A Case Study on the Appropriateness of Using Quick Response (QR) Codes in Libraries and Museums

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1. Abstract

Libraries and museums are increasingly looking to mobile technologies, including quick response (QR) codes, to better serve their visitors and achieve their overall institutional goals; however, there is a lack of information regarding patrons' perceptions of QR codes—information essential to successful implementations. The purpose of this case study was to explore staff members' and patrons' perceptions of QR codes at Ryerson University Library and the Museum of Inuit Art in order to determine to what extent QR codes are appropriate for use in libraries and museums. Observations and 56 patron and staff interviews were conducted to obtain data on usage, knowledge, reactions and expectations regarding QR codes in these institutions. It was found that QR code usage was low, but that there was potential for use, with patrons' reactions generally positive. Three themes were identified from an analysis of the results: an assumption that young people and smartphone owners use QR codes; that QR codes are only used for one-way provision of information, not to initiate a conversation; and that QR codes can be used to personalize one's visit to an institution. Libraries and museums are advised that, based on these findings, QR codes can provide a cost-effective and potentially powerful tool for information provision; however, patrons should be first surveyed to tailor these initiatives to their wants and needs.

2. Introduction

Wireless technologies, and more specifically mobile phones, are becoming ubiquitous in modern society. According to the Pew Internet & American Life Project reports, 85% of American adults own a mobile phone (Duggan, 2012), and 45% of all American adults own a smartphone (Rainie, 2012). Specifically in Canada, the use of mobile phones is growing, reaching similar levels to the US; in 2010, 78% of Canadian households reported owning a mobile phone, up from 74% in 2008 (Statistics Canada, 2011), and a study of Canadian mobile phone users reported that smartphone usage has increased from 33% (March 2011) to 48% (March 2012) (Quorus Consulting Group, 2012, p. 5). Furthermore, adults are not just using mobile phones for voice calls and texts. A study found that 40% of American adults are using their phones to perform data-related activities (Smith, 2010), while 83% of American youth, ages 15 to 24, are using advanced data features on their phones (Nielsen, 2010). In particular, mobile phones

are being used to access data at the time of need: 51% of American adults have used their phone for quick information retrieval (Smith, 2011).

One way that mobile phone users are able to access data quickly is through the use of quick response (QR) codes. QR codes were developed by Denso Wave in 1994 and are two-dimensional bar codes that are capable of much higher capacities of information storage compared to their traditional bar code predecessors (Denso Wave, 2010) (see Figure 1). To use a QR code, one would need a smartphone, iPod, netbook or similar device with a camera, a QR code reader application installed, and, in most cases, Internet access, either through a wireless network or through a data phone plan. The user would scan the code and gain access to a variety of information, from textual information and URLs, to contact information that can initiate a text message or phone call. Although QR codes were first developed in the 1990s, only more recently have they been appearing in public spaces in Canada, such as on posters, flyers, newspapers, and magazines. A recent survey from comScore found that 16.1% of smartphone users in Canada have scanned a QR code, compared to 20.3% for the leader, the US (comScore, 2012, p. 32).

Figure 1 - Example of a QR code

In response to the increased use of QR codes as marketing tools, libraries and museums are starting to experiment with this technology. For example, the Providence College Library has tried using them in promotional material to provide users with links to websites for more information on mobile services and special events in the library (Pulliam & Landry, 2011, p. 72).

But other more innovative ideas are being experimented with. Some libraries and museums are using QR codes to link a physical item with its electronic counterpart. The University of Colorado at Boulder Libraries implemented a pilot using QR codes on signage to link patrons to maps and instructions (Hicks & Sinkinson, 2011, p. 64). The University of Huddersfield Library is using QR codes to

link from the print journals to the electronic holdings or from shelf end displays to related external resources (Walsh, 2011, p. 433), as did the University of California-Irvine libraries (Kane & Schneidewind, 2011). Some libraries, such as the San Jose State University Library, are using QR codes to link to mobile versions of their websites (Ohigashi Oasay, 2011, p. 300), while others, such as the University of Miami Library, are using them to assist in readers' advisory functions (Miami University Libraries, 2011). The Contra Costa County Library has even taken it a step further, linking the library with its patrons while they are commuting: it is providing posters on transit buses with QR codes patrons can scan in order to download audiobooks while travelling (MacKinnon & Sanford, 2010, p. 6). Finally, Indiana University's Fine Arts Library is using QR codes in course syllabi to link to library resources (MacDonald, 2012).

Others are moving in the opposite direction, linking the electronic to the physical, through text or audio. The University of Bath and Ryerson University Library are two examples of libraries that are embedding QR codes into their online catalogue records, so that when the codes are scanned they will provide textual information, such as a call number and title, which can be stored in the mobile device and used to locate the physical item in the library (Robinson, 2010; Ryerson University Library & Archives, 2012). These libraries are also using QR codes to download audio tours to patrons' mobile phones, so that they can take self-guided tours (Robinson, 2010; Ryerson University Library & Archives, 2010). Similarly, the Museum of Inuit Art is using QR codes to guide patrons and provide additional information to supplement exhibits (Museum of Inuit Art, 2011). Libraries, such as the Claude Moore Health Sciences Library, are also using QR codes to provide further information on art housed within their spaces (Barker et al., 2012, p. 70). Further, some libraries are using QR codes to allow students to quickly and easily book a study room or sign up for a workshop while out and about in the library (Lombardo, 2012, p. 18).

QR codes are also being used to bridge institutions. The Ueno Zoological Gardens and the National Science Museum in Tokyo used QR codes to create a cross-institutional mobile phone audiovisual guide (Arita-Kikutani & Sakamoto, 2007), while France's biggest Science Museum used QR codes to connect its physical exhibits to its library holdings, and vice versa (Vandi, 2011), creating richer experiences for the patrons.

As mobile phones were originally intended as communication devices, some institutions are recapturing this idea through QR codes. The University of Huddersfield uses QR codes to initiate texts and phone calls for reference help by providing contact information directly to the mobile device

(Walsh, 2009, p. 8). The Colorado pilot also used QR codes to link patrons directly to chat windows to receive reference help (Burns, 2011, p. 64).

