Archaeological Museum Exhibits and Accessibility for the Sensory and Visually Impaired

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Description of the Project and Audience

From 2009 to 2010, the percentage of the total United States population with a disability grew by 2%, according to a study from the American Association of People with Disabilities (AAPD). The AAPD counted 304,287,836 people living in the United States with 36,354,712 of them having some kind of disability (American Association of People with Disabilities and the Employment Practices and Measurement Rehabilitation Research Training Center at the University of New Hampshire, *2011 Annual Disability Statistics Compendium*). For individuals with visual impairments or sensory differences, museum displays are often inaccessible – housed in glass display cases and interpreted via signage. This project, the final outcome of which was an exhibit entitled *Printing the Past: SC in 3D* at the Horry County Museum, fosters inclusivity for our target audience – those with visual and sensory disabilities – but works for all museum-goers, as visitors both with and without visual/sensory disabilities gain the opportunity to touch and learn about South Carolina's unique past.

Though the Americans with Disabilities Act (ADA) required museums to become accessible to all populations, given the fragile nature of archaeological and historical artifacts, it is often not possible to truly engage with an audience with visual/sensory differences, who may benefit instead from a tactile experience (Stringer 2013, Sherman 2008, Majewski 1987). This project addressed this deficiency through a 3D scanning and 3D printing program and inclusive exhibit design in partnership with the Horry County Museum in Conway, South Carolina. Coastal Carolina University students assisted with scanning, printing, and exhibit narration (audio and braille), providing opportunities for them to learn about Horry County's history and prehistory, as well as learn about accessibility in museum design. Museum professionals gained knowledge about accessibility for their visually/sensory-impaired audiences during demonstrations that coincided with Horry County Museum's hosting of the South Carolina Federation of Museums conference. Finally, the public and the target audience, in partnership with organizations that serve these communities (SOS Health Care [autism services] and the South Carolina Commission for the Blind) were invited for a grand opening of the exhibit and asked for feedback about the effectiveness of the design. Copies of the 3D printed artifacts were also added to traveling classroom kits for educational programs run by the Horry County Museum.

The mission of the Horry County Museum is "to collect and preserve material related to the prehistory, natural history, history and culture of Horry County; to interpret and to create exhibits of such materials and to prepare educational programs related to them for presentation to the public." The Horry County Museum typically gets approximately 25,000 visitors each year, mostly drawn from the local community, school groups, and organized tours. The artifacts selected for 3D scanning and printing captured a diverse subset of the collections, working closely with the Museum's Director in selection and interpretation. A few categories of artifacts enumerated here: Native American artifacts spanning Paleoindian through to modern-day Native American culture and people (the Waccamaw Indian People are the descendant community in Horry County – and Chief Harold Hatcher spoke with students participating in this project on ways of respectfully presenting the Native American past and present). The 3D exhibit includes an assortment of pottery (with varying surface treatments that may be of tactile interest), projectile points, a decorated pipe, and groundstone. The historic period in Horry County includes its military history (the former Myrtle Beach Air Force Base played a major role in the

growth of the region), represented in the 3D exhibit by aviator goggles, buttons, and military medals/medallions. Other historic artifacts include children's toys and personal items (including an ear trumpet, used by individuals who were hard of hearing, which opens conversations about how people in the past may have overcome sensory differences of their own). At the request of the Museum's Director, the exhibit also contains three Pleistocene fossils.

The goal of this exhibit was to provide accurate 3D scanned and printed replicas of archaeological and historical artifacts from the Horry County Museum collections in order to create a tactile exhibit accessible for audiences with visual/sensory differences. Artifacts were scanned using a NextEngine 3D scanner and edited using Scanstudio software in order to create accurate digital 3D images of each object. Then, artifacts were 3D printed using a Creality10s 3D printer with Cura software for manipulation of 3D files. Printing was done using 1.75mm 3D printer filament in a variety of colors, capable of achieving +/- 0.03mm accuracy. Colors were selected to closely match individual artifacts, including metallic copper, brass, and silver. Multicolored artifacts were painted with acrylic paints. Text panels were printed on foamboard using "dyslexie" font, designed to be easily read by individuals with dyslexia, and large-print booklets were also available for audience use. All text was also printed as transparent braille panels that were affixed over the exhibit text for braille readers, and audio buttons using EZSoundbox 200 second audio players provided audio for non-readers. All text and images could also be accessed using QR codes printed on the exhibit panels that were linked to soundcloud files and the exhibit website.

