DESIGNING A GPS MOBILE TOUR—A LESSON IN USER-CENTERED DESIGN

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This case presents the design of a GPS (Global Positioning Satellite) guided smartphone tour. The tour was a redesign of an assignment for an introductory Physical Science course in which students take a guided tour of a local canyon. The app is downloaded to students' personal devices and provides a guided tour. I am giving special attention to how the user's experience is shaped by the environment, technology and social context which surrounds the tour.

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INTRODUCTION

The computing power of modern day smartphones combined with GPS technology has made it possible to provide context sensitive information based on a user's location. This combination of technology is used daily to provide directions to tourists, travel information for commuters, and even virtual monsters for gamers (Biseria & Rau, 2016). It was this technology which led to the proposal of *the Rock Canyon Mobile Tour*.

Rock Canyon, a hiking destination in Provo, Utah, is visited each semester by students enrolled in an introductory Physical Science course at nearby Brigham Young University. A single day is scheduled each semester for students to participate in a guided tour highlighting geological features throughout the canyon. Students are required to complete an assignment that involves answering questions about their experience at the canyon.

Unfortunately, due to the limited availability of the tour, many students are unable to take advantage of this opportunity. The Rock Canyon Mobile Tour was designed with the purpose of providing these students an alternative method for learning about Rock Canyon's geology.

This project was completed as part of an undergraduate mentor program which allows students to propose and receive funding for various projects. As the primary designer of this tour, I was an undergraduate student who had been unable to attend the TA (Teaching Assistant) guided version of the tour while enrolled in the course. Although the course's faculty members were enthusiastic for the mobile tour's creation, little direction was provided as to the tour's design.

My only experience designing instructional materials prior to this project involved the development of instructional videos for teenagers with intellectual disabilities. I also began this project with basic coding skills and prior experience designing GPS based activities through Geocaching as a hobby. Specifically, my experience Geocaching included

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the creation of a GPS tour that guided geocachers to various statues throughout my university campus.

OVERVIEW OF THE ROCK CANYON MOBILE TOUR DESIGN

Students are introduced to the Rock Canyon Mobile Tour via an email sent out by their professors providing a brief explanation of the tour and how to access it. The mobile tour is accessed on iOS or Android devices by downloading the Massachusetts Institute of Technology's (MIT) Taleblazer app. After downloading the app, students are able to access and download the content of the tour to their personal devices. Upon clicking start, students are presented with instructions to travel to a parking area located at the mouth of the canyon. They also are reminded to bring water, sunscreen, and to wear appropriate clothing. A map is provided and a green triangle icon is placed where students are directed to go.

Throughout the tour, students have access to three menu items at the top of their screen: Map, Inventory and Log. The Map option provides students with a map displaying their current location and any icons associated with *points of interest* (POI) along the tour. The Inventory icon allows students to review any of the information presented at POIs along the tour, and the Log option presents a record of all actions the student completes along the tour.

Upon reaching the parking area, students are presented with a description explaining the tour and a brief outline of the canyon's history. They are also reminded of how to receive credit for the assignment once the tour is completed. Throughout the tour, nearly all content is presented using rich text and images.

Following this introduction, seven new POI icons are displayed on the map. Students are then instructed to visit and learn about each location to complete the tour.

Once students arrive within 30 meters of a POI, a ringing sound effect is played and an image is displayed on the screen of a nearby geological feature with options to learn more about it. Information about these features is presented as text, images, or instructional videos.

FIGURE 1. This screen capture shows the map view within the tour app. Students are shown this screen displaying the first location after clicking start and reviewing the instructions for the tour.

After completing all of the actions at a POI, the icon for that location is removed from the map and the information about the location is added to the student's inventory where it is available for review. I determined this process to clearly indicate which POIs still needed to be visited. Once students

FIGURE 2. This screen capture shows the first message displayed to users upon their arrival to Rock Canyon.

have visited and completed the actions at all seven locations, a final message is displayed, and students are provided a link to an online survey to report their experience.

DESIGN CONTEXT

Several factors directly impacted the final design of the Rock Canyon Mobile Tour. These included the design team, the environment of Rock Canyon, the possible social context of students who would use the tour, and the technology used to create and complete the tour. I will explain each of these influences and how they contributed to the overall design.

