Analyzing Interactivity in Historical Location-Based Augmented Reality Applications

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Abstract

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This paper aims to contribute to the body of knowledge regarding historical augmented reality applications and what makes them effective as learning tools. Many papers have gone into the technical details of design and implementation and several studies have been conducted to measure their effectiveness. What this paper aims to do is study what aspects in particular make AR mobile apps effective in heritage education. This paper will analyze user interaction in a small selection of apps through two frameworks in order to discover what aspects make these apps effective and what could be improved. The purpose of this is to offer developers insight into what aspects make an app effective as a learning tool at a historical site, so that such aspects can be included in future projects.

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Introduction

This paper aims to contribute to the body of knowledge regarding historical augmented reality applications and what makes them effective as learning tools. Many papers have gone into the technical details of design and implementation, and several studies have been conducted to measure their effectiveness. What this paper aims to do is study what aspects in particular make AR mobile apps effective in heritage education. This paper will analyze user interaction in a small selection of apps through two frameworks in order to produce a new framework that analyzes what aspects of the apps are effective and what could be improved. The interaction this paper will focus on is HCCI: human-computer-context-interaction. This type of interaction describes how the user interacts with the app to interact with the historical context. To analyze this interaction, the two chosen frameworks are: educational game principles and context immersion principles. The context immersion framework was chosen because it covers the augmented reality part of the app, as one purpose of augmented reality is to immerse visitors in the historical context. The educational game framework was chosen as augmented reality historical apps have many similarities to games. These two frameworks and their particularities will be covered more in depth in the next chapter.

Chapter 1 - Background and Frameworks

1.1 *Augmented Reality at Historical Sites*

Interpretation can be defined as “story-lines adopted to help visitors engage with and understand the place or objects in a real-world heritage site or museum” (Khan 2). Interpretation at these sites is a “learning, communication and management tool that increases the visitors’ awareness and empathy to the site” (Khan 2). The modern smartphone contains all the technology needed to serve as a standalone interpretative guide, such as internal GPS, gyroscope, accelerometer, compass, speakers and a high-resolution screen (Khan 2-3, Kim 80).

This technology allows the average smartphone to use augmented reality. Augmented reality, often referred to simply as AR, involves “overlapping computer-generated images onto a real world” using the phone’s camera (Kim 81). The digital objects are often reactive to the user’s movement as the cellphone’s “embedded gyroscope will capture user’s gesture data and combine it with the simultaneous movement within virtual scenes” (Khan 3). This paper will look specifically at location-based AR applications, which “respond to one’s position in the real world and augment physical landscapes with digital information, allowing users to explore the surrounding environment” (Georgiou 24 – originally quoted as Cheng and Tsai 2013). This is usually accomplished through a GPS-based system or a marker-based system. This makes location-based AR a powerful tool in historical sites, as 3D models can be superimposed over ruins, giving the user an idea as to how the site used to look (Khan 5). However, AR apps can also function as site guides and learning tools, incorporating various media such as interactive maps, 3D models, photos, videos, text, and audio clips.

A study in Taiwan, undertaken by Yu-Lien Chang, Huei-Tse Hou, Chao-Yang Pan, Yao-Ting Sung and Kuo-En Chang, did an extensive user study regarding the use of an AR mobile guide at a historical site. The researchers discovered that AR mobile guides improve the visitors’ experience. The study found that “that visitors’ affective and cognitive experiences regarding heritage sites were associated with the quality of the interpretive media provided” (Chang et al. 166) and that “visitors perceive AR guidance activities as interesting, fun, challenging, and a method of achieving first-hand experience” (Chang et al. 167). The basic set-up of the user study was this: a group of students were given an exam prior to visiting a historical site to measure their knowledge; then they were broken into three groups. One group was given no guidance whatsoever, while another group was given an audio guide, and the third group was

given an AR guide. After the visit to the site, the students took the test again and were interviewed about their experience. It was discovered that the group with the AR guide had improved the most in their test scores and also came away with a greater appreciation of and sense of attachment to the site in question (Chang et al. 175). The Chang et al. study hypothesized that this was achieved by establishing a site's "geographical and historical context" in the app (Chang et al. 168). Thus, "when visitors visit the heritage site, the context allows them to feel interested in and interact with the heritage site" (Petrucco 120). In essence, context immersion facilitated by the app increases learner motivation and interest.

1.2 *Challenges in AR*

While augmented reality offers many benefits to heritage education, there are many drawbacks as well. On the technical side, "the availability of free Wi-Fi connection, the cost of data roaming connections, the interoperability across mobile platforms" needs to be considered when implementing an app at a historical site (Khan 3). If Wi-Fi cannot be implemented at the site, then the users have to rely on their mobile data. If the site is remote, mobile data coverage may not be available; if visitors are from overseas, mobile data can be too expensive to use. Creating an app compatible with many platforms will allow more users to access the guide, however every phone is different, which presents its own challenges. Researcher and developer Dr. Cushing described several challenges with GPS during the creation of the app *Walk1916*. She noted that as every phone's GPS is different, it was difficult to guarantee every user the same experience, and that the augmented reality content wouldn't spawn reliably in front of every user's phone camera (Cushing 2017).

On the educational side, "visitors tend to focus excessively on the content of the AR system and the additional information in the AR, thereby neglecting the physical surroundings and environment" (Chang et al. 167). While outdoors, "visitors were susceptible to distractions from external objects and engaged in fewer discussions and interactions about the historical sites with companions" (Chang et al. 175). This means that the AR app must encourage interaction with the site itself, and not just interaction with the digital content, lest the AR take over the entire experience. There is also a risk that if the content isn't engaging enough, visitors can easily be distracted by external stimuli. Potential solutions include integrating activities such as cooperative learning, tasks, games and role-playing; these could encourage peer-computer-context interaction and lead to less distraction (Chang et al. 175-176). On the other hand,

mobile apps have often proved to have too much content, causing a cognitive overload in the user (Petrucco 116). This paper will look at what mechanics and activities are incorporated into the selected apps and how they encourage context interaction and reduce or exacerbate the challenges associated with mobile learning.

1.3 *Context Immersion in Historical Interpretation*

Immersion can be created and delivered by technology such as head-mounted VR displays; however immersion can also be a psychological state, a sense created through a “continuous stream of experiences” (Kim 80). AR is more of the latter, as a phone screen is too small for complete sensory immersion; instead, mobile AR enables strong immersion through context (Kim 80). In a study of AR immersion conducted by Mi Jeong Kim, she created a framework consisting of four main elements that enhanced context immersion: location-based tracking, object recognition, communication with other users, and the ability to manipulate or grasp AR objects.

Kim also discovered that users felt motivated to continue using the app when there was enjoyable and useful content (Kim 84). Through a survey, she was able to discover that mobile AR connected users to real life or contexts not confined to the digital world. Therefore, the first step of developing an app for a historical site is to “establish its geographical and historical context”, which can then inform the location-aware media (Chang et al. 168). This media should “immerse and integrate” visitors and facilitate “active exploration of the significance and value of heritage places” (Chang et al. 168).

The specific type of interaction the Chang et al. research studied, and one which this paper will as well, is called “human-computer-context interaction” in which “visitors not only pay attention to the physical features of the exhibits, but also interact with the historical background or cultural context, which provides a more in-depth learning experience” (Chang et al. 167). This type of learning is called situated cognition, which assumes that learning is produced through interactions in a given context (Chang et al. 168). The context in this case is cultural and historical, usually tied to a physical site or exhibit (Chang et al. 168). AR is a delicate balance between site interaction and exhibit interaction. In that sense, “mobile AR creates a context-immersive space” (Kim 84) and is also responsible for facilitating “a visitor’s interaction with all aspects of the context about the exhibits” (Chang et al. 167). What aspects of the app in

particular accomplish this will be analyzed through the framework of context immersion, which contain four elements, and will also be analyzed through educational game principles discussed in the next chapter.

1.4. *Mobile Learning in AR*

To analyze how an AR historical app would encourage human-computer-context interaction, this paper will use a framework from educational game theory, which is based in the learning sciences. An educational game framework was chosen because educational apps are similar to games. Games have rules and goals and rely on user input in order to function (Adams and Formans 1). Historical apps likewise require user input and react based on what the user does. Therefore, an educational game framework covers both the historical educational side of the app as well as the user interaction side.

Researchers at Carnegie Mellon University have developed a framework for analyzing and designing educational games. The framework developed by the study contains three components: learning objectives, MDA, and Instructional Design Principles.

To determine what the app's learning objectives are, three questions must be asked:

1.) What prior knowledge does the user need to have before starting?
2.) What knowledge or skills can the user be expected to learn from the app?
3.) What knowledge or skills might the user learn that goes beyond what they encounter in the app?

MDA principles involve mechanics, dynamics, and aesthetics. Mechanics are the "basic components out of which the game is built: the materials, rules, explicit goals, basic moves, and control options" (Aleven et al. 71). This paper will analyze the types of mechanics that exist in historical AR applications and how those create and encourage user interaction with the historical site and the historical material in the app itself.

The dynamics are "behaviors that result when applying the game's mechanics with player input" and the aesthetics "capture the emotional response" of the player (Aleven et al. 71). Aesthetics can include things like "sensation, fantasy, narrative, challenge, fellowship, discovery,

expression, and submission" (Aleven et al. 71). This paper will be looking at how mechanics, visuals and sound influence the player's emotional response.

In order to incorporate the learning sciences, the framework uses collections of Instructional Design Principles, primarily lifelong learning principles and game-based learning principles (Aleven et al. 73). The lifelong learning principles were developed by Arthur Graesser from the University of Memphis and are based in psychology and the cognitive sciences. The game-based learning principles were developed by James Gee at the University of Wisconsin-Madison. These principles analyze how games use learning principles to motivate and entertain players (Gee, n.d.). The purpose of these Instructional Design Principles is to "provide a way to think and talk about *how* a game supports learning, and whether it does so in ways consistent with learning sciences findings and recommendations" (Alevan et al. 73). This also includes identifying "principles that a game might violate or ignore" (Alevan et al. 73). The goal is not to look for a complete coverage of principles, but to look for a "coherent story, supported by principles, as to how the game supports learning" (Alevan et al. 73).

Additionally, this paper will describe the app's characteristics of narrative linearity and gameplay. These types of historical apps can usually be classified as games of progression. Progressive games "offer many predesigned challenges" that often must be completed sequentially and are well-suited to telling stories (Adams and Formans 23-24). Analyzing how linear or non-linear the historical narrative is will reveal how much control the user has over their gameplay experience.

Gameplay modes affect how other game mechanics behave; different modes can enable or disable mechanics at certain times or change the behavior of said mechanics. Different modes give the player "a certain experience that feels different from other parts of the game – that is, other gameplay modes" (Adams, 41). In order to discuss mechanics, this paper will also mention what gameplay modes propagate which mechanics.

This paper will go into depth in all three parts of the educational game framework in order to form an analysis of the type of learning principles each app possess and how the user interacts with those principles, as well as the historical context, through mechanics. This paper will apply both this framework and the framework of context immersion to historical apps to analyze what

aspects encourage learning and HCCI; then, based on this analysis, provide ideas that could improve the design of these apps.

1.5. *Selection criteria*

Apps were chosen for analysis based on the following criteria. To be a candidate for review, each app must:

1. Be location-aware through GPS or a marker based system
2. Have an augmented reality component
3. Contain factual historical information
4. Be available to the public either by download or on a provided handheld device
5. Be about a historical site or several historical sites that are accessible by the public

The historical sites themselves did not have to meet any additional criteria, though the differences and similarities between them and the effect that has on the apps will be analyzed in the following chapters. The apps chosen are as follows: *Walk1916*, *Jumieges3D*, and *Fortress of Bastille*.

The first app, *Walk1916*, involves many historical buildings in the heart of ever-changing Dublin. The buildings were chosen due to the role they played during the Easter Rebellion and the app aims to relay their involvement to the user through augmented overlays. The second app, *Jumieges3D*, is about a centuries old abbey in the countryside of France; the app educates users about monastic life and architecture, using augmented reality to rebuild ruins. The third app, *Fortress of Bastille*, recreates this famous building in situ through augmented reality and takes the user through the Storming of the Bastille.

Chapter 2 - *Walk1916*

2.1. *Introduction to the app*

Walk1916 is an app that was released in the year 2016, funded by the Irish Research Council, and developed by Dr. Amber Cushing at University College Dublin and her master's students using the HauntedPlanet engine. The app was made to commemorate the centenary of the Irish rebellion typically referred to as the Easter Rising or Easter Rebellion. The rebellion started Easter Monday, April 24, 1916 and lasted six days. Rebels gained control of several key locations in Dublin and the British Army was sent in to quell the uprising. Due to having a greater number of men and heavier artillery, the British stopped the rebellion and the main leaders of the rebellion were executed. However, the uprising sparked a great push for Irish Independence, and the War for Independence started just two years later which led to the creation of the Irish Free State in 1922.

Walk1916 aims to encourage people to visit 10 sites relating to the Easter Rising and learn about what role these key locations had in the rebellion. This means the app's area of coverage encompasses a lot of Dublin's city centre. Some of the sites don't exist in their original form anymore due to the changing nature of a city, however the app uses augmented reality to attempt to recreate them. Once a user is at a site, they unlock the content regarding that location. As stated in the introduction to the app (Figure 2.1.), that content includes text, audio of that text, and a historical photo.

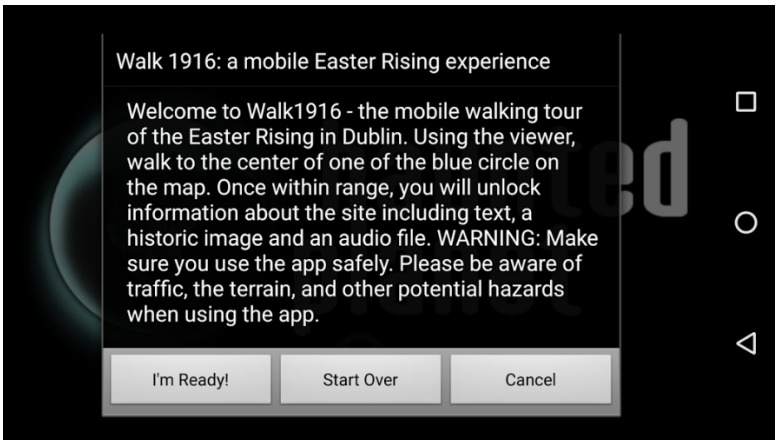


Figure 2.1. Introduction screen of *Walk1916*.

2.2. *Modes, Mechanics and Dynamics*

The app has three modes: map, casebook, and camera. The mechanics are: navigation, content review, and photo capture. What behaviors these mechanics enable (“dynamics”), will be discussed in the following paragraphs.

The map mode shows the user a Google map of Dublin, in which the area of play is delineated with a purple shape and the player is represented as blue dot. This mode enables the navigation mechanic, in which the user navigates to the encounters, or “experience locations”, by tracking their blue dot on the map. Specific encounters are shown as small, faint blue dots. This creates a site-exploration dynamic, prompting the user to physically explore what is around them.

