Designing Inclusive Cultural Heritage Experiences – an Academic Course on Enhancing Museum Accessibility for Cognitive Impairment Visitors

Alexandra Danial-Saad, Yael Avni, Julia Sheidin and Tsvi Kuflik

The University of Haifa, Abba Khoushy Ave 199, Haifa, 3498838, Israel

Abstract

In recent years, there has been a growing interest in exploring the potential of state-of-the-art technologies to enhance the museum visit experience of cognitively impaired visitors. However, developing cultural heritage experiences for cognitively impaired visitors is not straightforward, and multiple factors, including knowledge about the available opportunities, desires, barriers, and abilities, affect their participation. This paper presents a multidisciplinary graduate course that collaborates with museum staff and cognitively impaired visitors to explore techniques for designing and developing such experiences. The goal is to apply universal design principles, user-centered design and co-design approaches to make the cultural heritage accessible and enhance the museum visit experience of individuals with cognitive impairment.

Keywords

Cultural heritage, Cognitive impairment, Museum experience, Inclusive design, Technology innovation, Inclusive Museum, Academic course, Digital accessibility.

1. Introduction

Museums have a major role in society, evolving from repositories of art and artifacts to cultural educators [31]. Despite the shift towards free-choice learning, where visitors determine their learning path, the traditional museum setup involving displays within glass cases and on walls poses challenges for individuals with disabilities. This includes limited exploration opportunities due to the nature of exhibit placements and the inaccessibility of artifacts. Museum labels, often concise yet informative, can be challenging for people with disabilities, particularly those with visual, cognitive, or motor impairments. This explains why only 7% of museum visitors have disabilities [3]. Encouraging inclusivity within museums and galleries can lead to a more diverse audience, allowing a broader range of visitors to engage with and gain value from the cultural offerings fully [21]. Assistive and digital accessibility technologies can create a more authentic experience, potentially bringing the user closer to previously inaccessible artifacts and sites and enabling them to function independently and with dignity [10][14][15]. Well-adapted technology may contribute to the visitors' varied needs, thereby encouraging participation, self-esteem, and quality of experience [8].

Exploration of museum accessibility, especially for individuals with cognitive impairments (including Intellectual and Developmental Disabilities (IDD), sensory hypersensitivity, and attention deficit hyperactivity disorder (ADHD)) is an evolving and crucial aspect of cultural inclusivity that museums have only recently begun to address. Accessibility for these individuals involves considering how information is presented, how exhibits are designed, and how interactions are facilitated [11].

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asaad@univ.haifa.ac.il (A. Danial-Saad); yaeliv@gmail.com (Y. Avni); sheidin.julia@gmail.com (J. Sheidin); tsvikak@is.haifa.ac.il (T. Kuflik)

0000-0002-2904-8548 (A. Danial-Saad); 0009-0005-3723-6150 (Y. Avni); 0009-0002-9092-7231 (J. Sheidin); 0000-0003-0096-4240 (T. Kuflik)

Despite the recent heightened interest in accommodating these impairments, literature has primarily focused on simplifying text [17]. For example, many museums have created social stories and other visual guides that use pictures and simple text to prepare children for the sights, sounds, smells, and possible tastes and objects to touch [5]. Notably, Guedes et al. [11] conducted an evaluation of museum websites and applications and suggested guidelines to support the design of accessible materials for people with IDD. To effectively support individuals with IDD, they highlighted the importance of upholding consistency and simplicity, significantly enhancing the overall user experience.

We aim to equip developers with the skills necessary to create inclusive systems. This initiative builds on the achievements of our previous "Advanced Technologies in Development and Rehabilitation" course, which was acclaimed by both the museum and its target audience representatives [2]. In our previous course, our collaborative work generated various recommendations for improving the accessibility of exhibits and their accompanying information for blind visitors within museums. Now, we are shifting our focus toward developing technologies specifically designed to accommodate the needs of individuals with cognitive impairments.

