

QR codes: do they provide the missing link between the physical and digital?

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Abstract

This paper provides a comprehensive overview and critical analysis of the implementation of Quick Response codes (QR codes) in academic and public libraries, and investigates their varied uses within Australian and International institutions, with the support of a VALA Travel Scholarship. QR codes are a primary technology being used by libraries to engage and assist users by providing a bridge to access the ever-expanding amount of library information and resources that have been optimised for use on mobile devices. This paper explores the various applications these libraries have found for QR codes, and the processes involved in their implementation, promotion and maintenance; reception by library staff and patrons; future applications for the technology; and discusses related technologies.

Mobile devices and QR codes

Mobile devices with internet capability - smartphones such as Apple's iPhone and devices running Google's Android operating system, and tablets like Apple's iPad - are becoming increasingly popular for use by the general population. In 2011, approximately one third of American adults and Australians owned a smartphone (Smith, 2011; Gilmer, 2011). For libraries, this presents an opportunity to deliver services and information to users via an increasingly popular medium, one that is preferred by some people (Johnson et al, 2011).

There are numerous resources and information services available at libraries that are optimised for viewing on mobile devices but a perennial barrier to their use is raising awareness to users and enabling easy access to these resources. One method of facilitating access and the promotion of library resources on mobile devices is via QR codes.

What are QR codes?

QR codes are two-dimensional barcodes that hold more characters than a traditional barcode, thereby enabling them to store more information such as links to websites, email addresses or phone numbers. The codes were originally created by a subsidiary of Toyota, Denso-Wave, in 1994, for tracking purposes (Denso Wave, 2011). However, QR codes are now commonly used in Japan, where they have been used for "mobile tagging", a process where a QR code is scanned with the camera on a mobile device, and by using a code-reading application, various data can be made available to the mobile device owner.

QR codes can direct users to information such as text and contact details (for example telephone numbers) and URLs. QR codes are commonly used in advertising on billboards, signs, and in books and magazines to link users to online information. A major strength of QR codes is that the scanning program will, almost always, save downloaded data so the user can view the information later (for instance, when they have a wireless connection and do not have to worry about data limits or slow download speeds).

Another benefit of QR codes is that they can link users to further information from the physical to online world; a means of augmenting the existing information, therefore adding value to physical resources (Ashford, 2010). This is where QR codes could benefit libraries and library users the most. A library user may want to access information and resources, and may want to access these resources on their mobile device; QR codes act as a cost-effective and easy bridge to this information.

Although QR codes are widely used in Japan, it has only been with the recent uptake in smartphones and other internet-enabled mobile devices that QR codes have been adopted, primarily for advertising, in countries such as Australia, the United States and parts of Europe. The codes are increasingly being used by some very well-known companies with a broad audience, for example, music television stations such as MTV and Canada's Much Music, as well by as universities, real estate agents, and on film posters. Though QR code use has been limited and they are not yet widely recognised, the codes are increasingly being scanned by more people (Radwanick, 2011).

Various uses for QR codes in libraries

During April-May 2011, I visited 14 public and academic libraries in England, Canada, the United States and Australia as part of the 2010 VALA Travel Scholarship, to observe how the libraries implemented QR codes. My observations included meeting and discussing with library staff involved with the implementation of the codes, and I also corresponded with librarians at other libraries I could not visit. Below is an outline of the various uses for QR codes in these libraries, and the reception the codes have received from library users, and more in-depth case studies of two of the libraries I visited that have used QR codes for a variety of uses. Finally, I will discuss perceived barriers of using QR codes, the potential for future uses and related mobile technologies.

Within catalogue records

One of the initial uses of QR codes has been within library catalogue records, and also one of the most popular, with many of the libraries I visited having adopted this use for the codes, including the University of Ryerson Library and Archives in Toronto, San Diego State University Library and the University of Bath and Huddersfield Libraries.

The codes are embedded in each item record, and, when scanned, send shelf-location information to the user's mobile device. Such information can vary, but typically includes basic bibliographic information such as title and author, as well as call number, floor and library building. By using QR codes, library users do not need to record the exact location information as this data has been stored on their mobile device, and they are certain to have all of the necessary information to find the item in the library's collection. The latter point is perhaps the best aspect of using QR codes, as sometimes patrons may have the skills to find an item in the catalogue, but do not know which information to record in order to find it on the shelf (Walsh, 2010).

Linking users to online resources

A number of libraries are using QR codes online and within the physical space of the collection to direct people to relevant online resources instantly, and more conveniently (“just in time”) than by providing a URL. For example, the University of California in Irvine have placed QR codes within the mathematics collection in the library that can direct students to the library’s mathematics e-book databases. They have also used QR codes to link the physical with the online to e-journal databases and subject guides.

