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How Design Can Promote and Facilitate the Learning of Scientific Information in a New and Innovative Way

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HONORS PROJECT

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The final project consists of an Herbarium Collection redesign and a mock-up of an Interactive App. As a double major in Graphic Design and Biology, I set out to create a project that would encompass both fields of study while also solving a problem I had personally experienced within the field of Science. Currently there are only a few traditional approaches utilized by most college professors to teach scientific information to students. These methods include textbook readings, lectures, and PowerPoint presentations. It has been shown that the ways in which technical information is disseminated significantly affects learner comprehension and without good design the learning process can be difficult and tedious.

So the question becomes this: How can design promote and facilitate the learning of scientific information in a new and innovative way? In an age of technology and interactive media, there is a need and desire to present information in a way that doesn't bore but rather excites and engages students. Thus, I took it upon myself to create a project that would show that good design does and should have a place within Science education. More, specifically I decided to redesign content involved with tree identification typically presented in most college level Plant Taxonomy classes. This then provided me with a vehicle in which to illustrate how design can enhance one's experience with and the understanding of scientific data that is communicated through a unique and nontraditional format.

The process I followed to reach the final outcome of this project was extensive. I was lucky enough to be enrolled in two classes that were beneficial to this end. These were Interactive Graphic Design and Plant Taxonomy. Within my Interactive Deign course, the appropriate design of an Application for the iPhone 5 was taught. The steps to create an

App were not as simple as one might think. To begin, the audience must be determined. Then the question, of how and where the users would apply the App should be considered. I chose an audience that had minimal formal training in the sciences. This demographic tended to be somewhat disinterested in the scientific field because of the wordy, technical and often confusing language used to explain and present information. Furthermore, this audience allowed me to take on a more superficial approach to the dissemination of information and thereby avoid the possibility of the learner getting caught up in explanations of convoluted scientific processes. I wanted to make sure this project, while providing important data and information, centered more on the design and the clear visual presentation of the information for learning.

After I chose an audience for my App I began structuring a location while considering why someone would use the App. This then turned into the generation of the following online description of the App that one would see if it were an actual App in the Apple Store:

> *Download this fun, easy App to identify the trees around the pond, located near the Bowling Green State University's Recreation Center. Take an interactive tour around the path of trees and discover more about the morphology, origin, sustainability and replacement cost. Not only will this App help you become more familiar with certain types of trees, but it will also give you a better understanding of what kind of trees you should or shouldn't plant within your backyard. By having a place on campus accessible to students and faculty, this App will allow for an interactive experience where you can explore and actively learn.*

After coming up with an appropriate idea for an Application, the design and structure of the App was the next logical step. I decided to name the App and project in its entirety, *Tree Tag.* The name originated from the fact that in tree identification, botanists will often place a metal, labeled tag on the tree so that future visitors can identify the tree. Thus I thought I would continue this tradition while also structuring my designs around this idea of tagging a tree with a physical tag. For example, the logo or App icon illustrates this Tagging idea by incorporating the circular shape of a tag in juxtaposition with the sharp, geometric leaf shape, and thus symbolizing the name *Tree Tag*. Finally, the color for the system design was chosen to contrast any included photos of the trees which consist of lighter greens and browns.

The structure of the App was the next step in my process. I wanted the App design to be simple while simultaneously stimulating the viewer visually. I used a lot of symbols in combination with type to easily communicate with different types of learners. The grid structure is also simple so as not to overload the screen with so much information that the viewer becomes inundated. I made sure that every key and button was necessary so once again, the user did not become confused about what information was being presented and so that he or she could navigate the system without becoming frustrated. The most important and difficult part for me to design was the layout of the App. Making sure every screen and path within the App made logical sense was a challenge but required a lot of sketching and trials of organizing the information in a hierarchical way.

The typography for the App was the last to be selected. Only when the App design had been fully laid out did I realize what I wanted to portray with the type. Because I was

taking a traditional medium, the practice of tagging trees and data basing of trees, and then placing it in a modern context online, I wanted to use a typeface that directly expressed this. Gill Sans MT was chosen to represent a more modern sans-serif typeface while the Georgia typeface, which has a serif, was chosen to represent all that is traditional. Furthermore, both of these typefaces were easily transferable online and were readily supported by users' computers.

Now that I have discussed some of the visual construction considerations for the project, I want to go into the other more physical tasks required to collect the necessary information to be included within the App. Here is where my Plant Taxonomy class, taught by Helen Michaels, became a huge asset to my project. A requirement of this class was to go into the field and collect specimens of trees and plants. Students then had to complete a pressing process and ultimately place their collections within a larger collection located in the Bowling Green State University Herbarium, a room where preserved plant specimens are stored.

