

Friends of the North Carolina Museum of Natural Sciences

Sparks! Ignition Grant Final Performance Report

Project Title: *Enhancing the Museum Experience for Visitors with Visual Impairments and Blindness*

Description of Project Partners:

- **Liani Yirka**, North Carolina Museum of Natural Sciences Curator of Special Populations. Ms. Yirka and the museum managed all fiscal responsibilities of the grant, facilitated meetings and research activities, and provided all content for the innovation.
- **Ed Summer**, Manager of Accessibility and Applied Assistive Technology at the SAS Institute, Inc., served as the co-director of the project and was intimately engaged in all aspects of the project. Mr. Summers provided technical direction on the creation of the accessibility of the innovation.
- **Dr. Scott McQuiggan**, SAS Institute, Inc. Senior Manager of Educational Software Development and Curriculum Pathways, led a team of software designers to develop the iOS application (app) for the project.
- **Diane Brauner**, Certified Orientation and Mobility Specialist, collaborates on multiple projects related to the education of students with visual impairments with the SAS Institute, Inc. Ms. Brauner provided direct consultation on the development of the application for individuals with visual impairments and blindness. She also supported all educational and evaluative activities of the project.
- **Dr. Derrick Smith**, Associate Professor of Special Education at the University of Alabama in Huntsville, served as the external evaluator for the project. He oversaw the development of the evaluation plan and led efforts to complete a rigorous evaluation of the innovation with the support of all partners.

Overview:

In order to meet the goal of the North Carolina Museum of Natural Sciences' mission in reaching as inclusive of an audience as possible, this project created a fully-accessible iOS application (app) to provide an enhanced experience for all visitors, including those with visual impairments and blindness. An iterative process with cycles of development, evaluation by the populations of focus, and refinement were used to create the universally-designed app for the Museum. The app includes pertinent information about the Museum and its exhibits, but also includes innovations, such as interactive and accessible maps, that make the museum more accessible. The application supports focused pre-planning for individuals with visual impairments by providing audio feedback through the map features, thus supporting the development of "mental maps" of the museum. The evaluation found

that individuals with visual impairments felt that they had more control of their visit which made it more enjoyable.

Changes:

- The SAS Institute, Inc. development team was increased to include Lucy Kosturko and Philippe Sabourin.
- Due to challenges with the development of the software, the timeline had to be amended. While the first prototype was developed on time, the evaluation of the app required multiple iterations to test and refine the innovative technology. This led to major adjustments to the evaluation timeline that limited the number of participants. The project team also had challenges getting the app into the Apple App Store which shortened the allotted time for external evaluation of the app.
- The summative evaluation was amended due to the changes in the timeline and the challenge in locating participants in the Raleigh, North Carolina area, particularly students from the Governor Morehead School for the Blind. The research team expected to have between 30-50 participants but due to scheduling constraints with the Governor Morehead School for the Blind, we were only able to recruit eight participants for the primary face-to-face aspect of the evaluation.
- Another change for the evaluation is that the team decided to attempt to have individuals with visual impairments and blindness download the app and review the app from afar. Upon completion of the review, the participants were asked to complete an online survey that focused on the accessibility and usability of the app as a tool for pre-planning a visit to the Museum. The project team exhausted all avenues to recruit participants but had limited success with the recruitment.

Activities Completed During the Project:

The app development team consisted of museum staff, software developers, software testers, a blind software accessibility specialist, a user experience designer, a visual designer, a project manager, and a Teacher of the Visually Impaired that is also certified to teach students with visual disabilities to orient themselves and move safely in public spaces.

Development process

The project was initiated with a kickoff meeting that was facilitated by experienced facilitators from the Software Quality Division within SAS. During the meeting, project team members brainstormed features and then prioritized those features.

The project team followed SAS Research and Development (R&D) standards as defined by the Software Quality Division within SAS R&D. Examples of these

standards include source management standards, build tools, a process for tracking defects, usability standards, and accessibility standards.

The team followed an agile development process. Iteration zero was a short iteration that allowed the team to set up infrastructure for the project. This infrastructure included the creation a branch in the SAS source management system for project source code, the creation of build scripts to build the source code, the creation of a component in the SAS defect tracking system for quality control, the creation of email distribution lists to facilitate team communication, etc.

