Libr-AR-y Tours:

Increasing Engagement and Scalability of Library Tours Using Augmented Reality

Author Names

Sarah LeMire (corresponding author)
First Year Programs Coordinator
Texas A&M University Libraries
slemire@library.tamu.edu

Stephanie J. Graves
Director of Learning and Outreach
Texas A&M University Libraries
stephaniegraves@tamu.edu

Michael Hawkins
IT Consultant for Learning Technologies
Texas A&M University Libraries
hjm@library.tamu.edu

Shweta Kailani
Senior Instructional Designer
Texas A&M University College of Liberal Arts
skailani@tamu.edu

Libr-AR-y Tours:

Increasing Engagement and Scalability of Library Tours Using Augmented Reality

Abstract

Orienting patrons to library spaces, collections, and services is an important, but time-intensive, challenge for many librarians. Library tours are one strategy commonly employed to familiarize patrons with library spaces and services. Augmented reality provides a new opportunity for librarians to develop engaging and interactive unmediated tours. Augmented reality tours provide participants with an opportunity to explore library spaces and service points while affording librarians the chance to share valuable information about those spaces and services. This article details how one library constructed an augmented reality tour and shares assessment-based insights into participant responses to the augmented reality format.

Keywords

augmented reality; library tours; scavenger hunts; outreach; assessment

Introduction

Libraries have more than just books. This simple message, together with more detailed information about the extensive services and programs offered by modern academic and research libraries, is delivered by librarians each year as new students, staff, and faculty arrive on university campuses. Library tours are a common method that librarians use to orient new patrons to library spaces, collections, and resources. However, providing tours is a time-intensive process, and even the act of coordinating a large number of tours can eat up precious staff time. For this reason, a number of libraries have moved to self-guided tours that participants can follow on their own time and which require little coordination for staff.

This article describes a new approach to the self-guided library tour. Librarians and staff at Texas A&M University, one of the largest universities in the United States, turned to augmented reality (AR) for an unmediated approach to library tours. Augmented reality, a technology recently made popular with the Pokémon Go app, enhances the experience of viewing one's physical surroundings by superimposing a virtual layer of information in the form of images, video, or other digital content. Texas A&M University Libraries' AR Tour is designed to provide an engaging and interactive tour experience to first-year English composition students. The AR Tour scales easily to accommodate hundreds of students without overwhelming tour coordinators or staff at library service points. Librarians piloted the AR Tour in the Fall 2016 and Spring 2017 semesters and after each semester assessed how participants responded to the tour. This case study describes how the AR Tour was conceived, developed, and implemented. It also provides detailed, assessment-based insights into how participants responded to the AR Tour model.

Literature Review

Librarians have been increasingly interested in leveraging the benefits of augmented reality to improve library services and increase patron engagement. The library literature features articles from recent years discussing the potential of augmented reality to improve library services, introducing benefits such as improved patron wayfinding, facilitated shelf reading, and the ability to highlight unique library collections (Eckart 2011; Farkas 2010; Hahn 2012; Hodgson, Lambert, and Ramirez 2012; Meredith 2015).

While a substantial portion of the library literature explores prospective use cases for AR, there are several articles that describe AR projects in varying stages of development. For example, van Arnhem and Spiller describe a soft-launched augmented reality prototype intended to connect

library patrons with supplemental information and context about local artwork housed in the library (van Arnhem and Spiller 2014). Armstrong, Hodgson, Manista and Ramirez from the University of Manchester describe their pilot of the SCARLET project, which used augmented reality to enhance students' learning about both primary and secondary sources in special collections (Armstrong et al. 2012). The authors observe that, in a special collections environment, "AR enables students to experience the best of both worlds: to enjoy the sensory delights of seeing and handling original materials, while enhancing the learning experience by 'surrounding' the object with digital images, online learning resources and information on the items before them and on related objects held in the library and elsewhere" (Armstrong et al. 2012, 54).

Some scholars have provided examples of technology-based models for orienting students and visitors to their libraries. For example, librarians have created photo and video-based library self-guided tours, QR-code based audio tours and video tours, and beacon-based tours using videos to convey informational content (Bradley et al. 2016; Foley and Bertel 2015; LeMire et al. 2017; Mikkelsen and Davidson 2011; Whitchurch 2012). In recent years, librarians have begun to explore augmented reality-based approaches to tours, scavenger hunts, and other library orientation activities. One popular strategy has been to use augmented reality applications such as *Aurasma* to create interactive self-guided tours for students. Librarians at the University of Houston Downtown used *Aurasma* to structure an orientation for students using pop culture-infused videos (Lota and Tschaepe 2015). Others have used the apps *Aurasma* and *Junaio* to create video and text-based self-guided tours that are intended to improve engagement with patrons (Berrish, Jambhekar, and Yue 2013; Mulch 2014). In addition to tours of library spaces, some libraries have developed augmented reality tours of their campuses. For example,

BeaverTracks from Oregon State University's libraries provides participants with a geolocation-based historical walking tour of campus that features images from the University Archives (Griggs 2011).