3. Problem Statement

From these examples, it is clear that libraries and museums are implementing new technology, such as QR codes, in their institutions; however, the motivations for these initiatives are not always clear. In many cases, these projects were initiated in order to experiment with new technology or in response to an assumption that new technology will better serve their users. A successful project involves identifying its purpose and goals in response to a particular need; however, often, due to a lack of resources or enthusiasm to "get started," the needs assessment step in the project's lifecycle is omitted or is informally based on assumptions and experience. The problem in this case is that wasted time and effort can result if the new technology implementation does not serve a need.

In general, in-depth patron and staff reactions and expectations regarding QR codes do not appear to have been studied, but are essential because user feedback is often cited as a requirement to move forward with further QR code initiatives in libraries and museums. For example, the Hicks and Sinkinson (2011) study recommended that more information on patrons' awareness, reactions, and usage patterns regarding QR codes are needed to help drive future QR code implementations in the library (p. 68). Pulliam and Landry (2011) also suggest that it would be helpful to gain a better understanding of their users and their needs to move forward with their future QR code initiatives (p. 73). Some libraries have tried to obtain user feedback, but have resulted in very few responses, such as the University of California-Irvine libraries' QR code implementation (Kane & Schneidewind, 2011, p. 122).

A problem can also arise when inaccurate assumptions of need are substituted for a formal needs assessment. Often, common assumptions can propagate without evidence to support these ideas. Before projects, based on these ideas, move forward, it is important to gather concrete data to validate or challenge these common assumptions. This research study aimed to address these problems by gathering data on patron and staff reactions and expectations regarding QR codes to identify and test assumptions and needs to support further QR code implementations.

The purpose of this case study was to explore staff members' and patrons' perceptions of QR codes, using Ryerson University Library and the Museum of Inuit Art as example institutions. The perceptions of QR codes were generally defined as what expectations staff members had from their institutions using

QR codes, and what reactions and expectations patrons had regarding QR codes in libraries and museums. The study addressed the following research questions:

- To what extent are QR codes appropriate for use in libraries and museums?
    - What are patron's reactions to these institutions using QR codes?
    - What are patron's expectations regarding using QR codes in these institutions?
    - Why are libraries and museums using QR codes?

4. Literature Review

The studies done on QR code usage in libraries and museums usually revolve around piloting QR codes in an institution, and then surveying participants or tracking statistics on usage. The Colorado pilot involved implementing QR codes around the libraries to provide links to maps and instructions, and to provide an opportunity to chat with a librarian for more assistance (Hicks & Sinkinson, 2011, p. 64). The study analyzed data on how many times a QR code was scanned to determine if QR codes were being used and which were the most popular (Hicks & Sinkinson, 2011, pp. 65–66). The study also discussed the challenges involved in implementing QR codes in the library, such as user awareness and education (Hicks & Sinkinson, 2011, pp. 66–67). The study highlighted the importance of tracking QR code usage statistics and recommended being mindful of access barriers, such as being aware that not all users own a mobile device (Hicks & Sinkinson, 2011, pp. 65–67). The study provided very valuable information for practitioners who wish to try QR codes in their own institutions; however, the study focused almost solely on implementation and usage statistics.

The Toyko zoo and museum study surveyed participants on the audiovisual guide through the use of a questionnaire (Arita-Kikutani & Sakamoto, 2007, p. 40). The study found that in general most users had no problems using QR codes, although some visitors complained about dark lighting conditions affecting a successful scan of a QR code (Arita-Kikutani & Sakamoto, 2007, p. 42). In this case, user feedback on QR code usage in this specific context was gathered, regarding what worked and did not work; however, the questionnaire asked more general questions about the content of the guide, with only one question directly focused on code recognition (Arita-Kikutani & Sakamoto, 2007, pp. 44–45). Furthermore, the Japanese public are more familiar with this type of technology (Walsh, 2009, p. 7), making the findings difficult to apply to a Canadian context.

The Museum of English Rural Life in Reading, UK, used QR codes in an attempt to improve accessibility and enhance their visitor experience (Haworth & Williams, 2012). The researchers ran a

series of interactive activities that involved scanning QR codes for more information on museum objects in a variety of formats (audio, video, text, images) and observed patron reactions (Haworth & Williams, 2012, p. 286). The study observed that participants were enthusiastic and that by using interactive media and allowing participants the choice of format, their experience was tailored to their individual needs (Haworth & Williams, 2012, p. 290). This study provided some useful perspectives on using QR codes to improve accessibility, but focused more on implementation and presented only general observational data. The University of Bath conducted a study in 2008 that involved surveying students regarding their awareness and usage (or potential usage) of QR codes (Ramsden & Jordan, 2009). Although the findings were useful in determining that student QR code awareness and usage was low (Ramsden & Jordan, 2009, p. 5), the survey is over 3 years old and focused on students in the UK. Also, due to the nature of the measurement instrument, in-depth reactions and perceptions of students regarding QR codes were not gathered.

In 2009-2010, the University of Huddersfield implemented QR codes in their libraries, surveyed users regarding QR code awareness, and tracked usage (Walsh, 2010). The library found that initially QR code awareness was low, but by hosting a library competition involving a QR code treasure trail and implementing other promotional efforts and training, it increased; however, usage remained low, indicating other barriers to success (Walsh, 2010). Survey results suggested that insufficient motivation to install a QR code reader and use QR codes could be the major barrier (Walsh, 2010, pp. 61–62). This study is a few years old and also focused on students in the UK.

From these examples, it is clear that QR codes are being used in libraries and museums in a variety of ways; however, apart from reporting how they are being used, few studies attempt to determine how QR codes are being perceived by patrons and institutions, how patrons are actually interacting with these codes, how successful these pilot implementations are at meeting institutional goals, why institutions are using them and what they hope to gain. In addition, few studies focus on examples of QR code usage in Canadian institutions.

