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Research Paper

Inclusive Co-Creation: Rethinking Museum Experiences using technologies for Sensory-Impaired Visitors

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ABSTRACT

The visitor experience is increasingly enhanced by museums, which align with co-creation theory. However, people with sensory impairments, such as vision or hearing loss, often face barriers that restrict their access to and enjoyment of museums. This study investigates how people with sensory impairments (PwSI) experience museums, focusing on the key factors that influence their engagement and ability to co-create within museum environments. It aims to identify how physical, communicational, attitudinal, and technological elements affect accessibility and visitor satisfaction. By exploring these dimensions, the research seeks to provide a deeper understanding of how museums can foster inclusive, interactive, and value-driven experiences for PwSI through co-creation strategies. The survey included PwSI who had visited museums in the past three years. Respondents in Portugal and abroad (N = 254) received the questionnaires both in-person in Portugal and online. Analyses of linear regression revealed that different dimensions of PwSI's co-creation in museums are significantly influenced by visitor-specific constraints and museum-specific factors.

Strategic recommendations for museum managers are provided to foster more inclusive and value-added visitor experiences.

Keywords: People with sensory impairments, Visitor's experience, Museums; Co-creation; Experiences

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1. INTRODUCTION

Museums are evolving from traditional repositories of artifacts to dynamic spaces that actively engage visitors through immersive, interactive, and inclusive experiences. As centres for education, culture, and community, museums have embraced co-creation as a powerful strategy to foster deeper connections with diverse audiences. Co-creation allows visitors to become active participants in shaping the museum experience, enhancing their emotional and intellectual engagement while democratizing access to cultural knowledge. However, while these advancements have significantly enhanced the visitor experience for many, barriers persist for PwSI, including those with visual or hearing disabilities.

For PwSI, museums often remain challenging environments where accessibility is limited, and opportunities for meaningful engagement are constrained. Despite growing recognition of inclusivity as a cornerstone of contemporary museum practices, comprehensive research on the antecedents of co-creation for this group is sparse. Addressing this gap is essential to foster equitable access and enrich the visitors' experiences.

This study explores the factors that influence the co-creation experience for PwSI in museums from the museum point of view, drawing on data collected from 254 PwSI respondents in Portugal and abroad. Linear regression was used to identify the relationship between co-creation factors (e.g., accessibility, engagement, and technology use) and PwSI museum satisfaction. This method was chosen because it allows for predicting how different factors impact visitor experience while controlling for demographic variables. This kind of regression is a statistical technique that can be used to analyse the influence of several independent variables on a single dependent variable. The aim is to use the independent variables whose values are known to predict the single dependent variable selected by the researcher. The weight of each independent variable estimated by the regression analysis, denotes the relative contribution of the independent variable to the overall prediction and facilitates the interpretation regarding the influence of each variable in making the prediction.

The findings contribute to the broader discourse on museum inclusivity by offering strategic recommendations for museum managers to design spaces and programs that foster co-creation and deliver value-added experiences for PwSI.

An important gap persists on how experience in museums and, more importantly, museum-related factors—including physical, communicational, and attitudinal environments—specifically influence the co-creation experiences of PwSI in museums. Bridging this gap is essential for developing targeted strategies that enhance the inclusivity and overall value of museum experiences for PwSI.

Recognizing the potential of co-creation to enhance museum experiences and the constraints PwSI face in this process, this paper aims to extend the co-creation theory to the analysis of PwSI experiences in museums, by highlighting the interplay of sensory, emotional, and social dimensions in visitor engagement,

Considering the aspects previously mentioned, the definition of the research questions had to comply with the main elements of the present research: the "experience" factor related to the sensory impaired visitor and the approaches museums could establish to improve their visiting experiences and overall sensations. Within this scope, this study addresses two key research questions: (i) How can museums enhance the sensory impairment visitor experience in museums? and (ii) What can museums use as strategies to impact positively the visit experience for PwSI?

The main theoretical contributions thus are: (i) to provide actionable insights for enhancing accessibility and inclusion in museums. (ii) to give voice to PwSI by identifying the most impactful strategies in this scope. Regarding managerial contributions, this paper provides inclusion in museums, enriching PwSI experience and satisfaction studying co-creation in museums

The paper includes a literature review on visitors' experiences in museums, cocreation of experiences and PwSI methodology description, results analysis and discussion, and concludes with the main contributions, limitations and suggestions for future research.

2. LITERATURE REVIEW

2.1 The visitors' Experiences in Museums

Museums have long been institutions dedicated to preserving and showcasing collections that reflect the diversity of human history, culture, science, and art. As centres of knowledge, they serve as crucial spaces for education and engagement. However, in

recent years, the role of museums has evolved beyond merely displaying artifacts to creating interactive, immersive experiences for visitors. Today's museums are dynamic spaces that foster exploration, learning, and personal connections with their exhibits.

The organization, structuring and delivery of experiences in museums has become an increasingly vital aspect of modern cultural engagement, which has also been sustained by a considerable body of research studies (Nigatu et al, 2024; Yi et al, 2022; Preko et al, 2020; Hsu & Liang, 2020; Furferi et al, 2024). This reality plays a major role within the scope of Museums' experiences, which constitute a key element of art museum operations and management (Yi et al, 2022). These experiences invite visitors to actively contribute to the creation of exhibits, programs, and even the museum's overall direction, fostering a deeper sense of connection, ownership, and understanding of the content.