Overall, there remains little information in the literature regarding outcomes and participant responses to augmented reality projects despite the continued growth in the number of AR articles focused on potential library use cases. One study, by researchers at National Chengchi University, found that elementary school students who used an augmented reality-based game to learn the Chinese library classification system performed just as well as they did after traditional instruction (Chen and Tsai 2012). While this study demonstrates the potential for augmented reality in some library instruction scenarios, it primarily focused on learning performance rather than on affective outcomes. Further, a focus group following the SCARLET project found that "the use of this kind of technology and methodology was vital to their own studies and highlighted that they felt that the SCARLET project is part of the future of education" (Armstrong et al. 2012). This project further demonstrates the potential value of AR in a library context, but both the project scope and the assessment were limited in nature. In addition, some of the projects that did not report formal assessment did include a few comments from participants, suggesting that they are gathering and incorporating participant feedback (Boyadjian 2014; Mulch 2014). This case study helps to fill a gap in the existing literature by demonstrating how AR has the potential to address issues of scale in library instruction and outreach, and by providing an in-depth look at the affective nature of participants' responses to an AR library tour model.

Background

The Texas A&M University Libraries has a robust instruction program that reaches a large number of early undergraduate courses. Like many university libraries, one of the primary collaborative partnerships is with the English department's composition and rhetoric core course, ENGL 104. This course addresses foundational composition skills, is typically taken by freshman or sophomore students, and many sections are taught by graduate teaching assistants. In the fall semester, there can be more than 60 sections of ENGL 104, with 25 students enrolled in each section. The spring semester is slightly smaller, with between 45-50 sections of the course. The total student population enrolled in the course ranges between 2,000 to 3,000 students annually.

Librarians at Texas A&M University teach at least one information literacy instruction session for the majority of ENGL 104 sections. The scheduling, coordination, and instruction of a multi-section program of this scope takes considerable resources, both in time spent by multiple librarians and allocation of library facilities to host the sessions. Instruction sessions typically occur about halfway through the semester, when students are assigned their annotated bibliography and research paper project. After several years of successful information literacy instruction sessions, a seasoned English graduate student who was working with the English department to revise lesson plans for the course approached librarians about adding an additional library visit to the standard ENGL 104 curriculum. Librarians were thrilled by the invitation, seeing it as an additional opportunity to work with students and an indication of the value of the library's instruction program. However, the specifics of the proposal were problematic. The graduate student proposed a library scavenger hunt which would be taken by ENGL 104 students during a single week at the beginning of the semester. The articulated learning outcomes were to

orient students to the locations of key library service points, introduce essential library services, and demonstrate how to find library materials such as books. If all ENGL 104 sections participated, an estimated 1,500 students could descend on library service points over the course of several days during the busiest time of year for circulation and reference desk personnel. After discussions, the librarians determined that the scale of a traditional face-to-face scavenger hunt would overtax the library's staff and service points. The library also could not provide the additional personnel for service desks required to ensure that the scavenger hunt would be successful. Further, past experience with scavenger hunts had taught the librarians that staff involved in providing support would benefit from additional training to ensure students receive complete and correct information. This, however, would increase the burden on already limited resources. To address issues of scale, minimize staff time, and strategically allocate resources, the librarians concluded an alternative to a face-to-face scavenger hunt was required.

The librarians, together with other library and English department stakeholders, formed a project team to explore alternatives to a traditional library scavenger hunt. Initial brainstorming resulted in the concept of using AR to create a self-paced library tour that students could take on their own time, alleviating scheduling and facilities concerns. By placing the content into a virtual application, the tour could be unmediated by staff, reducing the strain on personnel and service points that would typically answer scavenger hunt questions or provide clues to the next location. The only allocation of staff resources necessary for the success of the project would be by the project team as the application was developed and tested.

Developing the AR Tour

App Selection

The project team had only six weeks between the initial proposal from the English department and the deadline for full project implementation. Given this constraint, the team needed to work quickly. It was clear that the project would require the use of a pre-existing augmented reality app, since the tight timeline did not allow for a custom-built solution. A few project team members volunteered to explore available apps in the Apple Store and Android Marketplace. The app exploration team included the University Libraries' Instructional Design Librarian, an educational technology staff member, and the Instructional Designer from the College of Liberal Arts.

Fortunately, the app exploration team had a number of AR software options to choose from. In recent years, development of AR apps and tools has increased significantly, including both free and paid products. The app exploration team considered three types of AR tools based on the classification of Wojciechowski & Cellary: marker-based AR, marker-less AR, and location-based AR (Wojciechowski and Cellary 2013). Marker-based AR tools use physical markers, which are typically labels that contain a colored or black and white pattern (e.g. QR codes). The AR markers are recognized or registered by the AR application when the camera on the participant's mobile device scans the label, which triggers an event. For instance, it could trigger an image or a video to display on the mobile device screen, superimposed on top of the marker image. In contrast, marker-less AR apps recognize the shape of an actual object in the physical environment, such as a photograph. Upon recognizing the designated object, marker-less AR apps will display the augmented information (e.g. the image or video). Finally, location-based

AR superimposes information directly onto the device screen after being triggered when a pre-established geographical location is reached by the participant's mobile device.

Despite the variety of AR options in each category to consider, the team found few studies that focused on the affordances (uses, features, advantages, effectiveness, limitations, challenges, costs, etc.) of the tools with respect to their use in educational settings. As a result, the team developed its own criteria to assess the merits of each app under consideration. These criteria included cost of development, cost to participants, development program type (web interface, mobile interface, or software package), ease of development, and ease of use from the perspective of the participants. Thirteen apps were evaluated against these criteria and the summary of results from that Fall 2016 assessment is provided in Appendix A.