5. Procedures

From a pragmatic worldview, which is focused on real-world problems and their solutions (Creswell, 2009, pp. 6, 10), a qualitative case study approach was proposed. Two instrumental case studies, used to better understand an external problem (Berg, 2001, p. 229), were selected to consider and compare: Ryerson University Library and the Museum of Inuit Art. Both institutions recently implemented QR

codes in a variety of ways in their institutions and were conveniently located in Toronto, Ontario (Ryerson University Library & Archives, 2012; Museum of Inuit Art, 2011), and, therefore, were expected to provide rich data for study and address the lack of Canadian research in QR code usage in libraries and museums. This case study used both observations and short interviews to collect data on staff and patron perceptions regarding QR code usage. In-depth data was gathered at both the Ryerson University Library and the Museum of Inuit Art in order to provide better insight into QR code usage. By engaging with patrons and staff at two different institutions, a broader range of patron perceptions was collected (Berg, 2001, p. 229) because the museum and library serve different people—the library serves mainly university students, while the museum serves the general public.

Staff and patrons at both sites were interviewed to gain insight into their thoughts on QR code usage in general, and their reactions to it being used at the museum and library. Gathering this data was essential to identifying themes and addressing the research questions regarding patrons' reactions and expectations. Staff interviews were used to gain insight into why the museum and library were implementing QR codes. Comparing these perspectives could then inform the main research question regarding the appropriateness of using QR codes in libraries and museums—is it a good fit between the institution and its patrons, and is it serving its intended function? Although interviews can have limitations based on how articulate participants are and on the skill of the interviewer (Creswell, 2009, p. 179), they are still an excellent way to gain insight into the interviewee's perspective on a topic and to obtain information on unobservable data (Simons, 2009, p. 43).

Observational data was collected on patrons who were interviewed to obtain estimated demographic information and information on their behaviour at the institution with regards to QR codes (e.g., were they seen scanning a QR code). Observations were also used to determine if patrons had smartphones, if they had them out and available to use to scan a QR code, and their proximity to QR codes in the institution. Because observational data provides a "sense of setting" and non-verbal information that cannot be captured in interview data (Simons, 2009, p. 55), it is an excellent supplement to interview data. Observational data collected provided additional insight into patrons' perceptions and helped to address the main research question regarding appropriateness by identifying patron behaviours and their relevant characteristics.

By using multiple sources of evidence, a richer data set can be analyzed, and through triangulation, this can address construct validity (Yin, 2009, p. 42). In terms of external validity, although case studies have been criticized as not being statistically generalizable to populations, they can be analytically

generalizable to a broader theory (Yin, 2009, p. 43) or concept (Simons, 2009, p. 165). Through the use of a collective case study, cross-case generalizations can be determined by performing cross-case analysis to identify themes that span cases, further enhancing external validity (Simons, 2009, p. 164). Reliability was considered by double checking interview data for typos, discussing coding decisions, and making notes of coding decisions to ensure consistency in coding (Creswell, 2009, pp. 190–191).

5.1 Sites

Ryerson University Library has recently experimented with QR codes. There is a QR code near the front entrance that visitors can scan to obtain an audio tour of the library. QR codes are also on some signage to link to websites for more information on the library and reference services. Finally, QR codes have been inserted into the library catalogue, where a QR code is displayed in the catalogue record for each physical item. If users scan the QR code, information such as title, author, and call number are sent to their phone, which they can then carry with them into the stacks to help them locate the item physically. Ryerson has a webpage on their library site that visitors can consult for more information on QR codes and how to use them.

The Museum of Inuit Art recently implemented QR codes in their special exhibit space and main exhibition. There are QR codes scattered throughout that provide more information on an associated piece of art. For example, there might be a link to a map of where the artist is from or a video showing the artist creating the work. There are also QR codes found on signage at the entrance of the museum that can be scanned to link up to the museum via various social networking sites, such as Facebook or Twitter. In the special exhibit space, QR codes are being used for patrons to scan a code next to particular piece of art in order to leave a comment or question about that piece for the artist to respond to via a blog. The museum has a sign at the entrance that explains what a QR code is and how to use it. The museum is also in the process of being able to loan devices that can read QR codes to patrons without such a device, so that all visitors have the ability to use the QR codes.

5.2 Participants

For this study, participants were made up of staff members on duty and patrons who visited the Ryerson University Library and the Museum of Inuit Art in March 2012. Those participants who visited the Ryerson University Library were primarily Ryerson University students, while patrons who visited the Museum of Inuit Art were members of the general public. Patrons were selected for interviews based on their presence in the institution during site visits and their interaction (or lack of interaction) with QR codes. Staff members on duty during site visits were also interviewed. Interviewees were all adults only,

over the age of 18, and were voluntarily participating, with the option to withdraw from the study at any time.

Each site was visited five times during a 1 week period, for a total of 2 weeks of data collection. Each visit lasted approximately 1-2 hours, and visits were varied by time of day and day of the week. Selecting 2 weeks as the time period of research was based on wanting to obtain an adequate amount of participants in a reasonable amount of time. Observations and interviews do not normally prescribe a standard amount of time; in fact, one of the strengths of case study research is its flexibility in not being constrained by time or methods (Simons, 2009, p. 23). For example, Khoo, Rozaklis, and Hall (2012) did a survey of the use of ethnographic methods studying library users and found that observational collection periods ranged from 4 hours to 2 years (p. 85). However, from examining other ethnographic observational research conducted in libraries, 2 to 3 weeks was found to be a common duration (Bryant, 2007; Given & Leckie, 2003; McEwen & Scheaffer, 2012; Xia, 2004).