Several studies posit the importance of considering the different dimensions of experiences in museums, highlighting how the integration of technology, visitor engagement, and exhibition design contribute to create memorable and transformative visits (Lu et al, 2023; King & Lin, 2024; Chernbumroong et al, 2024). Museums now seek to engage visitors emotionally and intellectually, creating spaces that allow for deeper connections with exhibits, encourage personal reflection, and stimulate critical thinking. According to Nigatu et al (2024), the main research trends that have been identified in recent studies are connected with sustainability, mixed reality, social media, accessibility, emotion, co-creation, interpretation, exhibition, and museum visitors' experience and engagement. The authors also state that in these key areas several dimensions should be highlighted, namely the physical aspects, the sensory experiences, the restorative moments, the introspective experiences and the hedonic sensations. In this specific context, the study also stresses the crucial relevance of emotional experiences, which 'involve nostalgia, surprise, and joy', while relational experiences 'stem from social interactions and a sense of belonging' (Nigatu et al, 2024, p. 5496).

Erdogan and Enginkaya (2023) study is in line with the previous definition of experience categories, but the authors enhance the significance of behavioural responses, namely satisfaction, positive word of mouth and revisit intention. The same research also highlights the 'crucial role of the museum environment in determining visitor experience' (Erdogan & Enginkaya, 2023, p. 708). Yi et al (2022) research was also focused on these aspects, but the authors have attempted to produce a different approach, by narrowing the set of contexts to three: physical, personal and social. In the first case, we have to consider

the environment, exhibitions, artwork labels, and guide media. As far as the personal context is concerned, issues like visiting motivation, prior knowledge, and personal interest or choice are the most relevant. Finally, the social context usually includes interactions with friends, other visitors or even art museum officials (Yi et al, 2022).

The main scope of Li (2024) study is centred in the vital importance of assessing the visitors' sense of experience, by measuring their pre-visit and on-site experiences. In this context, the role played by the visitors' expectations is paramount. Following this line of thought, five types of visitor expectations were identified: 'relaxation and enjoyment, cultural entertainment, personal identity, historical reminiscence, and escapism from reality (Li, 2024, p. 29).

One of the most significant shifts in the museum experience has been the integration of technology. Early museum visits were characterized by static displays and solitary observation. Today, museums leverage digital tools, virtual reality (VR), augmented reality (AR), interactive screens, and gamified exhibits to enhance engagement (Yolthasart et al, 2024). These technological innovations enable visitors to interact with artifacts in ways that were previously impossible. For instance, VR and AR technologies allow visitors to step into reconstructed historical environments or examine artifacts at a microscopic level. In this particular context, virtual reality enhances the quality of museum exhibitions by integrating innovative storytelling techniques and immersive interactions that combine experiential learning with creative entertainment and a variety of other experiences (Yolthasart et al, 2024).

Such immersive technologies create experiences that transcend traditional viewing, giving visitors a sense of agency and participation. Lu et al (2023) stated that the use of technology in museums 'has shifted from basic computer displays to innovative smart technology' (Lu et al, 2023, p. 151). This research is mainly focused on the critical role of technology in improving the visitors' experience, the importance of creating memorable recollections and the high level of acceptance of younger generations towards the use of technological devices.

The interactive nature of these technologies not only deepens visitors' understanding of the artifacts but also enhances their emotional connection to the material (Kung, 2024). For example, museums such as the Smithsonian National Museum of Natural History and the Louvre in Paris have integrated interactive displays that bring objects to life, transforming what could be a passive activity into an active and engaging experience.

The shift from passive observation to active engagement in museums is essential in creating meaningful experiences. In the past, visitors typically had limited opportunities to engage beyond looking at the exhibits and reading descriptions. Today, however, many museums provide opportunities for visitors to interact directly with exhibits. These interactive features, which may include touch screens, tactile displays, and participatory installations, encourage visitors to explore and learn at their own pace (Hsu & Liang, 2020). In art museums, interactive installations invite visitors to contribute their thoughts, feelings, or even create their own artwork, making the museum experience more personal and participatory.

The role of museums has expanded to facilitate a two-way exchange between the visitor and the content. Curators and educators often focus on creating exhibits that encourage personal interpretation, making the experience more relevant to diverse audiences (Preko et al, 2020). For instance, visitor feedback may be incorporated into evolving exhibits, allowing museums to reflect on the impact of their displays and improve future exhibitions.

Museums are also increasingly emphasizing inclusivity, ensuring that experiences are accessible to people with a wide range of abilities. This involves designing exhibits that accommodate people with visual, auditory, and cognitive disabilities. Sensory experiences such as soundscapes, tactile displays, and interactive touchpoints are essential in making exhibits more accessible to all. According to Yi et al (2024, p. 45), modern museums 'have created several cutting-edge techniques to promote wealth and well-being as a result of the growth of digital technology, to help people feel less alone, relieve pain, elevate their moods, and improve their memories'. The use of multisensory engagement in museums allows visitors to connect with exhibits on different levels, beyond just visual observation. By appealing to multiple senses, museums enhance accessibility and provide a richer, more immersive experience for all visitors, regardless of their physical abilities (Dong, 2024).

Another key aspect of the modern museum experience is the use of thematic and immersive exhibits. Rather than presenting artifacts in isolation, many museums create exhibits that tell compelling stories, taking visitors on a narrative journey through time and space (Lu et al, 2023). This shift enhances the emotional impact of the exhibits and provides a more holistic understanding of the artifacts within their cultural and historical

contexts. Such thematic, immersive experiences foster empathy and understanding, leaving a lasting impression on visitors.