Unfortunately, the nascent technology lacked a single platform that would encompass all the desired features. Accordingly, the app exploration team had to determine which features were most important to the success of the project. The most important criterion was determined to be the cost to students, as the project team did not want students to incur any costs in order to participate in the AR Tour. App portability was determined to be the next most important criterion. Having the tour available on both the Android and iOS operating systems would ensure the tour was accessible to the broadest number of participants possible, as well as allow students to use their own personal device if available.

After eliminating apps that did not meet these two key criteria, the team then considered a second tier of priority features. Based on initial testing, the team established a preference for apps with web-interface-based developer tools rather than SDK-based (Software Development Kit) tools due to their ease of use and more timely development capabilities. This major criterion

eliminated a few contenders like *ZapWorks* and *Wikitude*. Second, the team narrowed the pool down to just those apps using marker-less AR technology. This decision allowed the team to leverage physical signs already posted in the library to serve as the triggers for the virtual tour. Initially, location-based AR tools were also under consideration by the team. However, at the time of evaluation, existing geo-location or geo-aware apps were not advanced enough to determine geo coordinates for different vertical levels. As a result, the team determined this type of AR app would not be suitable given the tour would include stops on multiple floors of the library.

The app evaluation team selected *Gamar* for the tour, a marker-less AR app with an easy-to-use developer web interface. *Gamar* met almost all the team's primary criteria and is compatible with both iOS and Android. The app does not require participants to create a personal account to experience the tour, a feature which addresses privacy concerns. Additionally, *Gamar* showed the map/trail to the participant at the beginning of the AR Tour, aiding navigation from one stop to the next on the tour. Another plus of this app is that *Gamar* is primarily built for educational purposes and comes with some built-in assessment features that include embedded multiple choice questions, a star rating system, and an open-text comment box provided upon completion of the tour. While the tool set is not sophisticated, it allowed the project team to gather some basic student feedback. This information helped the team to improve the tour in later semesters.

Constructing the Tour

Once the project team selected *Gamar* as the platform, the next step was to develop the tour content. The project team worked closely with stakeholders in the English department to identify library resources and services that directly supported the ENGL 104 curriculum. Each of the

identified resources and service points would constitute a stop on the AR Tour. The team developed six stops for the tour (Table 1).

Stop Name	**Stop Description**
Course Reserves	Library service point where students can check out textbooks and other materials for their classes.
Media Services	Library service point where students can check out DVDs, Blu-Rays, video cameras, laptops, projectors, and other equipment.
Study Rooms	Example of library spaces that students can reserve in advance for group work.
AskUs	Library service point where students can check out books and other materials, ask reference and directional questions, and receive virtual reference support.
University Writing Center	Housed in the library, the University Writing Center provides individual and group consultations for students to improve their writing.
Finding a Book	Students must navigate the library stacks to find a specific book on the shelf (or a posted image in the same location if book is checked out).

Table 1: ENGL 104 AR Tour Stops

Once all the tour stops were identified, the project team developed a script for each location. The *Gamar* app included major constraints that had to be taken into account when developing the script for each stop. The app could incorporate only a limited amount of information for each stop (Table 2). Each screen had a text limit, typically set at 120 characters. While the character

limit was a hindrance when developing scripts, it also obliged the project team to be concise and deliberate in the content provided to the participant. The app also restricted video content to the final stop of the tour. This limitation, in particular, was very challenging for project team members, as they had to limit themselves to developing content that could be displayed in text and static images.

Stop Information	**Description**
Intro	The intro is a slide that provides an introductory description of the stop. For example, “The Libraries have lots of different types of places to study, and this is a popular choice for group projects.” *Gamar* limits: One image and 120 characters.
Main clue	The main clue is a slide that directs participants to the stop location. For example, “Head to the 2nd floor of the Annex. Don’t venture far from the elevators & look for the second room signs.” *Gamar* limits: One image and 110 characters.
Additional clue	The additional clue provides more direct guidance to participants having trouble finding the stop location. For example, “Room numbers 202-204 & 207-212.” *Gamar* limits: One image and 120 characters.
Trigger	This image appears on the mobile device screen when participants use the app to scan the correct stop location. Available images include fireworks, confetti, and a thumbs-up sign, among others.
Story	Once participants have found the right location, the story provides important information about that stop. For example, “The Libraries have hundreds of study rooms that you can use. Some study rooms are large enough for group projects.” *Gamar* limits: One image and 120 characters.
Story	*Gamar* provides the ability to add a second story to add supplementary information about the stop. For example, “Many study rooms can be reserved online. You can click on Study Spaces & select the library where you want to reserve.” *Gamar* limits: One image and 120 characters.

Activity	The activity is an ungraded check on learning. For example, “Which of the following is NOT a way you can reserve a room?” *Gamar* options include a text quiz, image quiz, and comment, among others.

Table 2: *Gamar* Stop Information

Next, using a mobile device signed into the *Gamar* app, team members identified and scanned a fixed physical object at each of the stop locations. The scanned item acts as the “trigger” for the stop in the AR Tour, triggering the overlay of virtual images and text for that specific area onto the tour participant’s screen. When scanning an object, multiple vantage points and perspectives were captured by walking all the way around each item to ensure that the stop could be triggered from all possible directions. This process was repeated for each stop on the tour.

Once all the stop triggers were scanned, the next step was to assemble the tour as a “trail” within the *Gamar* content management system (CMS). Within the administrative structure of the *Gamar* CMS, project team members could view all the content for each stop, edit each piece of stop information, and change the order of stops. For each stop, photographs of the library location, descriptions of the services provided at that location, and a short check on learning were added to the CMS.