2. Background and Related Work

Accessibility in museums has different meanings. It involves criteria that highlight a holistic and inclusive approach to museum accessibility, considering not just the museum's physical environment but also the broader experience of all visitors [10]. To ensure accessibility for all visitors, there are several guidelines by the Americans with Disability Act (ADA) that museums should follow [23]. Accessibility considerations listed in the Smithsonian Guidelines for Accessible Design include but are not limited to, public spaces, furniture, color usage, language and label design, text choices, interactive elements, and circulation routes [27]. In recent years, accessibility also focused on integrating innovative technologies to enhance experiences for visitors with disabilities. Therefore, it is very important to consider accessibility in the development and deployment of new technologies in museums [4]. This helps create a more authentic experience, potentially bringing the user closer to previously inaccessible artifacts and sites [10].

Guidelines for museum accessibility for cognitive visitors

The “Smithsonian Guidelines for Accessible Exhibition Design” offers museums a set of guidelines as well as design tools to meet the world accessibility standard [12]. Below are provided indicative guidelines specifically tailored to address accessibility for cognitive disabilities:

- “Offer a programmatic path for traveling through the exhibition. People with cognitive disabilities, like most individuals, learn best from an orderly presentation. An exhibition that reveals its topic through an obvious storyline, theme, or repeated element offers landmarks, repetition, and a connecting thread to follow a complex presentation” (p. 7).
- “Include people with disabilities in exhibition topics, photographs, and presentations of perspectives” (p. 7).
- “Present information to all the senses. Multisensory presentations provide choices for the sensory channel used and interesting repetitions of key points. Some people, however, have difficulty sorting overlapping sights and sounds” (p. 7).
- “Tactile experiences can greatly assist people with cognitive disabilities” (p. 12).
- “Use readily legible typefaces. The typefaces that are easiest for people with low vision, language problems, or cognitive disabilities are sans serif or simple serif. Maintain consistent label locations throughout the exhibition for ease of finding. Use easily legible typefaces like ‘sans serif’ or ‘simple serif’” (p. 19).

- “Instructions are more effective for people with cognitive disabilities if participant action is required after each direction rather than after a string of directions. This step-action-step format assists people with short-term memory problems” (p. 28).
- “Provide touch-sensitive areas in predictable locations that are at least 75 mm (3 in.) in diameter. Small touch areas require fine muscle control. If areas are too small, people with cerebral palsy or other mobility impairments often activate unwanted areas instead of or in addition to those selected” (p. 32).

3. Method

In recent years, there has been a growing interest in exploring the potential of state-of-the-art technologies to enhance the museum visiting experience for visitors with cognitive impairment. Our goal is to train students (developers to be) to design and develop such innovative systems inspired by the work of Umanski and Avni [29], Newell et al. [18] and Cavazos et al. [6], where student teams conceived and realized inventive systems. To accomplish this, we have adopted the Project-Based Learning (PBL) approach as our core pedagogic method [9]. This methodology prioritizes practical, hands-on projects, enabling collaboration among students in small groups and applying theoretical concepts in real-world contexts. Following the paradigms of universal design principles [1][28], user-centered design [20] and of co-design [24], students gain a deeper understanding and involvement in the technology development process to enhance museum accessibility.

3.1 Conceptual Framework and Technologies

Our goal is to train a multidisciplinary team of students (developers to be) to design and develop an accessible environment for cognitively impaired people by exploring the potential of advanced technologies (intelligent user interfaces) using the user-centered design (UCD) approach, involving students and lecturers with technological background and experience (from the information systems department) and students and lecturers with therapy experience and background (from the department of occupational therapy) using design approach. The course will combine theoretical and practical aspects aimed at developing several experiential kits (for specific cultural heritage topics) for cognitively impaired visitors. The course will follow a co-creation approach where the students will be introduced to the human-centered design approach [26], design thinking methodologies [19], and interaction design principles [13], and co-design [24], as well as to the Human Activity Assistive Technology (HAAT) model [7]; the Matching Person and Technology (MPT) model [25] and the 7 universal design principles focusing on the User-Centered Design (UCD) approach to ensure that the product or prototype meets the needs, wants, and expectations of its intended users [16][30]. Based on all these models and principles, the students will work together with individuals with cognitive impairments and the museum staff to better understand the challenge and the opportunities, to design the experience, create three dimensional (3D) models of museum artifacts, print 3D replicas and augment them with audio commentary where input methods such as pushbuttons, microswitches, and Radio Frequency Identification (RFID) scanning technologies will be used to activate the audio in context.