The design and architecture of museum spaces are equally important in shaping the visitor experience (King & Ling, 2024; Medakovic et al, 2024). The layout of exhibits, the lighting, and even the space between artifacts can significantly impact how visitors engage with the collection. Modern museums are increasingly designed with open, flexible spaces that encourage exploration and interaction. Natural light, engaging spatial arrangements, and thoughtful circulation paths help create an atmosphere that is conducive to discovery (Dong, 2024). Some design and architectural solutions serve not only as practical approaches to exhibition but also as aesthetic expressions of the museum's collections and displays. Medakovic et al (2024) posit the critical role of spatial organization in optimizing functional arrangements and enriching the visitor experience.

2.2 Cocreation Experiences in Museums

Another major shift that can be identified within the scope of Museum engagement strategies is related to the concept of cocreation, an approach that has emerged as a dynamic drive in the world of museums. Cocreation in museums refers to the active involvement of visitors in the process of creating, shaping, and interpreting museum content (Yang et al, 2023). Unlike traditional models where museums control the creation and presentation of exhibitions, cocreation invites collaboration between museum professionals (curators, educators, artists) and diverse audiences. This collaborative effort can take many forms, including participatory workshops, crowdsourced content, community-led exhibitions, and the co-designing of educational programs (Sawczuk, 2021).

The central premise of cocreation is that visitors are not just passive recipients of knowledge but are active participants in the cultural dialogue. By engaging with the museum in a creative, collaborative manner, visitors contribute to shaping the museum's narrative and bring their unique perspectives into the museum experience (Yang et al, 2023).

One of the most compelling reasons for implementing cocreation in museums is its potential to democratize knowledge and make the museum space more inclusive. Traditionally, museum content has been designed by experts and presented as authoritative, often excluding the perspectives of underrepresented or marginalized communities (Yang et al, 2023). Cocreation disrupts this top-down model by allowing

diverse voices to contribute to the creation and interpretation of museum exhibits. As stated by Yang et al (2024), there should be a clear emphasis in the creation of experience value. For example, community-led exhibitions that draw on the experiences and histories of local groups allow museums to reflect a more holistic and diverse range of narratives. This approach ensures that the stories of historically marginalized communities – such as indigenous peoples, immigrants, and minority groups – are not only acknowledged but celebrated. Moreover, it provides visitors with the opportunity to see their own identities and cultures represented in the museum space, fostering a sense of belonging and recognition (Medakovic et al, 2024).

Cocreation experiences are inherently interactive, transforming the museum from a passive environment into an active, participatory space. When visitors are given the opportunity to contribute to an exhibit or program, they engage with the material in a much more personal and meaningful way. Rather than simply observing the artifacts or reading the labels, visitors become part of the creative process, which deepens their connection to the content (Liu & Sutunyarak, 2024).

This active participation enhances learning outcomes by fostering critical thinking, problem-solving, and creativity. When people are involved in cocreating museum content, they are more likely to think critically about the topics at hand, challenge existing narratives, and form their own interpretations (Chernbumroong et al, 2024). This process of personal engagement leads to higher levels of knowledge retention and a more profound emotional connection to the subject matter.

Cocreation also plays a significant role in building communities within and around museums. Collaborative projects, such as workshops or co-designed exhibits, encourage individuals to work together, share ideas, and build relationships (Hsu & Liang, 2020). These projects create networks of people who share common interests and develop a sense of collective ownership over the museum experience.

By involving visitors in cocreation, museums not only create a more engaging experience for those who participate but also develop a broader sense of community. Visitors who feel a sense of ownership and belonging are more likely to return to the museum, recommend it to others, and become ambassadors for the institution within their communities (Sawczuk, 2021).

In the digital age, cocreation has expanded beyond physical spaces, enabling museums to tap into the potential of virtual and augmented reality, crowdsourced digital platforms,

and online communities (Kung & Lin, 2024). This digital cocreation allows for greater accessibility and global participation, extending the museum experience to people who might not have access to the institution in person.

Online platforms such as digital galleries, virtual exhibits, and interactive websites enable users to contribute their own content, ideas, and perspectives from anywhere in the world. The integration of technology also allows museums to experiment with new forms of storytelling and immersive experiences, creating more dynamic and flexible ways for audiences to engage with the museum's content (Lu et al, 2023).

Cocreation provides museums with the opportunity to stay relevant in an ever-changing cultural and technological landscape. By involving visitors in the process of creating exhibits, museums can ensure that their offerings are responsive to the needs and interests of their audiences (Nigatu et al, 2024). This process often leads to more innovative and experimental exhibits, as the input of diverse participants brings fresh perspectives and creative ideas. As stated by Furferi et al (2024), the key to museums' resilience and growth lies in their ability to invest in innovation, which, when combined with creativity, can provide visitors with a compelling experience.

Cocreation experiences in museums represent a transformative shift in the way institutions engage with their audiences. By involving visitors in the creation and interpretation of exhibits and programs, museums foster deeper engagement, promote inclusivity, and encourage lifelong learning (Erdogan & Enginkaya, 2023; Li, 2024). As museums continue to innovate and adapt to new technologies and societal needs, their role as cultural and educational institutions will remain crucial in shaping the way we understand and experience the world around us. Ultimately, cocreation not only enhances the museum experience but also helps to reshape the museum as a space of shared creativity, collective knowledge, and cultural exchange (Medakovic et al, 2024).

2.4 Visitor Typologies according to the level of technology used

In order to develop tailored and inclusive strategies, it is essential to recognise the heterogeneity among museum visitors. Recent research has emphasised the value of visitor segmentation based on behavioural patterns, motivations, and technological interaction (Lu et al., 2023; Erdogan & Enginkaya, 2023). Yi et al. (2022) propose categorising the museum experience into physical, personal, and social contexts, each shaped by individual needs and expectations. Furthermore, studies by Yolthasart et al. (2024) and Liu & Sutunyarak (2024) highlight how technology adoption varies among

visitors depending on age, accessibility needs, and familiarity with digital tools. The use of personas—fictional profiles that represent key user types—has emerged in user experience (UX) design and museum studies as an effective method to humanise data and guide inclusive design (Dong, 2024; Medakovic et al., 2024).

