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The Liquid Galaxy in the Library: A Study of Use and Users of Interactive Digital Display Technology at UNC-CH

1. INTRODUCTION

Libraries have begun to incorporate virtual spaces in the form of immersive monitors/displays into their offerings. An example of this is the Liquid Galaxy at the Davis Library Research Hub at UNC-CH. The Liquid Galaxy (LG) is an eight panel, large scale (approx. 8 ft.) curved display space that allows users to explore Google Earth (as well as Mars and the Moon), Google Street View, and overlaid historic maps as uploaded by library staff. The Liquid Galaxy has been available and free for use without registration or training since September 2014 (Library News, 2014). Since its debut, the Liquid Galaxy has been used for class related lectures and activities and for historic map displays; however, its primary use is by individuals exploring Google Earth.

This research project investigates the use of the LG and users response to the LG via interviews and open-ended survey. Initial observations demonstrated that users typically use the LG to tell stories, often nostalgic stories (e.g. stories from their personal past history) and share personal history with others. Often people find the house where they grew up and snap a photo of themselves with it in the display, but this is the most basic activity; more expansive use includes giving fellow students/colleagues tours of their home area. So the LG functions as a space of

personal engagement with a virtual landscape as well as a research and educational tool.



Figure 1: The Liquid Galaxy at Davis Library – UNC Chapel Hill displaying the UNC Campus and surrounding area

2. BACKGROUND

2.1 Background: Immersive Displays in the Library

Literature on digital display technology in libraries is surprisingly scarce given the emphasis that displays as library resources is starting to receive, especially as collaborative tools for research in the form of large display monitors. Much of the

discussion regarding display technology in workspaces generally has been focused on discussions of technical specifications and evaluation of potentially upgrading display technology (for example see Chung, 2012). There has been a modest amount of literature on display as design, for example an article on the Hunt Library and its cutting edge immersive displays which detailed their integration into a larger, cutting edge building as an act of good design, rather than how they ended up being utilized (Swartz, 2013). Examples of larger scale displays in libraries are the interactWall at the Curve in the Georgia State University Library and the VideoWalls at the Hunt Library which have similar multi-panel immersion to the LG. There are five large displays at the Hunt library, collectively referred to as “VideoWalls” and these walls are said to make Hunt library a “storytelling building” (“VideoWalls,” 2015). The VideoWalls are mediated experiences, users must submit content to the library staff who then upload it, the content must meet certain technical and content specifications and the libraries also provide staff for video production education and support. The interactWall is a single, large (24 by 4.5 feet) immersive display that is interactive by being touch sensitive (CURVE, 2015). Some interesting aspects of the interactWall include the fact that multiple users can display material at once and that more than one type of device can connect to the interactWall (CURVE, 2015). The interactWall must be reserved for use, but its technical specifications make it possible to display content directly from devices without many technical skills or digital design specifications that are tailored to the device. The interactWall and VideoWalls are

not entirely public, they require some assistance by library staff. These types of display walls are becoming far more common within libraries, and these are just a few examples of places where the technology has been deployed.

As compared to larger display walls, advantages of the LG technology are that by being smaller and having limited capabilities it is also less expensive and more accessible. By being simple and limited to being used to display Google Earth and Streetview via a joystick, the LG does not require staff to act as intermediaries between users and the LG for most applications.

2.2 Background: The Liquid Galaxy Technology

The Liquid Galaxy technology has its origins at Google, in its ‘20%’ time program, where Google employees were given 20% of their scheduled work time to dream up and actualize whatever project they wanted. The Liquid Galaxy at UNC-CH is a series of 7 screens which are run off of synchronized, parallel desktop computers which then display Google Earth and Google Street View as well as other web accessed .kml files. The user interacts with the display using a joystick, which sends a signal to the “master node” computer/software which then captures the coordinates (latitude, longitude, altitude, heading, tilt, roll, and planet name for Google Earth, and heading/location in Street View) in Google Earth and updates all the computers simultaneously, with each “slave” computer having an offset programmed into its location decoding (this is what allows for each screen running of an individual