Codes can be used in the library to provide supplementary or course-related information. Some posters made by subject librarians at the University of Sheffield Library have provided links and QR codes that direct students to relevant journal articles, news sources and librarians’ blogs. Also, at the George Fox University Library in Portland, Oregon, QR codes have been used within the library to link students to YouTube trailers for films being used in their courses.

These uses of the codes add value to the library’s physical services by directing people to the online resources immediately where they assess the usefulness of the resources instantly (the codes also serve to market and raise awareness of the library’s online resources and services). It is easier for someone to scan the code and access the information immediately, rather than write down a URL and type it in later (they may forget, be uninterested later, or possibly write the wrong address). Also, if a user decides not to access the online information on their mobile device, perhaps they find searching a journal database too difficult or clunky, even if the database is mobile-optimised, they still have the information saved on their phone, and can email or share the details and access it later on their desktop computer, for example.

Library tours and instructions through QR codes

Tours organised by libraries are useless if a potential patron cannot attend, but a QR code provides a way of making tours available to all library patrons through online audio and video tours. Libraries offering this service (for example, Ryerson University Library and Archives) have also used QR codes on posters that alert patrons to the tours. QR codes to audio or video tours provide introductory library information at the point of need: when the user needs to know how to find their way around the library or know how to use the library.

Demonstrating how to use library resources and equipment is another productive use of QR codes. The University of Huddersfield library has used QR codes that direct users to videos that demonstrate how to use the library’s photocopying and printing system. Some other ideas for the use of the codes include at self-borrowing machines to demonstrate how to borrow items, or at catalogue computers to link users to guides that outline how to search the catalogue.

Apart from libraries, some art galleries have provided QR codes next to selected artworks to provide more information for visitors. The Queensland Art Gallery/Gallery of Modern Art (QAG/GoMA) in Brisbane and the Powerhouse Museum in Sydney provide free wireless internet to users as a means of encouraging visitors to scan the QR codes. QAG/GoMA use QR codes next to the wall labels at various artworks that link users to short videos of curators discussing the artworks and artists. The Powerhouse Museum has used QR codes for a number of exhibitions and for a recent show, 'Love Lace', they have developed an application for iPhone and Android smartphones that comes with a built-in QR code reader. When the QR codes in the exhibition are scanned, the user is directed to the relevant information in the application such as more text and videos. By providing the scanning software within the free application, the Powerhouse has noticed much more interest than for previous shows (S Chan, 2011 pers. comm., 4 December).

Scavenger hunts

Similar to a tour, a further means of educating users about the library services is through "scavenger hunts", which have typically been conducted in public and academic libraries; for example, the UTS Library in Sydney. The participants are asked a series of questions, and QR codes are used at various locations in the library to give answers or hints to users. As people correctly answer a question, they are directed to another part of the library, and to the next question. These scavenger hunts are a fun and participatory method of introducing the library to patrons.

Raising awareness of the library's services outside of the traditional library space

Some public libraries such as Contra Costa County Libraries in California have used QR codes on promotional material displayed outside the library to direct people to online information and resources. As such, QR codes can be placed on the side of buses, on street signs and at train stations, to link to the library's free e-book collection, offering a service to the public beyond the library space.

Directing users to reference assistance (such as email or chat)

With the increased use of remote reference services, libraries have used QR codes to refer patrons to their "ask a librarian" services including email, chat and SMS messaging such as at the University of California, Irvine. These codes are typically used at the point of need: in catalogue records (or near catalogue computers), so library users can ask for assistance if they need research help, whether within the collection or at unattended service points.

Basic library information

QR codes can be used at various points within a library, on a university campus or in the street to provide basic information for people. For example, the library's location(s), opening hours and contact details. Although this is basic information, it is nevertheless useful and important, and easy to provide to patrons.

Social networking

Many libraries, such as UTS, the University of Melbourne and RMIT University, have created Facebook and Twitter accounts as a means of communicating with, and delivering information to patrons. These, along with other social networking tools like FourSquare, are useful for communicating by popular methods, great for marketing the library and making it more "fun". By embedding QR codes in the physical space, people can scan the codes and instantly engage with the library via social media.