Several studies posit the importance of carefully designing the profile of visitors, namely, to identify their motivations and anticipate their willingness to visit a particular museum (Gürel & Nielsen, 2019). The knowledge obtained regarding their preferences and tastes would be a relevant tool to use according to each specific museum reality.

This topic is closely related to the way museums should organize their collections and use technology to enhance and improve the visitor's experience. The establishment of personas that could represent a wide variety of visitors, would be a positive and meaningful contribution to explore new museum service experiences in consonance with the characteristics and variables of each persona (Lui & Zaffwan, 2018).

3. METHODOLOGY

3.1 Data Collection

The methodology of this study involved a quantitative approach to investigate the co-creation experiences of museum visitors, particularly focusing on individuals with sensory impairments. Data were collected through a structured survey targeting people with sensory impairments (PwSI). The sample included 254 respondents from Portugal and other countries, with the survey distributed both online and in-person in Portugal to ensure broad accessibility and participation. The survey was administrated in Portuguese and translated in three languages, English, French and Spanish, by native speakers. A pretest was conducted among people with sensory impairments and, after considering this feedback, the questionnaire was changed according to the comments.

In the data collection process, the questionnaires were conducted in 2020.

3.2 Survey Design

In this study, a selected section of a broader research project was utilised to assess various dimensions of co-creation in museums, grounded in established theoretical frameworks (Sawczuk, 2021; Yang et al, 2023). The portion of the original survey employed focused on collecting both demographic data and patterns of engagement with technology during museum visits. The main sections included: (i) socio-demographic profile such as country of residence, gender, age, education level and situation regarding work, type of

impairment (visual or hearing impairment (ii) museum visiting habits and (iii) co-creation with technologies such as engagement with various technological tools during museum visits. Participants responded to a set of statements measuring their interaction with digital and interactive tools within museums, such as: (i) using electronic devices to obtain information; (ii) engaging with entertainment devices (e.g., games) (iii) using interactive equipment and panels (iv) performing online museum-related activities (e.g., research, games) (v) using audio guides, mobile applications, social media and (vi) experiencing augmented or virtual reality

Respondents rated their experiences on a 5-point Likert-type scale ranging from (1) to (5) with higher scores reflecting greater engagement or co-creation activities in each dimension.

3.3 Data analysis

In the data analysis methodology, we initially characterize the sample using descriptive statistics. To analyse the visiting habits and technology usage patterns among people with sensory impairments, the same statistical technique was employed. The data collected from the structured questionnaire were processed using SPSS (version 21), and measures of central tendency (mean) and dispersion (standard deviation and standard error) were calculated to summarise participants' responses across key variables. The number of museum visits was analysed to determine the average frequency and variability of visit behaviour within the sample. Additionally, a 5-points Likert-scale was employed, ranging from (1) "totally disagree" to (5) "completely agree". The aim was to examine the degree of engagement of various technological tools and digital resources in museums. These included items on the use of electronic devices for obtaining information, entertainment devices, interactive equipment, audio guides, digital applications, social media, and virtual or augmented reality. The results were reported in mean values and standard deviations to identify the most and least used technologies, providing insights into user preferences and potential accessibility barriers. This approach enabled the identification of trends in digital engagement, offering a foundation for targeted recommendations on inclusive museum practices. Next, we examined the differences in technology used in museums on having or not a hearing or visual impairments

To further explore how visitors with different types of sensory impairments engage with technology in museums, chi-square tests were conducted. These tests compared the frequency of use for selected digital tools—audio guides, interactive equipment, and

augmented/virtual reality—between visitors with hearing impairments and those with visual impairments.

4. RESULTS

The analysis of the collected data revealed relevant information about the profile of the participants and the use of electronic devices in museums (Table 1). The sample consisted of 256 individuals, with ages ranging from 17 to 88 years (Mean = 48.16; SD = 14.611). Regarding nationality, 28.5% of the participants were international, while 71.5% were national residents.

Regarding gender distribution, 63.3% of the participants identified as female, while 36.7% identified as male.

In terms of educational background, 57.8% of the participants reported having a higher education degree, whereas 41.8% had secondary education or below. Additionally, 0.4% of the respondents did not provide information regarding their education level.

Regarding occupational status, 40.2% of the participants declared themselves inactive in the labour market, while 59.8% were employed. This distribution indicates a majority of economically active individuals within the analysed sample.

With regard to the presence of hearing impairment, 38.3% of the participants reported having this condition, while 61.7% stated that they did not have any hearing limitations. As for visual impairment, 57.8% of the respondents reported having some visual difficulties, whereas 42.2% indicated that they did not have this condition.

These results provide valuable insights as the predominance of individuals with visual impairments underscores the need for inclusive measures tailored to this group, while the significant presence of economically active individuals suggests a strong potential for engagement with innovative technological solutions within the museum environment.

Table 1. Sociodemographic profile

Variable	Percentage	Frequency n=
Gender		
Female	63,3%	162
Male	36,7%	94
Age	48,16	
Schooling (complete)		
With grade	57,8%	146
Without grade	41,8%	107
Work Conditions		

Active	59,8%	153
Non- active	40,2%	103
Nacionality		
Portuguese	71,5%	183
Other	28,5%	73
Impairment		
Visual Impairment	61,7%	148
Auditory Impairment	38,3%	98

The study analyzed the visiting habits of people with sensory impairments in a sample of 254 individuals, resulting in an average of 6.366 visits. However, the high variability in the data is evident from the standard error of 15.210, suggesting a significant dispersion in visiting habits among participants. This high standard error may indicate that some individuals make frequent visits, while others make few, leading to a possibly skewed distribution.