After iteration zero, the team conducted four development iterations. Each iteration lasted approximately four weeks with each beginning with a kickoff meeting that was used to plan the goals of the iteration. During each iteration, the project team met at least once a week to review progress and resolve open issues. Each iteration concluded with a live end-of-iteration demo for a broad group of museum staff including staff from the Exhibits team, Education team, Information Technology team, etc. This broad group of stakeholders provided feedback and direction that drove requirements for the next iteration.

User feedback

The needs of users with disabilities were represented throughout every step of the development process by several team members. The Project Director, Liani Yirka, is the Curator of Special Populations at the museum. Through her daily work she is intimately familiar with the needs of museum patrons with disabilities and as an individual with a hearing impairment she is particularly attuned to the needs of patrons with hearing impairments. The co-Director of the project, Ed Summers, is a blind software engineer. He brought many years of personal experience into every discussion with the project team. In addition, as the Senior Manager of Accessibility at SAS, he leveraged many years of professional experience and intimate knowledge of accessibility standards that are used in the software industry. Finally, Diane Drauner leveraged her more than twenty years of experience working directly with students with visual impairments.

In addition, the project team conducted a focus group at the end of iteration three. The focus group consisted of a diverse group of ten museum patrons with visual impairments. The ages of the focus group participants ranged from approximately eight to 65. The functional vision of the focus group participants ranged from a visual acuity of approximately 20/80 to total blindness.

During the focus group, each participant received an iPad. Each participant was allowed to configure the accessibility features of the iPad to meet their needs. For example, some participants enabled the color inversion feature, some participants enabled the zoom feature, and some participants enabled the VoiceOver screen reader. The participants received a brief overview of the app and then each participant completed a few simple tasks using the app. Then, all the participants

discussed the strengths and weaknesses of the app as a group and the project team collected feedback. After the focus group, the project team prioritized the feedback and included the high priority items as requirements during iteration four.

Project Results:

There were three levels of evaluation conducted on this project: Formative, Summative (on-site) and Summative (off-site). Here is a brief summary of each:

Formative:

Ed Summers and Diane Brauner conducted a focus group on June 14, 2014 as part of the on-going evaluation of the app for individuals with visual impairments. The team put out a call for Raleigh-area participants with 43 individuals with visual impairments responding. In order to have a productive focus group, Ed and Diane selected 10 participants from various age groups and visual acuities.

From the focus group, the team had very positive results from the focus group. Overwhelmingly, the participants found the app to be accessible and perceived that it would be a useful tool when pre-planning and visiting the Museum. During the focus group, the participants found some notable “bugs” in the software that were noted and were fixed by the SAS team. It was determined at this time that the app was ready for submission to the Apple App Store for distribution.

At this time, the SAS development team also determined that it was out of the scope of this project to use iBeacon technology for indoor orientation. At the time, Apple was in the preparing to launch iOS 8 which may have had major implications on the app and iBeacons as a whole. The team determined that it was more appropriate to wait for the implementation of iOS 8 before focusing on using iBeacons within the Museum. This is a priority for the version 2.0 of the app.

Summative (on-site):

On September 26-27, an on-site evaluation of the app was planned and attended by all members of the research team. Again, the Raleigh-based team focused on recruiting individuals with visual impairments in the area to come to the Museum. During their visit, they were provided direct instruction on how to use the app and then asked to use the app to create a “mental map” or route to a specific exhibit within the Museum. They were asked to complete a pre-trip questionnaire that focused on demographic information. Basic results from the “Entry Survey” are as follows:

- 8 participants during the on-site visit.
- Average age: 21.75 (range from 14-38)
- Sex: 4 females, 4 males

- Race/Ethnicity: 6 Caucasian, 1 African-American, 1 Hispanic
- 87.5% (7/8) of the participants had “no-light perception” or “light perception-projected”. This means that these participants were “functionally blind” and could not travel without the aide of a long cane, dog guide, or human guide. One participant had low vision and was able to travel independently.
- 75% of the participants perceived themselves to have intermediate or advanced independent orientation and mobility skills. Two of the participants considered themselves to be highly dependent on others for travel.
- 100% of the participants perceived themselves to have intermediate or higher skills in the use of iDevices and most owned at least one iDevice.