Accessibility and Access

The project team identified accessibility as a major concern right from the start of the AR Tour development. The app evaluation team quickly found that none of the apps on their list met the criteria for compliance for participants with disabilities. Regardless of the software selected, an AR Tour would not be accessible for anyone with severe vision impairments and of limited use for those with impairments that restrict mobility. To comply with accessibility standards and

make the tour useful for all students, the project team developed an offline version in accessible document form. The alternate version of the AR Tour contained all the same information, with the exception of physically scanning the stops. Students using the accessible version were able to learn about all the stops and complete the same assessment as their peers. Designing for accessibility is a primary concern in the field of AR. Given the technology continues to mature and is becoming more mainstream, the team hopes that an accessible solution will soon be in development.

In addition to providing an accessible version of the AR Tour for students with disabilities, the project team also ensured that students without a mobile device could participate. The project team coordinated with the Libraries' AskUs department, which operates the library circulation and help desks, to place mobile devices on reserve at the service desks. For the first implementation of the tour in the Fall 2016 semester, the project team was unsure of the number of participants who might not have or choose to use their own device. The team opted to err on the side of caution and secured 14 iPad Minis from the Libraries' Learning and Outreach department as well as seven iPads from the Libraries' Medical Sciences Library for a total of 21 devices. To make the technological component of the tour as easy as possible for participants, the devices were placed into guided access mode connected to the network inside the *Gamar* app. Guided access allowed the team to lock the device into single app mode in order to limit participants' use of the device exclusively to the *Gamar* app. The project team also coordinated with AskUs staff to develop a set of step-by-step instructions that AskUs staff could use to clear the *Gamar* app after each use, ensuring that each student checking out a device would be able to start the tour from the beginning.

After the Fall 2016 semester, the project team retrieved the 21 iPads and iPad Minis they had placed on reserve and were informed by the AskUs staff that only a few had been checked out during the semester. Given this information, the project team decided to significantly reduce the number of iPads on reserve for the Spring 2017 semester. Only four iPad Minis were placed on reserve in Spring 2017, a reduction by 17 devices. Even though the low demand for library iPads suggested that most participants have their own devices, placing a few devices on reserves ensured that all students had equitable access to the tour content regardless of financial situation. The project team will continue to place a few devices on reserve each semester and plans to add the *Gamar* app to all the mobile devices circulated by the library to reduce the number dedicated specifically to a single use case.

Implementation

Once development of the AR Tour was completed and prior to implementation, the team communicated with library stakeholders to make them aware of the project and answer questions. While the tour was designed to be unmediated, the team wanted to ensure public service staff were aware of the project in case students approached them with questions. In addition to meeting with the AskUs staff who provided assistance at the main service desks in the library, the team also shared information with the shelving personnel since the students would be required to locate a specific book within the library's circulating collection. Because the project team could not guarantee any selected book would remain on the shelf during the tour period, an image of the book's cover was adhered to the shelf adjacent to its location. Shelving staff were informed about the surrogate book so it would not be removed accidentally.

After internal library stakeholders were informed, the team next connected with the English department. Faculty and graduate students were provided with a set of instructions that they

could share with their students who would be participating in the tour program. The project team developed several supporting documents to facilitate implementation of the AR Tour (Table 3).

Product	Developer	Description
App instructions	Library personnel	Handout providing step-by-step instructions, including screenshots, for using the *Gamar* app (PDF)
AR Tour map	Library personnel	Map of the AR Tour, including number and order of stops (PDF)
Blackboard quiz	Library personnel	AR Tour-related questions and answers to be uploaded by instructors into Blackboard as a quiz. Question format primarily multiple-choice, which corresponds to the checks on learning within AR Tour app. Also includes a question requiring a file upload, as participants are asked to take a selfie at the end of the tour and upload that selfie into Blackboard.
AR Tour assignment sheet	English department personnel	Assignment sheet that English instructors can provide to participants with instructions for completing the tour and the accompanying Blackboard quiz.
Accessible alternate version	Library personnel	Accessible document version of the AR Tour, including locations of tour stops, descriptions of triggers and provided content, and checks on learning.

Table 3: AR Tour Supporting Documents

A project team member from the English department disseminated AR Tour supporting documents to the faculty and graduate students teaching ENGL 104. Each individual faculty member or graduate student then determined whether or not to assign the AR Tour to their specific sections of ENGL 104 and, if so, communicated assignment expectations to their respective students.

Assessment Methodology

Assessment was a core element of the AR Tour project. The team planned to assess the AR Tour in multiple ways. First, the team planned to assess the project's learning objectives, as the AR Tour was intended to accomplish a few specific goals: to orient students to the locations of key library services points, introduce essential library services, and demonstrate how to find library materials such as books. Second, the team planned to assess the AR Tour for the purposes of programmatic improvement. Iterative improvements are a regular element of the Libraries' instruction and outreach programs, and the team anticipated the need to update the AR Tour each semester in response to participant feedback.