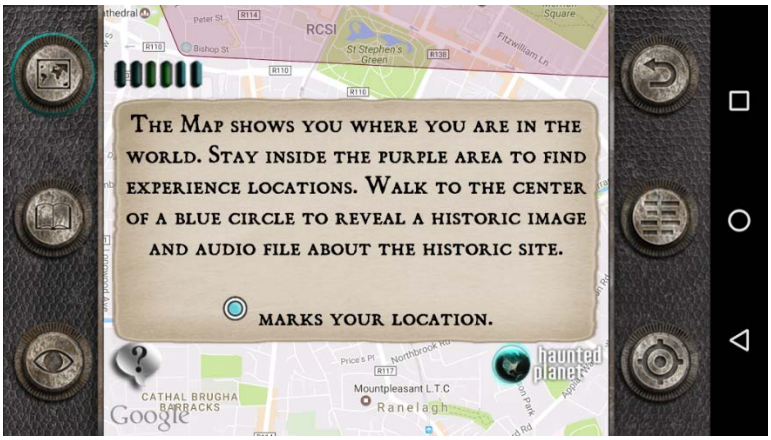


Figure 2.2. The map mode with instructions.

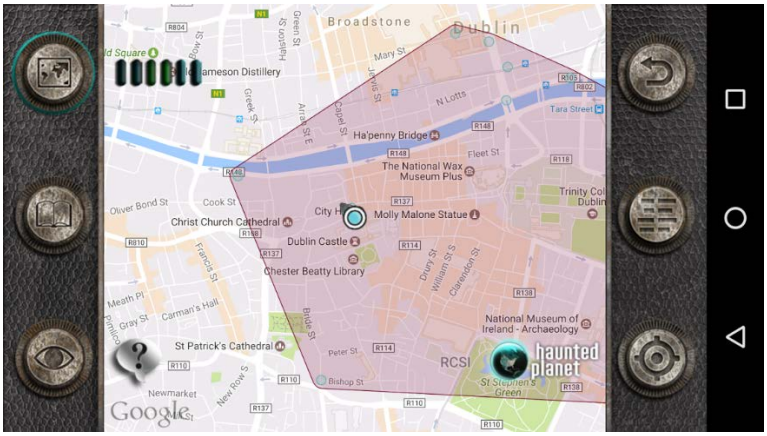


Figure 2.3. A user’s blue dot in the area of play.

Casebook mode displays the list of locations the user can visit; this mode enables the review mechanic, because if the player has been to that location already, this is where they can see the content they've unlocked. In this mode, the user can see the historical photo of the site they visited, plus the article written about it and the audio version as well. The review mechanic creates another kind of exploration dynamic: content exploration. The user is invited to learn by exploring the written, visual and audio material.

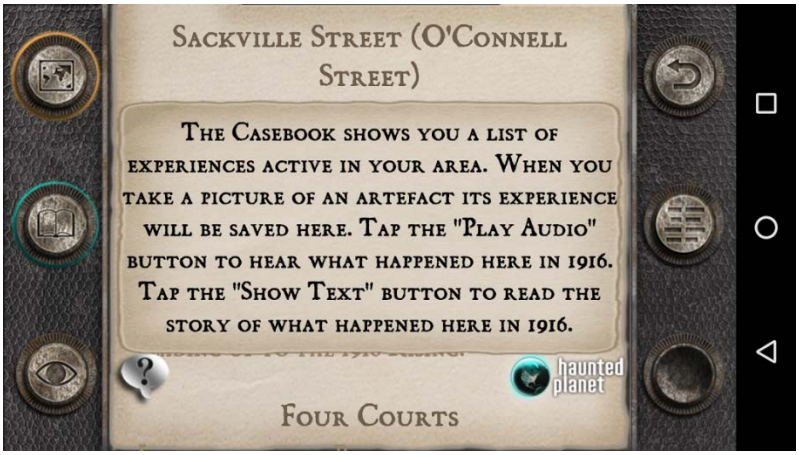


Figure 2.4. Instructions for casebook mode.

Figure 2.5. Casebook mode with the content for the Dublin Castle location.

The last mode is camera mode, which facilitates the photo capture mechanic. The camera mode uses the phone's camera to display the world around the user, then the user must rotate the camera until the augmented content comes into view. This augmented content is a building cut-out from a historical photo and it spawns somewhere around the user; arrows direct the user

towards it. Once the user sees the augmented historical content, they capture it with the camera button and unlock the written/audio material as well as the full historical photo.

The app prompts the user to switch to camera mode once the user is in the blue circle denoting an encounter.

Figure 2.6. Nearing the Dublin Castle encounter bubble.

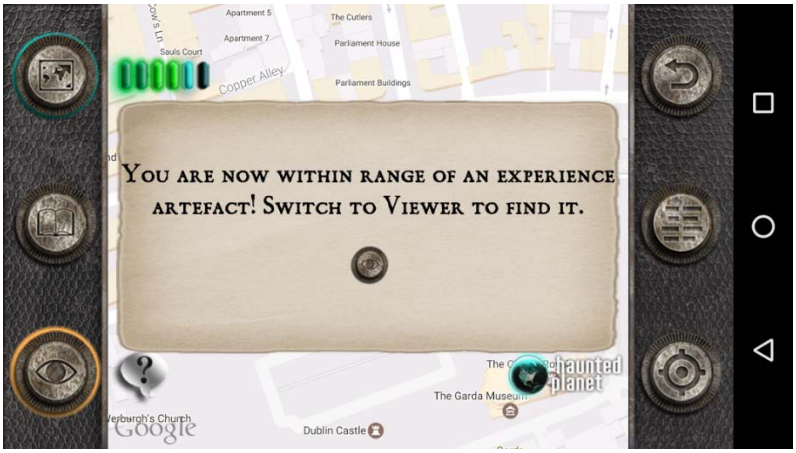


Figure 2.7. The app alerts the user to switch to Camera mode.

Figure 2.8. The augmented content comes into view in Camera mode.

2.3. *Linearity*

The player can visit any location in any order; the app does not encourage players to visit the sites in historical order, so the narrative unfolds for the player in a non-linear fashion.

The head researcher, Dr. Cushing, explained in an interview that she chose a non-linear structure to help enforce the app's neutral narrative. The development team wanted the app to showcase many perspectives in order to eliminate a nationalistic patina from the tour, which is common in many walking tours around Dublin (Cushing 2017). Telling the story from multiple perspectives (i.e.: Irish and British), would help create a neutral narrative, which would enable users to explore and "develop their own understanding of the historic event" (Cushing 2017). That is another reason why "the narrative stands alone…it doesn't rely on any of the other sites", as it encourages users to forge their own path and not rely on one "expert curator telling the story" (Cushing 2017).

2.4. *Locative Aspects*

Walk1916 is a GPS-based locative app. There are ten sites users may visit and they are labeled as small circles on the in-app map. The user has to walk in the real-world to unlock the content.

This is called a *hard movement mechanic* (Haahr 213). There is only a hard movement mechanic present. If the user could move through the content without having to move physically, such as by tapping on their screen, that would be a soft movement mechanic (Haahr 2013).

The area of play is rather large; the researcher, Dr. Cushing, notes that if the user were to visit all of the sites, it would take them approximately two hours, which makes it difficult for the users to complete the app unless they have set aside several hours of time. During user studies, which were 45 minutes long, 6 sites were visited on average and those sites were concentrated in the middle of the map (Cushing 2017). However, as the area of play is so large, and the structure is progressive and non-linear, this means the user can use the app whenever they have time in the city. According to Dr. Cushing, this helps users integrate technology into their everyday lives. During the user studies, she discovered that people would use the app as an exercise tool or while they were waiting for a train or during their walk to work.

2.5. *Aesthetics - Visuals and Sound*

Visuals help aid user interaction. The purple rectangular box in map mode helps users stay in-bounds. The sidebars have icons that help the user switch between different modes. The icon style is round and rusted like a dial and the images on the dials looking like engravings. The outline of these icons will glow orange when it is time to use that mode, prompting the user to press them when more content is available. Once the user selects an icon, the outline turns blue to indicate that that mode is active. There is also a sound level meter and the bars jump whenever a sound is played. There is no background music; however, there are sound effects to help navigation. Once the user is inside the blue circle representing an encounter, a sound will play – like a shimmering gong – indicating that the player should switch to camera mode to search for the augmented content. The camera icon will also flash orange.

Visuals also help aid in context immersion, setting the tone and time period of the app. In *Walk1916*, the menu textures are rusted metal and parchment. The typography is a strong serif font called Dominican in brown and black ink, reminiscent of newspapers perhaps, especially since the headings are in small caps. The visual style hearkens back to the days of typewriters and newsprint, due to the parchment texture of the background and the ink-like serif font. The

harshness and somber tone of the Eastern Rebellion is conveyed through the visual style of the sidebars and icons, gunmetal grey and rather rustic.

Combined with the content-exploration dynamic, the two main aesthetic elements might be categorized as narrative and discovery.

2.6. *Historical Digital Content*

At each encounter, the user can unlock one historical image and one article which can be read or listened to. The user can use casebook mode at any time and review what they've unlocked, even when they're at home.

The augmented reality content is a cut-out from a historical photo. Cut-outs were used for the augmented content instead of 3D models due to budgetary reasons. Each encounter unlocks only one historical image; this is due to difficulties in copyright law and the fact that few sources from the Easter Rebellion have survived (Cushing 2017).

Once the user enters camera mode inside an encounter bubble, the augmented content spawns randomly. Arrows then point the user to where the 3D object may be hiding.

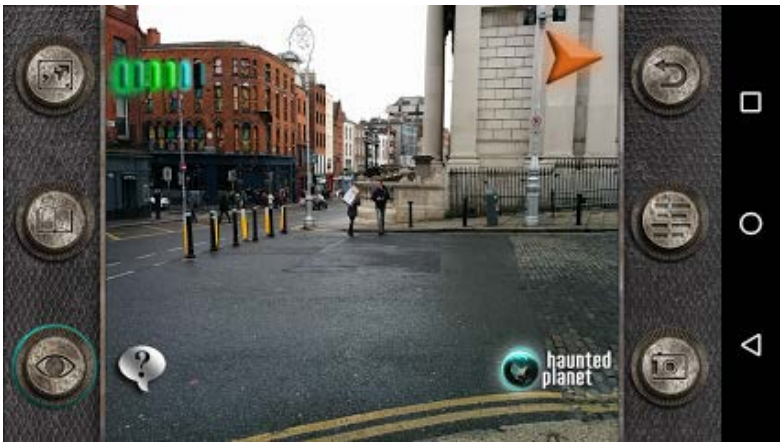


Figure 2.9. Searching for the AR content at Dublin Castle.

It is not explained what this does for gameplay or why this is what unlocks the information. Perhaps the photo capture mechanic serves as sort of a historical hunt, with the user searching the past for clues. However, trying to photograph a flying building might not capture the somber occasion of the Rebellion. In addition, the augmented overlay is difficult to line up with the actual

building, thus defeating the purpose of using such an overlay. Perhaps, once the user enters the encounter area, the app could direct the user to stand at a certain location, similar to *Fortress of Bastille*, so that the overlay would match up accordingly, thus supporting context immersion.

The text is the written version of the audio. There is a button to pause/play the audio, but there is no way to see how long it is or scrub through it. As of writing this paper, the app is only available in English.

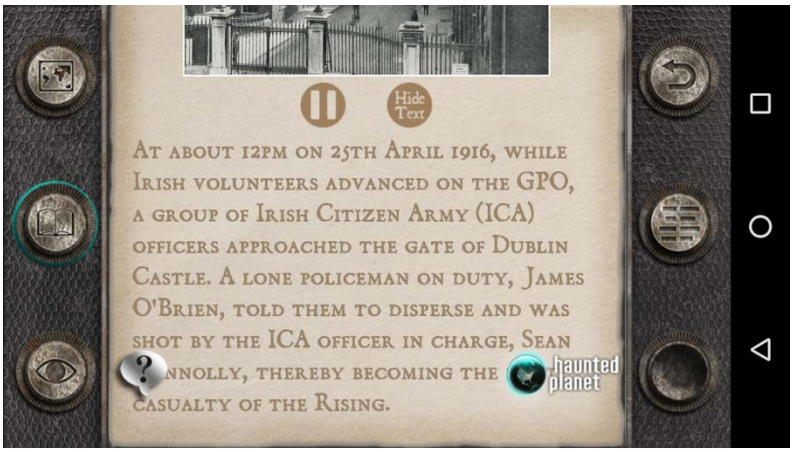


Figure 2.10. Text with the audio playing at the Dublin Castle location.

2.7. *Learning Objectives*

Prior to beginning *Walk1916*, the app assumes the player has knowledge of the basic events of the Rebellion. As there is no introduction to the event in the app, it assumes the user knows about the factions involved (Irish rebels and British Army), the reasons why a rebellion occurred, its outcome, and the effects it had on Ireland's push for independence. The knowledge the users are expected to learn is the history behind ten buildings in the city that were a part of the rebellion. The app does not go into the specifics of the nation before and after the rebellion, nor does it cover the rebellion as a whole, its goal is to illuminate a bit of history pertaining to each building. Knowledge transference occurs over a broad range of topics. The app takes users through the city of Dublin, which improves their knowledge and navigation of the city. Some of the 10 encounters have placards that relay more of the building's history and the history of Ireland throughout multiple centuries.

2.8. *HCCI, Context Immersion, and Instructional Design Principles*

Walk1916 encourages interaction with the physical features of a place by requiring users to walk to the historical sites in order to unlock the digital content. Once there, the users interact with the historical context by attempting to photograph an augmented cut-out of a photograph. Once successful, they can read or listen to the short text about the site and view the photograph. This implements Lifelong Learning Principle #3: Dual Code and Multimedia Effects, which states that information is remembered better when "delivered in multiple modes (verbal and pictorial), sensory modalities (auditory and visual), or media (computers and lectures)" (Graesser 2009).

However there is no introduction to the app to explain its purpose or anything about what the Easter Rising was. Thus, the initial context interaction is weak. Context interaction with the entirety of the Easter Rising is only built up the more sites the user visits. If significant context interaction and immersion is established up front, it could encourage users to visit more of the sites, as evidenced by the Chang et al. study.

The user is immersed in the historical context through the navigation mechanic, which relies on location-based tracking, encouraging them to visit the sites. The photo capture mechanic involving augmented reality may encourage the users to look at the site, but just long enough to find the historical cut-out. After that, the user engages with the context through the screen only. The review mechanic with the historical photo helps immerse the users in the past and the information is short and relevant. There are no further activities at each site to encourage interaction with the site or with the app. The app is self-contained, there is no way to share photos or progress with others.

While immersion and interaction is strong for Dublin, as the user has to do a lot of navigation through the city, there are very few mechanics of interaction at each site, which results in low context immersion. After navigating and capturing, the user can only review the information. As the developers wanted a non-linear narrative, there is nothing, such as a story or character or narrative, to link the sites or spur the user to complete them. However, additional activities at each location could increase interaction, and then could also satisfy principle #11 Multiple Examples. Additional optional activities at each site would keep the experience short as the developers intended, but also incorporate learning principles to engage those who wish to explore more.