3.2 Implementation

After an introductory lesson, the students will split into groups of four students. The museum staff will select several topics and artifacts related to each theme. To ensure that the suggested concepts meet the needs of individuals with cognitive impairments users, the development process includes all stages of the Design Thinking method from UCD [19]:

1. *Empathy*: The students generate empathy and familiarity with the field of development by talking with the museum staff, accompanying individuals with cognitive impairments during the visit to the museum, and reviewing relevant literature.
2. *Define & Ideate*: The teams will be asked to present their concepts based on literature reviews and user interviews while producing quick prototypes (such as video prototypes and cardboard prototypes) to communicate better and refine their ideas. This will include creative thinking about using relevant state-of-the-art technologies, including 3D replicas of objects within multimodal interaction systems that deliver information through visual, auditory, and haptic feedback, catering to various learning styles and sensory needs. Augmented reality (AR) will be pivotal in crafting interactive storylines and engaging visitors through gamified learning pathways. Additionally, audio commentaries will enhance accessibility, offering content in simplified language or as audio descriptions, and computer games will provide interactive learning experiences, all underpinned by insights from comprehensive literature reviews.
3. *Prototyping*: the teams will be asked to produce semi-working prototypes that can be tasted with actual users. For that matter, replicas will be produced using 3D scanning and 3D printing, audio files will be recorded, and primary code will be written. All groups will face the same questions regarding interaction design, and each of them will choose to solve them differently.
4. *Testing Evaluating*: For the initial usability test, students will employ the Wizard of Oz testing technique—an approach used to evaluate a system that is still in development, proven to be highly effective in assessing interactions and performance [22]. While 3D artifacts and audio files will be generated, the activation of interactive artifacts will be overseen by a "hidden wizard". Students may test these concepts with individuals with cognitive impairments, even if they are not fully functional, and incorporate enhancements into the final projects.

The final prototypes will be developed and refined according to the observations of the intermediate tests. It will be presented at the end of the course.

4. Expected Contribution

When reviewing the literature in the context of making museums more accessible for visitors with cognitive impairment, the effort focuses on simplified text, social stories, and guidelines for accessible materials [11][17]. The aim of this project is to train a multidisciplinary team of students (developers to be) to design and develop an accessible smart/intelligent environment for cognitively impaired visitors by exploring the potential of advanced technologies using the UCD approach, universal design, and co-design approach. These approaches involve collaboration between students and lecturers with expertise in technological experience and background, and those with therapy experience and background.

Such a course offers a unique opportunity to test, evaluate and compare the performance and satisfaction from the interaction with various prototypes. Although these prototypes are similar enough in terms of the amount and type of information, they differ in interaction and manipulation methods. Such an opportunity is not common, and the ability to compare different elements of the same interactions with the same participants can lead to a better understanding of visitors' needs and expectations. The insights gained from these comparisons can inform the development of more accurate guidelines to improve information accessibility for this audience within museums.

Additionally, the course has the potential to significantly contribute to the field of accessible design and human-computer interaction devices and interfaces. By providing valuable insights into the design and development of technological solutions for visitors with cognitive impairment, the course offers essential insights into designing and developing more inclusive user interfaces and devices. Furthermore, the knowledge and skills acquired by the graduate students during this course will be invaluable in their future endeavors, equipping them to tackle challenges in accessible design and enhance the inclusivity of digital and physical spaces alike.

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