Through the use of these technologies, we were able to meet our goal of creating an exhibit that is accessible to people with a variety of sensory differences including visual and hearing disabilities, sensory and learning differences, and people with autism or other disabilities. However, technology also facilitated the creation of an exhibit that is universally designed and as barrier-free as possible. The exhibit is great for people with disabilities, but it also provides an experience for all visitors that allows tactile learning and touching a (re-created) piece of the past. The experience of touching and feeling an artifact, even if it is a 3D rendering, helps people connect to the past and understand the experiences of people who lived hundreds or thousands of years ago. Additionally, the use of digital spaces, websites, and videos allows people who are unable to visit the museum physically to interact with artifacts and interpretation.

Advertising

The exhibit was advertised through social media (including the Horry County Museum's Facebook page, and SOS Autism's Facebook page, as well as Facebook and Twitter accounts for the CCU Department of Anthropology and Geography, the CCU student Anthropology and Geography Club, Cultural Heritage at CCU, and personal pages for the co-PIs). Printed posters were hung on CCU's campus and throughout the Horry County community. Media releases were prepared and sent by Coastal Carolina University to local news outlets and the exhibit was featured on the local evening news (WMBF and WPDE, Conway and Myrtle Beach, SC). Direct invitations were sent to SOS Autism and their clients, the South Carolina Commission for the Blind, members of the Horry County Museum, the Waccamaw Indian People, and the Dean, Provost, and President of Coastal Carolina University. Finally, invitations and information were sent to politicians who represent the local community: Senator Lindsey Graham, Senator Tim Scott, and Representative Tom Rice.

Evaluation of Effectiveness

The objective of *Printing the Past: SC in 3D* was to remove barriers to access for those with disabilities by bringing a hands-on museum experience to a population that is unable to benefit from traditional museum exhibit design. However, benefits were not limited to the target audience of those with visual/sensory differences. We also sought to educate Coastal Carolina University students in 3D scanning/printing and museum design and to educate museum professionals about the technology and ways it can be used to make museum exhibits more accessible. As a result, evaluation of the project design addressed its benefits to multiple audiences.

Evaluation of the effectiveness of the exhibit for the target audience was done through the use of an evaluation questionnaire (IRB 2019.217) administered on the opening day of the exhibit. A total of 171 people visited the exhibit on its opening day, and 95 people also attended an opening reception. A total of 51 people completed a survey upon exiting the exhibit, of which 39 (41%) completed the optional demographic portion and of those, 13 (33%) self-identified as having a disability or accessibility challenges. Respondents with disability and accessibility challenges offered suggestions in their evaluations to include bigger pictures and artifacts, and several requested headphones for the audio (which were provided, but only two pairs were available, and that was not enough for the opening day crowd). All of the respondents to the survey – including those who self-identified as not having a disability or accessibility challenges - stated that the ability to touch the 3D printed artifacts greatly improved their museum experience.

Evaluation of the effectiveness of the exhibit on CCU students who participated in the design was conducted through online course evaluations that assessed experiential learning objectives. A total of 14 students completed online evaluations. Students stated that they enjoyed the project and learning the 3D scanning/printing technology. The ability to see the project to completion and interact with its target audience was one of the biggest benefits. One student commented “The museum project for this course has by far been the best class project that I've done. Not only was it enjoyable in the sense that we had a lot of freedom in what we were doing, but the fact that it was applicable to a larger audience made the project that much more worthwhile. While projects that I've done in the past certainly helped me learn, this project went beyond that and really allowed students to create a project that we could be proud of and that will serve a larger audience in the long run.”

However, perhaps the farthest-reaching impact is that this project serves as a model for other museums. The partnership between multiple University departments and the Museum allowed the use of sophisticated technology, which distributed costs that might otherwise have been prohibitive. The transparency in the development of this project, and the exhibition of our process within the exhibit and online, should serve to inspire other museums to create similar exhibits and partnerships.

Follow-Up and Dissemination of Materials

Printing the Past: SC in 3D will remain on display at the Horry County Museum for one year, at which point, exhibit stands will be moved and placed throughout the Museum hallways for visitors to explore while walking between other exhibits. Additional 3D printed copies of artifacts and the accompanying text will be placed into education kits that are used in school outreach programs and teaching materials. The website for the exhibit will remain online with photographs, text, and audio links. Dr. Dillian and Dr. Clary continue to work closely with the Horry County Museum and can respond to any ongoing needs related to the exhibit.