As the sites are in various states of disrepair and are constantly changing, further activities would most likely have to be customized for each location. For example, photo quizzes wouldn't be appropriate at Jacob's Biscuit Factory, which has been torn down and is being rebuilt. However, at relatively static sites with accessible interiors like Dublin Castle and the General Post Office, additional exploratory activities would be appropriate. For example, the first broadcast transmission in Ireland occurred during the Rebellion when the Irish captured the GPO and sent out a transmission over Morse code. The message declared that Ireland was in revolt. Ergo, a further activity at the GPO could involve the user decoding the message, thereby learning something about broadcast, transmission, and the Rebellion.

Quizzes could still be used to see if users absorbed knowledge by utilizing multiple choice quizzes. The user could earn additional rewards or unlock content by playing the quizzes. These activities would encourage the context interaction to occur less with the city of Dublin as a whole, and more with the sites relating to the Eastern Rising; this would also help increase immersion as the user would have more to do and learn about at the sites. This would still keep the narrative non-linear, but would encourage further interaction and immersion if the user so desired.

However, if it is not possible to incorporate more mechanics and activities at each site, then to increase interaction for users on the go, the app could alert the user to a nearby site. The app could send notifications, even if the app is closed, that there is an encounter nearby. That way the app could still fulfill the developer's purpose, which was to make the tour useful for people to use during idle moments in their everyday lives. This will also serve a dual-purpose as it fulfills Gee's game education principle #9 "Just in Time" and "On Demand", which is when the user receives information when he or she **"**feels a need for it, wants it, is ready for it, and can make good use of it" (Gee, n.d.). Notifications would help achieve this goal and make it easier for the user to incorporate technology and mobile learning into their everyday lives.

Chapter 3 - *Jumieges3D*

3.1. *Introduction to the app*

Jumieges3D helps guide visitors through the ruins of Jumieges Abbey. Jumieges Abbey is a monastery in Normandy, France. It has a long history, being founded in the year 654. It has been renovated and rebuilt several times before its eventual dissolution during the French revolution. The app was developed by Gael Hammon and Didier Happe from the company ArtGP with the assistance of Conseil Général de Seine Maritime. The app provides information at four encounters, going into detail about the architecture of the monastery, its involvement in various historical events, and the life style of the Benedictine monks who lived there.

3.2. *Modes, Mechanics and Dynamics*

Jumieges3D has three modes: map mode, camera mode, and content mode. The mechanics are navigation, time travel and content review. The map mode allows users to navigate by showing them a map of the monastery and encounter spots. The user is not shown on the map, as the app does not use GPS. The camera mode utilizes augmented reality to enable users to time travel. Users exercise the time travel mechanic by pointing their camera at the ruins and adjusting the strength of the 3D model overlay of the historical reconstruction. Content mode enables the review mechanic, in which the user can listen to sound clips, watch videos, read a short article, and even take a quiz.

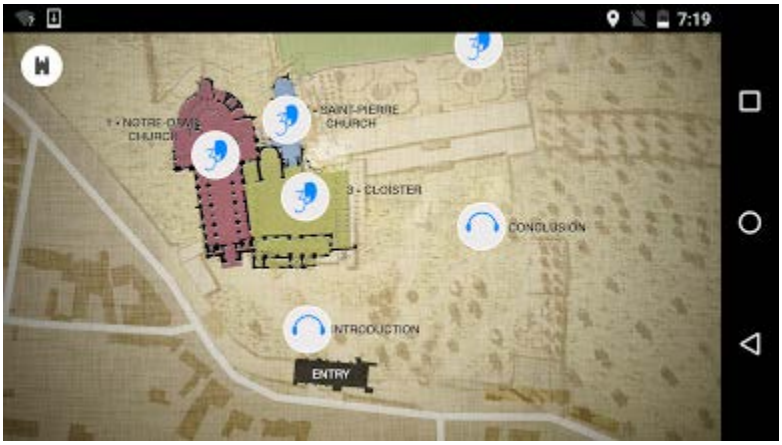


Figure 3.1. Map of Jumieges, showing the four encounters plus the introduction and conclusion.

3.3. *Linearity*

The narrative is non-linear; users can visit whichever encounter they wish in whatever order they desire.

3.4. *Locative Aspects*

There are six encounters with content; two are reserved for introduction and conclusion, while four are in the abbey itself. The user may skip the introduction if they wish to; if they listen to the introduction, the narrator does suggest a first location, the Notre Dame, but the user can disregard this if they want. All the encounters are shown on a map of the abbey, although the user's location is not shown. As the abbey is rather small and self-contained, and the map fairly clear, this isn't a hindrance to exploration. There is a soft movement mechanic: the user does not have to physically move in order to access the digital content. The user can tap the icon representing the encounter and be given all the content, no matter where they are standing or if they are even in France or not.

Once an encounter is tapped, the app then directs the user to stand by a marker and point their camera phone at the monastery. This is so the historical reconstruction is lined up with the ruins streaming through the user's camera. The user can control their 'trip back in time'. There is a dial on the side that lets the user change how much of the ruins are visible and how much of the 3D model is visible.

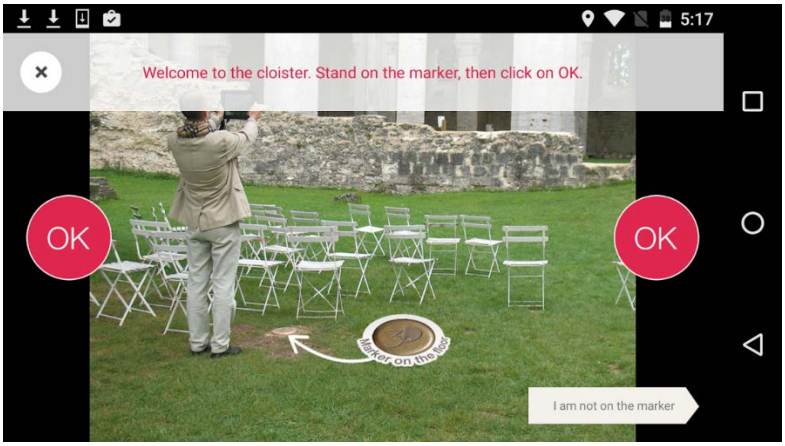


Figure 3.2. The app indicating where the user should stand to line up the AR content.

However, there is also a button for someone who isn't standing on the marker, enabling long-distance access to the content. By tapping on the 'I am not on a marker' button, a 360 photo of

Jumieges is displayed in the user's phone and the user can still transition back and forth between the view of the ruins and the reconstruction.

Once the user is in camera mode, then the button pops up to take the user into content mode. It is a round headphone icon off to the side, and once the user presses it, a list of available content is brought up.

Similar to *Walk1916*, the navigation mechanic encourages a site-exploration dynamic and the content review encourages an exhibit-exploration dynamic. The time travel mechanic encourages exploration of both the site and the exhibit. The quiz, while not strictly a mechanic, may encourage a competitive dynamic.

3.5. *Aesthetics - Visuals and Audio*

The visual style of this app is fairly modern; the map icons have a blue and grey color scheme while the hotspots have a pink and white color scheme. The visual style isn't tied to the Gothic or Corinthian design of the monastery nor is it stylistically influenced by monastic manuscripts. The interface is clean and straight forward.

There is no background noise during the app's runtime, nor are there sound effects when a user taps a button. The videos usually contain a background track, though not always completely through the video. Choir music fills the gap between narrations and often plays over b-roll footage. The time travel and content review mechanics create the discovery and narrative aesthetics. These aesthetics are not supported by visuals and audio, with an exception of the map. The map of Jumieges resembles an old, hand-drawn map, perhaps prompting the discovery aesthetic like a navigational map of old would.

3.6. *Historical Digital Content*

Each encounter offers a camera mode; in fact, the user has to enter camera mode in order to access the audio and visual content. The user access the content by pressing the headphone icon. This will display a list of content: a short article, many sound files, a photo album, some videos, and a quiz.

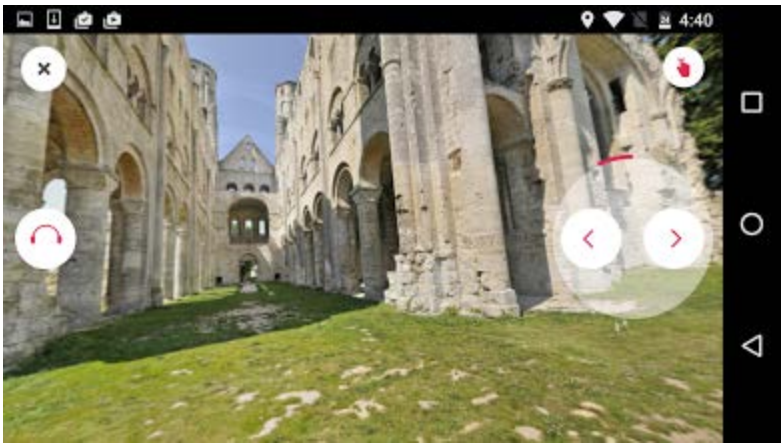


Figure 3.3. Camera mode, viewing the ruins.

The dial on the right enables the user to time travel, transitioning between ruin and 3D model. The X button will bring users back to the map. The hand icon changes how the user peruses the camera footage. By default, the 360 degree view rotates with the phone's gyroscope as the user swings the phone around to view the ruins. However, if the user presses the hand icon, the user can explore the 360 photo by swiping with their fingers instead.

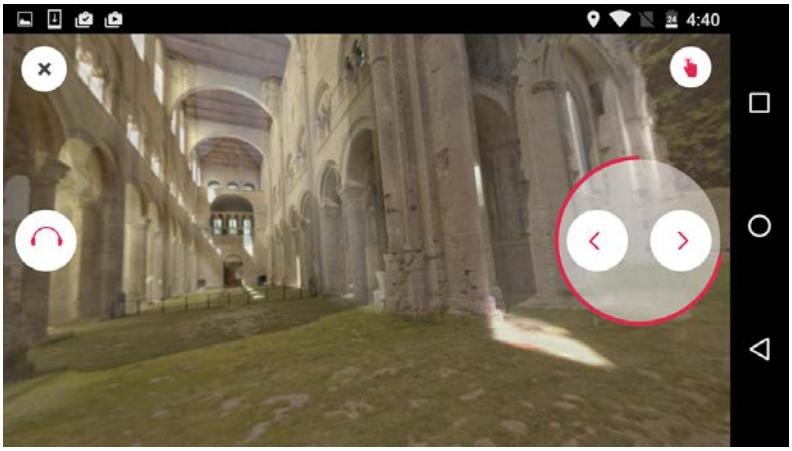


Figure 3.4. Camera mode, transitioning between ruin and 3D model.

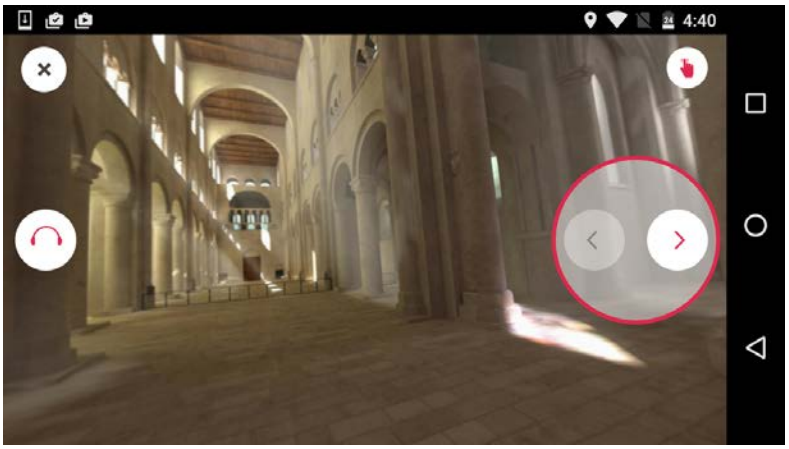


Figure 3.5. Camera mode, full 3D reconstruction.

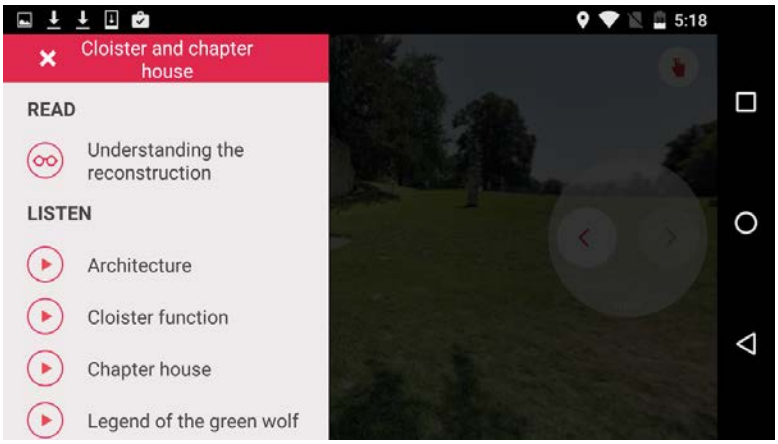


Figure 3.6. List of content brought up by tapping the headphone icon at the Cloister.

For each encounter, the content is organized under headings: Read, Listen, Watch, and Play. ‘Read’ contains a short article that explains a bit about what the user will listen to and watch at each encounter.

‘Listen’ features several sound clips and when tapped, the length of the clip is displayed along the bottom of the screen as a bar; no exact time of each clip is given. The user is able to scrub through the sound clip by adjusting the slider, play/pause the clip, and jump to the next one. However, there are no transcripts available.

The photo album is accessible only after the user starts to listen to the sound clips. A button on the bottom right becomes available. The photos can only be swiped through one at a time, there is no gallery view; a small explanation of the photo is provided underneath it. The album

contains modern-day photos of the ruins as well as historical sketches and photos of documents relating to the architecture of the monastery or the monastic lifestyle. The photos may be related to other monasteries, not necessarily Jumieges, in order to put Jumieges in the context of religious life. The photos draw from multiple sources to demonstrate how Jumieges may have operated in its heyday, as first-hand sources are scarce in some areas. The sound clips can still be listened to while in camera mode or while flipping through the photo album.

Figure 3.7. Photo in the photo album, showing monks working in the garden at another monastery.

The quiz is a photo quiz. It asks the user to identify which picture could have been taken where they are standing now. There are three pictures to choose from, and they are close-ups of some small detail. This encourages users to actually study the architecture and not just focus on the app.

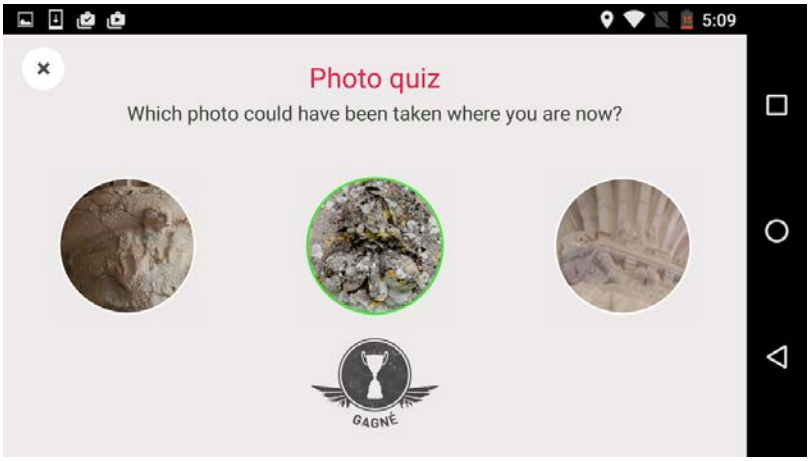


Figure 3.8. The photo quiz for the Maurist Gardens with a correct answer.