In terms of sampling, all patrons who visited the museum during the site visits and consented to an interview participated, along with any staff working at the time. It was unknown who would be visiting the museum during these times; the participants were a convenience sample of museum visitors, but no systematic rules were used in selection. The museum visits were done during a school term break to try to capture more potential interviewees during a busier period at the museum. For the library, interviewees were again a convenience sample selected from the first floor of the library, (Creswell, 2009, p. 148), with the only selection rule used was that library users were selected if they were sitting at the ends of a row of seats or if there was an empty spot next to them. This was done to facilitate interviews. By selecting patrons with space for the interviewer to sit near them, it was easier for the interviewer to conduct interviews on the spot without disturbing other patrons (i.e., by asking them to move or squeezing into a tight spot between them and the interviewee). The library visits were done during a busier time during the term (end of March) to try to capture more potential interviewees, and again any staff members working at the time of the site visits were also interviewed. Varying the times of the visit and essentially performing an unsystematic selection of patrons to be interviewed were both conscious research design aspects aimed at increasing the external validity of the study (Yin, 2009, pp. 43–44) and were noted in other studies adopting a similar approach (e.g.,McEwen & Scheaffer, 2012). In general, there were only rare occasions that a patron declined to participate at the museum. More library users declined to participate, but this could be due to the research being conducted at a busy time of year for students.

A total of 56 participants were observed and interviewed, which is comparable and sometimes even exceeds sample sizes of participants in other similar studies regarding user perceptions of different technology uses in academic libraries and museums (Arita-Kikutani & Sakamoto, 2007; Hansen, Johnson, Norton, & McDonough, 2009; Maceli, Wiedenbeck, & Abels, 2011; McEwen & Scheaffer, 2012; Salem & Seeholzer, 2011). As exploratory case studies are usually smaller in scale (Berg, 2001, p. 230), the sample size was considered appropriate and provided sufficiently rich data for analysis.

5.3 Interviews

At each site, 12 staff members and 16 patrons were interviewed. Interviews were 5-10 minutes in length. These short, semi-structured interviews consisted of a mix of open and closed questions and differed for staff and patrons. In addition, slightly different sets of patron interview questions were used, depending on whether the patron was observed to be using a QR code in the institution or not. If the participant approached did not know what a QR code was, a prepared prop was shown with a simple definition and an example. Note taking was used to record interview data to put participants at ease, and to avoid lengthy transcription efforts and logistical difficulties with audio recording interviews in potentially noisy public spaces (Simons, 2009, pp. 52–53). Conducting interviews was the main method of data collection for this study and was the most appropriate method to use in order to gather people's perceptions (Simons, 2009, p. 43) and views regarding QR code usage in libraries and museum.

5.4 Ethnographic observations

To supplement the interview data, observations of interviewees were recorded. Observational data was recorded regarding the interviewees' gender and what approximate age group they fell under: young adult, ages 19-30; adult, ages 31-64; or senior, ages 65 and above. Using a floor plan of the museum and the first floor of the library, the interviewees' locations were recorded, along with locations of QR codes, where applicable. Observations regarding interviewee activities were also noted, such as if they were holding a smartphone or if they were scanning a QR code. This additional data provided context and valuable information not captured in the interviews.

6. Results

6.1 Demographics and Observations

Overall, 32 patrons were observed and interviewed: 14 males and 18 females. In terms of age ranges, 12 were considered to be young adults, 19 were adults, and 1 was a senior. A total of 24 staff members were observed and interviewed, with an even number of males and females. For staff, 11

were young adults and 13 were adults. Of all the patrons observed across both institutions, only one patron was actually seen scanning a QR code during the site visits (at the museum) and one other patron mentioned in the interview that he had scanned one earlier in his visit to the museum, but that activity had not been observed by the researcher.

Patrons not observed using QR codes and staff were both asked if they knew what QR codes were (see Figure 2). Approximately 19% of patrons interviewed knew confidently what QR codes were, with another 47% knowing what they were once they were shown the prop, saying things like they "knew what they were, they just didn't know what they were called."

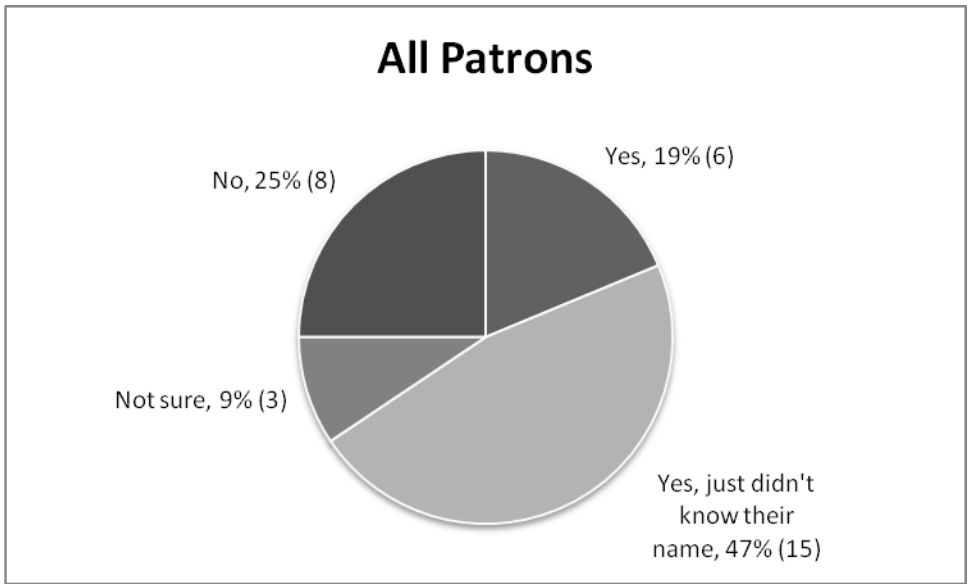

Figure 2 - Patrons' knowledge of QR codes

This can be further broken down by age. Overall, only a slightly larger percentage of young adults knew what QR codes were than adults (see Table 1), and in both cases it was the majority of them. Unfortunately, only one senior patron was interviewed, due to a lack of senior patrons visiting both institutions; that patron also knew what QR codes were.

Response	Young Adults	Adults
Yes	8% (1)	21% (4)
Yes, just didn't know their name	58% (7)	42% (8)
Not sure	8% (1)	11% (2)
No	25% (3)	26% (5)

Table 1 - Young Adults' vs Adults' knowledge of QR codes

Another way to consider this data is to look at it by institution. More patrons of the museum knew what QR codes were than visitors to the library. In terms of staff members' knowledge of QR codes, overall the majority of staff knew what a QR code was; however, there was a significant difference in staff knowledge between the museum and the library, where 100% of museum staff knew what QR codes were, while only 25% of library staff could confidently say they knew.