computer to have a different portion of a viewshed displayed) (as described in Arroyo et al 2014). Each node then accesses the internet to get Google Earth information for its location (Arroyo et al., 2014). Caching of Google Earth in a web proxy cache helps improve the speed of this interaction, allowing for a speedy update of imagery in response to user input via the joystick (Arroyo et al., 2014). In 2010 Google made this Liquid Galaxy program/schema Open Source, such that its specifications and instructions for implementation are available to all. However, in this documentation they also included a link to the company Endpoint, which at the time was part of their “materials” division (Albanesius, 2010). Endpoint is now an independent contractor that can be hired to build, install and support systems, and is the contractor that Davis Library uses for its LG.

The LG in Davis Library has certain limitations. The content management system (CMS) provided by Endpoint will only allow bookmarks to be created in Google Earth, not in Google Maps Street View. Also, Google Street View cannot be searched with an entered address in the same way Google Earth can. This means classroom activities that require Street View need to be navigated to in a time consuming way which reduces its utility. Endpoint has stated that these features will be added in the future, however, after a year of use they have not arrived. Another limitation is that all maps and other materials must be uploaded in kml format (kml stands for Keyhole Markup Language, a form of Extensible Markup Language (XML) designed specifically to hold geographic locations). These uploaded maps that are overlaid via

uploaded KMLs to the CMS must be activated in one window at the LG input panel and then bookmarks can be used to navigate to the file. This process is slightly convoluted and means that unless users know this process they will be unlikely to activate/navigate to the uploaded historic maps (also, there is no metadata available on the display, so they would not know what they were observing if they did manage to activate the map layer). Library personnel have expressed frustrations with these limitations, and users in the study also expressed some frustration with these limitations as well.

2.3 Background: Google Earth and its uses for education and research

Viewing locations in Google Earth is the primary purpose of the LG. Google Earth is a geographic visualization technology for viewing aerial views of earth (as well as Mars and the Moon) that has been freely available to the public since 2005 provided by Google Inc. (Doctor, 2010). The Google Earth platform essentially operates as a simplified Geographic Information System, as there are tools within its “Pro” version that allow for measurement and other basic analysis. However, these tools and many of the other standard functions within Google Earth, such as linked information and the capability to view different imagery taken at different points in time are not available in the Liquid Galaxy implementation of Google Earth. The LG is essentially “view only” when it comes to Google Earth. The exception to this is that

there is the capacity to upload .kml files in order to overlay historic maps within the content management system of the LG.

Google Street View is also available on the LG, though without the search capability of Google Earth, users cannot enter addresses into the Davis Library LG to locate specific places within the Street View. Street View is a program by which Google has photographed many locations via a car, usually travelling streets. The coverage is remarkable, though not perfect (there are many places in Africa, for example, that lack Google Street View coverage). There are some specific bookmarks for Streetview that cannot be edited by library staff provided by Endpoint in the Davis Library LG. These include museums such as the Musee D'Orsay and monuments such as Stonehenge; the bookmarks encourage viewers to take a virtual walking tour of famous and significant places using the LG.

As with the literature on digital display in libraries, there is also a scarcity of studies on Google Earth and Google Street View in library settings (Dodson and Nicholson, 2012). Most of the literature about using Google Earth in a library setting describes the use of Google Earth as a library resource discovery tool. An example of this includes Brenner and Klein (2008) who describe the development of a Google Earth based display tool in their library for exploration of digital collections related to Portland and its City Planning, which was then embedded in class and library websites. Another example is Ballard (2009) who describes his process of using