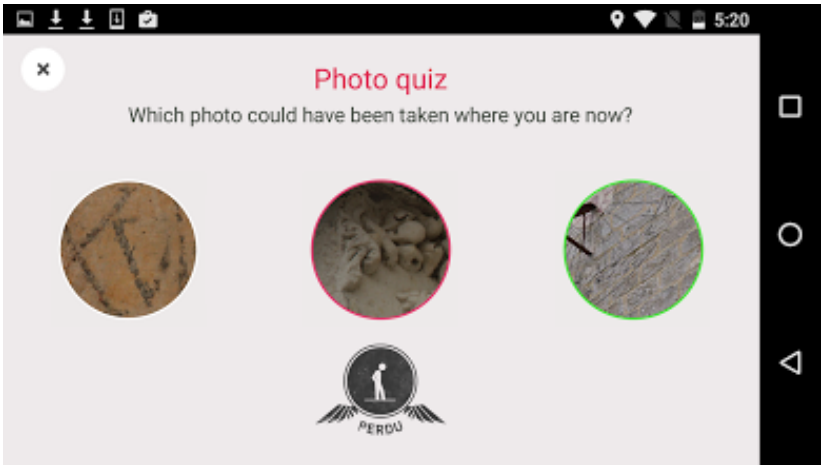


Figure 3.9. The photo quiz with the incorrect answer.

The app does not tally up the results of all the quizzes the user takes, nor can the user connect with others to share quiz results and compare scores. The app saves the results of the quiz, and everything the user has listened or watched so far, by marking them in green. However, this only saves for the duration that the app is open. If the app is closed and opened again, all markers of progress are erased.

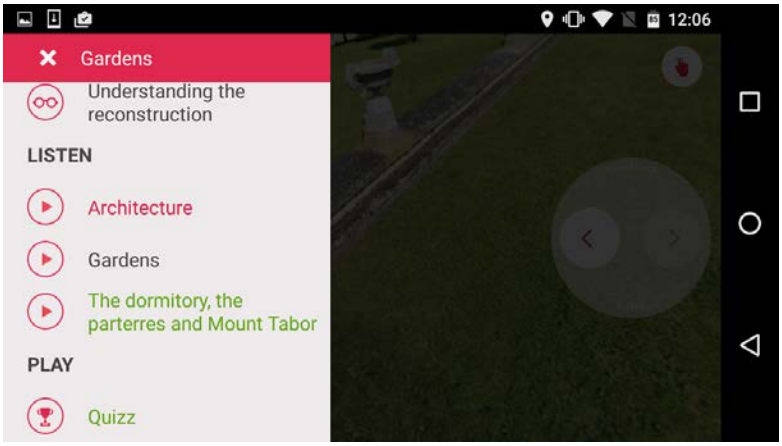


Figure 3.10. Color-coded progress.

The videos are interview-style, wherein an expert explains some aspect of the monastery and monastic life while strolling through the ruins.

Figure 3.11. Screenshot of the beginning of one of the videos, an interview with an expert.

There is also one video in which there are some historical reenactments. The narrator tells the user about the legend surrounding the abbey's formation and actors are used to help tell this tale. The video has a play/pause button, but there is no way to scrub through the content or jump to the next video. Transcripts are not available for videos or sound clips.

All the app content is available in four languages: French, English, German and Italian. The user can review the content at any time, either while wandering around between encounters, at the encounter, or at their home. They can listen to the sound clips while viewing the augmented reality and also while flipping through the photo album.

Additionally, *Jumieges3D* has a menu system. This is opened by pressing the monastery icon in the top left corner when in Map mode.

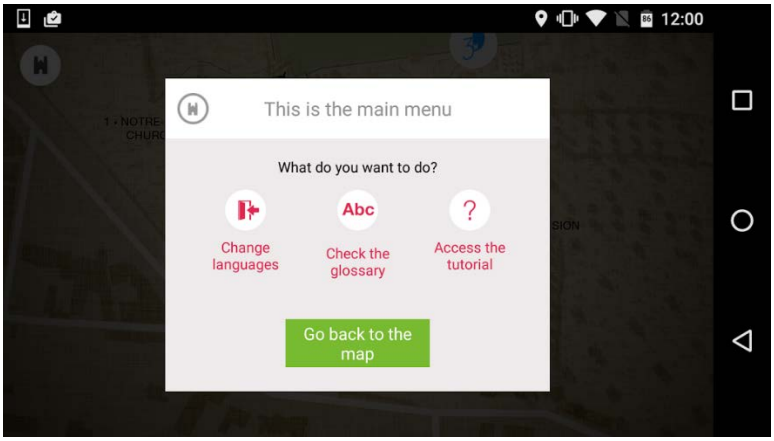


Figure 3.12. *Jumieges3D* menu.

The menu allows the user the option of changing languages, checking the glossary, and accessing the tutorial. The tutorial instructs users how to view the 3D reconstructions and use the time travel mechanic, plus how to listen to the audio commentary. There is also a small glossary. The glossary entries don't link to a dictionary or Wikipedia nor do they have references listed.

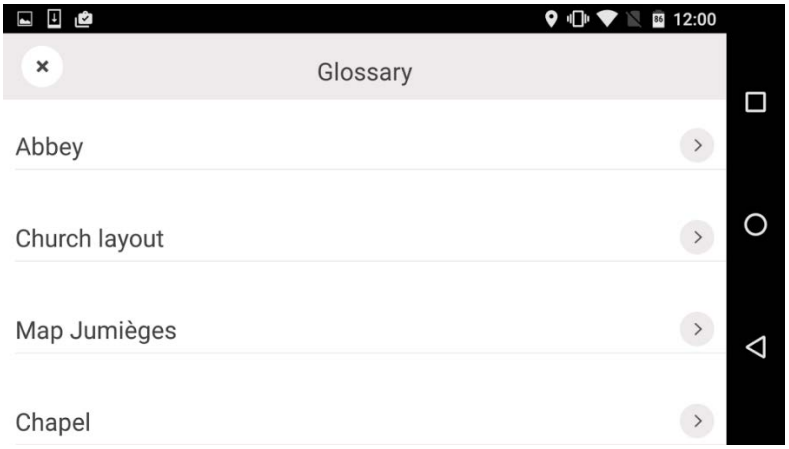


Figure 3.13. *Jumieges3D* Glossary.

3.7. *Learning Objectives*

This app assumes no prior knowledge of Jumieges, French history, monastic life, or architecture and treats the user as a blank slate. *Jumieges3D* has a wide knowledge transfer; even within the app, the user encounters photographs, sketches and books relating to religion and is exposed to different monasteries, authors and time periods. Therefore, the user may learn about other monasteries and monks not directly connected to Jumieges.

3.8. *HCCI, Context Immersion, and Instructional Design Principles*

Context interaction is motivated by the time travel mechanic. While all of the content is available no matter where the user stands, the allure of time traveling in real-time is perhaps the strongest way in which the app encourages the user to actually explore the site instead of just stand in one place and breeze through all the content.

Context immersion is also conveyed most strongly through the time travel mechanic, allowing users to step back in time and view the monastery as it may have been. The user has control

over the transition and can look at photos and listen to sound clips while viewing the AR. This multi-modal approach allows the user to be immersed through several different means. As the user is not tied to one place while listening or viewing the context, the context interaction is strong, as the user can interact with the app content while simultaneously interacting with the site through untethered exploration.

Jumieges3D implements several Lifelong Learning Principles. Through its use of video, audio and text, it makes use of #3 Dual Code and Multimedia Effects, in which the material is relayed through the user through a variety of means. However, there is an abundance of material, most of it auditory without a transcript, and that could be in violation of the principle as it may cause cognitive overload. This is also a violation of #15 Manageable Cognitive Load, which states that "the demands on working memory can exceed capacity when there is auditory input that does not match written text and there is visual animation and other movement to monitor at the same time, especially early in learning" (Graesser 2009). There are no transcripts so that the reader may follow along, which is also a detriment to accessibility as the hard-of-hearing will not be able to make use of the audio clips or the videos. In addition, though context immersion is engendered by the mobility and fluidity of content, they are moving around the site, and looking at the augmented reality, and listening to the audio, which could also risk putting them into cognitive overload.

Jumieges3D also makes use of #4 Testing Effect through the photo quizzes. The implementation of this principle supports context interaction and context immersion. Such an approach encourages the user to actually study the site, allowing them to take in details of the architecture they may have otherwise missed. This means the user is spending less time staring at the screen and is using the app as a tool for exploration rather than a crutch. However, the app could go one step further. After the user answers the quiz, the app could provide some textual explanation of what the user was looking at. This would reward the user for playing with having the benefit of giving them more information. The user is corrected immediately if they are wrong, which ties into #12 Feedback Effects, but adding information after the user has completed the quiz will give them more feedback. It will also give the user more information at a pertinent time, after their interest has been piqued by the quiz, thereby implementing #9 of James Gee's game principles: "Just in Time" and "On Demand". This principle states that information should be provided to the learner right when they "need and can use it" (Gee, n.d.).

One convenient addition that already addresses the “Just in Time” and “On Demand” principle is the presence of a glossary.

As stated, *Jumieges3D* contains multiple sources of information, including photos from other monasteries and texts from relevant monastic books and also maps and paintings. This enacts Lifelong Learning Principle #11 Multiple Examples**,** which states that learners should be provided with “examples of concepts, especially examples that are selected from different academic disciplines (e.g., correlations in historical events and medicine) and different domains of knowledge (applied and abstract)” (Graesser, 2009). *Jumieges3D* combines this principle with Lifelong Learning Principle #10 Stories and Example Cases**,** which states that “stories and other forms of narrative are easier to read, comprehend, and remember than other types of learning materials... example cases in a story-like format are persuasive, easy to comprehend, and very memorable” (Graesser, 2009). While most of *Jumieges3D* is documentary-like, there is one video that recounts the founding of the monastery. It’s a myth, a legend, and the story is told like one, complete with reenactments.

Chapter 4 - *Fortress of Bastille*

4.1. *Introduction to the app*

Fortress of Bastille recreates the Storming of the Bastille using augmented reality, 3D models, and a narrator. The Storming of the Bastille occurred on July 14, 1789, during the French Revolution. The Bastille was a political prison and symbol of the monarchy's power; it also contained barrels of gunpowder that rebels against the monarchy would dearly liked to have had. While the day initially started with negotiations, eventually the mob became impatient and found a way into the fortress. The fighting continued and eventually the fortress was taken by the civilians and prisoner's governor was killed. The Storming of the Bastille is considered the symbolic starting point of the French Revolution and is celebrated as The National Celebration, known to English speakers as Bastille Day. Though the Bastille fortress was destroyed, the July Column stands where it used to be as a commemoration of the event.

The app was developed by a company called Pilgrim XXI. There are four encounters the user is able to visit and an additional photo opportunity. As the fortress is destroyed, the app uses augmented reality to resurrect it where it would have stood.

4.2. *Modes, Mechanics and Dynamics*

Fortress of Bastille has three modes: map mode, camera mode, and content mode. Mechanics include a navigation mechanic, a time travel mechanic, a destroy/animation mechanic, a photo capture mechanic, and a content review mechanic.

Map mode enables the navigation mechanic, wherein users are able to guide themselves to the encounters on the map.

Figure 4.1. Map mode.

Touching the binocular icon will bring up a series of directions, where the user is asked enable to stand in a particular location, then line up their phone camera with a faint photo overlay of the surrounding area in order for the AR to spawn in the correct place.

Figure 4.2. Directions for standing in the correct location.

Figure 4.3. Directions continued, showing the user how to point their camera.

While the directions tell the user they should go to Place de la Bastille in Paris to do this, the app does not require that to function, as demonstrated in the image below. Here, the photo overlay is used against a white wall. This means that there is a hard movement mechanic as well as soft. Users are encouraged to physically move to line up the photo at each encounter, and are therefore rewarded with a different view of the Bastille blending into the cityscape.

However, the content can be accessed from anywhere just by tapping on the buttons, thus the soft movement mechanic.

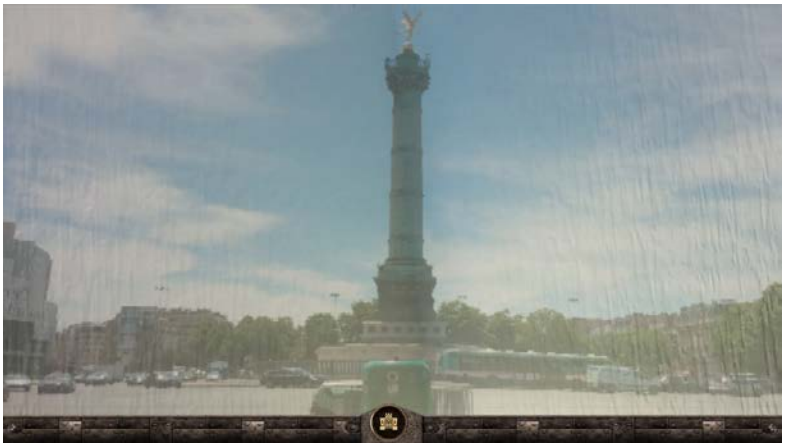


Figure 4.4. The photo overlay against a white wall.

Once the user is happy with the alignment, they press the fortress icon and enter camera mode, where the augmented reality content is spawned. This is a time travel mechanic, as it allows users to see the Bastille in its former glory. This is a 3D model of the Bastille fortress, rendered in an angle from where the user would see it standing, fitting into the current Parisian cityscape. There are three external views of the fortress, from the left, right, and left-centre. There is also a view from inside the fortress.

Figure 4.5. Different external views of the fortress.

Figure 4.6. Different external views of the fortress.

Figure 4.7. Different external views of the fortress.

Figure 4.8. Internal view of the fortress.

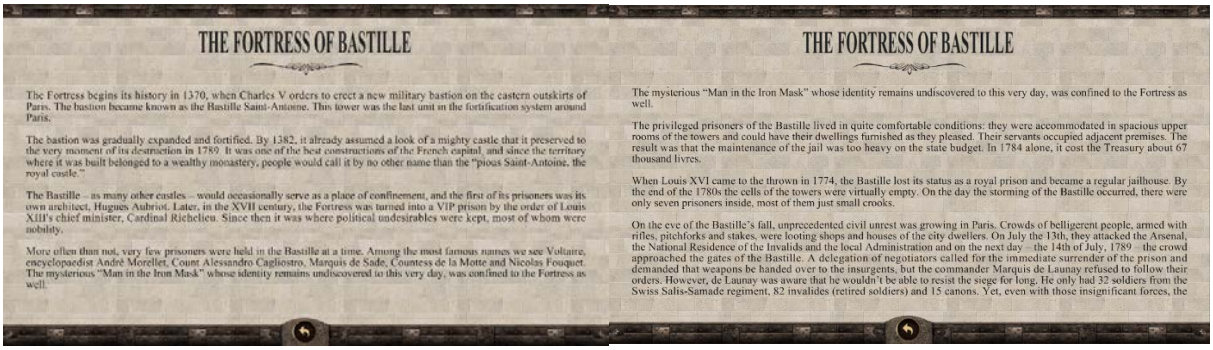
The user must be in the exact location for the model to blend into the real world landscape. If the user backs up or steps forward, the model does not adjust to accommodate this. The user can't zoom in and out on the models either. They were designed to be viewed from four points and exactly at those four points.

