IMPROVING ACCESSIBILITY AT THE MONNIG METEORITE GALLERY: THE IMPACT OF IDEA ON FREE-CHOICE LEARNING IN PLANETARY SCIENCE. R. G. Mayne[1], A. Biswas[2], K. D'Spain[2], A. Matthews[2], A. Taddesse[2], A. Tuten[2] and B. Wei[2], [1]Monnig Meteorite Collection, Sid Richardson Building 244, 2950 West Bowie Street, Texas Christian University Fort Worth, TX 76109 (r.g.mayne@tcu.edu), [2]Department of Computer Science, Tucker Technology Center, Suite 341, 2840 West Bowie Street, Texas Christian University, Fort Worth, TX 76109

Rethinking Learning Environments: Traditionally, schools and universities have been considered the primary centers of learning. However, the last few decades has seen an increasing demand by the public for free-choice learning, which is defined as learning guided by a person's needs and interests [1]. Free-choice learning sources *e.g.* the Internet, television, film, books, podcasts, and Museums, are transforming the educational environment for the general public, leading to societies of lifelong learners [2]. In fact, during an investigation into how, where, and why people learn science, more than 50% of respondents attributed their scientific knowledge to free-choice learning experiences [3].

The contextual model of learning is a theoretical framework through which free-choice learning can be evaluated. It states that all learning is a result of interactions between an individual's personal, sociocultural, and physical contexts [4]. These three contexts reflect that learning is influenced by a person's own motivation and knowledge, their interactions with others, and the location and design of the learning environment. Here, we focus on the findings that (1) all learning is bound to the physical environment in which it occurs [4], and (2) learning is negatively impacted if the physical environment is not accessible to the learner [4, 5, 6]. An environment that is inclusive, diverse, equitable, and accessible (IDEA) is vital to maximize the learning that takes place in all free-choice planetary science learning.

The Changing Face of Museums: Science museums have undergone a revolution since their inception. [7] defines three generations of museums, based on their defining goals. The first museums began as private collections that primarily benefited research scholars, and it wasn't until the late 18th century that they were also viewed as a way to educate the public (the second generation). After World War II, the third generation of museums grew rapidly, with a focus only on public education. In the last few decades, a proposed fourth generation has appeared which encourages active engagement with science, alongside social responsibility [8].

Museum approaches have transitioned from the visitor as the outsider, then as a passive observer, and finally as an active participant in the science [9]. Museums of older generations continue to be popular, but, where possible, they are also incorporating principles from later generations within their exhibits.

The Monnig Meteorite Collection and Gallery: The Monnig would be classified primarily as a second generation museum, as educating the public is not its sole purpose; it comprises a scientific research collection (the Monnig Meteorite Collection) as well as a Museum (the so-called "Gallery"). Most of the exhibits within the Monnig are display cases of meteorite samples, paired with accompanying text (Figure 1). However, the exhibits do include many third generation aspects, such as an educational game and interactive video screens. While there have been some updates to the technology in the exhibits in the last twenty years, most of the Gallery remains unchanged since its opening in 2003.

Figure 1: Exhibit within the Monnig Meteorite Gallery illustrating the pairing of samples with text displays.

Significant strides have been made in Museum design in the last two decades to improve the accessibility for visitors. While a complete redesign is not possible for most older generation museums like the Monnig, it is possible to implement small, but meaningful changes.

The Monnig Gallery was viewed through an IDEA lens, with the goal of identifying areas of weakness. Here, we focus on the goal of improving the visitor experience for those with visual impairments.

The Brief: We presented the following brief to Seniors within the TCU Computer Science Program: *Design an application that allows those with visual impairments to visit the Gallery and understand the content presented.*

All computer science majors at TCU are required, as part of a senior research project, to identify and analyze a computer science problem, develop and implement a workable solution to the problem, and then document the results of their efforts. Five students selected the brief given by the Monnig for their project.

Implementation: Visual impairment is measured by examining eight fundamental visual functions: visual acuity, visual fields, contrast sensitivity, color vision, binocular function, visual search, glare and light/dark, adaptation, and visual efficiency [NRC ref]. Five of these were identified as functions that could be aided by the application. These are listed below, along with a brief description of the considerations used in application design to aid each function.

1. Visual acuity - ability to change text size, careful selection of font style and spacing.
2. Light sensitivity - ability to change backgrounds and contrast of the screen.
3. Contrast sensitivity - high contrast ratio necessary.
4. Visual fields - one direction scrolling, use of only single column text, careful selection of font style and spacing.
5. Color vision - careful selection of colors used throughout application.

The application begins with three separate menus, each with their own screen, which allow the user to customize the app to their needs. Menu 1 allows them to select their language. The beta version includes English, Spanish, and French, but later versions could include more language options. Menu 2 provides a font size selection (Figure 2), and menu 3 allows users to identify their color blindness type. These variables can be reset or changed at any time.

The Monnig Meteorite Collection database has images of all of the meteorites within the Gallery and the text from each exhibit will be reproduced within the application. The images will be shown on a high contrast background (as compared to the exhibits) to allow for better viewing of the samples. Voice transcription will also eventually be available.

Wayfinding, the ability for the user to identify where they are within the Gallery, on the application will be achieved in one of two ways. QR codes will be placed on each display case, allowing users to scan and locate the relevant exhibit on the map, when needed. In addition, bluetooth receivers will be used so that the application can identify where in the Gallery the user is located.

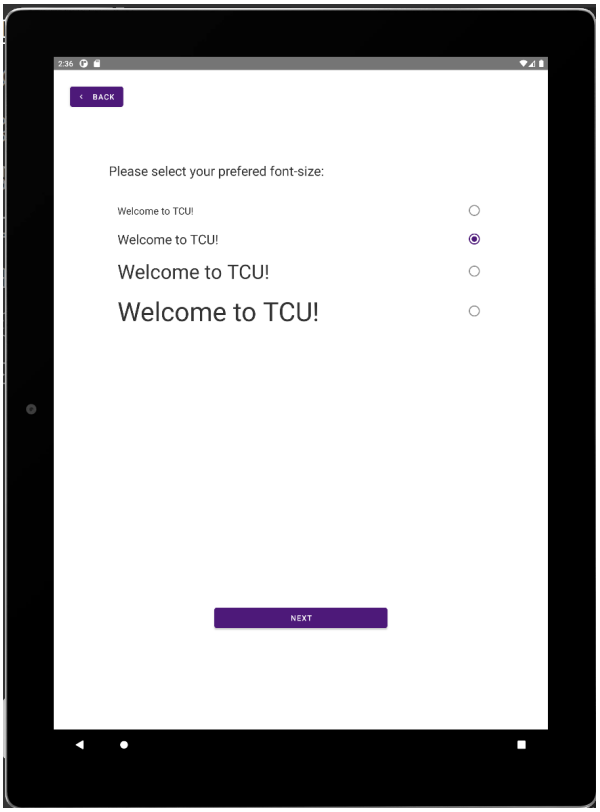

Figure 2: Font size selection menu within the beta version of the application.

The application will be made available for free through the google play store. The Monnig Gallery will also have several tablets with the application available for visitors.

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