Jun 2nd, 12:00 AM

Reorganizing the Relationship of Digital Library Resources and Physical Learning Environments

Antti M. Rousi
Aalto University, antti.m.rousi@aalto.fi

Michael Fosmire
Purdue University, fosmire@purdue.edu

Risto Maijala
Aalto University, risto.maijala@aalto.fi

Benjamin D. Branch
Purdue University, bbranch@purdue.edu

Nicole Kong
Purdue University, kongn@purdue.edu

Reorganizing the relationship of digital library resources and library-as-place through mobile devices and QR-codes – preliminary examination of user experience latitude through an user experience framework

Rousi, Antti M.
Aalto University Library, Finland, antti.m.rousi@aalto.fi

Fosmire, Michael
Purdue University Library, United States, fosmire@purdue.edu

Maijala, Risto
Aalto University Library, Finland, risto.maijala@aalto.fi

Branch, Benjamin Dewayne
Purdue University Library, United States, bbranch@purdue.edu

Kong, Nicole
Purdue University Library, United States, kongn@purdue.edu

Abstract

Introduction. This study examines the theoretical variance of user experience generated by linking digital library resources via QR codes into library learning environments.
Methods. A heuristic evaluation was done about the theoretical variance of user experience created by the QR code linking procedure. This evaluation was based on Garrett's (2003) framework of user experience. The targets of the evaluation were two existing QR code portals of both Aalto and Purdue University Libraries.
Results. The existing QR code portals generate variation of varying degrees into all of the elements of user experience.
Conclusion. Despite the breadth of variance created, perhaps the most important factor resided in that the QR code portals may be designed to respond to the user needs of a single physical location. By taking a single physical location as the starting point of service design, all of the elements of user experience may be adjusted to responds to the user needs inherited within it. QR code portals also allow new kinds of visualizations of digital resources, which can be used to facilitate connecting with the most relevant resources. Communicating about the time dimensions of library services and different mobile workflows should be further investigated.
Keywords. User experience, usability, digital library resources, mobile devices, learning environments

1 Introduction

There is a lot of potential in the variables of physical space and location for the purpose of enhancing the user experience of digital library resources. New studies in customer perceived value are stressing that as technology allows multiple interactions on both multiple locations and times, perceived value also depends on bringing together right resources and users at the right time and place (Heinonen, 2004). As the library patrons are more accustomed of using smart phones and tablets, more library services can be designed using the approach of 'bring your own device'. With the possibilities brought by increased mobile device usage, libraries are now able to rethink and reorganize the relationship of digital library resources and physical library space.

Out of all possible services based on mobile devices, this work focuses on the application of combining mobile devices and the Quick Response (abbr. QR) code technique to provide access to digital library resources. As mobile phones, tablets, QR codes and content management systems provide affordable media for transmitting digital content, they allow the design of site specific portals into the digital library resources. Even though the technique of mediating digital library resources via QR-codes is being adopted quickly in practice, more systematic examinations could reveal the technique's true potential.

This preliminary work develops a heuristic evaluation of the user experience of two existing QR code portals, and discusses how they enhance the user experience of digital library resources. One of the examined QR code portals is currently used in the Aalto University Library and the other in the Purdue University Libraries. To produce a framework for this examination, this work draws from user experience (UX) research. By examining how the QR code portals enhance site-specific user experience, this work contributes to the discussion about the development of physical library spaces or, as coined by Applegate (2009), 'library-as-place'.

This paper is structured as follows. First the technique of mediating library resources via QR codes is discussed. Secondly, a literature review of UX research conducted within the field of Library and Information Sciences is presented. Then the framework of this study is introduced, after which the methodology and limitations are discussed. What follows is the section of analyses consisting of the UX of two QR code portals. As conclusion, the variation of theoretical UX generated by the QR code portals is examined and discussed at the learning environment level.

2 Mobile devices, QR codes, digital library resources and content management systems

Studies on mobile phone markets expect that the performance of the markets is to accelerate both in US and Europe contexts (MarketLine, 2012a & 2012b). These devices are easily equipped with the ability to read QR codes. QR codes are two-dimensional machine-readable codes that can transmit various types of information. Most commonly they provide URLs to be opened on a mobile device. This work focuses on the application consisting of QR codes, a content management system, LibProxy technique for user authentication, digital library resources and the user's own mobile device. Figure 1 displays the outline of this technique.
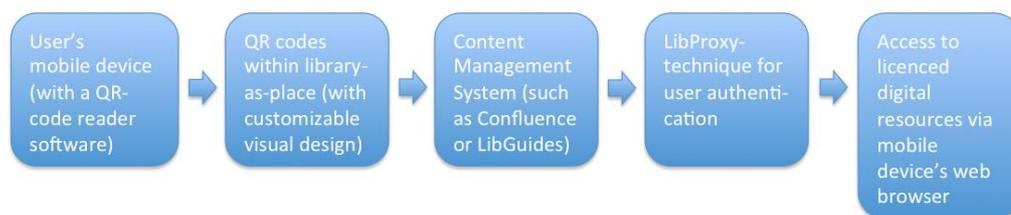