The internal view is a 360 model, in which the user can still see through to the real world through the gates and uncovered ceiling of the model.

Once the user enters camera mode, the narration automatically begins. The narration is different in each encounter and tells the story of how and why the Storming of the Bastille happened, what occurred afterwards, and the ripple effects that influenced later revolutions. The narrator also describes how the Storming of the Bastille came to be celebrated, and why the Bastille, thoroughly dismantled after the Storming, was remembered with a monument. There is no way to pause/play the narration or scrub through it.

Once in camera mode, a menu on the bottom of the screen appears with three icons. The arrow icon takes the user back to map mode, the information icon displays the narration transcript, and the canon icon represents the destroy/animation mechanic, in which case the user unleashes animated destruction upon the Bastille.

By tapping on the information icon on the bottom of the screen, the user can bring up a transcript. This content review contains the text version of the narration from all of the encounters, not just the encounter the user is currently at and listening too. The transcript is displayed as a wall of small text, difficult to read on small screens, and difficult to follow along with the narrator because all of the sites are mixed together in the same transcript.



THE FORTRESS OF BASTILLE

The Fortress begins its history in 1370, when Charles V orders to erect a new military bastion on the eastern outskirts of Paris. The bastion became known as the Bastille Saint-Antoine. This tower was the last unit in the fortification system around Paris.

The bastion was gradually expanded and fortified. By 1382, it already assumed a look of a mighty castle that it preserved to the very moment of its destruction in 1789. It was one of the best constructions of the French capital, and since the territory where it was built belonged to a wealthy monastery, people would call it by no other name than the "pious Saint-Antoine, the royal castle."

The Bastille – as many other castles – would occasionally serve as a place of confinement, and the first of its prisoners was its own architect, Hugues Aubriot. Later, in the XVII century, the Fortress was turned into a VIP prison by the order of Louis XIII's chief minister, Cardinal Richelieu. Since then it was where political undesirables were kept, most of whom were nobility.

More often than not, very few prisoners were held in the Bastille at a time. Among the most famous names we see Voltaire, encyclopaedist André Morellet, Count Alessandro Cagliostro, Marquis de Sade, Countess de la Motte and Nicolas Fouquet. The mysterious "Man in the Iron Mask" whose identity remains undiscovered to this very day, was confined to the Fortress as well.

THE FORTRESS OF BASTILLE

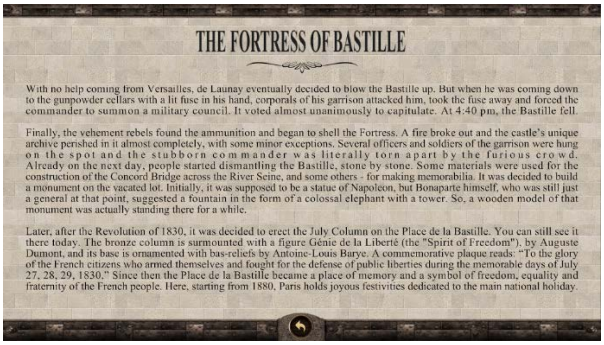
The mysterious "Man in the Iron Mask" whose identity remains undiscovered to this very day, was confined to the Fortress as well.

The privileged prisoners of the Bastille lived in quite comfortable conditions: they were accommodated in spacious upper rooms of the towers and could have their dwellings furnished as they pleased. Their servants occupied adjacent premises. The result was that the maintenance of the jail was too heavy on the state budget. In 1784 alone, it cost the Treasury about 67 thousand livres.

When Louis XVI came to the thrown in 1774, the Bastille lost its status as a royal prison and became a regular jailhouse. By the end of the 1780s the cells of the towers were virtually empty. On the day the storming of the Bastille occurred, there were only seven prisoners inside, most of them just small crooks.

On the eve of the Bastille's fall, unprecedented civil unrest was growing in Paris. Crowds of belligerent people, armed with rifles, pitchforks and stakes, were looting shops and houses of the city dwellers. On July the 13th, they attacked the Arsenal, the National Residence of the Invalids and the local Administration and on the next day – the 14th of July, 1789 – the crowd approached the gates of the Bastille. A delegation of negotiators called for the immediate surrender of the prison and demanded that weapons be handed over to the insurgents, but the commander Marquis de Launay refused to follow their orders. However, de Launay was aware that he wouldn't be able to resist the siege for long. He only had 32 soldiers from the Swiss Salis-Samade regiment, 82 invalides (retired soldiers) and 15 canons. Yet, even with those insignificant forces, the

Figures 4.9 – 4.11. Transcript from "*Fortress of Bastille*".



THE FORTRESS OF BASTILLE

With no help coming from Versailles, de Launay eventually decided to blow the Bastille up. But when he was coming down to the gunpowder cellars with a lit fuse in his hand, corporals of his garrison attacked him, took the fuse away and forced the commander to summon a military council. It voted almost unanimously to capitulate. At 4:40 pm, the Bastille fell.

Finally, the vehement rebels found the ammunition and began to shell the Fortress. A fire broke out and the castle's unique archive perished in it almost completely, with some minor exceptions. Several officers and soldiers of the garrison were hung on the spot and the stubborn commander was literally torn apart by the furious crowd. Already on the next day, people started dismantling the Bastille, stone by stone. Some materials were used for the construction of the Concord Bridge across the River Seine, and some others - for making memorabilia. It was decided to build a monument on the vacated lot. Initially, it was supposed to be a statue of Napoleon, but Bonaparte himself, who was still just a general at that point, suggested a fountain in the form of a colossal elephant with a tower. So, a wooden model of that monument was actually standing there for a while.

Later, after the Revolution of 1830, it was decided to erect the July Column on the Place de la Bastille. You can still see it there today. The bronze column is surmounted with a figure Génie de la Liberté (the "Spirit of Freedom"), by Auguste Dumont, and its base is ornamented with bas-reliefs by Antoine-Louis Barye. A commemorative plaque reads: "To the glory of the French citizens who armed themselves and fought for the defense of public liberties during the memorable days of July 27, 28, 29, 1830." Since then the Place de la Bastille became a place of memory and a symbol of freedom, equality and fraternity of the French people. Here, starting from 1880, Paris holds joyous festivities dedicated to the main national holiday.

While in Camera mode, the user can use the animation/destroy mechanic. This is represented as a small canon icon on the bottom right of the menu. Pressing this icon starts the 3D model animation; the user watches, as before their eyes, the Bastille is destroyed as it was in the Storming. It allows them to participate in the event and even control when it happens.

Figure 4.12. Bastille fortress being destroyed, external view.

Figure 4.13. Bastille fortress being destroyed, internal view.

Additionally from map mode, there is a camera icon that will enable the photo capture mechanic. This takes the user to a photo opportunity with a 3D model. This can be used to capture a photo of friends with a French revolutionary; to take the picture, the user taps the camera icon again. However, it is not clear where the photo is saved. There is no photo review mechanic, so the photo is not saved in the app itself, and checking the camera roll on the phone during user testing provided no results.

Figure 4.14. Photo opportunity with 3D model.

The navigation mechanic encourages a site-exploration dynamic, and the content review encourages exhibit-exploration. The time travel mechanic encourages exploration of both.

4.3. *Linearity*

Fortress of Bastille has a non-linear structure as the encounters can be done in any order. In addition, the destroy/animation mechanic can be used at all four encounters and at any time during them.

4.4. *Locative Aspects*

While the app tells the user they must be in Place de la Bastille, the content can be accessed from anywhere. The context immersion is lessened, perhaps, as the user does not get the full effect of seeing the Bastille resurrected in its proper place among Parisian streets, however the knowledge is still available to those unable to relocate themselves to Paris.

4.5. *Aesthetics - Visuals and Sounds*

The visual style of the app is somewhat rustic, similar in ways to *Walk1916*, in that the color palette consists of parchment and gunmetal. The background of the text portion is a parchment texture and the menu consist of strips of metal with bolts, perhaps as a reference to war and the fortress Bastille itself. The buttons are round and textured as well, with a crosshatch pattern, and the icons inside the buttons are some sort of pale grey/gold color. They are perhaps similar to buttons on a coat or dials on a piece of machinery, similar to *Walk1916*. The text, however, seems to be a standard font: Times New Roman.

There is no background music in *Fortress of Bastille*; however, there is noise when the user decides to destroy the Bastille. Sounds of destruction, of explosions and tumbling brick, punctuates the animation. As far as the 3D model goes, there is no information on how it was recreated and what historical sources the model was based on.

Similar to the other two apps, narrative and discovery are the dominant aesthetics, created by the navigation and content mechanics.

4.6. *Historical Digital Content*

The app provides a 3D model of the Bastille fortress from four different views. It is not stated which paintings, drawings, or historical markers this model is built from. Providing these materials would not only provide a source of information for users, it also could increase context interaction, as the user could be immersed through multiple means. This would also support Lifelong Learning principle #3, in which the information is relayed to the user in different modalities. Having a section for historical photographs and sketches would enable users to glean extra information.

The historical narration informs the user about the events surrounding the Storming of the Bastille and its effect on the French nation; it also explains how the holiday celebrating the Storming came to be. Providing videos of these celebrations or photographs could also help users interact with the context, in this case its modern day context. This would give the user more knowledge transference. Additionally, if there were historical artefacts surviving the Storming, then a photo gallery of these would also be helpful. Paintings or engravings of the people mentioned in the narration could also help. This would enable the app to more fruitfully use Lifelong Learning Principle #3.

The contents of the app are available in Russian, English, French and Chinese.

4.7. *Learning Objectives*

The app provides a thorough rundown of events and enough explanation of the main players involved that the user doesn't need to know anything about the Bastille in advance, aside from the fact that it once existed.

The app aims to teach users why the Storming of the Bastille happened, what the events were, what the effects of those events were, and then provides detail on the current-day celebrations of the Storming of the Bastille. Knowledge transference could occur in several areas, but is relatively limited as the material only comes in two modalities: text and audio. There is no additional content like photos or videos that could encourage knowledge transference into additional areas of French history and modern day culture.

4.8. *HCCI, Context Immersion, and Learning Principles*

Compared to the previous two apps, *Fortress of Bastille* is unique as it encourages user interaction with a historical site that no longer exists. There are no ruins or remnants for the user to explore or for the models to reconstruct. Through augmented reality, the app is able to completely resurrect a demolished building in its original position in order to show users what it would look like and inform them about its role in the French revolution. Therefore, much of the interaction happens through the screen. There is some interaction with the surrounding areas, as the user is asked to line up their phone camera with the semi-transparent photo overlay in order to correctly spawn the 3D model of the Bastille. Then, the user can interact with the historical site (which is the 3D model) and the surrounding environment by looking at the landscape and seeing how the model fits in.

Interaction continues through narration, which starts playing automatically. As there are no controls for pausing/playing or scrubbing through, the user's control is limited and therefore may not be accommodating towards their learning. Context immersion is accomplished through interacting with AR content, as the user can cause the Bastille to be destroyed. The sound effects also help to accomplish this, though the user cannot play or pause the narrator if the narrator is talking during the destruction, which could hinder enjoyment.

Out of the three apps, *Fortress of Bastille* is the only that encourages social interaction. The photo opportunity is ideal for a group of friends, or a selfie, and therefore immersion. However, if the photo capture mechanic was working and included in-app sharing abilities to external social media sites such as Facebook, the immersion would be far more complete. Additionally, if there were different photo opportunities at each encounter, it would encourage users to visit each encounter and also prompt more sharing and immersion.

While this app does provide text of the audio, a good start on principle #3 Dual Code and Multimedia Effects, the way it imparts the text is in violation of number #15 Manageable Cognitive Load. This principle states that "the demands on working memory can exceed capacity when there is auditory input that does not match written text and there is visual animation and other movement to monitor at the same time, especially early in learning" (Graesser 2009). The audio narration is divided up between the four different encounters; the text, however, is grouped together in one long essay. Therefore, in order to be more effective, *Fortress of Bastille* could divide the text up to match the audio. Then, in order for the user to listen at his or her own pace and pause/replay the narration, audio controls could be added to the scene. Or, another button could be introduced. Similar to *Jumieges3D*, this button could bring up the content and allow the user full control over how and when they play the audio, and the app could also allow them to read the text at the same time they listen to it. This would fix the cognitive overload issue and simultaneously make use of the Just in Time principle, as the audio would no longer start automatically, but be available when the user thinks they are ready for it.

Chapter 5 – Comparative Analysis

5.1. *Tabular Analysis*

The following chapter presents comparative analysis of *Walk1916*, *Jumieges3D* and *Fortress of Bastille*. These are compared regarding content, mechanics, dynamics, aesthetics, Instructional Design Principles and context immersion. The intention is to categorize them within the two frameworks and identify what qualities would make a historical locative app a strong learning tool.

	Game Play		Structure		Locative aspects		Content					
	Progressive	Emergent	Linear	Non-linear	GPS-based	Marker-based	Audio files	Text files	Video Files	Transcripts	Photos	Multiple Language Support
Walk1916	X			X	X		X			X	X	
Jumieges3D	X			X		X	X	X	X		X	X
Fortress of Bastille	X			X		X	X			X		X

Table 5.1. Comparing the presence and absence of features.

	Navigation	Content Review	Photo capture	Time travel	Destroy/animation mechanic
Walk1916	**X**	**X**	**X**		
Jumieges3D	**X**	**X**		**X**	
Fortress of Bastille	**X**	**X**	**X**	**X**	**X**

Table 5.2. Comparing mechanics.

	#3 Dual code and multimedia effects	**#15 Manageable Cognitive Load**	**#4 Testing Effect**	**#12 Feedback Effects**	**#11 Multiple Examples**	**#10 Stories and Example Cases**	**JG #9 Just in time and On Demand**
Walk1916	supports	supports	Not present	Not present	Not present	Not present	supports
Jumieges3D	supports	violates	supports	supports	supports	supports	supports
Fortress of Bastille	semi-supports (due to violation of other principles)	violates	Not present	Not present	Not present	Not present	violates

Table 5.3. Comparing Instructional Design Principles.

Mechanics	**Aesthetics**		**Dynamics**	
	Discovery	Narrative	Site-Exploration	Exhibit-Exploration
Navigation	X		X	
Content Review	X	X		X
Time Travel	X	X	X	X
Photo capture	X		X	X
Destroy/animation mechanic	X	X	X	X

Table 5.4. Comparing aesthetics and dynamics against mechanics.

	#3 Dual code and multimedia effects	#15 Manageable Cognitive Load	#4 Testing Effect	#12 Feedback Effects	#11 Multiple Examples	#10 Stories and Example Cases	#9 Just in time and On Demand
Navigation	X			X			X
Content Review	X	X	X	X	X	X	X
Time Travel	X				X		X
Photo capture	X				X		X
Destroy/ animation mechanic	X				X		X

Table 5.5. Comparing which mechanics support Instructional Design Principles.

	Location-Based Tracking	Object Recognition	Communication with other users	Adjustable AR
Walk1916	X			
Jumieges3D				X
Fortress of Bastille				X

Table 5.6. Comparing context immersion.