More than half of patrons not observed using QR codes and staff (approximately 59%) said that they had not used a QR code before; however, the difference between museum and library visitors was noticeable, with only 25% of museum patrons having used QR codes before, compared with 56% of library users. Of the patrons who do use QR codes, though, the majority of library visitors had only used them a few times in the past 6 months, compared with museum patrons who had used them more often. It was also found that 81% of museum visitors noticed QR codes being used in the institution compared to only 38% of library users.

Although not asked explicitly, observations were made regarding smartphone ownership and behaviour. At least 41% of all patrons were observed to have a smartphone—31% of museum patrons and 50% of library users. Furthermore, in order to observe this, people had to have had their smartphones visible, indicating that smartphones were often easily accessible and "ready for action"—in particular, many library users had their phones prominently placed on their desks in front of them.

Finally, patrons provided their thoughts on QR codes in general, as well as what they thought about them being used at the museum or library. Their comments were then interpreted and coded as being positive, neutral, or negative (see Figures 3 and 4). Overall, about 50% of all patrons expressed positive feelings about QR codes in general, while 81% were positive about the institution using QR codes specifically. In general, library users were more positive than museum patrons regarding QR codes.

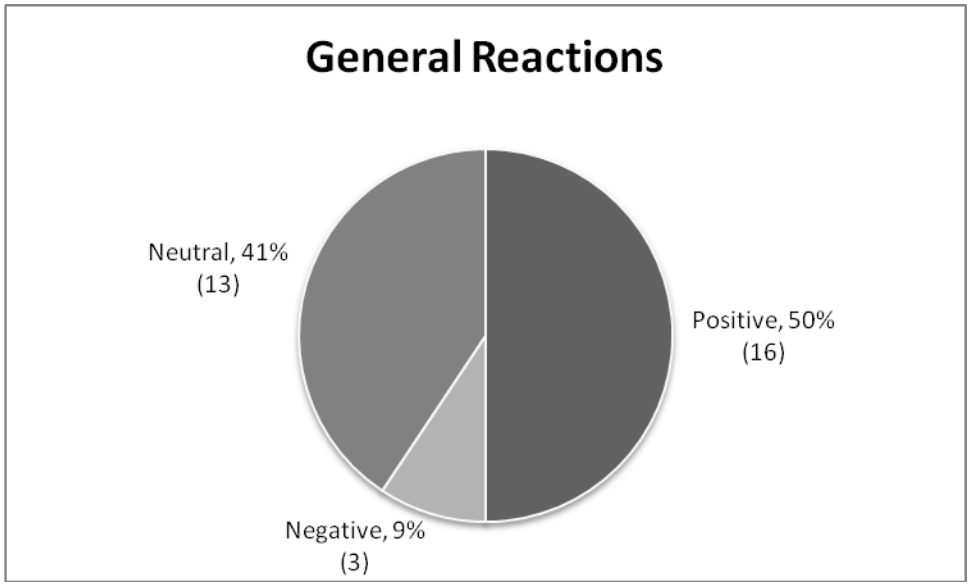

Figure 3 - General feelings expressed about QR codes

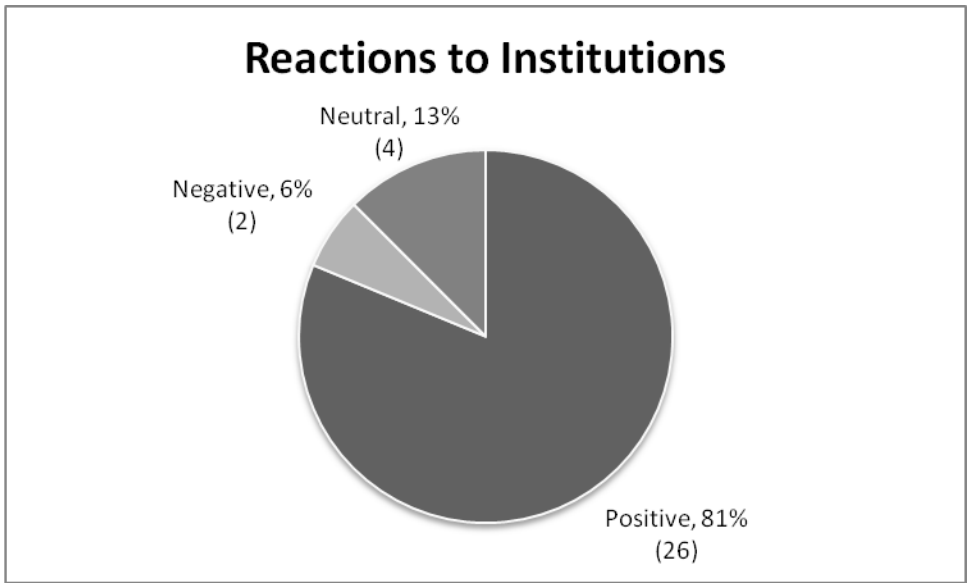

Figure 4 - Feelings expressed about QR codes being used by the institution visited

6.2 Interview Themes

Multiple open-ended questions were used to solicit patrons' reactions to QR codes in general, what they thought about them being used at the museum and library, and why they believed the institution was using them. Multiple open-ended questions were also used in staff interviews to gather their perceptions regarding how the institution was using QR codes, what they believed were the goals of and future plans for using QR codes in their institution, how they expected patrons to interact with QR codes, what questions visitors were asking about them, and their expectations regarding QR code usage now and in the future. Qualitative data was gathered from these questions, and through an inductive process, the data was analyzed, coded and categorized to identify themes (Rasmussen, Østergaard, & Beckmann, 2006, pp. 110–111). An inductive approach was taken to gain a greater insight and knowledge on QR code usage (Rasmussen et al., 2006, p. 110), which was the aim of this exploratory case study.

A number of themes arose, but three key themes were identified surrounding patrons' and staff members' perceptions on QR code usage, including who uses QR codes and how they can be used. Two themes were common to both the museum and the library, while the third was mainly specific to museum visitors and staff, but may serve to inform future QR code initiatives in libraries.