Figure 1 Technique for mediating digital library resources via QR codes

Whereas traditionally digital library resources have been accessible through workstations, it is now possible to mediate them through posters that contain QR codes. The prerequisite of the above technique is that the users can access the Internet with their mobile devices.

3 User experience research and Library and Information Science

Research of user experience emerges from the background of human-computer interaction and usability studies (Hassenzahl & Tractinsky, 2006) and as an approach it is producing increasing

amount of interest in the field of Library and Information Science (see e.g. Jarrett, 2012; Majors, 2012; Gross & Sheridan, 2011). Hassenzahl and Tractinsky (2006, 95) define UX as consisting of the user's internal state, the characteristics of the designed system, and the context or the environment where the interaction occurs. While other studies differentiate between usability and user experience (McNamara & Kirakowski, 2006), most often the concepts are treated as overlapping (Law & van Schaik, 2010; Hassenzahl & Tractinsky, 2006).

The vast majority of user experience research done in the context of Library and Information Science focuses on the usability of emerging web-scale discovery systems, such as Primo, VUfind and Summon (see e.g. Majors, 2012; Gross & Sheridan, 2011; Sadeh, 2007). Lately there has been a rise of interest for ethnographic studies of the usability of library home pages and preferred physical learning environments (e.g. Wu & Lanclos, 2011) and also towards the motivational factors influencing engagement with the digital information environment (Connaway et al., 2013). However there seems to be limited discussion on the potential within the new means of converging digital resources with physical environments. What follows is an introduction to Garrett's (2003) elements of user experience, which is used as the framework of this study.

4 The elements of user experience

Garrett (2003, 21-33) proposes that user experience could be examined through a framework consisting of five planes that are conceptual categories for examining the qualities and aims of systems. The planes are named as surface, skeleton, structure, scope and strategy plane. These planes examine systems with varying degrees of abstraction, and form a continuum from the most concrete qualities into the most abstract ones accordingly. The planes are further divided into sections of web as a software interface and web as an information system. (Garrett 2003, 21-33) Figure 2 presents Garrett's framework as a whole.
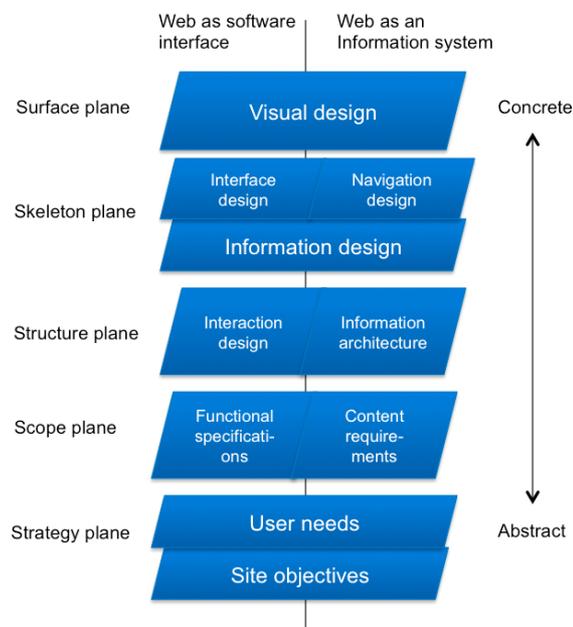
Figure 2 The elements of user experience according to Garrett (2003, 33).