	Location-Based Tracking	Object Recognition	Communication with other users	Adjustable AR
Navigation	X			
Content Review				
Time Travel				X
Photo capture				X
Destroy/animation mechanic				X

Table 5.7. Comparing which mechanics support the Context Immersion Framework.

5.2. *Game Education Framework*

As Table 5.1 shows, all of the apps are non-linear. This may be because, as Dr. Cushing mentioned, non-linear structure gives the user the most control over their own learning. Non-linear structure enables users to decide which encounters they want to visit at a historical site and how much time they wish to spend at each encounter. It is interesting to note that all of the apps are progressive and non-linear. There are no instances of hybridization within the apps.

The apps also contain very similar mechanics. As location-based apps, they all have some sort of navigation mechanic to allow the user to maneuver through the historical site and the content. As they are AR-based, a photo capture mechanic is to be expected. However, where they differ most strongly is in the content review mechanic. Table 5.5 reveals that the content review mechanic supports most of the learning principles.

A combination of text, audio, video and photographs supports #3 Dual Code and Multimedia Effects. However, the way all of this information is conveyed to the user can put the app in violation of #15 Cognitive Overload. In *Jumieges3D*, transcripts weren't available for the videos or the audio. In *Fortress of Bastille*, the transcript wasn't lined up with the audio files and the user had no control over the playback. *Walk1916* allowed users the most ease of access, allowing them to read transcripts while playing the audio files and allowing them to pause and play the audio. While it may seem counter-intuitive to provide *more* content in the form of transcripts, the educational game framework shows that transcripts actually help avoid cognitive overload. Providing transcripts and audio controls enables the user to learn at their own pace and in the manner that most benefits them.

As evidenced in Table 5.5, most of the mechanics allow information to be provided in multiple modalities, such as a map, a photo, or an augmented model. This also helps enforce principle #11, multiple examples.

The main dynamic that the content review and navigation mechanic created was the exploration dynamic. Out of the eleven elements present in the taxonomy of aesthetics, two of them are strongly represented in these apps: narrative and discovery. Table 5.4 hypothesizes which mechanics create which dynamics and aesthetics. The time travel mechanic seems to be the only mechanic that creates all of the elements. Time travel can create a discovery aesthetic by inviting the user to discover what the site used to look like; it can also serve to tell the historical

narrative, quite literally showing the user a slice of history. Time travel also encourages site-exploration and exhibit-exploration. This may be due to its augmented nature, in that it blends the site and exhibit. If such augmented content is also adjustable, this also serves to increase context immersion, which will be discussed more in the next chapter.

Therefore, to strongly implement the game education framework, a location-based historical AR app should:

1. Present information to users through many modalities, such as text, audio, videos, photos, and AR content.
2. Avoid cognitive overload by providing transcripts for all media, allowing transcripts to be read while listening to the audio component, and providing browsing controls for audio and video content.
3. Test for knowledge.
4. Provide immediate feedback from that test.
5. Provide multiple examples pertaining to the historical context, such a multiple activities (i.e.: quizzes) and multiple sources or media to explain concepts.
6. If appropriate, use storytelling to convey history.
7. Provide information to users when they need it and when they ask for it, including introducing concepts and content at relevant points in the historical experience, and providing a way to review content easily. This also includes providing ways for the user to access different modes and mechanics easily.

5.3. *Context Immersion Framework*

Context immersion is affected by several different mechanics. *Jumieges3D* and *Fortress of Bastille* both contain AR that is adjustable and interactive. In *Jumieges3D*, users can use the time travel mechanic to adjust the model overlay. In *Fortress of Bastille*, users can use the destroy/animation mechanic to start the animation on the model.

As mentioned in the previous chapter, the time travel mechanic is particularly versatile. Using augmented content to show history encourages an exploration dynamic and discovery and narrative aesthetics. Allowing users to not only see AR content, but grab and adjust it, also increases context immersion. It is important to note that according to the framework, the AR must not be just present, but must also be malleable by the user. The photo capture and animation mechanic could also be employed to make use of adjustable AR and should perhaps

be used in conjugation with or in addition to the time travel mechanic. This is because the time travel mechanic also covers all the aesthetics and dynamics, making it a powerful asset to a historical app.

Fortress of Bastille is the only app that attempted to enable any sort of social factor; none of the apps incorporated social learning activities, but the photo opportunity in *Fortress of Bastille* did attempt to foster interaction with other users. However, it should be noted that the photo capture mechanic has not been fully implemented in *Fortress of Bastille* and needs to be fixed. If it was repaired and if in-app sharing to social media was enabled, it could increase context immersion.

Fortress of Bastille and *Jumieges3D* are marker-based and do not include GPS elements, although as the content takes place in a very small area, GPS is not needed. The apps have a map mode that enables a navigation mechanic, which still functions as part of immersion.

None of these apps offer object recognition. *Fortress of Bastille* could probably not make much use of it, as the entire site is recreated in the app and therefore nothing is left of the building *to* recognize. However, a static site like *Jumieges3D* could make very good use of object recognition. Many religious objects or notable aspects of architecture could be scanned to bring up more content. The photo capture mechanic could enable this aspect of context immersion.

Walk1916, involving multiple buildings that change over time, would have a harder time implementing this aspect of context immersion. The sites would have to be carefully chosen as not every site would be suitable. As discussed in the chapter about the app, sites with public access, and those with historic displays, such as the General Post Office and Dublin Castle, would be good candidates.

Therefore, a historical location-based app would strongly support context immersion if it had the following qualities:

1. Location-based tracking or some sort of navigation mechanic for marker-based apps.
2. Object recognition of historical artefacts at a suitably static and accessible location.
3. Some way for users to connect with each other, such as a photo opportunity or the ability to compare quiz scores, or perhaps something like a scavenger hunt competition.
4. AR content that is adjustable by the user, such as a time travel mechanic.

5.4. *Examining HCCI*

The two frameworks, educational game principles and context immersion principles, work together to encourage interaction with the historical context, both with the site itself and the exhibit (i.e.: the content in the app). Several learning principles, if implemented correctly, can generate learning and learning motivation, increasing the interaction with the exhibit. These include Lifelong Learning Principles #3 Dual code and multimedia effects, #15 Manageable cognitive load, #4 Testing effects, #12 Feedback effects, #11 Multiple examples, #10 Stories and example cases, and Gee's #9 Just in time and On Demand principle. The main mechanic that encourages interaction with the exhibit is the content review mechanic. The content review mechanic determines the success of the app in implementing learning principles. An easy to use and easily accessible review mechanic enables #9. For example, *Walk1916* had one place (Casebook mode) where all the unlocked content was neatly stored and accessible whenever the user wished.

The cognitive load principle was violated when the apps didn't provide transcripts or provided them at the wrong moment. This is an easy fix, as all that has to be done is include transcripts and provide controls for the audio and video segments. *Jumieges3D* incorporated the most principles, as the app included multiple examples, testing effects, as well as feedback. The app's quiz also encouraged site-interaction, imploring the user to study the site to interact further with the exhibit. This was unique among the apps (although it should be noted that the nature of *Fortress of Bastille* means that site-interaction is practically non-existent).

The navigation mechanic encourages interaction with the site itself; the navigation mechanic also supports the location-based tracking feature of context immersion. As stated in the context immersion framework, objection recognition, communication with other users, and adjustable AR are other factors that increase context immersion. The mechanic that supports adjustable AR is the time travel mechanic. It also creates aesthetics of discovery and narrative, and creates an exploration dynamic, which encourages both site interaction and exhibit interaction. The animation mechanic and possibly the camera/photo capture mechanic could also enable adjustable AR, though the time travel mechanic interacts most strongly with the historical context. Though none of the apps included object recognition, the camera mechanic would support that as well. This could be a boon, as it would allow users to analyze historical artefacts through object recognition, thereby interacting with the site and the exhibit through one mechanic. Communication with other users was not supported by the apps, although *Fortress*

of Bastille did attempt to create social interaction with the photo capture mechanic. Allowing users to experience the content together or compete against each other would help increase context immersion.

Conclusion

Human-Computer-Context-Interaction was analyzed in three historical location-based AR apps by using two frameworks. This was done in order to discover what aspects of these types of apps made them effective learning tools. These two frameworks focused on game education principles and context immersion principles. The game education framework analyzed learning objectives, mechanics, dynamics, aesthetics, and Instructional Design Principles. The context immersion framework analyzed location-based tracking, object recognition, communication with other users, and adjustable AR.

Through comparative analysis, it was discovered that the main mechanics in these types of apps were: navigation, content review, photo capture, time travel, and animation. The dynamics these mechanics created in users was one of exploration, both with the site and the app itself. The aesthetics created by the exploration dynamic and enhanced by visuals and audio were discovery and narrative.

The instructional design principles were most clearly present in the content review mechanic. Most of the apps presented information in multiple modalities, but the way in which such information was conveyed to the user often resulted in cognitive overload. Implementing transcripts and media controls would help lessen cognitive overload. This means it is just as important for a developer to consider what information is put in the app as how the user moves through the information. Managing the balance between cognitive overload and other learning principles seems key; if the user is too overwhelmed by the presentation of the information, there is no guarantee they will continue to review the content or continue using the app at all.

The time travel mechanic was the most versatile of all mechanics, as it encouraged the exploration dynamic with the site itself and the app content. It also is an important part of context immersion as it can enable adjustable AR. Object recognition and communicating with other users was not present in any of the apps. Providing these features could easily be done through the photo capture mechanic and would strength context immersion. Object recognition would also support the exploration dynamic, which encourages both site interaction and exhibit interaction.

Future work could focus on the linearity of such apps and their gameplay structure. It would be interesting to discover if combining emergent and progressive gameplay could introduce new mechanics that incorporate different learning principles. Non-linear narrative structures allow the user maximum control over their experience, as they can spend as much time as they wish at one encounter and only see encounters they think are interesting. If a linear structure is implemented then time constraints would have to be taken into consideration and that would change the way the content is presented to the user. Another interesting question to address would be: do non-linear structures lend themselves to progressive gameplay? Or could non-linear structures be just as compatible with emergent gameplay?

Investigating these possibilities could incorporate a wider variety of narrative structures, gameplay types and learning principles into location-based historical AR apps.

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Appendix

Ethics Committee Application

School of Computer Science & Statistics
Research Ethics Application

Part A

Project Title: Interactivity in Mixed Realty Applications at Historical Sites

Name of Lead Researcher (student in case of project work): Arlene Kalem

Name of Supervisor: Mads Haahr

TCD E-mail: kalema@tcd.ie Contact Tel No.: 085-152-2844

Course Name and Code (if applicable):

Degree: Master of Computer Science in Interactive Digital Media.

Course code: DPTCS-IDME-1F09

Module name: Research Paper.

Module code: CS7044

Estimated start date of survey/research: March 22nd 2017

I confirm that I will (where relevant):

- Familiarize myself with the Data Protection Act and the College Good Research Practice guidelines http://www.tcd.ie/info_compliance/dp/legislation.php;
- Tell participants that any recordings, e.g. audio/video/photographs, will not be identifiable unless prior written permission has been given. I will obtain permission for specific reuse (in papers, talks, etc.)
- Provide participants with an information sheet (or web-page for web-based experiments) that describes the main procedures (a copy of the information sheet must be included with this application)
- Obtain informed consent for participation (a copy of the informed consent form must be included with this application)
- Should the research be observational, ask participants for their consent to be observed
- Tell participants that their participation is voluntary
- Tell participants that they may withdraw at any time and for any reason without penalty
- Give participants the option of omitting questions they do not wish to answer if a questionnaire is used
- Tell participants that their data will be treated with full confidentiality and that, if published, it will not be identified as theirs
- On request, debrief participants at the end of their participation (i.e. give them a brief explanation of the study)
- Verify that participants are 18 years or older and competent to supply consent.
- If the study involves participants viewing video displays then I will verify that they understand that if they or anyone in their family has a history of epilepsy then the participant is proceeding at their own risk
- Declare any potential conflict of interest to participants.
- Inform participants that in the extremely unlikely event that illicit activity is reported to me during the study I will be obliged to report it to appropriate authorities.
- Act in accordance with the information provided (i.e. if I tell participants I will not do something, then I will not do it).

Signed: Arlene Kalem ..... Date: 08/02/2017 .....

Lead Researcher/student in case of project work

Part B

Please answer the following questions.		***Yes/No***
Has this research application or any application of a similar nature connected to this research project been refused ethical approval by another review committee of the College (or at the institutions of any collaborators)?		No
Will your project involve photographing participants or electronic audio or video recordings?		Yes
Will your project deliberately involve misleading participants in any way?		No
Does this study contain commercially sensitive material?		No
Is there a risk of participants experiencing either physical or psychological distress or discomfort? If yes, give details on a separate sheet and state what you will tell them to do if they should experience any such problems (e.g. who they can contact for help).		No
Does your study involve any of the following?	Children (under 18 years of age)	No
	People with intellectual or communication difficulties	No
	Patients	No

School of Computer Science and Statistics
Research Ethical Application Form

Details of the Research Project Proposal must be submitted as a separate document to include the following information:

1. Title of project
2. Purpose of project including academic rationale
3. Brief description of methods and measurements to be used
4. Participants - recruitment methods, number, age, gender, exclusion/inclusion criteria, including statistical justification for numbers of participants
5. Debriefing arrangements
6. A clear concise statement of the ethical considerations raised by the project and how you intend to deal with them
7. Cite any relevant legislation relevant to the project with the method of compliance e.g. Data Protection Act etc.

Part C

I confirm that the materials I have submitted provided a complete and accurate account of the research I propose to conduct in this context, including my assessment of the ethical ramifications.

Signed: Arlene Lealem ..... Date: 08/02/2017 .....
Lead Researcher/student in case of project work

There is an obligation on the lead researcher to bring to the attention of the SCSS Research Ethics Committee any issues with ethical implications not clearly covered above.

Part D

If external or other TCD Ethics Committee approval has been received, please complete below.

External/TCD ethical approval has been received and no further ethical approval is required from the School's Research Ethical Committee. I have attached a copy of the external ethical approval for the School's Research Unit.

Signed: ..... Date: .....
Lead Researcher/student in case of project work

Part E

If the research is proposed by an undergraduate or postgraduate student, please have the below section completed.

I confirm, as an academic supervisor of this proposed research that the documents at hand are complete (i.e. each item on the submission checklist is accounted for) and are in a form that is suitable for review by the SCSS Research Ethics Committ

Signed: ..... Date: 7/2/2017 .....
Supervisor

Completed application forms together with supporting documentation should be submitted electronically to the online ethics system - https://webhost.tchpc.tcd.ie/research_ethics/ When your application has been reviewed and approved by the Ethics committee, hardcopies with original signatures should be submitted to the School of Computer Science & Statistics, Room 104, Lloyd Building, Trinity College, Dublin 2.