The analysis of the collected data highlights the varying levels of engagement with different electronic and interactive technologies in museums (Table 2). The most frequently used technology was electronic devices for obtaining information (M = 3.39, SD = 1.393), indicating that visitors actively seek information through digital means. Interactive equipment (M = 3.16, SD = 1.453) and museum-provided electronic devices (M = 2.95, SD = 1.691) were also widely used, suggesting that visitors appreciate hands-on, interactive experiences within the museum setting. Interactive

Table 2. Average levels of technology use among individuals with sensory impairments

Measure	**Mean Devition**	**Standard**
Electronic devices for obtaining information	3.39	1.393
Electronic devices for entertainment (e.g., gaming devices)	2.46	1.546
Interactive equipment	3.16	1.453
Used electronic devices (e.g., computers) available in the museum	2.95	1.691
Performed online activities related to the museum (e.g., research, games)	2.24	1.570
Used interactive panels	2.80	1.581
Used audio guides	2.28	1.722
Used mobile/digital applications	1.85	1.348
Used social media	1.77	1.266

Following the initial analysis conducted across the entire sample (Table 2), which provided an overview of the average levels of technology use among individuals with sensory impairments, a more detailed examination was undertaken by segmenting the data according to the type of impairment—visual or hearing (Table 3). This progression

in the analysis aimed to better understand how different groups engage with and experience technological resources within museum settings. By disaggregating the data, distinct usage patterns emerged, such as a higher reliance on audio guides among visually impaired visitors and a notable preference for interactive equipment among those with hearing impairments. This comparative approach offers valuable insights for the development of more targeted and inclusive strategies tailored to the specific needs of each group.

VISITORS WITHOUT AND WITH HEARING IMPAIRMENTS										
	TDIS		DIS		INDIF		AGRE		TAGRE	
	Without Hearing Impairments	With Hearing Impairments	Without Hearing Impairments	With Hearing Impairments	Without Hearing Impairments	With Hearing Impairments	Without Hearing Impairments	With Hearing Impairments	Without Hearing Impairments	With Hearing Impairments
I used eletronic devices to get more information	19,6%	10,2%	10,1%	8,2%	22,8%	18,4%	15,8%	42,9%	31,6%	20,4%
I used eletronic devices for entertainment (e.g., eletronic devices with games)	43,7%	40,8%	15,8%	16,3%	10,8%	13,3%	8,2%	19,4%	21,5%	10,2%
I used interactive equipment	23,4%	17,3%	15,8%	7,1%	19,0%	17,3%	13,9%	43,9%	27,8%	14,3%
I used computers available in the museum	46,8%	23,5%	3,2%	4,1%	13,3%	12,2%	9,5%	30,6%	27,2%	29,6%
I carried out online activities related to the museum	51,9%	59,2%	7,6%	10,2%	12,7%	11,2%	6,3%	9,2%	21,5%	10,2%
I used interactive panels available in the museum	41,1%	24,5%	15,2%	6,1%	10,1%	18,4%	8,9%	36,7%	24,7%	14,3%
I used audioguides	47,5%	82,7%	3,2%	4,1%	6,3%	3,1%	9,5%	4,1%	33,5%	6,1%
I used mobile/digital applications	65,2%	66,4%	6,3%	7,0%	11,4%	10,2%	8,2%	8,2%	8,9%	8,2%
I used social media	66,5%	67,6%	6,3%	6,6%	15,8%	13,7%	4,4%	5,1%	7,0%	7,0%
I used virtual and augmented reality	79,7%	82,8%	3,2%	3,5%	5,7%	4,3%	5,7%	3,9%	5,7%	5,5%

VISITORS WITHOUT AND WITH HEARING IMPAIRMENTS										
	TDIS		DIS		INDIF		AGRE		TAGRE	
	Without Visual Impairments	With Visual Impairments	Without Visual Impairments	With Visual Impairments	Without Visual Impairments	With Visual Impairments	Without Visual Impairments	With Visual Impairments	Without Visual Impairments	With Visual Impairments
I used eletronic devices to get more information	12,0%	18,9%	8,3%	10,1%	18,5%	23,0%	40,7%	15,5%	20,4%	32,4%
I used eletronic devices for entertainment (e.g., eletronic devices with games)	41,7%	43,2%	16,7%	15,5%	13,0%	10,8%	18,5%	8,1%	10,2%	22,3%
I used interactive equipment	20,4%	21,1%	8,3%	12,5%	18,5%	18,4%	38,9%	25,4%	13,9%	22,7%
I used computers available in the museum	45,9%	37,9%	3,4%	3,5%	14,9%	12,9%	9,5%	17,6%	26,4%	28,1%
I carried out online activities related to the museum	59,3%	51,4%	9,3%	8,1%	11,1%	12,8%	8,3%	6,8%	12,0%	20,9%
I used interactive panels available in the museum	25,9%	41,2%	5,6%	16,2%	18,5%	9,5%	32,4%	10,1%	17,6%	23,0%
I used audioguides	81,5%	45,9%	3,7%	3,4%	2,8%	6,8%	4,6%	9,5%	7,4%	34,5%
I used mobile/digital applications	68,5%	64,9%	8,3%	6,1%	7,4%	12,2%	8,3%	8,1%	7,4%	8,8%
I used social media	69,4%	66,2%	6,5%	6,8%	10,2%	16,2%	6,5%	4,1%	7,4%	6,8%
I used virtual and augmented reality	88,%	79,1%	4,6%	2,7%	1,9%	6,1%	0,9%	6,1%	4,6%	6,1%