Benefits and problems associated with implementing QR codes

Some benefits of QR codes have been mentioned earlier, such as their ease of use and linking between the physical and online world. Other benefits associated with QR codes include:

- QR codes are relatively cheap to implement as most QR code generators are available free, and are equipped with analytics for measuring use. The only costs of the codes relate to staff wages in implementing and maintaining them; and
- The appeal and marketing value in appealing to library users (and potential users). Though not particularly attractive on posters, QR codes are increasingly recognised and used by people with smartphones, and therefore might present the library as a forward-thinking, technologically-savvy institution. In this respect, the library is perhaps seen by a younger generation that may not have otherwise perceived libraries as places to go to *at all* when searching for information (Gauder, 2010).

Contrary to the benefits, there are some problems associated with QR codes in libraries, including:

- People could potentially reject QR codes if the technology fails. For example, scanning in poor light or off a computer screen can be troublesome, as some camera phones cannot read the code properly and it becomes blurry. Furthermore, the more information stored in a code (for example, a long URL), the more complicated (or pixelated) it will be, and thus harder to scan. A way to get around this problem is to use a URL shortener such as bit.ly or g.oogl;

- QR codes need to be used for the correct purpose. For example, if a QR code directs mobile users to a website that is not optimised for viewing on a mobile device, it may not be easy to read or navigate and could deter them from using codes in the future;
- The codes have the potential to lose their impact if used too much: overuse may overwhelm patrons and make each code indistinguishable from the last; and
- Because QR codes are only one application among many on devices that are relatively new, they are not well known. Users need to be educated about what the codes are and their use. However, awareness of barcodes and barcode readers has increased markedly over the last few years with the proliferation of mobile devices (Radwanick, 2011) so this is likely to diminish.

However, along with educating users about QR codes, how to use them and what they can do is the fact that most mobile devices do not come with a QR code scanner. Another barrier to the use of QR codes is that people need to download a third-party application that may use much of their data download allowance. Thus, the inconvenience associated with scanning a QR code (downloading an application, opening the application and then scanning the code) may be too great, depending on the situation (Greenfield, 2011)

There are many advantages of using QR codes to promote library services and to provide a 'bridge' between physical and online resources, as well as problems with their implementation. However, looking at QR codes in this light might be too narrow, and perhaps should be viewed more broadly as an openness toward trying new technologies and methods within libraries. As Christopher Landry from Providence College Library (which I was not able to visit) mentioned to me in an email, by using QR codes he has realised what can be achieved with research and experimentation and to "promote these vital aspects of our profession... if you do have the time and it doesn't need an investment, try it out and see what you can do". Perhaps the point is not what can be done with QR codes, but what tools and technology can be considered, and experimented with, to expand on, supplement and enhance library's services.

Case Studies: The University of California at Irvine and University of Huddersfield

University of California, Irvine (UCI), United States. Visited in May 2011

During 2009, the UC Irvine Libraries created two positions that form the Emerging Technologies Team (ET Team). Danielle Kane and Jeff Schneidewind, who have library and information technology backgrounds, form this team. Their role is to investigate, test and implement new technologies within the library.

A major project conducted by the ET team is the testing of QR codes within the physical library space, linking users to online information and resources. The ET team has used QR codes for a number of purposes: on posters and signs directing students to the mobile-optimised version of the library website; information about the library's opening hours; promotional material; and within the physical collection to direct students to related online resources such as mobile-optimised books, journals and subject guides. The development of the project has involved discussion with subject librarians to plan which resources the codes should direct people to. Some examples of the use of QR codes at the UCI library include:

- Within the Mathematics book collection to direct students to the library's e-book collection;
- In the Art section they send students to an online guide that outlines the various sections within the Art monographs collection;
- In the Chemistry periodical collection, QR codes direct students to mobile-optimised databases; and
- Within the English and Literature section, the QR codes link students to a subject guides that lists mobile-optimised databases for Literature.

By testing QR code use on a broad range of subject areas, Danielle and Jeff have been able to gather data and test how different student user groups use the mobile resources. Although the project has only been in action for a short time, the data that has been collected reveals that initially the codes are not popular (presumably because each user group is unaware of the purpose of the codes) but, generally, after a while the scans have increased (Kane & Schneidewind, 2011).

QR codes have also been used at the UCI library, within the collection to direct students to relevant subject guides, which again have been modified for viewing on mobile devices. Finally, they have also included QR codes to ask students for feedback on the codes. While Danielle and Jeff have not received a lot of feedback from these codes, the comments have been positive (Kane & Schneidewind, 2011).

The UCI library has also used QR codes within the physical space to direct students to online information and assistance. Printed and digital signage throughout the library encourages students to scan QR codes that direct them to resources such as online reference (email and chat), class bookings and to contact subject librarians and arrange consultations.