Although the team hoped to use *Gamar* analytics, in part, to assess learning objectives, this turned out to be impractical. The AR Tour was constructed with checks on learning throughout the tour, most commonly in the form of multiple-choice questions. However, the team soon learned that *Gamar*'s "Check Analytics" function was not yet in operation, and while *Gamar* staff were able to provide analytics upon request, these analytics did not include participant responses to checks on learning. Instead, the team developed a short quiz, similar in format to the checks on learning in the AR Tour, which ENGL 104 instructors could embed into Blackboard. This quiz served both as a mechanism for instructors to provide course credit for completing the AR Tour and as an assessment method. Librarians received anecdotal feedback from ENGL 104 instructors about quiz results but have not yet completed an in-depth assessment of quiz data.

Assessing the AR Tour for the purposes of programmatic improvement turned out to be similarly challenging. The team was interested in learning how many participants completed the tour and how long it took them to complete the tour. The team requested and received tour analytics after each semester, but the data included in these analytics was limited in usefulness. *Gamar* reported

aggregate numbers of participants, session duration, and average session duration. However, these analytics did not differentiate whether participants simply opened the app or whether they completed the tour, and without this context it was difficult for the team to get a clear picture of how the tour was being used.

In order to improve the tour, the team also wanted to better understand how participants were responding to the tour and whether there were specific problem areas. In this respect, *Gamar* analytics proved to be unexpectedly helpful. The final question all *Gamar* app users received was a request to rate the app from one to five stars and to answer the question, "Enjoyed playing this trail?" When the project team requested tour usage analytics from *Gamar*, the company also provided answers to these final questions. The team requested and received analogous data following the Spring 2017 semester. Because these data were collected for programmatic improvement purposes and included no personally identifiable information, the team was able to obtain institutional review board permission to analyze these data for research purposes.

The data set consisted of 487 ratings for the Fall 2016 semester and 421 ratings for the Spring 2017 semester. It also included 135 comments for Fall 2016 and 96 comments for Spring 2017. The project team sorted the ratings to identify the number of participants who gave the AR Tour one, two, three, four, or five stars in each semester (Figure 1).

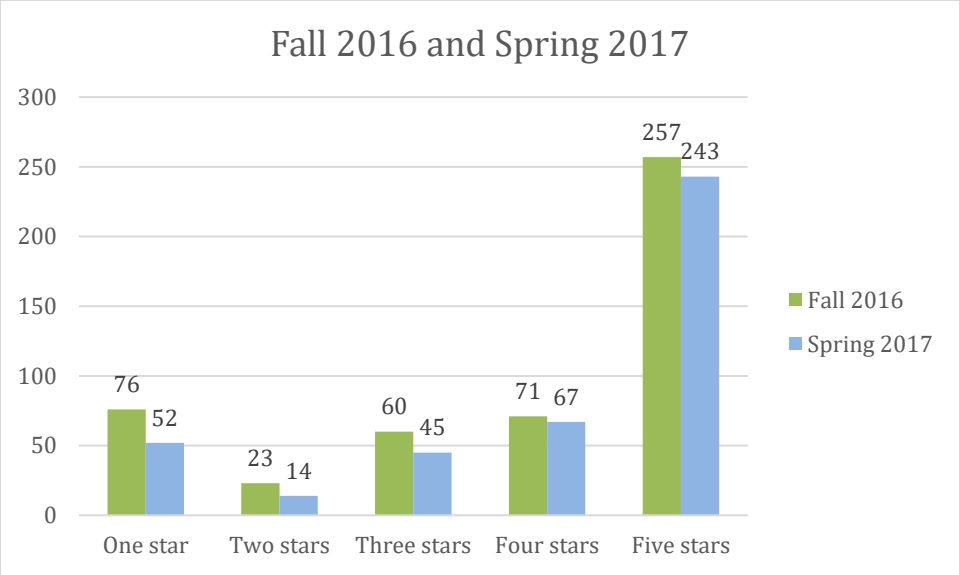

Figure 1: Participant Ratings by Stars

Using a grounded theory approach, one team member coded the comments that participants provided into twelve categories (Table 4). All comments were provided in free-text format, so some participants included comments that fell into multiple categories.

Category Name	**Example Comments**
App positive	User friendly
Content is difficult	Hard, difficult, Tests your knowledge
Content is easy	Easy
Fun	Fun
General negative	Ew, nah, trash
General positive	Lit, Great, Good

Layout issues	Stairs, Too much walking
Neutral	Fine, Ok
Technical problems	Book wouldn't scan, app funky
Tour construction problems	Questions confusing, Location difficult to find, Couldn't find book
Useful	Informative, Will come in handy

Table 4: Comment Categories and Example Comments

Assessment Findings

Based upon participant ratings, the team found that the Fall 2016 participants had a generally positive response to the ENGL 104 AR Tour, with 328 out of 487 participants giving the tour four or five stars. Despite the overall positive response, the Fall 2016 participant ratings revealed that there were significant issues with the tour: a total of 32.6% of the Fall 2016 participants rated the tour with three stars or fewer , and 76 participants, or 15.6%, gave the app only one star. Although the team expected that not all participants would give the tour a positive response, they were not anticipating that nearly one-third of participants would have a neutral or negative response to the tour. Given this information, the team turned to the coded Fall 2016 participant comments for additional information. 135 participants provided a total of 157 comments during the Fall 2016 semester (Figure 2).