All participants were asked to create a “mental map” or route to a specific exhibit within the Museum. They were then asked to use the provided iPod Touch along with the app to travel to the exhibit. They were provided assistance from Diane Brauner, a certified orientation and mobility specialist, but only when they asked for support. Diane was asked to provide limited support which included providing information about the participants directionality. Due to limitations of the version 1.1 of the app, the participants still needed support to determine the cardinal direction they were pointing as they traveled. Dr. Derrick Smith, a research and a certified orientation and mobility specialist, observed each participant as they traveled throughout the museum. His findings will be provided later but here are some initial findings from his observations:

- 100% of the participants used the app extensively throughout the travel.
- It was observed that the most successful travelers had developed a strong mental-map of their route before they traveled. They then used the app as a reference guide as they moved through the museum.
- Many of the participants were very efficient when using the app. For instance, they would use “dead time” (such as time on the elevator or immediately after stepping off the elevator) to re-orient themselves before traveling on with their route. From an orientation and mobility perspective, this was a very strong finding that this app supports independent travel.
- Overwhelmingly, participants with dog guides traveled faster and more efficiently than those using the long cane only. The dog guides helped the participants to travel through the museum and avoid the major obstacles (exhibits in the middle of the room).
- Half of the participants used audio cues or clues (escalator, elevator, smells from the cafeteria, etc.) as they traveled.
- Many of the participants found small “bugs” with the app as they were using it. There were noted and provided to the development team.

After completion of the route, all participants were asked to complete a semi-formal interview about the trip and their perceptions toward the app. The “exit survey” was primarily qualitative in nature, but contained three relevant Likert-scale questions.

When asked “How easily did you locate the desired exhibit?” (on a scale of Difficult, Somewhat Difficult, Neutral (Neither difficult or easy), Somewhat Easy, Easy), the findings were:

- 12.5% found it “Easy”
- 62.5% found it “Somewhat Easy”
- 12.5% found it “Neutral”
- 12.5% found it “Somewhat Difficult”

When asked “What is your level of agreement of this statement: Planning with this app made me more confident about today’s museum visit.”

- 62.5% “Strongly Agreed”
- 12.5% “Agreed”
- 12.5% “Strongly Disagreed”

When asked “What is your level of agreement with this statement: I wish there was a similar app that contains maps for other types of buildings such as shopping malls, grocery stores, airports, etc.”

- 87.5% “Strongly Agreed”
- 12.5% “Agree”

*It must be noted that the one participant who gave the lowest rankings throughout the entire exit survey was the participant who had the most difficulty using the device. They did not have strong VoiceOver skills which impeded their ability to travel independently. This may have tarnished their opinion of the app.

Qualitatively, the majority of the participants enjoyed their visit to the museum and found the app very useful. One participant stated when asked if they enjoyed their visit, “Yes, it is a great experience when you are able to plan before with the app.” Another participant when asked the same question stated, “Yep, because I had a mental picture of what was around.”

The most compelling statements were made when the participants were asked, “How did the map impact your overall ability to have a self-directed museum experience?” Here are some of the responses:

- “It was really helpful! It is needed everywhere.”
- “It was awesome! I love knowing where the exhibits were.”
- “It gave me confidence.”

- “It was very helpful.”
- “Yes, I want it NOW in the App Store.”
- “I went from no idea to knowing landmarks and boundary areas which are helpful.”

Overall, the participants expressed that they felt “more independent” with the app within the museum. They used the app extensively throughout their visit and enjoyed the independence that it gave them. However, it must be noted that during this visit, the participants were not trained on how to use the app to gather information about the exhibits as they traveled. Ironically, multiple participants in their exit interview mentioned this as a needed feature.