Note: TDIS= Totally disagree | DIS = Disagree | NAGREEDISAGREE= Neither agree or disagree | AGRE= Agree |TAGREE=Totally agree

Visitors without hearing impairments were more likely to use electronic devices for obtaining information (31.6%) compared to those with hearing impairments (20.4%). Entertainment devices, such as gaming devices, were used similarly by both groups, with a slightly higher percentage among those without impairments (21.5%) compared to those with impairments (10.2%). Interactive equipment was more frequently used by hearing-impaired visitors (43.9%) than by those without impairments (27.8%), suggesting that they may rely more on visual interactivity. Computers available in museums were used at almost the same rate by both groups, although those with impairments (29.6%) reported slightly higher usage than those without (27.2%). Online activities related to museums were more popular among those without hearing impairments (21.5%), suggesting potential accessibility barriers for the hearing-impaired group. Audio guides were significantly more used by hearing-impaired visitors (82.7%), likely because they rely on alternative assistive audio solutions. Augmented and virtual reality (VR/AR) was the least used technology, particularly among hearing-impaired visitors (5.5%), indicating accessibility limitations or lack of awareness.

Regarding visual impairment, visitors with visual impairments were more likely to use electronic devices for obtaining information (32.4%) compared to those without impairments (20.4%). Entertainment devices, such as gaming, had similar levels of usage, with slightly more use among those without impairments (10.2%) than those with impairments (22.3%). Interactive equipment was preferred more by visually impaired visitors (22.7%), suggesting a reliance on haptic or touch-based experiences. The use of computers was nearly equal between the groups, indicating digital accessibility in this area. Interactive panels were used more frequently by visually impaired visitors (23.0%) than by those without impairments (17.6%). Audio guides were highly used by visually impaired visitors (34.5%), reinforcing their importance in accessibility solutions. However, VR/AR was the least used technology across all groups, particularly among those with visual impairments (6.1%), highlighting potential usability issues.

These findings suggest that visitors with hearing impairments benefit more from visual and interactive experiences, such as interactive equipment and audio guides, while visitors with visual impairments engage more with audio-based tools like audio guides but may still struggle with VR/AR accessibility. Entertainment devices, such as gaming systems, had low adoption across all

groups, suggesting that museums might focus more on educational and interactive technologies. VR/AR is significantly underused, pointing to a need for improved accessibility or visitor education on its availability. To enhance inclusivity, museums should focus on improving digital and interactive resources, expanding audioguide options for both visually and hearing-impaired visitors, and increasing awareness and training on accessible technology solutions for their staff.

Building on the segmented descriptive analysis presented in Table 3, chi-square tests were subsequently conducted to examine whether the differences observed in technology usage between visitors with hearing and visual impairments were statistically significant. This inferential analysis aimed to determine whether specific technologies—such as audio guides, augmented/virtual reality, and interactive equipment—were used differently depending on the type of sensory impairment.

The results of these tests, summarised in Table 4, provide robust evidence of group-specific engagement patterns and highlight the importance of tailoring museum technologies to meet the distinct needs of diverse visitor profiles.

Table 4. Chi-Square Test Results Summary

Technology	PwHI	p-value	PwVI	p-value
Audio Guides	Yes (less use)	< 0.001	Yes (more use)	< 0.001
VR/AR	No	0.067	Yes (more use)	0.021
Interactive Equipment	Yes (more use)	0.022	No	0.200

Concerning audio guides, there was a statistically significant difference in their use by individuals with hearing impairments ($\chi^2 = 32.85$, $p < 0.001$), confirming that these visitors were significantly less likely to use audio guides compared to those without hearing impairments. This result aligns with expectations, as audio-based resources can pose clear barriers for hearing-impaired individuals unless accompanied by captions or transcripts.

A similarly strong but opposite pattern was found for visually impaired individuals ($\chi^2 = 33.50$, $p < 0.001$), who were significantly more likely to use audio guides. This confirms the value of audio guides as essential accessibility tools for those with visual limitations, facilitating independent navigation and learning in the museum space.

Regarding the use of VR/AR, no significant difference was observed between hearing-impaired and non-hearing-impaired visitors ($p = 0.067$), suggesting that VR/AR usage does not vary meaningfully in this context. This may indicate either limited availability or general underuse of VR/AR technologies across the board, rather than specific accessibility issues related to hearing.

In contrast, a statistically significant difference was found among visually impaired visitors ($p = 0.021$), who were more likely to use VR/AR tools. This somewhat unexpected finding may reflect emerging accessibility features in VR/AR technology (e.g. haptic feedback, audio spatialisation) that enhance the experience for visually impaired users.

In terms of interactive equipment, a significant difference was observed among hearing-impaired participants ($p = 0.022$), who were more likely to engage with these tools. This suggests a preference for tactile or visual interaction that compensates for the limitations of audio-based resources, underscoring the importance of hands-on experiences for this group.

No significant difference was found among visually impaired visitors ($p = 0.200$), indicating that both groups used interactive equipment at similar rates. This may reflect either accessibility barriers (e.g. lack of tactile interfaces) or the overall usability of these tools across audiences.

Grounded in the literature review and supported by the findings of this study, five personas are presented to illustrate the diversity of museum visitors according to their level of technological engagement and accessibility needs (Table 5).