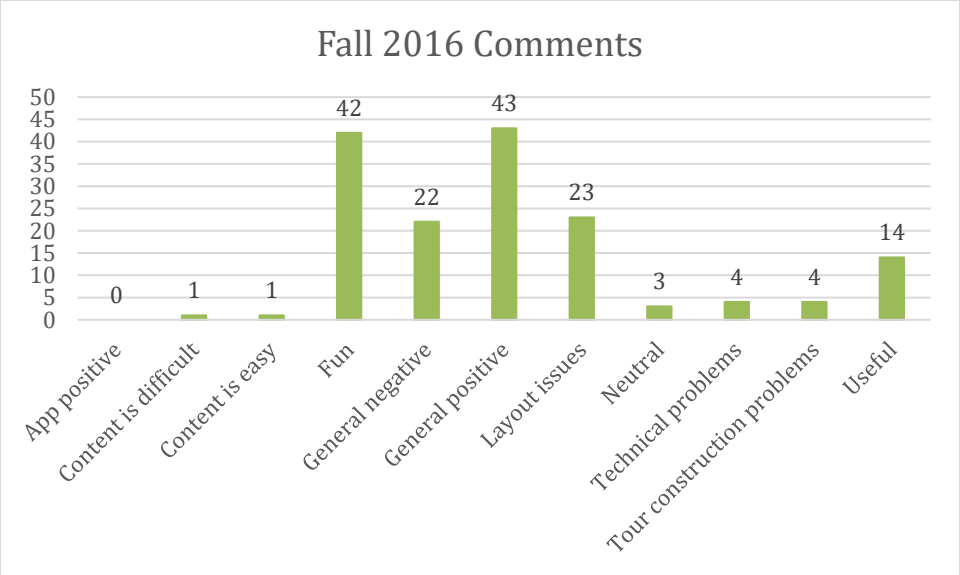

Figure 2: Fall 2016 Comments

The coded comments revealed that the most common sentiments from participants were generally positive ones (e.g. “It was awesome i love this so much” and “Twas lit”) and comments specifically describing the tour as fun (e.g. “This was kinda fun :-)” and “Today was great had a lot of fun!!!!”). However, a significant portion of the comments fell into the “general negative” category. The participants providing negative comments, many of whom also provided low ratings, had some harsh criticism for the tour, such as “this was the most asinine and tedious thing that I have ever done” and “I hated my life after it.” Part of the reason for this negativity may be related to the comments from the “layout issues” category, which overwhelmingly revealed that participants disliked the way the tour stops were laid out. The tour was structured to send participants zigzagging around to different parts of the library, which meant that it included quite a bit of walking. Participants noticed, commenting “Too much walking back and forth” and “Much more walking than I expected.”

Based upon the Fall 2016 participant ratings and comments, the project team restructured the tour for the Spring 2017 semester. Tour stops were reorganized so participants could move from one stop to the next without having to retrace steps. Given these changes, the team anticipated more positive feedback for the Spring 2017 semester, which proved to be the case. Participants from the Spring 2017 semester provided slightly more positive feedback than those from the Fall 2016 semester. A total of 310 out of 421 participants gave the app a four or five-star rating in Spring 2017, an increase of 9.3% over the previous semester. Furthermore, fewer participants rated the app poorly. Only 26.4% of participants gave the app three stars or fewer, a decrease of 19% from the previous semester. While the team would like to continue to implement iterative improvements to further reduce that percentage, they believe that these higher ratings indicate that participants approved of the tour layout in the Spring 2017 semester.

To confirm this perception, the project team investigated participant comments from the Spring 2017 semester. Just as in the Fall 2016 semester, comments from the Spring 2017 semester respondents fell most commonly in the “General positive” and “Fun” categories (Figure 3). For example, the “General positive” category included such comments as “It was a great learning adventure!!!” and the “Fun” category included comments like “Loads of fun” and “Fun way to learn about the libraries!”

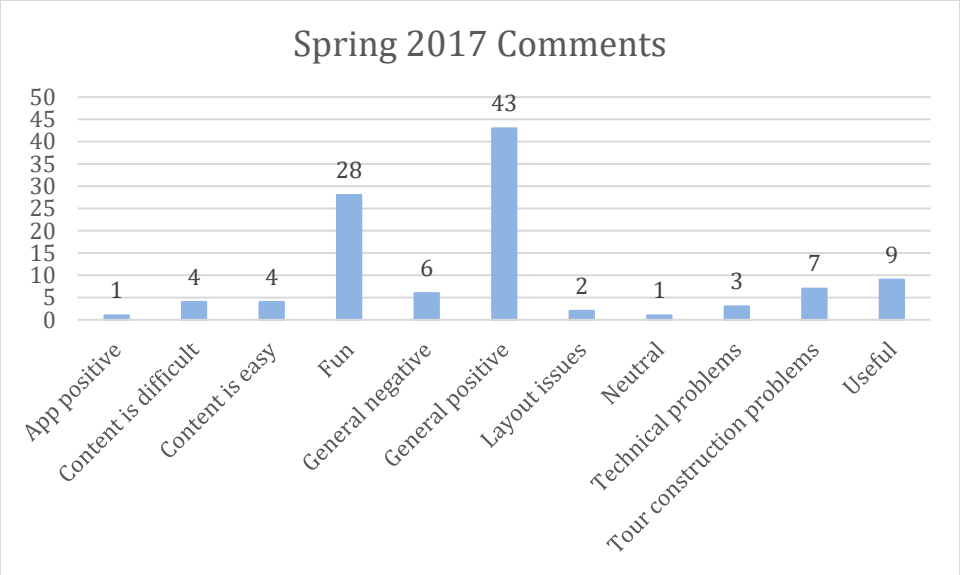

Figure 3: Spring 2017 Comments

These comments confirm that the altered layout for the Spring 2017 semester improved participants' experience. Although comments in the layout issues category constituted the third most common comment from the Fall 2016 semester, there were only two comments related to layout in the Spring 2017 semester. The number of general negative comments also dropped substantially.