For the most part the specimens collected were plants or trees with leaves and reproductive parts such as fruit or flowers. For a few of my specimens I was unable to collect reproductive structures. However, when possible these were included within the collection created for the project. A press made up of two wooden planks or lattice and layers of cardboard with blotter paper held together with two adjustable straps was used to do the actual pressing (see pictures on CD, II. a.). The plant specimen was then carefully placed between two sheets of newspaper with some of the leaves facing up and some of them facing down, so that a viewer could get a more comprehensive understanding of the plant after it is glued down. Sometimes it was necessary to place tape on the branches so

they would not move while adding a layer of blotter paper and cardboard on top and then tightening the whole bundle between the wooden boards/ lattice. After the plants were securely placed within the press, the presses were dried within an oven-like cabinet, which circulated hot air around the press until the plant material had been fully dried. This process usually took about three to four days.

Once the process of preserving tree samples was completed, one other step was required. The plants were placed on special acid free paper using PVA glue and were pressed again to ensure proper drying and to secure the foliage to the paper. While gluing one must be careful that glue does not run over the edges of the leaves and branches and also make sure there is approximately a one inch margin around the specimen. Finally, the placement of the specimen must be such so as to leave room for a label at the bottom right of the page and a fragment packet at the top left.

Following gluing, labels were created so that anyone examining the specimen would know exactly what they were looking at, where it was collected, the day it was collected, and who collected it. However, after seeing this labeling process in completion I thought that I could design it differently and make the whole labeling system more technology friendly. The label was something I could change easily without completely deviating from the entire Herbarium collection scheme. I decided that using a QR code would save space on the paper and also allow the viewer to become more engaged in the material they were attempting to gather from the specimen. By simply scanning the QR code, within seconds an individual would be redirected to a site (erynpierce.com) displaying all the proper collection information (see pictures on CD, III. a.).

To take this a step further, I decided to include pictures of each representative tree specimen and actual pictures of the trees in their full form from the area around the BGSU Recreation center pond. This extra step made it easier for students or factuality examining the specimens to keep the information with them on their smart phone device and also gather the information without having the specimens directly in hand. Also, providing pictures of the trees in the field put the pressed specimens into context, especially the pine or spruce tree specimens who tended to lose their characteristic needles and color when stored in the Herbarium.

The Herbarium specimens currently stored here at BGSU have been collected in the same manner since the late 1800s and I believed it was time to utilize a more up-to-date approach since technology is so readily available and prevalent. I think that by taking this form of learning to an entirely different level, I have opened up a new range of possibilities for the Herbarium. If every specimen is incorporated into this online experience, I believe learners would be more excited and interested in the material and would want to utilize the herbarium for more than just a reference for identifying their own plant specimens. So now if someone wants to see defining characteristics of a species they are studying, they can pull from one of my collected specimens and not only retrieve the general taxonomic information, but also gain interesting facts regarding the plant's morphology, origin, sustainability, and replacement cost.

For each tree specimen in my collection, I made certain to have information that would be relevant to viewers not only within the biological field but also those with a general interest in trees who might want to know what they should or shouldn't plant within their own backyards. These topics included within the website linked to the QR

codes in the collection redesign and within the mocked-up App, were those covering a tree's morphology, origin, sustainability, and replacement cost. Morphology was meant to include basic defining characteristics of the tree such as the flower type and color, the shape and structure of the leaves, and also simple illustrations to further help with identification. The next section identifies the origin of the tree and clarifies whether the tree is invasive, native, or non-native to the area. Following this, viewers can discover each tree's sustainability factors. These include the amount of sun the tree needs, whether it can withstand urban environments, how much maintenance the tree needs to survive, and its beneficial impact on the environment as a resource for humans and animals alike. To make it easier for the viewer to determine if the tree is a good sustainable plant, a rating system was also utilized.

Steve Foltz the author of *Sustainable Plants Rating System* (http://www.plantplaces.com/SustainabilityRatings.shtml) and the Director of Horticulture at the Cincinnati Zoo and Botanical Garden in Ohio, created the creditable ranking system. This rating system ranges from 1 to 5, with a 1 indicating the tree in question as the least sustainable and a 5 the most sustainable. The number assignment is based on the average height and size of the tree (the larger the tree the more beneficial it will be for various ecosystems, the more shade it will provide, the more carbon will be absorbed, and the more green added to a space) and also the type of tree (herbaceous verses coniferous, etc).