The surface plane directs the examination into visual design of the system. The skeleton plane directs examination into information design, i.e. to presentation of information, and also into the interface functionalities and navigation designs of the system. The structure plane directs examination into the interaction design of the system, that is, on how the system responds to user behavior, and into the

underlying information taxonomies, i.e. information architectures, of the system. On the scope plane the functional specifications, i.e. what the system actually does, and content requirements, i.e. the required content for this functionality to happen, are examined. The strategy plane is the most abstract of the planes and consists of both user needs and site objectives. (Garrett, 2003, 32-34, 82, 93-94)

5 Methodology and limitations

This work uses Garrett's (2003) framework to perform heuristic evaluations of the UX of selected QR code portals providing digital library resources. In heuristic evaluation a set of experts examine whether each component of the systems follows a set of principles or heuristics (see e.g. Tan, Liu & Bishu, 2009). Despite the informal traits of the method, heuristic evaluation is commonly used in UX research (Fernandez, Insfran & Abrahão, 2011). As the main purpose of this preliminary work is not to create detailed analysis of the UX of a single system, but to use the concept of UX to broaden the thinking about the relationship of digital resources and library-as-place, this study does not per se evaluate different components of systems, but compares their attributes through the selected heuristics. The analysis work was done by the authors.

As to the limitations of this study, it is important to acknowledge that this work is not examining actual user experience, but possible UX latitude produced by the portals. It is also important to note, that the entity of a single analysis is not a mere website, but consists of the application's poster, landing page and target databases. It would not be feasible, or even desirable, to create detailed analyzes of the UX of the mere posters or a collection of target databases.

6 Analyses

6.1 UX of the Aalto University Library's digital portal

What follows is an examination Aalto University Library's digital portals elements of UX. Figure 4 presents a QR code poster used within the Aalto University Learning Hubs.

Figure 4 QR code poster leading to a single resource.

Visual Design

The visual design of the QR code poster presented in the Figure 4 is prominently based on a supposed need of the Library's patrons. The visual design incorporates and highlights this possible need in the learning environment. Its objective is to attract a student visiting the physical environment to try out the Scopus database.

Information Design

The information design is organized around a single resource, in this case the Scopus database. The poster presents a reason for using this resource and a way to access it (the QR code). The landing page strives to utilize sequenced pictures to provide hints about the most important features of the database.

Interface Design

The interface design allows user first only to read the QR code to navigate into the content management system (abbr. CMS). The landing page's interface is very straightforward, and there only is a small information section before the link to the database is provided. The landing page also provides links to related resources and information concerning the target database.

Navigation Design

The navigation design is prominently made of two steps: after the patron opens the landing page within CMS, it guides the user to log into the database. QR code portals also utilize more efficiently the hint offered by a physical space, i.e. the linked resources are designed to fit the needs of the users of the specific space.

Interaction Design

The interaction design consists of scrolling of the landing page, and once the database resource is opened, of interaction with the actual database or its mobile version. The user is able to utilize e.g. PDF library and reference management software to store found articles to be read on their mobile devices.

Information Architecture

Information architecture is arranged around the target database, i.e. the landing page is set to provide instructions on how to use the database and to offer information about the database's qualities in comparison to other digital resources. Information architecture is also set to instruct users with mobile device workflows that allow them to store PDFs on their mobile devices.

Functional and Content Requirements

As to the functional and content requirements, the efforts are directed towards increasing both the physical and intellectual accessibility of this database resource.

User Needs

The site's strategic objective is to directly link to the user needs of the patrons visiting a certain learning environment.

6.2 UX of the Purdue University Library's digital portal

Purdue's digital portals value efficiency and compactness over style, since smartphones have limited real estate to display content. As a result, the entire digital portal is focused on identifying the core types of resources and specific resources that students will likely need for their research projects.

Providing physical access to the digital portals, the Purdue Libraries constructed two types of posters. The first collection of posters have been branded as the Big 6: Citation Searching, Literature Searching, Full-text Collections, Handbooks, Standards, and Patents (see Figure 5). Students can either link directly to a specific resource, typically the most frequently used one for students, or link to an information page that provides a few more options for connecting to resources and explaining the purpose of the resource types and advantages and scope of the alternative options. For variety, we also created posters that focus on one of the topics (Figure 5), with reminders of the other Big 6 categories.

Finally, we created posters that link to subject guides. These posters we placed in the active learning classroom we created in the Engineering Library, as a way to not only add interest to the otherwise beige walls, but also as reminders for the students during the class, that high quality resources are only a click away. The classroom is designed as a place for activity, rather than lectures, and courses are preferentially allowed to use the space if students have research needs (classes are scheduled for the entire semester, rather than on a drop-in basis, in a partnership with the central space management unit). Classes that use this space also are primarily science, technology, and engineering courses, so they are a natural fit for the posters and the scope of use of the library space.

Enumerating the Garrett elements of user experience:

Visual Design

The Big 6 posters echo the simple, compact structure of a mobile device screen. Each element of the Big 6 uses a strong solid color, working together to create the overall interest of the poster, like the individual resource types work together for a fully actualized search strategy.