A review of the comments revealed another unexpected finding. The "useful" category received the fifth-highest number of comments, 14 total comments, in the Fall 2016 semester. Although the "useful" category received the third-highest number of comments in the Spring 2017 semester, the overall number of comments fell from 14 to 9. Researchers suspect that participants, many of whom are first-year students, found the AR Tour less useful in the Spring semester as they may already have been familiar with the library space. Indeed, one Spring 2017 semester participant commented that, "This would have been helpful last semester…." The

project team will continue to collect AR Tour participant feedback to evaluate whether a differentiated tour for Spring semesters may better meet student needs.

Finally, comments for both the Fall 2016 and the Spring 2017 semesters were added to a word cloud generator, WordCloud.com, as a way to visually represent the frequency of common language used by students to describe their experience with the AR Tour (Figure 4). The word cloud illustrates the generally positive comments provided by participants and provides a useful tool for understanding and promoting the AR Tour.

Figure 4: Fall 2016 and Spring 2017 Comment Word Cloud

Future Directions

Given improved feedback from participants in the Spring 2017 semester, librarians and English department faculty have opted to continue with the AR Tour model. However, feedback from

participants revealed room for continued improvement. One goal is to increase the rigor of the learning objectives associated with the AR Tour. Feedback revealed that participants commonly described the tour as fun or having a generally positive experience, but less than 10% of respondents described the tour as useful. Team members posited that, because a number of ENGL 104 students were sophomores, they may already have had some familiarity with the library and may not have immediately recognized the value of increased familiarity with library spaces and services. Project team members have been developing and piloting a different version of the AR Tour with the additional learning objective of familiarizing participants with different information formats such as newspapers, journals, and reference works. Based upon assessment of the pilot, librarians will determine whether to adopt the reworked version of the AR Tour for future ENGL 104 classes.

The AR Tour has proven to be a very scalable alternative to a traditional library tour or scavenger hunt, not only because it minimizes the strain on librarian time giving tours or setting up physical scavenger hunts, but because of its easy replicability. Once it has been developed, the tour can be altered or updated very easily, and modifications take effect almost immediately. The tour can also be tailored for specific use cases. In addition to iterative improvements for the AR Tour designed for ENGL 104, librarians have been experimenting with AR models for other first-year use cases. In Summer 2017, librarians developed a version of the AR Tour for Aggie Gateway to Success, a summer program for new students provisionally admitted to the University. Librarians have done both traditional tours and technology-based self-guided tours for this group in the past, but always in a mediated format in conjunction with a faculty-led course (LeMire et al. 2017). In Summer 2017, the Gateway program changed its structure to a zero-credit, student-led model. In response, librarians decided to pilot a version of the AR Tour

specifically aimed at the Gateway program with the goal of assessing the efficacy of AR Tour implementation outside of a credit-bearing course structure. Unfortunately, assessment of this pilot revealed that very few students completed the tour. Because the tour was not required of students as a part of a course assignment, librarians suspected that many students simply chose not to participate. Despite this outcome, librarians will continue to explore unmediated tour options for summer orientation and provisional admission programs.

Finally, librarians hope to expand assessment of the AR Tour by developing a more robust research study to gauge both participants' experience completing the AR Tour and whether participants are achieving learning outcomes. The *Gamar* app does not currently have the capability to embed informed consent so the project team plans to develop an external assessment tool that will help both librarians and the English department gain a better understanding of the impact of the AR Tour.

Conclusion

This case study's pilot implementation of an augmented reality-based approach to an unmediated library tour illustrates that this model can be an efficient and engaging way to orient first-year composition students to the library. Although the project team continues to improve the tour's construction and learning objectives, the majority of students who have taken the tour during the pilot project have responded positively. Furthermore, this model has proven to be highly scalable. Over 900 students have rated the AR Tour over two semesters. Librarians estimate that even more students completed the tour, having either done it as a group or just declined to rate the tour. The AR Tour model allowed librarians to accommodate a large quantity of students without overwhelming available staff and service points.

Augmented reality apps continue to become more affordable and accessible to librarians without readily available developer support, making experimentation with AR technology increasingly a lower-stakes investment for librarians. And as the affordances of augmented reality apps continue to improve, librarians will find that using augmented reality for common services like library tours makes sense as a way to relieve pressure on workloads and to facilitate formal assessment. But, most importantly, augmented reality can help shake up the standard library tour, providing participants with the type of engaging experience that leads them to comment, as one AR Tour participant did, “Everything is awesome!"

Acknowledgements

The authors would like to thank Elizabeth German and Nelson Shake for their work on the project to develop the AR Tour as well as Susie Goodwin, David Hubbard, and Sean Buckner for their feedback on a draft of this article.

References

Armstrong, Guyda, John Hodgson, Frank Manista, and Matt Ramirez. 2012. “The SCARLET Project: Augmented Reality in Special Collections.” *SCONUL Focus* 54: 52-57.

Berrish, Karen, Neeta Jambhekar, and Chloris Yue. 2014. “Augmented Reality Tour: Using New Technology to Import Old Information.” *Texas Library Journal* 89 (2): 70-73.