Table 5. Five visitors' personas

Persona	The Traditionalist Visitors	The Sensory Vistors	The Digitally Engaged	The Virtual Enthusiast	The Inclusive Co-creator
Level of Technology Use	Low	Moderate	Medium	High	High (participatory focus)
Profile	Older adult (60+), limited digital literacy	Person with visual or hearing impairment, aged 40–60	Young adult, tech-comfortable, curious	Tech-savvy young/adult visitor, active on social media	Person with sensory impairment, socially active and creative
Motivations	Relaxation, nostalgia, cultural appreciation	Inclusion, autonomy, equal access	Interactive learning, entertainment	Experiencing something new, sharing online	Contributing to the creation of inclusive experiences
Technology Use	Rarely uses tech; may use audio guides if assisted	Uses audio guides, tactile panels, text-to-speech tools	Uses apps, interactive panels, online research	Uses AR/VR, museum apps, social media	Participates in co-created exhibits, digital collaboration tools
Needs	Clear information, human support, traditional signage	Multisensory, accessible content, assistive tech	Gamified, engaging content in multiple media	Immersive experiences, connectivity, visual appeal	Inclusive tools for co-creation, collaborative spaces
Expectations	Calm, accessible environment with staff support	Feel welcomed with inclusive options	Interactive, personalised experiences	Highly digital and immersive museum visits	Museums as spaces of shared creativity and inclusion

The five visitor personas derived from the survey results and were based on other research projects (Li, 2024; Dong, 2024; Yi et al, 2022; Erdogan & Enginkaya, 2023; Sawczuk (2021). These

personas were developed to illustrate the diversity of engagement styles among museum visitors, particularly in relation to their level of technology use and accessibility needs.

These personas emerge directly from the empirical findings of this study—particularly the analysis of technology usage patterns by people with sensory impairments (PwSI)—and are supported by current literature on museum experiences, visitor segmentation, and digital inclusion.

The Traditionalist Visitors, for instance, reflects the visitor segment identified in previous research as valuing relaxation, nostalgia, and personal reflection (Li, 2024), and whose museum experience is more grounded in physical, low-tech interactions. This persona aligns with the physical context described by Yi et al. (2022), where visitors engage with the environment and exhibitions primarily through traditional means.

The Sensory Visitors illustrates the importance of accessibility and multisensory engagement, as advocated by Dong (2024) and Yi et al. (2024), who highlight how inclusive design and assistive technologies (e.g., audio guides, tactile displays) support emotional and intellectual connections for PwSI. This persona benefits from moderate technological tools that are adapted for sensory impairments, reflecting the increasing need for personalisation in museum design (Erdogan & Enginkaya, 2023).

The Digitally Engaged persona corresponds to visitors who seek interactive, gamified, and emotionally rich experiences, which have become central to modern museum practices (Lu et al., 2023; Yolthasart et al., 2024). This group is digitally literate and values hybrid experiences that combine entertainment with education, confirming the role of technology in enhancing both learning and enjoyment.

The Virtual Enthusiast represents a growing cohort of visitors who engage deeply with immersive and virtual environments (VR/AR) and often use social media to document and share their museum experience. This mirrors findings by Kung (2024) and Liu & Sutunyarak (2024), who argue that digital immersion and social interaction through online platforms can greatly enhance emotional engagement and extend the museum experience beyond the physical space.

Finally, The Inclusive Co-creator reflects the rising importance of co-creation in museums, as discussed in depth by Yang et al. (2023) and Sawczuk (2021). This persona actively contributes to the narrative and construction of museum content, embodying the shift from passive consumption

to collaborative cultural dialogue. This approach not only supports inclusion and representation but also responds to the call for museums to be participatory and democratised spaces (Medakovic et al., 2024).

5. CONCLUSION AND CONTRIBUTIONS

This study highlights how co-creation can improve museum experiences for people with sensory impairments (PwSI), emphasizing accessibility, technology, and visitor engagement. The results highlight the importance of accessibility, technological integration, and visitor engagement in fostering a more inclusive museum environment. The study's insights are valuable for museum managers, policymakers, and researchers aiming to improve cultural accessibility and engagement for diverse audiences. This study extends the existing literature on museum experiences by focusing on the co-creation process for PwSI.

5.1 Theoretical contributions

It offers several theoretical contributions: the expansion of co-creation theory by integrating co-creation principles within the context of accessibility, demonstrating how visitor experiences can be shaped through inclusive strategies; the identification of key factors influencing co-creation by examining how physical, communicational, and attitudinal barriers affect museum experiences, enhancing theoretical models of visitor engagement; and bridging the accessibility gap in museum studies by adding to the discourse on inclusive museum practices through empirical evidence from PwSI, highlighting strategies that can bridge accessibility gaps in cultural institutions.

5.2 Practical contributions

The study provides actionable insights for museum professionals and stakeholders seeking to enhance inclusivity in museum settings. These include strategic recommendations for museum managers on designing accessible and interactive museum spaces, integrating assistive technologies, and improving staff training on accessibility; enhancing visitor engagement through technology by underscoring the role of digital tools such as interactive panels, mobile applications, and audio guides in enriching museum experiences for PwSI; and promoting inclusive practices by highlighting the necessity for museums to adopt inclusive policies, such as multi-sensory exhibits, personalised engagement strategies, and participatory approaches to exhibit design.