CHECKLIST

Please ensure that you have submitted the following documents with your application:

1.	• SCSS Ethical **Application Form**	✓
2.	• **Participant's Information Sheet** must include the following: a) Declarations from Part A of the application form; b) Details provided to participants about how they were selected to participate; c) Declaration of all conflicts of interest.	✓
3.	• **Participant's Consent Form** must include the following: a) Declarations from Part A of the application form; **b)** Researchers contact details provided for counter-signature (your participant will keep one copy of the signed consent form and return a copy to you).	✓
4.	• **Research Project Proposal** must include the following: a) You must inform the Ethics Committee **who** your intended participants are i.e. are they your work colleagues, class mates etc. b) How will you recruit the participants i.e. **how** do you intend asking people to take part in your research? For example, will you stand on Pearse Street asking passers-by? c) If your participants are under the age of 18, you must seek both parental/guardian AND child consent.	✓
5.	• Intended **questionnaire**/survey/interview protocol/screen shots/representative materials (as appropriate)	✓
6.	• **URL** to intended on-line survey (as appropriate)	N/A

Notes on Conflict of Interest

1. If your intended participants are work colleagues, you must declare a potential conflict of interest: you are taking advantage of your existing relationships in order to make progress in your research. It is best to acknowledge this in your invitation to participants.
2. If your research is also intended to direct commercial or other exploitation, this must be declared. For example, *"Please be advised that this research is being conducted by an employee of the company that supplies the product or service which form an object of study within the research."*

Notes for questionnaires and interviews

1. If your questionnaire is **paper based**, you must have the following **opt-out** clause on the top of each page of the questionnaire: *"Each question is optional. Feel free to omit a response to any question; however the researcher would be grateful if all questions are responded to."*
2. If you questionnaire is **on-line**, the first page of your questionnaire must repeat the content of the information sheet. This must be followed by the consent form. If the participant does not agree to the consent, they must automatically be exited from the questionnaire.
3. Each question must be **optional**.
4. The participant must have the option to '**not submit, exit without submitting'** at the final submission point on your questionnaire.
5. If you have open-ended questions on your questionnaire you must warn the participant against naming **third parties**: *"Please do not name third parties in any open text field of the questionnaire. Any such replies will be anonymised."*
6. You must inform your participants regarding **illicit activity**: *"In the extremely unlikely event that illicit activity is reported I will be obliged to report it to appropriate authorities."*

TRINITY COLLEGE DUBLIN

Interactivity Questions for Mixed Reality Experiences

1.) How would you describe the narrative structure of your MR app?

2.) Why did your team choose this narrative structure?

3.) How much control does the user have over the narrative? To what degree? And in what manner (physical control or digital control)?

4.) What are the player's main objectives in this narrative? Does the user take on a narrative role?

5.) What mechanics allow them to complete those objectives? How do they enable/interact with these mechanics?

6.) How do the mechanics support the narrative structure?

7.) What guides the user through their objectives? What guides them through the story?

8.) What are the benefits of your chosen type of narrative?

9.) What are the limitations of your chosen type of narrative?

10.) How did you decide how much control the user should have?

11.) How does the user's navigation of physical space affect the digital content? How about the narrative structure?

12.) How do you think new technology, like HoloLens, will change the way users interact with MR apps?

Informed Consent Form

TRINITY COLLEGE DUBLIN
INFORMED CONSENT FORM

LEAD RESEARCHER: Arlene Kalem

BACKGROUND OF RESEARCH:

The goal of this research is to create an interactivity framework for the development of Mixed Reality applications at historical sites. How users interact with the digital content of the application in relation to physical spaces will be analyzed to construct a set of methodologies that can be used in the creation of future applications. Subject matter experts, such as application developers and historical site staff, will be interviewed to provide deeper insight into the creation and usage of these apps. Other purposes are:

1.) To ascertain important development choices that are considered when building Mixed Reality applications and how they affect the interactivity of the app.
2.) To analyze different types of user input and user control.
3.) To discover what type of MR applications are most useful to historical sites and their staff.
4.) To discuss how new technologies, such as HoloLens, change user interaction.

The interview will consist of open-ended questions designed to start a conversation regarding Mixed Reality user interactivity.

PROCEDURES OF THIS STUDY:

The researcher will be conducting an interview consisting of open-ended questions. For accuracy, the interview will be recorded, to ensure that misquotes in the research paper do not occur. As the questions are open-ended, the length of the interview will vary; the projected timeframe is around 30 minutes and will last no more than one hour. The interviewee may answer the questions in as much detail as they wish and may choose to skip questions they do not want to answer.

PUBLICATION:

This paper is part of a postgraduate course at Trinity College Dublin. The paper will be read by members of faculty and will be available to future Trinity College Dublin students to read. It may also be published in academic journals.

DECLARATION:

- I am 18 years or older and am competent to provide consent.
- I understand that by participating I waive my right to anonymity.
- I understand that by participating I give permission to be quoted as a professional in my field and that I will be cited as a reference.
- I understand that my answers will not be used by the researcher for any other purpose, including other papers written by the researcher.
- I have read, or had read to me, a document providing information about this research and this consent form. I have had the opportunity to ask questions and all my questions have been answered to my satisfaction and understand the description of the research that is being provided to me.
- I agree that my data is used for scientific purposes and I have no objection that my data is published in academic publications.
- I understand that if I make illicit activities known, these will be reported to appropriate authorities.
- I understand that I may stop electronic recordings at any time, and that I may at any time, even subsequent to my participation have such recordings destroyed (except in situations such as above).
- I understand that, subject to the constraints above, no recordings will be replayed in any public forum or made available to any audience other than the current researchers/research team.
- I freely and voluntarily agree to be part of this research study, though without prejudice to my legal and ethical rights.
- I understand that I may refuse to answer any question and that I may withdraw at any time without penalty.

- I have received a copy of this agreement.

PARTICIPANT'S NAME: Amber Cushing

PARTICIPANT'S SIGNATURE:

Date: 22-3-2017

Statement of investigator's responsibility: I have explained the nature and purpose of this research study, the procedures to be undertaken and any risks that may be involved. I have offered to answer any questions and fully answered such questions. I believe that the participant understands my explanation and has freely given informed consent.

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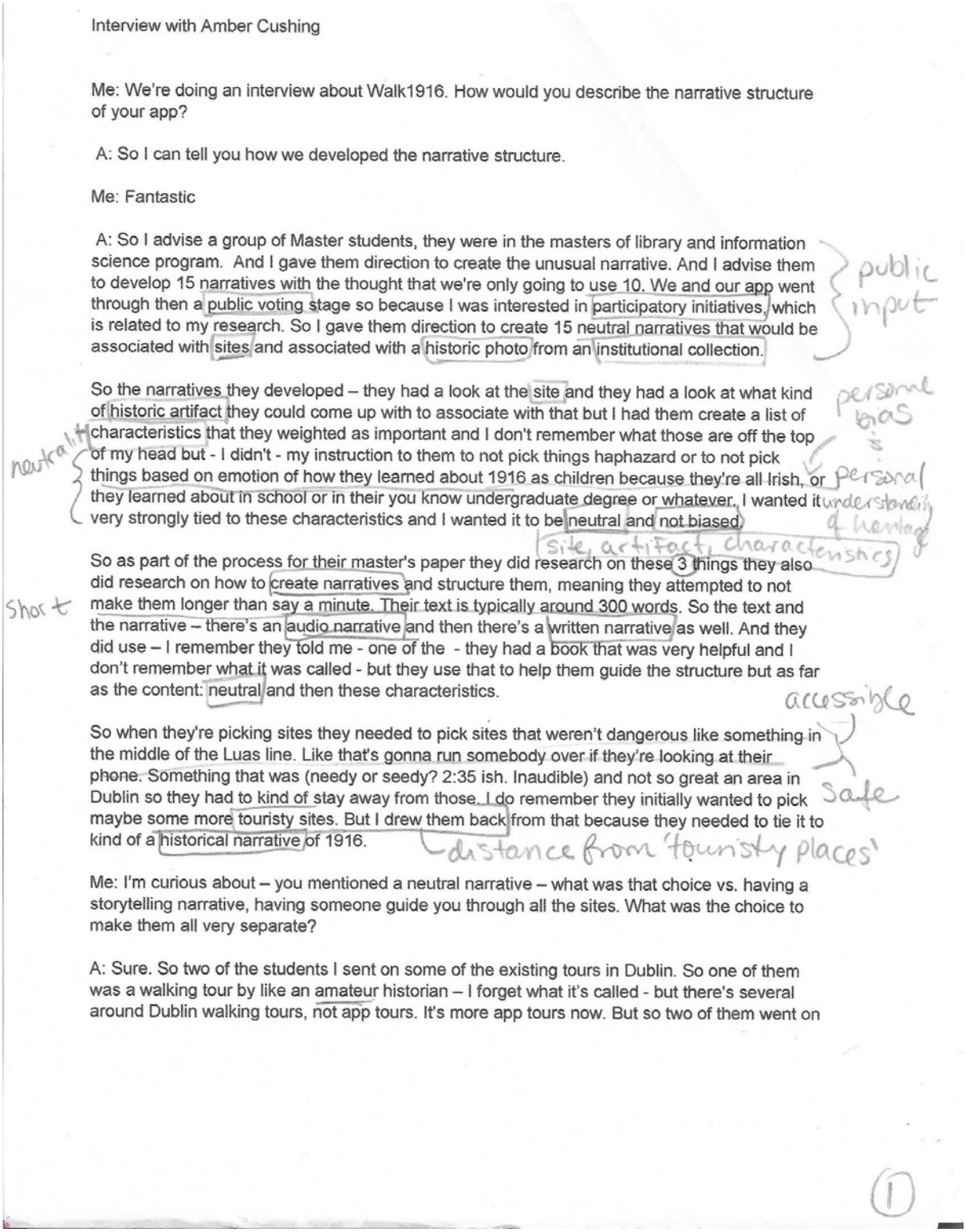
Interview Transcripts

Interview with Dr. Cushing about Walk1916.



Interview with Amber Cushing

Me: We're doing an interview about Walk1916. How would you describe the narrative structure of your app?

A: So I can tell you how we developed the narrative structure.

Me: Fantastic

A: So I advise a group of Master students, they were in the masters of library and information science program. And I gave them direction to create the unusual narrative. And I advise them to develop 15 narratives with the thought that we're only going to use 10. We and our app went through then a public voting stage so because I was interested in participatory initiatives, which is related to my research. So I gave them direction to create 15 neutral narratives that would be associated with sites and associated with a historic photo from an institutional collection.

public input

So the narratives they developed – they had a look at the site and they had a look at what kind of historic artifact they could come up with to associate with that but I had them create a list of characteristics that they weighted as important and I don't remember what those are off the top of my head but - I didn't - my instruction to them to not pick things haphazard or to not pick things based on emotion of how they learned about 1916 as children because they're all Irish, or they learned about in school or in their you know undergraduate degree or whatever. I wanted it very strongly tied to these characteristics and I wanted it to be neutral and not biased.

personal bias = personal understanding of heritage

neutrality

site, artifact, characteristics

So as part of the process for their master's paper they did research on these 3 things they also did research on how to create narratives and structure them, meaning they attempted to not make them longer than say a minute. Their text is typically around 300 words. So the text and the narrative – there's an audio narrative and then there's a written narrative as well. And they did use – I remember they told me - one of the - they had a book that was very helpful and I don't remember what it was called - but they use that to help them guide the structure but as far as the content: neutral and then these characteristics.

Short

accessible

So when they're picking sites they needed to pick sites that weren't dangerous like something in the middle of the Luas line. Like that's gonna run somebody over if they're looking at their phone. Something that was (needy or seedy? 2:35 ish. Inaudible) and not so great an area in Dublin so they had to kind of stay away from those. I do remember they initially wanted to pick maybe some more touristy sites. But I drew them back from that because they needed to tie it to kind of a historical narrative of 1916.

Safe

distance from 'touristy places'

Me: I'm curious about – you mentioned a neutral narrative – what was that choice vs. having a storytelling narrative, having someone guide you through all the sites. What was the choice to make them all very separate?

A: Sure. So two of the students I sent on some of the existing tours in Dublin. So one of them was a walking tour by like an amateur historian – I forget what it's called - but there's several around Dublin walking tours, not app tours. It's more app tours now. But so two of them went on

(1)

diverse audience need diverse viewpoints

bias

this walking tour given by this Irish amateur historian and they came back and they were like it's very nationalistic and there were some English people in our group who are kind of offended and a little uncomfortable like they notice that because I told them to pay attention everything not just what he was saying but the other people in the group. And so I was like okay - how we're going to address that is we're going to try to be as neutral as we can and remove this nationalistic kind of bombast from it to see how that works.

remove nationalism

Me: That's cool, I was wondering about that. So what do you think are the benefits but also the limitations of such a narrative?

A: So I know because I've just gone through the data. That – let me - we have 2 sets of data so the first set of data was that very neutral narrative; the second set of data was I tried to personalize it by focusing on women and a specific one - I haven't been through that data yet. So I can't really speak to that part of the app but I'll speak to the first part.

unordered

freedom to explore, untethered

So from my research and I just - this is stuff that's out, I've submitted to journals – I actually found that people sort of fell into 2 groups. So some people really like the fact that it was neutral and that they could kind of go to a site in any order the other thing is that this - the narrative stands alone. So it doesn't rely on any of the other sites, you don't visit the sites in any order. Some people really like that because it helped them discover and explore which is an element they really enjoy in kind of walking towards learning about history and heritage. It also helped them develop their own understanding. So they - all Irish people generally have this understanding of 1916 that they get from school. Some of them don't like it, some of them do like it, some remember some things over others. But this neutral perspective let them explore let them develop things in any order and really kind of develop their own understanding of the historic event.

being told what to think vs self discovery

independent learning

self-directed learning. Not told what to think

Where is the other group constantly were - I had people use the app and then asked them about it - they would, they would be like there's no story, I don't like it, there's not enough information you haven't given enough facts. Yuck. So that was their perspective and my perspective on that is: there are just some people who really like to engage and develop their own understanding kind of get in there and explore and then there's this group that want to be told a story and I actually labeled them the group of like 'want to be told a story'.

want a story. told what to think. or immersive?

So I was able to see that division and I would actually argue that, exploring and developing your own perspective is more useful in a lot of ways. Because of my background in learning about how cultural heritage institutions develop a societal documentary heritage. So there - so we need people to actually have an opinion and develop their own perspective because when they do that then they do things: they retweet about it, they read about it on Facebook, they share it with other people. Then we can develop a more inclusive - a documentary heritage because we have a 5, 10, 20 different perspectives. Rather than an expert curator telling the story and then there's one perspective.

different perspectives help develop narrative heritage

So there's definitely multiple opinions in there - I would argue that one is better especially in my background.

self-directed learning encourages (participation?) (interaction?)

develop perspective thru neutral narrative

(2)

historical fact vs remembered fiction

Me: Okay I'm wondering- is there any data on like if the people who want the story were foreigners who didn't understand the whole context of it , because there's not really – there's not an introduction to the app about you know – explaining what kind of happened. So I'm wondering if there's any data on the divide between Irish versus foreigners and their reaction to the app.

A: So I did collect some demographic data. But it's actually the Irish people who were upset. They were very like this isn't right, this isn't what I learned. One of, if I remember correctly, one of my participants had a very interesting perspective. He was Indian and he identified himself as such. He actually didn't have a problem with the neutrality because - how he understood the app is - he was like he wasn't concerned about like the specific details of 1916. He was concerned about the over-arching message of the movement and how related to it India's struggles as another English colony.

relatable message. Applicable to worldwide situations

So he wasn't so into the details but more about the overall message. And that was the other thing I saw. Some - I had some Italians as well and again I don't know unless they identify themselves. But they tended to look at the overall message rather than the details.

historical impact as a whole

Me: Okay so maybe the Irish people are focusing on what they learned, what isn't correct.