Boyadjian, Ani. 2014. “Augmented Library: Inside the Los Angeles Public Library Collaboration with a Local University to Experiment with Place-Based Storytelling.” *Library Journal* 139 (15): 30.

Bradley, Jonathan, Neal Henshaw, Liz McVoy, Amanda French, Keith Gilbertson, Lisa Becksford, and Elisabeth Givens. 2016. “Creation of a Library Tour Application for Mobile Equipment Using iBeacon Technology.” *Code4lib* 32, 1-17.

Chen, Chih-Ming, and Yen-Nung Tsai. 2012. “Interactive Augmented Reality System for Enhancing Library Instruction in Elementary Schools.” *Computers & Education* 59 (2): 638-652.

Eckart, Donna F. 2011. “Tech Tips for Every Librarian-Augmenting Your Reality Part 2: Nuts and Bolts Edition.” *Computers in Libraries* 31 (10): 34-35.

Farkas, Meredith. 2010. “Your Reality, Augmented,” *American Libraries* 41 (9): 24.

Foley, Marianne, and Katherine Bertel. 2015. “Hands-On Instruction: The iPad Self-Guided Library Tour.” *Reference Services Review* 43 (2): 309-318.

Griggs, Kim. 2011. “Geotagging Digital Collections: BeaverTracks Mobile Project.” *Computers in Libraries* 31 (2): 16-20.

Hahn, Jim. 2012. “Rapid Prototyping Mobile Augmented Reality Applications.” *ACRL TechConnect*. http://acrl.ala.org/techconnect/post/rapid-prototyping-mobile-augmented-reality-applications (Accessed on 28 June, 2018).

Hodgson, John, Jo Lambert, and Matt Ramirez. 2012. “Augmented Reality: A New Vision for Special Collections.” *CILIP Update* 11 (2): 43-45.

LeMire, Sarah, Stacy Gilbert, Stephanie Graves, and Tiana Faultry-Okonkwo. 2017. “Selfie as Guide: Using Mobile Devices to Promote Active Learning and Student Engagement.” In

Mobile Technology and Academic Libraries: Innovative Services for Research and Learning, edited by Robin Canuel and Chad Crichton, 55-71. Chicago: Association of College and Research Libraries.

Lota, Jovanni, and Bethany Tschaepe. 2015. "Tapping into the First Year Experience: Effective Learning with Augmented Reality and Pop Culture." Presentation at LOEX Annual Conference, Denver, CO, May 1.

Meredith, Tamara R. 2015. "Using Augmented Reality Tools to Enhance Children's Library Services." *Technology, Knowledge and Learning* 20 (1): 71-77.

Mikkelsen, Susan, and Sara Davidson. 2011. "Inside the iPod, Outside the Classroom." *Reference Services Review* 39 (1): 66-80.

Mulch, Beth Ebenstein. 2014. "Library Orientation Transformation: From Paper Map to Augmented Reality." *Knowledge Quest* 42 (4): 50-53.

van Arnhem, Jolanda-Pieta, and Jerry M. Spiller. 2014. "Augmented Reality for Discovery and Instruction." *Journal of Web Librarianship* 8 (2): 214-230.

Whitchurch, Michael J. 2012. "A Quick Response: QR Code Use at the Harold B. Lee Library." *Reference Librarian* 53 (4): 392-402.

Wojciechowski, Rafał, and Wojciech Cellary. 2013. "Evaluation of Learners' Attitude Toward Learning in ARIES Augmented Reality Environments." *Computers & Education* 68: 570-585.

Appendix A: AR App Evaluation Table

Name	URL	Price (for Developer)	Price (for Participants)	Device Compatibility	Program Type	Ease of Development [Rating 1-5, 5 being the best]	Ease of Use (for Participants) [Rating 1-5, 5 being the best]	Classification
Argon	http://argon.gatech.edu/	Free	Free	iOS	Software (SDK)	1	2	Marker-less and Geo Location
ARIS	http://arisgames.org/	Free	Free	iOS	Web Interface	3	4	Geo Location
Aurasma	https://www.aurasma.com/	Free	Free	iOS & Android	Web Interface	4	4	Marker-based
Augment	http://www.augment.com/	Free educational license	Free educational license	iOS & Android	Web Interface	1	3	Only for 3D models
Blippar	https://blippar.com/en/	Free educational license	Free	iOS & Android	Web Interface	3	5	Marker-less
ENTiTi	http://www.wakingapp.com/	Free	Free	iOS & Android	Software (SDK)	1	3	Marker-less
Gamar	http://gamar.com/	Free educational license	Free	iOS & Android	Web Interface	5	5	Marker-less
Layar	https://www.layar.com/	$3.50/page & $34/page	Free	iOS & Android	Web Interface	5	5	Marker-less
Onvert	http://onvert.com/	Free (Pro version can give you statistics, has a free educational license)	Free	iOS & Android	Web Interface	4	4	Marker-based
Playme	http://playmear.com/	$20/page or $50/month	Free	iOS & Android	Web Interface	4	4	Marker-less
PocketSights	https://pocketsights.com/	Free	Free	iOS & Android	Web Interface	5	5	Geo Location
Wikitude	http://www.wikitude.com/	€2490/year	Free	iOS & Android	Software (SDK)	1	3	Marker-less and Geo Location
ZapWorks	https://zap.works/	$247/year	$2/year	iOS & Android	Web Interface, Software (SDK)	2	4	Marker-based