The participants provided an array of suggestions on how to make the app more useful within the museum. Here are the most commonly expressed themes:

- *Indoor navigation.* Most of the participants wanted the app to have a feature that allowed them to know where they were within the museum. They wanted a feature such as that found in Google Maps or Apple Maps that shows their current location.
- *Compass.* Most of the participants also asked that a compass be embedded into the app to let them know what direction they were pointing. This would eliminate the need for support from a sighted person to determine their cardinal position.
- *Limitations of size.* Many of the participants expressed that many of the small areas on the map, such as the elevator and the restrooms, were very difficult to find on the iPod touch. Since the landmarks are so important to navigation, the participants asked that there be some way to locate these areas on the map with less effort.
- *Near me.* Some of the participants asked that a “near me” feature be added to the app. This would allow the participant to push a single button and receive a list of exhibits that are close to their current location.
- *Content.* Many of the participants asked for an easier way to “drill down” via the map to information about the exhibits as they passed them.

Summative (off-site)

The project team wanted to see if individuals with visual impairments could use the app to pre-plan a trip to the museum using the app. In order to collect this data, an online survey was developed in coordination with the entire team. Dr. Smith was able to provide an incentive for participation (iTunes gift cards). The entire research team utilized every means available to recruit participants to download the app and complete survey. Unfortunately, only three individuals with visual impairments completed the survey.

For those three participants, they all found the app to be very helpful in pre-planning a trip to the museum. They found the content about the exhibits to be the

most beneficial aspect of the app. However, they found the maps challenging to understand on their own. The research team hypothesized that this would be an issue and has made plans to develop a “Help Video” to support individuals who are using the app without support.

What’s Next?

With the app now tested and developed for the target audience, it has been approved for the Apple app store and can be downloaded for free. The app provides valuable accessibility and content information for anyone who wishes to use it. The North Carolina Museum of Natural Sciences purchased multiple iPod touches in order with the app installed for use by visitors with visual impairments and blindness. The Museum, with the guidance of Liani Yirka and other collaborative partners, will continue to provide opportunities for individuals with disabilities to participate as much in the museum experience as possible. Throughout this project, the museum was very receptive to recommendations to making the museum more accessible to all individuals including those with visual impairments and blindness. SAS plans to continue their partnership with the Museum including updating the app with advancements in upcoming versions and updates.

Grant Products:

The primary deliverable of the project is an iOS application that can be installed on any iOS device, such as an iPhone, iPad, etc., running iOS7 or later. The app is available as a free download from the Apple App Store. Museum patrons can install the app by searching the App Store for “North Carolina Museum of Natural Sciences” or opening the app’s download page on their device [<https://itunes.apple.com/us/app/north-carolina-museum-natural/id920517171?mt=8>].

The app serves as an interactive guide to the North Carolina Museum of Natural Sciences. The contains an interactive map of all the public spaces in the museum including all exhibits, restaurants, theaters, meeting rooms, restrooms, stairs, elevators, entrances, and exits. The app also includes a complete listing of all the exhibits within the museum. The app displays information about each exhibit including a text description of the exhibit, the location of the exhibit within the museum, and multimedia assets such as pictures, videos, or short audio clips that are part of the museum’s pre-existing self-guided audio tour.

The app contains features that allow museum patrons to virtually explore the museum and plan a visit or enhance their experience while in the museum. For example, the interactive map allows a patron to virtually explore the floors of both the Nature Exploration Center building and the Nature Research Center Building. A patron can tap on a specific exhibit and quickly view the description of the exhibit as well as multimedia assets that are related to the exhibit. A patron can also browse a listing of all the exhibits or search for exhibits by location, category, etc.

The app was specifically designed to be accessible to museum patrons of differing abilities. For example, the app is compatible with the VoiceOver screen reader that is available on every iOS device. This compatibility allows museum patrons with no vision to access all the features and functions of the app including the interactive map. Museum patrons with low vision benefit from the color scheme that includes sufficient contrast and the optional high contrast color scheme that can be enabled for the interactive maps. Museum patrons with hearing impairments benefit from the closed captions or transcripts that are provided for all the multimedia content. Museum patrons with physical disabilities benefit from the identification of wheelchair accessible entrances, exits, etc.

The secondary deliverable is a web-based Content Management System (CMS) that allows museum staff to maintain the existing content within the app and add new content as the museum exhibits evolve over time.