Google Earth .kml files for displaying links to the Quinnipiac library catalog. These two articles are some of the few that address the topic of Google Earth in libraries. One of the other few works on Google Earth in a library setting that includes a study of library practices involving Google Earth are the results of a survey conducted by Dodson and Nicholson in 2012. They identified specific librarians in the US and Canada who were involved with mapping and GIS services and gave them a short survey, much of which was yes/no questions out of respect for possible survey fatigue to which they received 83 responses (Dodson and Nicholson, 2012). In addition to a survey, they scanned websites for information about how libraries were using Google Earth. They mainly found evidence for the use of Google Earth as a finding aid, especially for maps/aerial photograph (Dodson and Nicholson, 2012). They also found that libraries used Google Earth for delivery of certain collections, for example digital imagery of historic postcards whereby postcards were indicated by points on a Google Earth map that when clicked on included the digital photos and links to more catalog information or overlays of historic maps (Dodson and Nicholson, 2012). In response to their survey, they found that the majority of librarians using Google Earth were specifically GIS or map librarians, rather than reference librarians generally (28.8 percent of Google Earth users working in a library had general reference responsibilities). Google Earth and Google Map products had used roughly equally by respondents, with 69 % saying that they had used the products monthly with 6 % saying they never used Google Maps or Earth (Dodson and Nicholson, 2012).

Respondents said that they used Google Earth for a variety of tasks, including Instruction, Promotion/Marketing, Answering/Research Questions, Creating/Accessing Finding Tools, Creating Webpages/Finding Objects, and for creating Learning Objects. Some of these activities overlap with the LG, while other are outside its scope of capabilities.

Google Earth also has uses for education that includes classroom support activities. Lamb and Johnson provide a summary of examples of Google Earth usage in education contexts, which include having students map locations based on significant events in novels or movies, analysis of the effects of earthquakes and other natural disasters, visualization of geological phenomena such as volcanoes, creating placemarks related to historic events, and other activities (Lamb and Johnson, 2010). These sorts of activities are not altogether dissimilar from those that the LG has been put to.

Other uses for Google Earth/Google Maps include support for artists who are interested in depicting landscapes that may be personally inaccessible as well as more sophisticated research. Research conducted using Google Earth includes archaeological, ecological and planning related studies. An example of this type of research was conducted by Sadr and Rodier in 2011, they used Google Earth Imagery in conjunction with historic aerial photos to investigate pre-colonial stone wall structures and settlement patterns in Gauteng, South Africa which documented shifts from a dispersed to a more nucleated settlement pattern in the pre-contact period,

perhaps as a result of climate change or conflict (Sadr and Rodier, 2011). A planning based example of Google Earth based research was a 3D model of potential gas leak trajectories based on 3D building models provided in Google Earth (Liu et al., 2013). These studies and others like them demonstrate the potential of Google earth and the LG for use in research activities.

3. METHODS

For this study, qualitative methods were used. Qualitative methods are those dealing with people and the qualities of their behavior, perceptions, and feelings and are usually set opposite quantitative methods, which are based on numeric measures which can be statistically verified and essentially framed as repeatable experiments (Staller, 2010). A qualitative approach is more appropriate than a quantitative one for capturing people's thoughts, uses and feelings regarding the LG. Quantitative approaches demand making assumptions about the nature of user interactions and framing questions in a way which pre-supposes a limited range of answers – hence bounding possible responses to those that the researcher has specified rather than the full range of what users may be thinking or doing (Staller, 2010). A limitation of qualitative studies is generalizability of qualitative responses and repeatability of qualitative studies is minimal, and this is the case here as well.

This study can be considered a “mixed methods” study, not in the sense of mixing quantitative and qualitative data, but in the methods by which observations of users

were collected. The specific methods I used to investigate the uses and responses to the LG are semi-structured contextualized interviews and observation of users at the LG and an online survey which included open-ended text based queries and short multiple choice and yes/no answers (a Qualtrix web survey, a link was advertised on the LG).

While the semi-structured interview format is not as rigid as a structured interview format as there are themes that are being followed rather than a set of specific questions, it is helpful to have a framework which can be used to guide the interview (Wildemuth and Liu, 2009). The following questions provided a framework for the interviews:

- Have you used the Google Earth LG before or is this your first time using it?
- What brought you to the library today? [was it specifically to use the LG]
- How do you like the LG?
- What place are you looking at [using the LG] today?
- Did you have a specific place you wanted to look at when you visited?
- Why did you choose to look at what you did?
- What emotions did you have while using the LG? Did you experience any emotions while looking at specific places?
- Did you interact with others while using the LG? What did you talk about?
- Are there aspects beyond the size of the screen that make using the LG different than looking at Google Earth on your laptop? Are these aspects positive or negative?