Finally, replacement cost of a tree can be found in my App and Collection redesign. The process of determining a tree's calculated replacement cost was extensive because a variety of factors are involved. In general the cost assigned to tree is relative to the current

tree diameter. The larger the tree the more expensive the tree will be to remove. The formula is as follows:

Tree Value = Base Value × Cross Section Area × Species Class × Condition Class × Location Class.

The Base Value "is the dollar amount assigned to one cross-section unit (square inch or square centimeter) of a tree's trunk cross-section area. It is based on the cost of the largest available replacement plant of similar species" (Purcell, http://www.extension.purdue.edu/extmedia/FNR/FNR-473-W.pdf). The Cross Section Area is dependent on the specific tree's diameter and thus the replacement cost will be different for every tree. Next, the Species Class number "is an assigned value based on all the landscape merits of a landscape tree species and its accompanying potential for problems." The relevant criteria for this assessment include "form, color, growth habit, flowering and fruiting characteristics, structural strength, longevity, insect and disease resistance or susceptibility, and maintenance requirements" (Purcell, http://www.extension.purdue.edu/extmedia/FNR/FNR-473-W.pdf).

Also included in the formula, is the Condition Class, which is a number between 0-100. The number is then chosen based on the individual tree's health and overall structure. Finally, the last value used within the calculation, is the Location Class value. Depending on where the tree is planted and what type of landscape in which it is located this number is assigned. All together these numbers will predict the replacement value of the tree and will also help determine if the tree is a good investment should the user decide to plant the tree within his or her own yard (for more information about how the trees I collected were rated and classified look at the CD, IV. b.).

To discover what types of trees were to be included in my collection I visited the BGSU Grounds Department. This is where I was able to obtain detailed maps of the trees, their specific location, and common names. Although these maps were extremely helpful for identifying the trees in general terms, they did not provide the scientific name, or the cultivated name. For example a Maple tree was simply labeled, "Maple" on the Map when it should have been called a Hedge Maple. This is where my taxonomy books and other textbooks came into play, along with the help of Jacob Meier, the Taxonomy Class Teaching Assistant. By using keys that asked questions about the tree's characteristics, I was eventually lead to the correct identification of the tree and was able to accurately identify all 17 different species of trees seen around the BGSU Recreation Center pond.

Considering all of the preliminary work I put into creating this project, I am very satisfied with the results. Not only have I created an idea for an interactive Map that learners of all ages can utilize, but also I have achieved a more engaging Herbarium Collection system that could change how botanists and scientists alike look at the information they are presenting to students and other interested individuals. I predict that if more individuals take the time to consider new ways to share, organize, and collect information, similar to how I treated the collection of trees, there will be a positive change in how those on the receiving end perceive that information. Technical material once considered boring, can help the user make connections between his life and the world around him. Armed with new insights the learner is equipped to question his own actions when it comes to the environment.

If I had a chance to do this project again I would seek funding so that a functioning App could be created following the mock-up of my idea. I think this App could be

something special for the University and would create a hot spot where students from other universities and schools could visit and practice their tree identification skills while also learning about what factors help determine whether a particular species would make a good back yard planting. In the future I hope to expand upon the project to make my ideas more of a reality. By making an outside installation that could be used in conjunction with the App and Collection Redesign, the project will seem more complete.

I envision the installation including a permanent entrance sign by the pond that would introduce the visitor to the project and direct them along the pathway of trees. A unique label would then mark the tree and display the tree's information and a QR code with which to scan to redirect the user to an informational blog. I have been doing research on what type of materials would be best for the trees and I picture using metal tags that I would etch with a laser so as to ensure the information's permanency. As a goal before I graduate I hope to create the last technical piece of this project for my senior thesis and show the work at the BFA show in April 2013. I would also like to display the pressed specimens with my unique label inside shadow boxes so that the viewer can get a full picture of what I have created (see completed pressed specimens on CD, III. b.). My hope is that viewers visiting the show that lack a background in science will attempt to interact with the project and be inspired to learn more about trees and the characteristics that make them unique.

Works Cited

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Dougherty, Brain. *Green Graphic Design*. New York: Allworth, 2008. Print. This book explores a variety of alternative forms of paper and plastic products that can be used in environmental packaging and print design. The goal of this book is to raise awareness about the environmental impact certain paper and plastic products have on the earth. Graphic designers, who want to become more conscious of the types of materials they incorporate within their designs, are the primary audience of this book. This resource is unique because it contains a current list of environmentally safe inks, plastics, and paper products that could be purchased from companies across the country. The author of this book, Brian Dougherty, is the founder of an eleven-year-old graphic design firm, Celery, that focuses on green design and brand strategy.