6. LIMITATIONS AND FUTURE RESEARCH

While this study provides valuable insights, several limitations should be acknowledged. The geographical scope primarily focuses on PwSI in Portugal and selected international participants, and future studies could expand to other regions to assess the generalizability of findings. Another limitation is related to the time period allocated to the application of the surveys (2020). In this context, the potential impact of post COVID 19 changes was not considered in the study, but in similar research projects this could be a very relevant issue to analyse and discuss. The rapid evolution of digital accessibility tools may influence museum experiences over time, and future research should examine emerging technologies and their impact on visitor engagement. This study concentrates on sensory impairments, and future research could explore co-creation experiences for individuals with other disabilities, such as cognitive or mobility impairments. By addressing these limitations, future research can further enhance our understanding of inclusive museum experiences and the role of co-creation in fostering accessibility for all visitors.

REFERENCES

Biedermann, N. (2021). Virtual Museums as an Extended Museum Experience: Challenges and Impacts for Museology, Digital Humanities, Museums and Visitors – in times of (Coronavirus) crisis. *Digital Humanities Quarterly, 15*(3). http://dhr.ruc.edu.cn/EN/

Chernbumroong, S.; Ariya, P.; Yolthasart, S.; Wongwan, N.; Intawong, K. & Puritat, K. (2024). Comparing the Impact of Non-Gamified and Gamified Virtual Reality in Digital Twin Virtual Museum Environments: A Case Study of Wieng Yong House Museum, Thailand. *Heritage, 7*.1870-1892. https://doi.org/10.3390/heritage7040089

Dong, S. (2024). Research on the Application of Digital Media Technology in Museum Exhibition: a Case Study of the national museum of Singapore. *Web of Conferences, 181*. https://doi.org/10.1051/shsconf/202418104031

Erdogan, H. H. & Enginkaya, E. (2023). Exploring Servicescape Experiences Across Museum Types. *Journal of Services Marketing, 37*(6). 706-718 https://www.emerald.com/insight/0887-6045.htm

Furferi, R.; Di Angelo, L.; Bertini, M.; Mazzanti, P.; De Vecchis, K. & Biffis, M. (2024). Enhancing Traditional Museum Fruition: Current State and Emerging Tendencies. *Heritage Science, 12*(2). https://doi.org/10.1186/s40494-024-01139-y

Gürel, E. & Nielsen, A. (2019). Art museum visitor segments: Evidence from italy on omnivores and highbrow univores. *International Journal of Arts Management 21*(2). 55-69. http://hdl.handle.net/11693/53287

Hsu, T. Y. & Liang, H. Y. (2020). Museum Engagement Visits with a Universal Game-based Blended Museum Learning Service for Different Age Groups. *Library Hi Tech, 40*(5). DOI:10.1108/LHT-08-2020-0198

Kung, C. H. & Lin, P. S. (2024). A Study on the Application of Artificial Intelligence in Interactive Museum Displays and Visitor Perception. *The International Journal of Organizational Innovation, 17*(2) https://www.ijoi-online.org/

Li, P. (2024). Cultural Communication in Museums: a Perspective of the Visitors Experience. *PLoS ONE, 19*(5). https://doi.org/10.1371/journal.pone.0303026

Liu, Q. & Sutunyarak, C. (2024). The Impact of Immersive Technology in Museums on Visitors' Behavioural Intention. *Sustainability, 16*, 9714. https://doi.org/10.3390/su16229714

Liu, S. & Zaffwan, I. (2018). Constructing a framework of user experience for museum based on gamification and service design. MATEC Web of Conferences *176(4).* 04007. DOI:10.1051/matecconf/201817604007

Lu, S. E.; Moyle, B.; Reid, S.; Yang, E. & Liu, B. (2023). Technology and Msueum Visitor Experiences : a Four Stage Model of Evolution. *Information Technology & Tourism, 25*. 151-174. https://doi.org/10.1007/s40558-023-00252-1

Medakovic, J.; Jelicic, J. A.; Ecet, D.; Neducin, D. & Krkljes, M. (2024). The Interplay between Spatial Layout and Visitor Paths in Modern Museum Architecture. *Buildings, 14.* 2147. https://doi.org/10.3390/buildings14072147

Nigatu, T. F.; Trupp, A. & Teh, P. Y. (2024). A Bibliometric Analysis of Museum Visitors' Experiences Research. *Heritage, 7.* 5495-5520. https://doi.org/10.3390/heritage7100260

Preko, A.; Gyepi-Garbrah, T. F.; Arkoful, H; Akolaa, A. A. & Quansah, F. (2020). Museum Experience and Satisfaction: Moderating role of Visiting Frequency. *International Hospitality Review, 34*(2). 203-220. https://doi.org/10.1108/IHR-o4-2020-0009

Sawczuk, M. (2021). Cooperation and Cocreation in the Scientific Activity of Museums. *Zarzadzanie Publiczne, 4*(56). 169-181. https://doi.org/10.4467/20843968ZP.21011.17873

Yang, Y.; Liu, S. & Song, X. (2023). The Cocreation of Museum Experience Value From the Perspective of Visitor Motivation. *SAGE Open, 13*(4). https://journals.sagepub.com/doi/epub/10.1177/215824402331202118

Yi, T.; Lee, H. Y.; Yum, J. & Lee, J. H. (2022). The Influence of Visitor-based Social Contextual Information on Visitors' Museum Experience. *PLoS ONE 17*(5). https://doi.org/10.1371/journal.pone.0266856

Yi, X.; Liu, Z.; Li, H. & Jiang, B. (2024). Immersive Experiences in Museums for Elderly with Cognitive Disorders: a user-centred Design approach. *Scientific Reports, 14*. 1971. https://doi.org/10.1038/s41598-024-51929-4

Yolthasart, S.; Intawong, K.; Thongthip, P. & Puritat, K. (2024). The Game of Heritage: Enhancing Virtual Museum Visits Through Gamification for Tourists. *TEM Journal, 13*(4), 3359-3372. https://doi.org/10.18421/TEM134-70

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