Theme 1: Many people assume that young people and smartphone owners use QR codes

A common theme occurring from patron and staff responses was that QR codes would be most known and used by young people and smartphone owners, with just over half (approximately 54%) of all participants making statements that support this idea. A common assumption was that new technology, like QR codes, appeals to and is known by younger people, with interviewees making statements such as "speaks to young people", "appeals to younger tech-minded people", "I think they are trying to appeal to the youth audience", "young people will use it more", and "easy for young people." Some people considered QR codes more for children, for example, saying "I wish my son had brought his phone to try it out." Responses also indicated that the assumption was that if you had a smartphone then you would automatically be a user of QR codes: "seems like a majority of people have smartphones, so they would use them", "I guess for people with smartphones they're fine", "easy for people with smartphones", and "if they have a smartphone they should recognize the code and what it does."

Theme 2: Many people assume that QR codes are only used for one-way provision of information functions, not to initiate a conversation

Another common theme, again supported by responses from approximately 54% of all participants, was that QR codes were solely used by museums and libraries to provide information. Common statements included “useful way to get information right away”, “seems like a quick way to get more info”, “effective way of disseminating information”, “get more detailed info if you want”, “another way of providing information”, and “I think it is mostly just for information.” One staff member was concerned that the use of QR codes might lead to information overload because the staff member felt there was already ample information on the signage: “we do have a lot of information... It might be overwhelming...” However, 67% of museum staff members spoke about how the museum is also using QR codes to connect with patrons through social networks and start conversations between visitors and artists, stating that one of the goals of QR usage is to “create longer lasting relationships” and to get “our audience to become comfortable talking to the artists.” Although, technically when you scan a QR code you only receive the information stored in the code, as demonstrated by the museum’s implementation, this information can initiate a two-way conversation.

Theme 3: People believe that QR codes can be used to personalize their visit to an institution

For this museum-specific theme, approximately 32% of all museum participants made statements regarding how QR codes could be used to personalize a visit to the institution. Some patrons suggested ways that they could use QR codes to control the flow and amount of information to personalize their visit, making comments such as “if you want further information you can get it... I wouldn’t scan that one, but would scan this one to show my daughter”, “replaces an audio tour...now you can scan to get more information on selected items”, and “instead of a recording or a tour guide, it is individualized, personal.”

7. Discussion

Overall, observed usage of QR codes during site visits was almost non-existent; however, it was recognized that observing Ryerson Library users scanning and using QR codes from the catalogue could potentially be difficult because they could be scanning codes at home and then bringing them to the library. For future studies on catalogue QR code use, it might be more effective to make observations in the stacks areas instead of the computer areas, to try to catch catalogue QR code users.

The majority of patrons and staff do, however, have at least an awareness of QR codes. It was significant to note that library staff members were less aware than museum staff. This could be due to the fact that the museum's implementation of QR codes was more formal and included educating staff about them, while the library's implementation was more experimental. Regarding awareness, it was also significant to note that museum visitors were much more likely to notice QR codes than libraries. This could be due to the "browsing" nature of experiencing a museum, which would suggest that more is noticed, while many library users may visit the library "on a mission" to get what they need and get out, without noticing signs and QR codes that might be present. It has been observed that visitor motivations can significantly influence the trajectory of their visits (Falk, Heimlich, & Bronnenkant, 2008). One staff member at the library remarked that when she said that information is on the sign over there to a student that student responded "we don't read signs."

In contrast, if one considers user "readiness" in terms of QR code usage, library users at Ryerson seem more open to the idea. Although all patrons had generally positive comments regarding QR code usage at both institutions, more library users appeared to have smartphones, had used QR codes before (at least to try it out once or twice), and had their phones out and ready to use, indicating that QR codes could be appropriate for this group. The problem may be rooted in the fact that awareness of QR codes in the library was low, hindering usage. One way to combat this would be to promote them more, something suggested by a more than one staff member in interviews.

At first glance, it might appear that from this discussion that in attempting to answer the research question regarding the extent that QR codes are appropriate for use in libraries and museums, that it may be more appropriate in libraries, if they are promoted. However, it is important to clarify that the appearance of readiness does not automatically mean these people will ever go on to use QR codes. This ties directly to theme 1, in that there is currently an assumption by both staff and patrons that smartphone owners are regular QR code users, taking a traditional technological deterministic view that "technology shapes society in some way –which includes social practices such as learning" (Oliver, 2011, p. 374). From this viewpoint, technology influences cultural norms and desires, and therefore, drives assumptions, such as theme 1. Although it is true that some sort of device, most commonly a smartphone, is required in order to use a QR code, having that device does not mean that the owner wants to know and use all features of the device. The case study findings show that although many people were interviewed and observed, only a couple people actually used a QR code in one of the institutions, and in general there was low usage recorded, with some smartphone owners not even

being aware of what QR codes were. This indicates that something more is required to explain the low adoption—perhaps a lack of awareness, or a lack of perceived usefulness or ease of use were at play, factors considered in Davis' technology acceptance model (as cited in Legris, Ingham, & Collerette, 2003). It should be noted, though, that smartphone ownership was only inferred from interview responses and observations. It would be helpful if future studies on QR codes gathered this information directly.

There is also the assumption by both staff and patrons that QR codes are known and used by young people. In general, this is a common idea in media and popular culture—that young people are comfortable and confident with technology, and adopt new technologies easily and quickly (Selwyn, 2009, p. 364; Buckingham, 2011, p. x). These young people, often called "Digital Natives," have grown up with networked digital technologies in their lives and the skills to use these technologies, living their lives in a profoundly different way than any generation before, according to a number of popular books on the topic, such as *Born Digital* by Palfrey and Gasser. However, others dispute these broad blanket statements and assumptions of all youth, arguing that this oversimplifies and exaggerates the reality (Thomas, 2011, pp. 1–10) and that there is little actual evidence to support these claims (Selwyn, 2009, p. 371). Based on numerous studies, the reality is that young people's technological abilities are highly influenced by demographic and socio-economic parameters, and that often times their actual use of "digital technologies remain rather more limited in scope than the digital native rhetoric would suggest" (Selwyn, 2009, p. 372).