- What things would improve the LG – what might you want but isn't currently there?
- Can you think of uses for the LG in the classroom or research?

These questions were designed to be specific yet open enough to encourage unique responses, and are also ordered to go from simpler to more complex questions (e.g. they have a “warm up” phase).

4. LIMITATIONS

The primary limitations of the study are based on the context, the fact that it is a qualitative study, and the limited range of participants. The generalizability of qualitative responses and repeatability of qualitative studies is minimal. Qualitative studies are highly situated, the context in which the questions are asked will change quickly with the passage of time and the nature of the responses as open ended rather than structured makes them idiosyncratic and difficult to compare to one another.

Another limitation is on the users queried in interviews - these are people who are seeking out the LG and decided to use it of their own volition, which means they have an inherent interest of some sort in the LG. This almost guarantees that most responses to the LG will be positive ones of varying degrees. People who may have negative responses, possibly thinking that the LG is not worth spending time on and perhaps even making judgments about library and university resources being misplaced with the LG, etc. are not likely to be captured by a survey or interview

structured in the fashion proposed here. This is a major limitation on the study; however, given that the aim of the study is to look at users of the LG and their responses and ideas regarding the LG, not the overall campus population, this is not a terrible limitation. A good follow up study to this one may be to create a broader survey given to a wider group that captures information from non-LG users about their perceptions and ideas regarding the LG.

5. RESULTS

The survey was advertised on the LG at Davis library via a sign with a Qualtrix link and QR code and was active in the month of April of 2015 and interviews were conducted during this period as well. There were a total of 25 survey responses/interviews (18 survey responses and 7 interviews). Most users answered all the questions posed but many answers were very terse, oftentimes just one word responses. Respondents were especially reluctant to talk about their emotional state when using the LG and response to qualitative questions were often brief. Direct observation of user interaction was helpful for adding additional context to verbal responses in some cases.

People had used the LG in groups or alone in nearly equal numbers and users often used the LG more than once – 60% said that they had used the LG multiple times (though this may have been skewed by Research Hub employees responding to the survey). A majority of respondents (84%) had not used the LG in a class related

activity. 44% of users came to the library specifically to use the LG, whereas 66% said that they were at the library for other reasons and used the LG incidentally. Total responses and questions with quantitative results can be found in Appendix A.

5.1 Reasons for using the LG

There are three general reasons that people chose to use the LG and look at the places they did, they: 1) had a research or educational purpose (a present based concern) 2) they were interested in looking at places they were either planning on travelling to shortly or wanted to travel to (the future, both practical and aspirational) or 3) a nostalgic connection (looking at places from their personal past). Sometimes people looked at several places that fell into different categories of intention, which was the case for one individual who looked for places near their hometown, but then went on to look at the area around their hotel for an upcoming trip to Paris. Some of these intentions did not lead to a selection of a specific location, for example one planning student reported looking at dense urban areas in Google Earth because he found them intellectually interesting and connected to his academic pursuits as a planner (similar to a research activity) but this user did not seek out specific cities or use the LG for a specific purpose.

A few individuals were more random in their approach and used bookmarks associated with the LG in an ad hoc fashion and weren't strategic or selective (rather

like flipping through TV channels with a remote) and had no intentions in their choices of places to look at other than basic curiosity/alleviation of boredom.

