VR scenarios

5. Conclusions

We answered the needs of our community partner, the AQLPH, and developed immersive VR scenarios that simulate physical and social interactions of PWD when visiting a museum. These scenarios were seen as potentially useful in the context of disability awareness training for museum employees. Embodiment and immersion, provided by our VR application, could contribute to helping participants adopt a different point of view when considering social and physical barriers experienced by PWD, engaging a reflection on their attitudes. More research is required to evaluate the effectiveness of a disability awareness training program that would include our VR scenarios; this could, for example,

include assessments or questionnaires to measure changes in disability awareness after training that includes the VR scenarios.

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Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Data from this study is unavailable due to privacy restrictions.

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