Even the term "young people" itself is actually quite vague (Boyd, 2008, p. 2). Hollway's social positioning theory proposes that people construct identities for themselves and others in their discourses (van Langenhove & Harré, 1998, pp. 16–31). When speaking about technology, people often brought up in interviews the idea of age, positioning tech-savvy, QR code users as young people, sometimes speaking as if this was a separate group from themselves, even if they were identified as a young adult by the researcher through observation. Others positioned themselves as a member of an opposite group that would not be comfortable with or quick to adapt to new technology; for example, when asked about questions they had received about QR codes, one staff member said that sometimes questions are asked by "middle-aged people, scaling the tower of tech. They want in but are coming in slow. People like me." Although from interviews with staff and patrons these assumptions were common, this sentiment contradicts this case study's findings that not all young adults knew what QR codes were and used them infrequently at best.

These findings illustrate one aspect of patrons' expectations and reactions regarding QR codes, addressing two of the sub-research questions of this study. These ideas indicate a reason why museums and libraries are using QR codes (and new technology in general), or at least what staff members believe is a reason, as asked in the third sub-research question. These institutions are hoping to reach and serve the assumed needs of their younger visitors, along with smartphone owners (two groups of visitors that overlap in some cases). However, some museum visitor studies performed in Scandinavian countries found that "there is a mismatch between the traditional museum public and the users of iPhones" (Valtysson, Holdgaard, & Ling, 2011, pp. 118–119), while another museum study performed by Susie Fisher found that, although they initially expected older museum visitors to be the least receptive to PDA trials, they found that these visitors, although struggling at first with its use, eventually found using the PDA in their museum experience to be "absorbing, enlightening and valuable" (as cited in Walker, 2008, p. 114). The University of Bath's survey found that QR code awareness and usage was low, although students were found to have the appropriate mobile technology to use QR codes, indicating the potential was there (Ramsden & Jordan, 2009). These studies illustrate the value of visitor studies and student surveys to gain valuable information on who the users of the institution actually are and what technology they actually use. From the findings of this study, it should be cautioned that the assumptions versus the reality regarding visitor demographics and technological abilities, and more specifically QR code usage, are not always congruent, and that further studies, such as the ones mentioned earlier, could help to break through misconceptions.

Another assumption, that QR codes are only used for one-way provision of information, not to initiate conversations, was a common theme in both staff and patron interviews. This assumption is suspected to be rooted more in historical assumptions regarding museums and libraries, along with the historical use of old forms of barcode technology. Traditionally, libraries have been considered "custodians of knowledge" (Traxler, 2008, p. 48) and with this reputation the implication is that one visits a library to receive information (i.e., a one-way transfer of knowledge). Museums have also been traditionally viewed as a place to "enlighten and educate the public" and an institution that "chooses what is to be preserved and communicated for future generations" (Valtysson et al., 2011, p. 105), again implying some information provision to the public, although less rigidly than the library.

Barcodes themselves have also been traditionally used to provide information about the item they are associated with; for example, a cashier at a store would scan a barcode to get the price of an item. They have also been historically used by staff members with specialized equipment. This technology's

history was seen to influence patrons' expectations regarding QR codes. Not only was one-way information provision a common theme, but a few patrons were also confused as to who would be using them. Some visitors thought QR codes would be used only by staff, saying "Isn't it used more for cataloguing?" and "I have vague idea that it is for security," while when asking another patron why they though the institution was using QR codes, she said "Maybe for employees to know more?"

However, more recently there has been an increasing amount of discourse surrounding re-inventing the roles and identities of libraries and museum, prompted in part by shrinking budgets and technological developments. Increasing visitors to both institutions has become a focus; for academic libraries, student outreach is important as these institutions are finding their students are "less dependent on the traditional library" (Dickson & Holley, 2010, p. 470) while museum leaders often measure museum success by number of visitors (Anderson, 2008, p. 294). The Museum of Inuit Art is using QR codes not only to provide information, but to connect visitors to their social networks and to start conversations with the artists; this is similar to the Handheld Education Project that strove to enrich the visitor experience using PDAs to "encourage a conversation, a drawing in and engagement with the objects and the related information and not a simple transfer of knowledge" (Economou, 2008, p. 145). According to Kevin Walker's research on portable technology use in museums, however, these technologies "continue to be used primarily for one-way information delivery" (Walker, 2008, p. 112), such as the mobile phone tour for the Japanese zoological gardens and science museum mentioned earlier (Arita-Kikutani & Sakamoto, 2007).

In academic library outreach, two-way communication as a way of engaging the community served is essential (Courtney, 2009, p. 3), and Dickson and Holley (2010) suggest that social networking can be another effective way to reach users and start a conversation, provided that users' needs and communication practices are understood and advertisement of these networks is reaching users (pp. 476-477). Currently, many libraries such as Ryerson University Library have been experimenting with QR codes for information provision, but they may want to consider how they can use QR codes effectively for outreach purposes and to engage with their users. But again, promotion and education of users will be necessary to challenge and break through the patron (and staff) assumptions of QR code uses that have been shaped by the historical role of libraries and museums, and the traditional usage of barcode technology.

These findings illustrate another aspect of patrons' (and staff members') expectations and reactions regarding QR codes, addressing two of the sub-research questions of this study. It is noted, however,

that there was a potential that some patrons and staff may have been influenced into thinking that QR codes are only used for information provision. For interviewees that did not know what a QR code was, they were shown a prop that gave an example of a QR code and a short definition that said "Quick Response (QR) codes are two-dimensional bar codes that can be scanned by a mobile device to receive information." Although, of those who were shown the prop, many simply needed to take a quick glance at the example to know what they were, with only a few taking the time to read the definition carefully. It is suspected that the prop's influence was minimal, but should be noted when considering this theme and the findings.