Stakeholders

A number of stakeholders were consulted during the creation of this exhibit, including SOS Healthcare, Myrtle Beach, SC, which serves individuals with autism and their families; and the South Carolina Commission for the Blind, Conway, SC. We also appreciated conversations with the Interim CEO of the Pennsylvania Association for the Blind, John McInerney, who has provided consulting assistance to museums on accessibility for visually impaired audiences. And, we received advice and guidance from Chief Harold Hatcher of the Waccamaw Indian People, Aynor, SC, whose ancestors made the Native American belongings within the collections. Chief Hatcher spoke with students on ways to respectfully present Native American material culture. Finally, students interviewed family members, where appropriate, of those who used or donated historic artifacts that became part of the exhibit.

Funding:

Funding provided through the Southeastern Archaeological Conference was used to cover expenses associated with 3D printing, exhibit construction, audio, and text and image panels used in the exhibit. The Horry County Museum donated the use of the exhibit space (valued at $2,000) for the project and assisted in the construction of exhibit stands.

The project was extremely cost-effective, given that the equipment to create 3D scans and 3D prints of the artifacts was already owned by Coastal Carolina University. The NextEngine 3D scanner and ScanStudio software can be purchased today for approximately $3,000 and the Creality10s 3D printer and Cura software are valued at approximately $450. As a result, expenses were for 3D printing filament and supplies, exhibit supplies, and text and image panels, as well as the opening reception at the Horry County Museum for the target audience and general public.

We made one minor change to our funding allocation during the implementation of the project. Specifically, we had budgeted approximately $700 for exhibit narration, using audio buttons and equipment marketed to museums. However, when we went to order from the company that we had selected, we discovered that they had gone out of business. As a result, we had to do additional searching online for audio kits and discovered a different option – individual battery-powered 200 second recordable audio boxes with pushbutton playback – that could be purchased for under $20 each. This dramatically decreased the amount of money we needed for audio equipment and provided a more elegant solution (https://invitebyvoice.com, EZSound Box), since the audio equipment could be powered by simple AAA batteries and could be recorded and re-recorded using the voice memo app on any smartphone that has an audio jack. Furthermore, if a sound box is damaged, it's cheap and easy to replace.

After discovering this cheaper solution, we contacted SEAC to obtain permission to re-allocate the leftover funds that were designated for audio equipment towards additional printed panels and images for the exhibit display. We were able to increase the images and text/braille panels as a result of this switch, and appreciate the help and flexibility provided by SEAC.

Because printing the artifacts as 3D replicas was relatively simple and inexpensive once the basic setup and digital files had been achieved, we also cost-effectively printed duplicates of some of the artifacts for the Horry County Museum to have on-hand in case portions of the display are damaged or broken, and that can go into educational and traveling kits. The Horry County Museum is enthusiastic about keeping the exhibit up for a full year and then using

components of the exhibit throughout its hallways as stand-alone displays. We will continue to work with the Museum on future needs in maintaining these materials.

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2008 *Museums and Difference*. Indiana University Press, Indianapolis.

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1987 *Part of Your General Public Is Disabled: A Handbook for Guides in Museums, Zoos, and Historic Houses.* Smithsonian Institution Press, Washington, D.C.

Online Exhibit Website - http://www.printingthepastscin3d.com
For people who are unable to visit the exhibit in person, students created a website that incorporates the audio and interpretation of the artifacts, as well as a layout of the floor plan, and information about the technology used to build this exhibit. Student perspectives on using the technology and creating the exhibit are also included.

SoundCloud - https://soundcloud.com/user-475547154/printing-the-past-sc-in-3d
We used SoundCloud to host the audio for the exhibit. QR codes on each exhibit label lead to the SoundCloud audio for people to use on smartphones or from home. The audio is also incorporated on each artifact kiosk for people to use in the exhibit.

Exhibit Video - https://www.youtube.com/watch?v=QoFlfWa09U8
This video is on display in the exhibit, as well as available in the online exhibit. The video, produced by Coastal Carolina University, Edwards College media services, shows the process of selecting artifacts, 3D scanning, 3D printing, and building the exhibit using new technologies.

Interactive Map
- https://www.arcgis.com/apps/webappviewer/index.html?id=0278e06efd4d4207857b6c355a06d8be
ANTH432 student Sydney James used GIS mapping technologies to create an interactive map of the artifacts and their original locations. Here, visitors can use the web map to identify where different artifacts on display in the "Printing the Past: SC in 3D" exhibit were found. Clicking on

different locations, which are color-coded by the types of artifacts found there, provides the visitor with general information about some of the objects on display.