5.1.1 Education and Research

Several of the respondents (n=3) were part of a class that used the LG as a backdrop to classroom presentations on specific WW1 monuments, where the monuments being discussed were viewed in either Google Earth or Street view, with varying degrees of success (sometimes the Google Earth was blocky and problematic due to its 3D rendering, sometimes Street view was unavailable). That is one example of an educational activity, other classes have used the LG to do proxy field work, for example investigating the differences in slums and rich areas in Brazil and other countries as kind of a field survey exercise. Research was another reason patrons mentioned for using the LG, either to research future trips, to investigate land cover (to clarify areas that were unclear in remotely sensed data) or to check out certain urban patterns/the layout of a city (for example a viewing of Barcelona, Spain was research related to a class assignment).

When respondents were asked in the interview/survey what ideas they could think of for research or educational uses about a quarter said they could not, with one specifically saying that it would not be good for classes. This may be because their use of the device for entertainment was seen as being at odds with a classroom purpose. However, many users did think that it could be used for a class with a single

word, “Geography” being a common answer (n=6) to the question “Can you think of research, classroom, or other applications the / Liquid Galaxy could be used for?”

Other respondents were more specific, with mentions of applications relating to hypothetical assignments. One respondent suggested a specific scenario: “If someone was reading the Kite Runner or a book like that they could visit the place that it was set using the LG to get a better idea of what it was like there” Another respondent suggested that it could be used in Urban Planning classes: “Students without travel funds could check out a planning field site using the LG.” Yet another suggestion was using the LG for art assignments: “Drawing places in an art class.” Other respondents mentioned activities similar to what the LG has already been used for, for example looking at overlays of historic maps, contextualizing historic places, and observing land cover and land use.

5.1.2 Trip Planning

People also used the LG to “scout” ahead of trips they were planning. This was seen by users as advantageous, one person described feeling more “confident” during their trip due to having explored the environs around their hotel prior to travelling. Other trip planning activities were more aspirational, as users visited places they wanted to visit in the future. This was a compelling activity to several users, and one reported that using the LG made them feel more “free” and that “sometimes I feel trapped [here at UNC] and even if it is just a simulated ocean, it makes me feel good.”

5.1.3 Nostalgic Visits

People often chose to go to their hometown or specific places from their past when using the LG. One reason for this is simply practical – people often know where these places from the past are located very well and can orient to them easily. In several instances, when asked, users did say that was a prime consideration for selecting a hometown or former home to look at. Other reasons include an emotional response or a desire to tell stories and connect or reconnect with others viewing the LG. Six people responded with variations on “nostalgic” when asked about what their emotional response was to the LG, which made it one of the most common emotional responses along with variations on “awe inspired.” An example of this type of past exploration activity which was observed during the study was three roommates using the LG to “visit” their old apartment they had shared during a summer school experience in a large city, the patrons hugged each other and described themselves as feeling “bittersweet” while using the LG to view their old neighborhood and places they had travelled together. There are also examples of patrons showing their growing up places to other patrons who were unfamiliar with those places as part of a storytelling about their past - this was especially compelling when students from multiple countries were exploring their individual significant places in a group and telling stories, in that instance the LG was a clear nexus of cultural exchange. Using

the LG to view places of personal significance allows patrons to engage with one another in ways that they would likely not have otherwise speaks to a type of utility that goes beyond education and research and into positive mental health and community building, which are also valuable functions of a university library.

5.2 Usability and user experience

When asked what made the experience of using the LG different than using Google Earth on a laptop, 7 users mentioned the “immersive” quality of the LG as being a positive attribute of the LG, which was the most common quality mentioned as being positive. Patrons also mentioned the clarity and speedy zoom capabilities as adding to the experience of using the LG: “it moves smoothly--more smoothly than Google Street View does on my own computer.” Praise was also given to the controls, with users typically finding the joystick easy to pick up and gain proficiency, even if there was initial frustration the learning curve was low. Several users mentioned that having played video games gave them familiarity with joysticks and allowed for greater ease of use. Two responses mentioned that the controls were “easy” and “intuitive.” Only one out of 25 users said that they felt there was no significant difference in using Google Earth/Street View on a laptop rather than using the LG. Minor criticisms of the LG experience or unpleasantness included two users who mentioned motion sickness as a problem when using the LG (it is hard to imagine how this could be mitigated) as well as issues with navigation and places that lacked

Streetview. Two patrons wanted to use the LG to investigate places their relatives had visited in Israel and were thwarted by the limited Streetview that was available in Israel, and another patron encountered difficulties visiting his childhood home in Streetview as it was a gated community where Streetview cameras evidently had not been let it. There is little that can be done to alleviate the limitations of Streetview, unfortunately, but its range is under constant improvement by Google.