The Design Team

The design process began with an initial meeting between me and two professors who oversee the course. This meeting helped to establish a vision of what the mobile tour

FIGURE 3. This screen capture displays icons at the seven locations students must visit in order to complete the tour.

would become. Both professors expressed that their primary goal for the mobile tour was for students to experience learning about geology outdoors instead of solely relying on textbooks and classroom instruction. They were less concerned with specific learning outcomes and more concerned that students had a positive experience. As a result, many of the decisions regarding the content and parameters of the tour were left up to me.

Although I had some familiarity with designing GPS based activities as a hobby, I lacked content expertise regarding geology. As a result, I relied heavily upon the content covered in the TA guided tour and relevant resources available online through the course website. To better familiarize myself with this content, I made several visits to Rock Canyon to identify specific locations to use for the tour. I also attended and recorded audio from the TA guided tour to deepen my understanding of the current assignment and its content.

FIGURE 4. This screen capture shows how content options are displayed when the learner arrives at a POI.

FIGURE 5. A photograph of Rock Canyon's walls.

Outdoor Learning Environments

Designing a learning experience for the outdoors required me to consider the terrain and weather of Rock Canyon.

Canyon Walls

Due to the abrupt nature of the canyon walls, cellular service in the area is generally very limited. This obstacle eliminated the option of using tools that rely on a data connection to deliver content to the user once triggered by the device's GPS coordinates. Instead, the tour would require a tool that allowed for nearly all content to be downloaded prior to arriving at the canyon.

To fit these constraints, I discovered two tools: *Wherigo* by Groundspeak and *Taleblazer* by MIT. Both of these tools offered the features necessary to create a data-free tour. I had prior experience using *Wherigo*, and it allows for greater customization. However, I chose to use *Taleblazer* because it does not require programming knowledge and has a graphical user interface (GUI) that would make later maintenance of the tour easier for future professors and TAs.

Weather

The changing of the weather and seasons also affected the design of the tour. In particular, this impacted the selection of geological features to use as POIs along the tour. The Provo area receives regular snowfall each year. This meant that the geological features needed to be both visible and accessible in snowy conditions. For safety purposes and practicality, this also meant that students could not be required to stray far from the main trail in order to visit a particular site. Based on this information, I chose not to include certain sites normally visited when students travel in large groups guided by a TA.

There were multiple times while testing the tour that I came to the canyon to find it was a few degrees cooler than expected or that I had not brought sufficient water. This experience led me to include an initial message to display before students arrived at the canyon reminding them to bring water, wear appropriate clothing, and bring good shoes.

Riverbed

A small river running through the canyon added further complexity to the design process. The selected POIs resided on either side of the river so that during late summer, winter and fall, students can freely cross the river bed at several

FIGURE 6. A photo showing the empty riverbed of Rock Canyon.

Dropstones

On the Northeast side of the water tank you will find a dark rock in the wall roughly 30 cm wide (see photo).

Found it!

Video

FIGURE 7. A screen capture providing specific directions once students have arrived within 30 meters of the POI.

locations. In the spring, however, a bridge located near the parking area becomes the only crossable location. This obstacle was only brought to my attention as I tested my initial design and found that I regularly crossed the river using paths through the riverbed.

I had originally envisioned the mobile tour as guiding students to each location one after the other in the way TAs guided students on the regular tour. Recognizing that the seasonal flow of the river would impact which route was most convenient and that students would be participating in this assignment throughout the year, I redesigned the tour to allow students the

freedom of choosing their own path and visiting the POIs in any order.

Social Context

A significant difference between regular tours and self-guided tours is the possibility that individuals will complete self-guided tours on their own instead of with a group. From a design standpoint, I assumed that most users would complete the mobile tour alone or in small groups. The most significant impact of this assumption was its influence on how directions were provided.

Guidance

On-site directions at the canyon is an important role TAs typically play throughout the original tour. Specifically, TAs guide students to each POI and point out precise features at those locations. As I journeyed around the canyon on my own to select POIs, I found certain features were difficult to identify without this kind of assistance. I chose to provide students with both general and specific directions as they drew closer to each location because I understood students in this context would have similar difficulties.