Initially the project team used Google Analytics for data collection and analysis. However, they have since changed the system and the Library's Web Services department "...have created an admin portal for us [the ET team] that allows for better statistics, tracking of active and inactive QR Codes..." (Kane, 2011). The programme has been successful, and is certainly reaching some library users who may not have accessed online resources before. At the beginning of the programme

in 2010, about 100 hits on the QR codes were noted in the first quarter. After expanding the uses for the QR codes, and most likely because of increased exposure and education on QR codes, during the first four months of 2011 approximately 600 hits on the QR codes were yielded.

This project, which is part of a wider push by the library to investigate and adopt new technologies, has been supported by library management who would like the ET team to expand the programme. Danielle and Jeff are thoroughly testing and investigating as much as possible; demonstrated by their engagement and involvement with the wider library and university community: working with subject librarians to ensure the QR codes direct users to the best resources, and working with the Web Services department to build an online portal to follow statistics. Future ideas include expanding on mobile location technologies, such as implementing a trial of FourSquare in the library and investigating emerging technologies for smartphones.

University of Huddersfield Library, England. Visited in April 2011

During 2009, the University of Huddersfield Library received a Teaching and Learning Innovation Project Fund from the University to “support innovative and inspiring projects to drive forward the University’s Teaching and Learning Strategy” (Walsh, 2010). As part of this project, the library introduced QR codes in the library’s physical and online environment to deliver “context appropriate help and information to blur the boundaries between the physical and the electronic world” (Walsh, 2010).

At the Huddersfield Library, the help and information services that have been delivered via QR codes include links to electronic resources, instructional videos, useful websites for further information and library contact details.

The Library’s surveys on mobile phone use and awareness found that while many students own a smartphone or other internet-enabled mobile device, few were aware of what QR codes are and even fewer had scanned the codes. To raise awareness of QR codes, the library started an in-house promotion that offered a prize to encourage students to scan the codes. After the promotion, an exit survey showed that more students had become aware of QR codes (almost a quarter surveyed).

The library also concluded that there was a lack of awareness among students about the library’s electronic resources collection such as e-journals and e-books, and that many students only used print resources or freely available electronic resources from the internet. To promote these resources, signs were placed in the physical collection with pictures of course textbooks or the journal, along with a QR code directing the user to the electronic version. Codes were also placed at various locations in the library to link patrons to online material such as television and radio programmes, and lectures. This pilot programme was not judged particularly successful as the codes were not scanned often and some were not scanned at all:

student feedback found that most people did not recognise the codes, did not have devices that could scan QR codes and did not see any great need to use them.

One aspect of Huddersfield's programme that was more successful involved linking patrons to online instructional videos. Although available through the library's website, it was expected that students would prefer to have guidance on searching for resources and using equipment (such as the print/photocopier credit machine) when really needed. As a means of providing immediate assistance for students, QR codes were placed in the journal collection directing people to videos that explained how to search for journals, and on photocopier machines, outlining how to credit print/copy cards. Other codes were also placed on each floor to provide a tour of the library, and some printed guides included QR codes to offer extra information and assistance with using the library.

Further uses for the QR codes at the University of Huddersfield Library include directing students to other subject relevant information on the internet, and contacting the library for additional help. The codes for help can link to the "Text a Librarian" service near catalogues for research assistance or to the IT Help phone number for technical assistance at computers and on printers. This ensures that students can contact someone for help immediately, and can save the contact information for future use. QR codes have also been used within catalogue records to store shelf-location information (this service has been the most heavily used).

After the QR code pilot study at the University of Huddersfield, much of the student feedback was mixed. While the promotion worked to raise awareness of QR codes, it identified barriers that discouraged people to use them, such as technical difficulties with finding and installing QR code readers, low usage of smartphones and associated costs of online access on mobile devices. These barriers are likely to become less of a factor as use and awareness of mobile devices increases and costs of accessing the mobile web are reduced (and wireless access increases).

Alternative and upcoming technologies

QR codes are not the only forms of technology being used or considered by libraries to augment users' experience in accessing and viewing information and resources. Other technologies that may supersede or work well alongside QR codes are Augmented Reality applications (AR) and Near Field Communication (NFC):

Augmented reality (AR)

This appears to be the most likely technology to be adopted soon, and may work well alongside QR codes. The 2011 *Horizon Report* suggests that augmented reality will be adopted within educational institutions in the next two to three years (Johnson et al, 2011).