A: Exactly. But not all. I mean you can't look into demographics in any way

ME: Hmm. Okay. That's interesting. So how did you decide how much control the user should have, like, over the app interaction.

independent narrative + lot of user control

A: So I - I mean there are certain things built in and we discussed that with Mads and I did work on this with a research partner. I sort of was the main PI who kind of took over most of it. He did have some input on the HCI kind of in the beginning. But I wanted to have a - an app where narratives stood alone and the user had a lot of control. So I – my background is personal information management and culture heritage - digital cultural heritage. So I wanted control over those 2 things. And because I was interested in the personalization I wanted users to have - be able to have more personal control.

users control their journey

Being any – viewing the sites in any order and not having them rely on each other. We also didn't give them a ton of instruction. We let them use it for 45 minutes and there was a research assistant there to kind of observe, following them around writing what they did, but I made it very clear to my research assistant not to give them instruction on what to do. So I - that was a purposeful thing to let them visit sites in any order and to not necessarily give them a ton of instruction.

independent learning exploration

Me: And how many sites do people visit on average because they're quite far apart?

A: Yeah, on average I'd say 6. I had – that's data from 15 users. And there were about 8 users who did the pilot.

(3)

distant sites not visited → distance challenges

Yeah everybody just kind of visited the ones in the middle. I had them start at the same point which is the Trinity gates. And people just kind of whatever direction. Only, I think, one person went to Boolan Mills because she was like well that's direction I have to walk back to because I work down there. So she just basically walked that way and just went to one. Every site was visited at least once. Wait except for Clanwilliams street – no one went to Clanwilliams street and Mount Street Bridge.

integration into daily life

Because again that was sort of more far-flung. The person who went to Boolan Mills could've gone to that one too but just decided not to.

Me: How does it take on average for them to finish those 6 sites?

short encounters, long distance between encounters

A: 45 minutes - depending - like some people did four – some people would do 6, but generally we only gave them about 45 minutes. If you wanted to do everything it would probably take - walking – it would probably take you more like 2:00 hours just due to - because of the distance.

Me: So why was only one picture included versus like many or a video? What was the decision-making there?

few historical sources survive

A: Well there's no - there's very few videos surviving from 1916. So I was very - I mean because of my research I was very interested in using digital surrogate of items in institutional collections in Dublin. So. I mean digital surrogates are surrogates of the primary document source. And there's only so many of those that survive, so you already have a limit there. There's like 1 video in all of Ireland from 1916. And it's not even of the aftermath it's of just random people walking around on the street like in 1911, so it's really - so video's really out of the question.

scarce artifacts

As far as multiple photos. There it's not like I can get a perfect before and after for every site on. And there's not a ton of that were directly taken of the aftermath. From what I understand only one or 2 photographers were actually let in like right after or as it was happening. So you're already dealing with a limited bunch. From that I wanted to work with the stuff in institutional collections in Dublin. So it's also a limit there. And within that there is some photos that maybe I wanted but maybe we couldn't get the rights to.

So. I mean I was dealing with a 90 year old man in Wicklow whose father took most of the photos. And there's a weird - but they have - has a weird relationship with Dublin City or Dublin city library and archives, where Dublin city has put them on their website; they put them on their website. And then they realized they actually don't hold the copyright so that this man would put it – so they set up this deal with him that they would host them but if people wanted buy rights to it you had to go to this man, so I'm like writing to this guy who will only deal with like postal orders because he won't give out his BIC or IVAN(?) and I mailed him stuff once and they like lost the check. So I had like - I mean lots and lots of different stuff but - but like there's other - the way that Irish copyright works is, like, there was company that owned one - there's a famous photo of Patrick (Padraic?) Pearse's surrender on Moore street. There's actually 3 stills like because they were taken at different times.

13:40

(4)

ignorance copyright law stealing

difficult communication w/ institutions

So any of those photos would have worked. One of those photos was on South Dublin library's website. I called them and said hi I'm inquiring about the rates book; they were like we don't know, we'll call you back. The next day the photo was taken down. And they refused to talk to me. So then I found the same photo but it was owned by, like publishing company in Cork. And there - you know - and then there was one owned by the national museum. The national museum wanted to charge me like 500 euro for one photo; this company in Cork was like you can use it for free just don't make any money off of it. So I was like okay I'll go them. So it's a lot of decisions like that. I don't – there are very - from what I understand there are very few people in Ireland who understand intellectual property well, especially in the institutional you know (lamb glam? 14:30) sector.

disorganized

expensive limited license

So their understanding is that they own the original they can sell rights to it; so there are 3 originals and these 3 different places just decided to do different things with it. I didn't press much further so that's why I, like, I went with this company in Cork and that's the photo we ended up using.

lack of consistency

Me: Sounds complicated.

A: Yeah a lot – a lot more so than I thought it would be.

Me: And if you could do the app again what would you change, what would you do differently?

Augmented + geo → powerful and difficult

A: I think that two of the most powerful things, being the augmented reality and the geo location were also two of the most difficult things. I don't want to - I wouldn't want to give those up. But, pinning something to a certain location with the GPS was very, very difficult because every phone has a different GPS, whether it's an Android or an apple. Apple phones, all apple phones, like if I pin something to a certain coordinates would work. But the android like would be all over the place.

phone challenges
lack of consistency

So. I would try to investigate geo location more and maybe not - you know we played around making the bubbles bigger, of whether or not an encounter would reveal. But maybe, if there's another way to get around this like reveal types of GPS coordinates. Or if we can do it some other way. I'd learn a lot more about geo location see if I could make it work better.

alignment

The augmented reality was wonderful but the size was not always great. Or the reveal was not always great; some people would be facing the wrong way or like the size would be off, I have a photo that I use when I discuss it at you know, at a conference and like the person is this big, the augmented reality people are like this big so it look it doesn't look perfectly.

controlling expectations

need more time

Some of that's controlling expectation but some of it's just, you know it doesn't look as like I want it to and ultimately it wasn't - I mean this isn't a commercial product and I was able to get what I needed from it. But if maybe if I had more time to think about some of those things I could've controlled those and possibly also controlled expectations a little bit more.

Me: Yeah I had a curious question about the models. I have a hard time like focusing in on them – they would jump around a bit.

techissues

(5)

A: The encounters.

Me: And so were they models re-constructed of the original as it was in 1916 or was it like based on current day?

A: They were a snippet on the photos. They were just a straight snippet from the photos and maybe if we had a lot more money we could do a reconstruction. I'm involved with a project at UCD computer science that is actually trying to reconstruct a virtual Sacksville street. But it's taking 3 years and it's not going very fast. They're using some of the narrative that we developed, but like it's a lot of money and it's not fast. So I mean I was on a funding cycle where basically I already had to extend that grant with the Irish Research Council. And, you know, they weren't thrilled with that.

So for me, I underestimated how long it takes to make stuff and do research; because I'm used to just doing research not having to make something first. So. Again, to get back to your last question, if I were going to do it again I would give myself much more time. And also realize that it's going to cost a lot more money to get what I thought I had we would end up with.

Me: Okay. How do you think new technology will change the future of historical apps and cultural appreciation.

A: So I don't think about it in the terms of apps because, this is I think where maybe computer science and information science differ. So I think that, I mean I study essentially how new technology influences practices surrounding cultural heritage. And it will be significant. My research in from what I've, you know, been doing for 10 years, suggests that the technology will personalize heritage.

And it's not, not there's actually three veins as to how one can personalize heritage, and this is again, we're talking strictly my research, I don't know what anybody else thinks. There's personalizing the experience, which is where HCI computer science apps stuff comes in, but there's also personalizing participation. Which is what we refer to as participatory initiatives. A lot of people do research on that and like crowd sourcing, but it's actually much more vast, it's people participating in heritage, which is this democratization of heritage. So heritage becomes more democratized; we get instead of the one expert opinion from the historian curator we get 5 opinions from you know somebody's family history collection to somebody else who maybe is the amateur historian to family history to it your individual interest (galore? 20:01), so heritage is democratized, but there's participation, participation experience, but also room for individualized (understanding? 20:10).

And also, I see technology allowing for more integration into daily life which is something else I find out from the app. So there's a lot of research on impact studies of cultural initiatives, that is phrased in terminology of enhancement of daily life. So one of the amazing you know results that I love from the app study that I found was that people liked it as an exercise tool. Because, it was walking. So that was fascinating to me because that, the other thing was there were other people who are like I want to immerse myself in heritage for 2:00 hours which is more traditional perspective, right you're a tourist you set aside time, you're going to do this. Other people were

need more money

modelling is slow

slow and expensive

slow

more money

more time

tech will personalize heritage

more perspectives

integration into daily life

enhancement of life

exercise tool

dedicate time for heritage

3 ways to personalize
- Personalizing experience → HCI
- Personalizing participation (contribution) → participatory initiatives which evals in the democratization of heritage
- integration into daily life

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like oh, I have 5 minutes and the train is not coming, I'm going to look at this and learn something.

So there's integration into daily life in meaning experiencing heritage in small doses but also combining it with activities like exercise or maybe commuting or something. When I say heritage is going to be more personalized those are 3 things I look at: experience, daily life, and contribution.

Me: And one more question about choosing the sites. Can you talk a bit more about like why you chose to go to a public survey or public poll?

A: Sure so that's again my interest and research in participatory initiative. So participatory initiatives: if you want to look at the history of like archival studies and scholarship which is my background, it's more than I can kind of describe in like 30 seconds but, since I'd say the seventies, there's been an interest and I say this is kind of the study of history in general, this kind of gathering of more of a social history, more perspectives.

So in the 1970s we see like women's studies, women's history coming in, we see maybe like the history of more minority cultures. That becomes more of the rhetoric, especially in the United States. I think it took maybe a bit longer in the UK but social history is the umbrella. And it's basically it's not just wars, it's not just rich people, it's not just the people who control things, it's like women, minorities, other people, poor people, stuff like that. That kind of influenced archival studies. So there's been this movement since the seventies and there was a German philosopher we won't go into, who influenced a lot of that writing.

But this (movement? 22:58) together other perspectives, other voices. So we're not just using that expert rich people whatever. So that movement's been percolating since the seventies. With the introduction of Web 2.0, meaning this kind of participatory culture, social media kind of stuff, that was made easy. So it's much easier to gather the perspectives of a bunch of different people.

So, I wanted to study that because I thought it had - I knew it had a role of personalization but I didn't know where it fit. And that's how I kind of – why I class participation as part of personalization because this voting allowed me to observe that and see it. So I wanted to study that so I basically just opened it up to voting and then I hired a publicist which is really weird. Because people don't always hire publicists to do stuff like this. It was very weird because we didn't talk the same language and had different goals and timelines and stuff but it was a very interesting learning experience working with a publicist.

And I hired the publicist because I wanted to have saturation in every county in Ireland, and he did that for me, he basically was saying I submitted it to this paper, this radio station, we have hit every county. So I can be more confident in my saturation and not just give that lip service and it's not to say people voted from every county but I was more confident that I at least put it out there.

So I don't even remember how many people participated. But what was interesting is there's a very clear line of people - how we asked we said - what are the top 5 most significant sites

associated with Easter Rising and the top 10 from the public vote will make it into the app. The top 10 of the 15. So it was very clear winners. All the sites that were associated with were where the Irish looked strong were the most highly ranked. Not surprising. So interesting like, note that the Royal Barracks was last. That was the British headquarters. Father Matthew Hall was way down there, you think oh that was the hospital, but that's where the Irish look weak because that's where the wounded went. So stuff like this - so that's not surprising. So what's interesting is one would think that from that public vote, there's a general consensus.

But then when we took that data and had people actually use the app there wasn't a consensus. Because someone would be like, you know, you should really have Trinity in there. Again Trinity, controlled the British, very low on the list, did not make the cut. But I had a couple of my participants say you know I don't understand why Trinity isn't on there, it's really pretty, people can have lunch. You know they can look a cool building and they can use the app, you're dumb for not putting it in there.

And so, I look at that and then I look at the other data and I can compare it, and be like actually there's way more perspectives. We can tell ourselves that everybody has this nationalistic perspective and we should go with that, but it's actually quite a lot more personal because you also see what somebody values into a tour. So when someone says, that's a mistake that you didn't put that in, they're saying to me: it's different from what I have in my head of what should be important for you.

And that again comes back to the personalization. We all have personalized understanding it's just that these tools make it easier for us to espouse those personal values. I

Me: This is kind of combating that in certain ways, of showing this is important for different reasons.

A: So that public vote not only allowed me to understand participatory motivations and actions. But it also served as a comparison from when I hear personal responses like that. So it's not just that I decided what was most important or my students did, its actual people did. So it's not just the students verses my participant or me verses my participant as students and me being the experts, its actual people. A person versus a person and that allowed me draw that comparison.

Me: You bring up a good point about like the tourism part of it. How did you balance those historical needs versus like the tourist experience?

A: So that's something that the students I - I let the students handle. So they did do some research on apps and some research on tourism. And I've done some research on it as well. But our needs were to give a neutral experience and to make it short so I guess the only way really tourist thing that we thought about was keeping it succinct and neutral. So because you know, the neutral things started out just to not offend people, but then it actually worked really well because it allowed me to understand how people perceive something neutral. So I wasn't, I didn't come at this from a perspective of tourism because in my mind tourism is about making money and I knew we weren't going to make any money. Or I should say, maybe

someday I will make money. But right now my goal is to understand. And that's really where I am.

And how I recruited people was, I posted on you know the electronic message board at UCD, but we also had a FaceBook page and I would pay for boosted posts of anybody in the area, so I wasn't necessarily going after tourists and I don't, I don't necessarily view this as a tourist thing because, tourism kind of differs from that daily life impact. Because when we're talking about daily life impact, we're talking about people who just – this – Dublin is their daily life. So. And I actually am more interested in how we expose or interest people from all swathes of society into heritage not just tourists. So I didn't think about tourists, they weren't like my number one thing.

tourism is not daily life

enticing locals

Qualitative Analysis

Major themes with description

Narrative Development through Participatory Initiatives

Develop a neutral narrative by collecting more perspectives, which is the democratization of cultural heritage, thereby attempting to reduce nationalism. The public were asked for their input (collecting more perspectives), which was a good way to test the pulse and see what Irish people judged most important. But their reaction to site selection vs. visiting them in an app were very different because people value different things in an app.

Tech

Phone inconsistency with geolocation; slow and expensive AR work; expectations were higher than results; most powerful things about the app and were the most difficult; tech can personalize heritage

User Experience

User controls their journey, freedom to explore, easy to integrate it into daily life. Independent learning; being told a story vs. self-discovery. Sites of importance vs. personal understanding of heritage. Some people argue the site selection due to their own personal value and historical understanding (which is another way multiple perspectives comes in).

3 ways to personalize heritage:

-Personalizing experience through HCI

-Personalizing participation through participatory initiatives

-Integration into daily life

Historical Artifacts

Scarcity of sources; copyright difficulties; expensive or limited license