For example, at one point, students are instructed that the best route to the "Dropstones" POI is to cross the bridge and follow the trail towards a water tank. Once students have approached within 30 meters of the POI, a beeping noise plays and a message is displayed informing the student that the dropstone they are looking for is on the northeast side of the water tank.

Ranges smaller than 30 meters to trigger content were tested; however, they were found to be unreliable as the canyon walls occasionally led to a bouncing GPS signal.

Technological Context

From the beginning of the design process, the technology required for a mobile tour had immediate influence on the design. It was essential that students willing to participate in the tour had reasonable access to obtain the hardware and software required to complete the tour.

Hardware

Poll (2015) estimated that 85% of college students regularly use a smartphone. Based on this information and similar observations by the professors responsible for the course, it was determined that students had reasonable access to phones that could handle GPS triggered applications.

Another important concern regarding hardware is battery life. At the time of the mobile tour's creation, TaleBlazer did not support audio recordings. Thus, the tour would require students to actively use their devices throughout the duration of the tour in order to navigate to the various sites and access the instructional materials.

Software

As previously noted, the MIT TaleBlazer tool and Groundspeak's Wherigo platform were selected because they allowed for students to access the mobile tour content regardless of connectivity. I selected TaleBlazer over Wherigo because of its ease of use for both development and implementation.

For development, TaleBlazer provides a web based GUI for tour development that uses a block-based coding language instead of requiring the developer to know a coding language. As the designer, I was confident I had the technical skills necessary to use each of the tools under consideration; however, I realized that the future maintenance of this product would be dependent on the technical ability of future TAs and professors rather than my own.

For students participating in the tour, TaleBlazer offers both an Android and iOS app. The interface of these apps also provides straightforward directions for downloading and accessing nearby tours. For these reason TaleBlazer was selected for this project.

Testing and Debugging

In my initial planning, I underestimated the extent to which testing and debugging would play a role in the design process. I attributed this underestimation to my lack of experience designing instructional materials and my unfamiliarity with TaleBlazer, including an overconfidence in the smooth-running demo tours provided by MIT.

Choosing Taleblazer limited the availability of the tour to Apple and Android devices. I determined that successful testing on each type of device would be required before the project was complete. Testing on both platforms was done to ensure a smoother experience for the students.

Striving to use both platforms led to several modifications in how the tour was designed. For example, the initial implementation of the tour revealed one POI after another to guide students along the trail. This required frequent hiding and unhiding of POI's on the map as students traveled throughout the tour. While this implementation ran smoothly on the iOS app, it frequently crashed on Android devices. This meant the tour had to be redesigned to include far fewer actions of this kind than originally planned.

Designing for Accessibility

This particular course is a required general course for all students who enroll at Brigham Young University. As a result, students vary widely in their backgrounds and physical capabilities. The TA guided tour requires students to travel approximately one mile round trip. As most students are able to complete this trip, the mobile tour was designed to follow the same general path.

In the past, students who could not complete the tour were provided internet resources about Rock Canyon. Unfortunately, these resources were not designed specifically for this course and focused on more advanced topics.

To accommodate the needs of these students, I designed an accessibility feature for the mobile app. These students are provided with a passcode that enables them to learn about every POI by clicking each map icon. Because this option removed the student from the canyon, I chose pictures for each POI that included all of the features referred in the videos and text.

Background Knowledge

Originally, after downloading the tour, students received their first instructions once they arrived at the Rock Canyon trailhead. It was assumed they would know how to make their way to Rock Canyon because they would be introduced to the option of completing the mobile tour in class. This assumption was challenged after considering the possible context of students who would choose to complete the mobile tour. I realized that many of these students would likely be participating in the mobile tour precisely because they were not present when the tour options were discussed in class.

For this reason, the information provided at each POI was explained in such a way that students could understand the content regardless of whether or not they had been in class.

Additionally, I chose to include directions regarding what students must do to earn credit for completing the tour because those instructions may have only been provided in class.

CONCLUSION

This was my first experience designing an instructional tool for a college-level course. This project led me to think carefully about user-centered design.

The choices I made, such as choosing one tool over for its ability to deliver content in remote locations came from considering the users' needs and the environment users would be placed in. These choices might be applicable to a range of other design situations in which I might find myself.

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