The major criticisms of the LG's usability were similar to frustrations that Hub employees have voiced, namely that the Streetview Option should be searchable by address the way the Google Earth view is and that the labelling of the different options on the screen is minimal and can be confusing. When asked if instructions would be helpful (currently there are none posted at the LG) users said that simple information - not so much "how to" instructions but descriptive "what is this and what can it do" details with an emphasis on information on the LG's capabilities would be helpful, as it wasn't initially clear that there was a Streetview option or where the keypad to enter addresses in Google Earth was. Essentially, if they know what the features are they can then look for them. Other users said that they didn't think there should be information added to the LG, as exploring the interface was a metaphor for the exploration it allowed in general.

6. CONCLUSION: What place does the LG have in the library?

This study could be considered a pilot study for a larger survey that may capture a broader range of library patrons - including those not predisposed to feel positively about the LG, which may not have been present in this small sample of users. Future studies could benefit from a broader range of respondents, including those who reject the display technology in addition to the users of it.

It is clear from this survey that users generally find the LG easy to use and have a positive experience with it. The fact that users visit the LG repeatedly, in both groups and alone points to the fact that this is a useful and fun object for patrons to experience in the library. Also, the fact that people were coming to the library specifically to use the LG speaks to its utility as a research and entertainment tool.

Users made many positive comments about the LG during the interviews and in survey responses to the open ended “is there anything else you would like us to know about your experience with the LG?” question, including: “it was cool, and I appreciate that it's available to UNC students!”; “It is a very interesting system that definitely benefits students. I would love to see it develop further.”; “This is such a cool thing!” and “It was awesome.” Emotions people described having about their experience using the LG were also positive including: “enlightening, inspiring,” “exhilarating,” “exciting,” and “good.” Again, this is a biased sample because it only includes people who have chosen to use the LG but it does demonstrate that people

who have used it appreciated the experience. The LG was mentioned in user interviews as a place that people include on campus tours and bring their family members to: “Tourists and parents visit it, even late at night - it’s become a draw to the library.”

Display technologies such as the LG are emblematic of the expanding range of activities that libraries are engaged in. Libraries are moving from being passive repositories into becoming more active spaces, places where people can engage in active learning, storytelling and gain research assistance that goes beyond the traditional reference services.

Libraries are also becoming support spaces, with features like therapy dogs during stressful points in the semester. Given LG users strong personal and emotional connections to what they were viewing on the LG, the LG could almost be seen as a therapeutic object as well as a practical and entertainment tool.

Awe is often our first emotion associated with libraries, the image of the stunned child entering a library and marveling at all the books, and then marveling at all the worlds within the books is somewhat iconic, and rightfully so. Displays such as the LG create a feeling of awe in many people as they allow for an immersive, unique look at the earth around us and have a positive role to play in the future of libraries.

The topic of display technology which is not being used for wayfinding but rather research or education itself has not been extensively studied within libraries. This study begins to contribute to what will hopefully be a growing body of research.

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Appendix One: Results from Quantitative (Yes/No) Questions

Did you come to the library to specifically use the Liquid Galaxy / Google Earth/Streetview Viewer?		
Response	Total	Percent
Yes	11	44%
No	14	66%
Have you used the Liquid Galaxy as part of a class lecture or class / related activity?		
Response	Total	Percent
Yes	4	16%
No	21	84%
Have you used the Liquid Galaxy multiple times?		
Response	Total	Percent
Yes	15	60%
No	10	40%
Did you use the Liquid Galaxy by yourself or in a group?		
Response	Total	Percent
Yes	5	20%
No	12	48%
Both	8	32%