Foltz, Steve. "Sustainable Plants Rating System." *Plant Places*. HortWebsites.com, Plant Trails, Zoos Best, Cincinnati Zoo, 1 Jan. 2007. Web. 2 Dec. 2012. <http://www.plantplaces.com/SustainabilityRatings.shtml>. This Website is a helpful resource in identifying cultivated varieties of plants found throughout Ohio. Also, the website includes a sustainability rating system that ranges from 1 to 5. A 1 is the least sustainable and a 5 is the most. This article about sustainability goes into

extensive detail about how the numbers are assigned to each plant and the credibility of the people and organizations involved in creating the system. The website would be a great resource for any person with a botany background seeking to identify a plant. The author of the article is the Director of Horticulture at the Cincinnati Zoo and Botanical Garden in Ohio.

Harris, Melinda Woolf, and James G. Harris. *Plant Identification Terminology an Illustrated Glossary*. 2nd ed. Spring Lake: Spring Lake, 2004. Print. An excellent recourse for any student or professional plant enthusiast that is trying to decipher a plant key, this text includes illustrations and descriptions of complex plant taxonomy terminology. This book is used by botany classes across the country to help students learn the terms necessary for accurate identification of plant specimens.

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"iOS Developer Library." *Apple Developer*. Apple, 2012. Web. 2 Dec. 2012. <http://developer.apple.com/library/ios/#documentation/userexperience/conceptual/mobilehig/Introduction/Introduction.html>. This specific part of the website was created for anyone looking to create an App with iOS interface. The site goes into the process for creating and designing an App from the ground up.

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spends viewing information that contains visuals versus information without. This article is meant for individuals looking to get a more in-depth understanding of how humans learn effectively. The author, Richard E. Mayer is a professor of Psychology at the University of California and has authored more than 400 publications.

Nokes, Jessi, and Erin Sappington. "At First Sight: Improving Your Training with Good Visual Design." *American Society for Training and Development* 64.8 (2010): 31-33. *Academic Search Complete*. Web. 21 Apr. 2012. This article is a guide to presenting information effectively and explains how to use visuals in an appropriately designed manor. Not only does this article give practical presentation tips, but it also supports its reasoning with facts on how visuals like pictures and graphs improve learning and recall. This article is intended to be for any individual looking to present information in an engaging and memorable way. The authors, Jessi Nokes and Erin Sappington, are college graduates and work for Vivid Learning Systems, a leader provider of online training solutions.

O'Bannon, Blanche, Kathleen Puckett, and Glenda Rakes. "Using Technology to Support Visual Learning Strategies." *Computers in the Schools* 23.1/2 (2006): 125-137. *Education Research Complete*. Web. 21 Apr. 2012. The article is very recent, and signifies the importance of using visual technologies as learning tools in the classroom. By going into details regarding the effectiveness of visuals in terms of learning textual information, teachers and educators are able to adopt ideas for learning into their own classrooms and school environments. Such ideas include, using programs that allow students to improve long-term memory by creating visual storyboards and mapping out ideas and concepts. The author, Blanche O'Bannon, is a professor at the University of Memphis in Memphis Tennessee and teaches courses in Educational Technology.

Purcell, Lindsey. "Tree Appraisal." *Purdue University*. Purdue U, 2012. Web. 2 Dec. 2012. <http://www.extension.purdue.edu/extmedia/FNR/FNR-473-W.pdf>. This article on Purdue University's educational website was written by Lindsey Purcell a Urban Forestry Specialist at Purdue University's Department of Forestry & Natural Resources. The article is helpful for anyone looking to know the price of replacing a specific tree by using a set of charts and a simple formula. This article is helpful because not only does it provide step by step directions and examples on how to estimate replacement costs of tress, but it goes into detail about the size, species, condition and location when assessing the value of a tree.

Rabeler, Richard K. *Gleason's Plants of Michigan, a Field Guide*. Ann Arbor: U of Michigan P, 2007. Print. This book allows any individual with a background in Botany to identify a plant with a series of keys. There are a few visuals included to help one compare a plant specimen's characteristics with the illustrated version displayed in the book. Finally, this book is a revised and expanded copy of Henry A. Gleason's field guide, *The Plants of Michigan*. The author, Richard K. Rabeler, is a Senior Research Museum Collection Manager and an Assistant Research Scientist at the University of Michigan Herbarium.

Appendix
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