AR is another means of integrating the digital and physical world, though in a much more interactive manner than with QR codes. AR is best defined as an “overlay or augmentation of the physical environment with sounds, graphics and perhaps location-based information (geolocation)” (Kane & Schneidewind, 2011). A person uses applications, such as Google Goggles or Layar, that use a mobile device’s camera to identify objects and provide more information on the object, layer information over the view from the device’s camera or locate the device and provide information based on the user’s location. QR codes are a facet of this AR technology (Cordova, 2011) but are less of an experience – QR codes are more of another way to access information, while AR can be a more interactive experience and enhance perceptions of reality.

Several universities have designed augmented reality applications that provide campus information and tours for students, such as Oregon State University’s ‘BeaverTracks’ application (Oregon State University Library, 2011). An example of a library using an AR application to add value to its users is the ‘Ludwig II – Walking in the Footsteps of a Fairytale King’ application developed by the Bavarian State Library in Germany (Bavarian State Library, 2011). The application provides location-based information about Ludwig II, the 19th century king of Bavaria, as well as 3D reconstructions of architecture from the time of his rule (Ceynowa, 2011).

While the most prevalent use for AR is to annotate existing spaces with an overlay of information (Johnson et al, 2011), this does not differ markedly with QR codes. However, the potential for more interactivity, games and play to enhance learning is greater with AR technology.

Near field communication (NFC)

NFC technology allows for data exchange by touching NFC-chipped items such as credit cards or smartphones with other objects that have NFC chips with data attached. While this technology could become popular within the next few years, it is less well known than QR codes. However, many Google Android devices are being equipped with NFC chips and Google is supporting the use of NFC and, among many other companies, has joined the NFC Forum, a non-profit organisation that promotes the use of NFC technology. With Google’s significant influence over trends and technology, it is likely NFC will gain more currency amongst mobile device users.

Some possible uses for NFC-enabled devices in libraries include storing patron data on a telephone, which could allow a mobile device to act in place of a borrowing card, or using these devices in similar ways to the current use of QR codes; for example, exchange of information from a sign to a user’s mobile device (McHugh and Yarmey, 2011).

Conclusion

With the continued proliferation of mobile devices, and the increased knowledge of their various applications, QR codes could become more well known and be useful in libraries as a bridge between physical and online resources.

In many ways, the benefits of QR codes outweigh the negative aspects: QR codes can add value to a library's physical resources and make access to library information and resources easier; they are cheap and easy to implement with little upkeep (the problem lies with choosing *what* to use the codes for); and they present a good marketing option for the library.

Perhaps the barriers to the use of QR codes – such as lack of awareness and data limitations – will be overcome with the increased knowledge among the population, and better data download plans from mobile carriers and the provision of wireless networks. However, the difficulty associated with the installation of a third-party application to a mobile device (the QR code reader), as well as needing to open the application on the device, scan the code and then load the information contained within the code is still a barrier (real or perceived) that can inhibit their use.

Another barrier is convincing users that scanning the QR code will provide them with valuable information or an enhanced experience. Some uses for QR codes that have been popular in libraries (or at least have been scanned more often) include embedding them in catalogue records, using them within the library to provide library tours and raising awareness of the library's online resources by linking to databases, e-books and subject guides. As well as these uses, perhaps libraries could look to similar industries such as museums. Queensland Art Gallery/Gallery of Modern Art and the Powerhouse Museum have given giving users a reason for scanning QR codes by providing additional interesting and valuable information when visitors require it, as well as providing free applications that include a QR code reader and free wireless.

Due to the multitude of similar technologies and tools and the knowledge required to use them, QR codes will face competition in becoming one of the new technologies of choice for linking library users with library resources. QR codes should be seen outside of a narrow answer to linking between the physical and digital, and may be able to also assist in other ways. They are certainly worth exploring as a useful technology within libraries, with varied uses already being successfully applied in the libraries visited as part of this study. They provide another option to improve the interface between library users and resources.

Appendix: List of libraries visited as part of the 2010 VALA Travel Scholarship

England

University of Huddersfield Library, 18 April 2011

University of Sheffield Library, 19 April 2011

Gloucestershire College Library, 20 April 2011

University of Bath Library, 21 April 2011

Canada

Ryerson University Library and Archives, 26 April 2011

United States

George Fox University Library, 29 April 2011

Sacramento Public Library, 1 May 2011

University of California Library, Berkeley, 2 May 2011

Contra Costa County Libraries, Walnut Creek Branch, 2 May 2011

University of San Francisco Library (Gleeson), 3 May 2011,

University of California Library, Irvine, 4 May 2011

San Diego State University Library, 5 May 2011

Australia

Melbourne University Library, 3 June 2011

UTS Library, Sydney, 10 June 2011

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