A museum-specific theme arose in both staff and patron interviews regarding the potential to use QR codes to personalize a visit, highlighting a difference in perspectives about these institutions. One of the museum's intentions in using QR codes was to create a more personalized and interactive experience, and from the interview data, it appears that at least a quarter of patrons interviewed have picked up on this. This idea of a personalized visit is not new to museums; the idea of providing additional and optional information via information kiosks, audio guides, and more recently through handheld devices has been pursued by many museums (Economou, 2008, pp. 137–155). However, museums are now harnessing the power of smartphones to further personalize each patron's visit (Valtysson et al., 2011, p. 111), which is not surprising as smartphones provide a much cheaper alternative to providing specialized equipment, and the interface is more familiar to patrons. A way of understanding this new phenomenon is by considering the theory of affordances: "how the physical characteristics of an object interplay with the way in which we perceive and interpret the use of the object" (Ling, 2004, p. 24). In this case, although the phone was originally designed as a personal communication device, it is being appropriated by the institution through the use of QR codes to perform a different function than were originally intended.

Other researchers, such as Scott Campbell, also discuss how mobile technologies are being used to personalize communal public spaces, for example by having a phone conversation that can be overheard by others, or by "cocooning"—shutting themselves off to others present by being plugged into and absorbed by their mobile device (Campbell & Park, 2008, p. 381). Patrons at the museum have recognized another way to personalize their visit and control the amount and what information they receive, via QR codes and their mobile devices. This suggests that, although not many museum patrons were seen scanning QR codes, they recognize their potential to enhance their visit, implying that there might be an existing motivation that museum staff can focus on.

These findings provide further insight into patrons' and staff members' reactions and expectations regarding personalization, including why museums are using QR codes, and to what extent they are appropriate for use in museums. Although museums and libraries can differ in terms of visitor motivations and experiences, the idea of personalizing a visit does not need to be constrained to only museums. Mobile technologies, such as QR codes, can provide "anywhere/anytime access to knowledge, learning and information, but they also provide just-in-time/just-for-me/just-here access...[a] basis for contextualization and personalization, where knowledge and learning are customized to the user's location, preferences, history and requirements" (Traxler, 2008, p. 49). For example, libraries have used QR codes placed on a study room door to connect students with the room reservation form, placed on DVDs linking to mobile-friendly trailers, or placed on physical items to provide links to their electronic counterparts (Ashford, 2010, pp. 527–528). These ideas were not on Ryersons' users' and staff members' minds during interviews; however, as QR codes become more ubiquitous, users and staff members' expectations may change.

8. Conclusion

It was uncovered when delving into patrons' and staff members' perspectives that common assumptions shaped by popular mythology surrounding youth and technology, along with historical roles of libraries, museums, and barcode technology itself, arose in responses across institutions; these assumptions may not accurately reflect realities, and should at least be recognized when making decisions regarding QR code initiatives. It was also found that museum staff and patrons identified the potential of QR codes to allow visitors to personalize their visits—an idea that could be considered by libraries for future QR code implementations. Overall, it was also found that QR code usage was quite low in both institutions; however, awareness of QR codes in general was much higher, and on the surface, the potential readiness of library users to begin being active QR code users was noted. As echoed by staff comments, educating visitors on QR codes and promoting them within the institution will increase their being noticed and may in turn increase usage.

In this case, these findings indicate that QR codes could be appropriately used in libraries and museums; however, as theme 1 findings suggest, museums and libraries are implementing QR codes in an attempt to reach a younger, tech-savvy audience, but may not succeed if that is not who their visitors really are or if QR codes are not actually used by that audience. Falk's research on museum visitor motivations and his identity-related categories framework (Falk et al., 2008, p. 57) could be applied in

combination with further study of QR codes to gain a better understanding of who tends to use QR codes, and could better inform future QR code initiatives in both libraries and museums.

It is also important to consider the many uses of QR codes, and shed common conceptions of them as only able to facilitate one-way information provision functions, in order to harness a greater potential for user engagement, interactivity, and even personalization of visits. The case study findings indicate that museum visitors are recognizing that the museum is providing them with an additional way of personalizing their visit. This intersection in perceptions between visitors and staff suggest that QR codes could be considered an appropriate tool in this case.

It is recommended, however, that caution and careful consideration be present in any new technology endeavour. Trying to do too much, too fast could alienate or confuse patrons. One museum study tried to provide five functions available to visitors using mobile devices, but found that users found it too complicated and unnecessary (Gammon & Burch, 2008, p. 50). This was echoed in interviewees' responses such as "we could enter an area of overusing them so then they are everywhere and no longer useful" and "might be overwhelming. If [patrons are] here for the first time, it might be too much."

There is always an investment associated with new technology, even with relatively cheap QR codes where that investment is mainly in time to plan and implement. So it is essential to identify if this is the right technology to use. For example, another technology that has been suggested in place or alongside QR codes is radio-frequency identification (RFID) tags, already present in many libraries for circulation (Walsh, 2011, pp. 434–436). RFIDs have also been experimented with at museums, such as in the eXspot project in California that "allows users to 'tag' exhibits that pique their interest during their visits and learn more about them online after their visits" (Hsi, 2008, p. 137). Although Google Places was using QR codes, it appears that they have decided to pursue a different technology that is similar to RFID called "Near Field Communication (NFC), a wireless technology that enables data exchanges over short distances" (Dreesen, 2012), indicating that there is always something new on the horizon. As one library staff member said, "I've seen a lot of technology in libraries. It becomes popular for a while, and then decreases in popularity." That being said, QR codes are a cost-effective solution compared to NFC and RFID, without requiring additional special hardware, suggesting that they may not disappear anytime soon.

Museums and libraries are always investigating new ways to better serve their visitors. Harnessing the power of mobile technologies through a relatively cheap medium of QR codes could be an appropriate way to better serve visitors; however, as with any endeavour, research, planning, and careful consideration of the reasons for implementing a new technology are essential to success. Larger scale survey studies collecting data on an institution's patrons' awareness, expectations, knowledge, and capabilities (including ownership of the technology required to use QR codes) will further inform practitioners in using this new technology to better serve its patrons.

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