Information Design

The posters are singly focused to provide links directly to resources that students may need. With the multitude of resources available, it is difficult for the Libraries to highlight and direct students to specific resources that might be most useful for them. Additionally, making students aware of the different kinds of information, not just journal articles, but standards, handbooks, and patents, is important so students can do a complete literature search.

Interaction Design

The Big 6 poster provides a quick entry into a subject resource provides instant gratification for the student who just wants to find something, while the alternate link provides additional resources for the student who would rather look before they leap and know more about what they are getting into before they start searching.

Functional Design

The posters provide QR code links to either the resource highlighted (the main QR link), or to an information page that provides links to other resources and an overview of the resource type the student has linked to. In addition, a traditional URL is provided for students without QR readers enabled on their mobile devices. This facilitates both the 'instant gratification' and 'look before they leap' styles of student user.

User Needs

Two main styles of users are addressed in this design, the quick searcher who is looking for some information immediately, and who has little bandwidth on their mobile device in which to view resources they find. The other is a researcher who has a deeper, long-term need for information and is willing to find out more about the resources available. They might read about the resources and do a more in-depth search later on a device that can accommodate more information on a screen (e.g., on a desktop or laptop computer).

Figure 5: Big 6 QR poster linking to mobile portal of Purdue resources (on left) and poster, focusing on one of the Big 6 topical areas (on right).

7 Variation created by the QR code portals to the UX of a learning environment

As a synthesis, Table 1 presents the variation within user experience that could occur when the previously examined QR code portals are situated into a learning environment equipped with workstations.

		QR code portal I – A single database, Figure 4 (Aalto Univ. Lib.)	QR code portal – "Big 6", Figure 5 (Purdue Univ. Lib.)	Variation within learning environment level
Surface plane	Visual Design	Poster draws from a single user need.	Poster utilizes a simple, block-style layout.	Differentiated visual designs presenting resources utilizing associations.
Skeleton plane	Interface design	Navigating through clicking links of the landing page (CMS).	Navigating through choosing link from poster, then selecting links of the landing page (LibGuide).	Allows the streamlining of interface design to providing selected digital resources.
	Navigation design	Prominently a two-step design of navigating into a database resource.	Consists of navigating in the mobile LibGuide and in the databases provided by it.	Increasingly database resource oriented navigation.
	Information design	Domain and resource specific. Mobile use oriented.	Resource focused, covering engineering domain.	Brings forth domain and resource specific information designs and mobile workflows.
Structu-re plane	Interaction design	Arranged around the mobile use of a single databases interaction design.	Arranged around the use of a mobile Libguide and from the interaction with the databases	Selected user interaction designs may be brought forth (e.g. by presenting instructions on the landing page)
	Information architecture	Arranged around the target database and its mobile use.	Arranged around a domains most significant databases.	Allows information architecture be arranged around selected domain specific resources. Mobile use may be supported.
Scope plane	Functional specifications	Easing both the physical and intellectual accessibility of a database resource.	Easing both the physical and intellectual accessibility of a set of database resources.	Allows the streamlining of functional specifications to providing mere digital resources.
	Content require-ments	Same as above.	Same as above.	Allows the streamlining of content requirements to providing mere digital resources.
Strategy plane	User needs	Location specific.	Location specific.	Allows to focus on the user needs present in an individual space.
	Site objectives	Responding to the user needs present in a single physical location.	Respond to the user needs present in a single physical location.	Allows the creation of varied site objectives that take into account varied physical sites.

Table 1 User experience characteristics of different portals

As presented in Table 1, the QR code portals generate the following theoretical variation within the elements of user experience at the learning environment level. They enable differentiated visual designs for presenting digital library resources utilizing different associations. They also allow the streamlining of interface design, functional specifications and of content requirements into providing access to selected digital resources. The QR code portals allow generating information designs and architectures that are arranged around specific domains, and they bring these structures to the forefront of a single physical space. The latter results e.g. to the possibility for increasingly database access oriented navigation and for providing assistance with mobile interaction with the target databases. However, perhaps most importantly, the QR code portals may be designed to respond to the user needs of a single physical location, which augments the effects stated previously. The QR code portal may thus be seen to generate variation of varying degrees into all of the elements of user experience as defined by Garrett (2003).

Discussion

With the new emerging technologies, libraries can with ease incorporate the dimension of physical space to be used more efficiently in providing and marketing digital library resources. By taking a single physical location as the starting point of service design, all of the elements of user experience may be adjusted to respond to the user needs inherited within it. With all content, not just journals, becoming increasingly electronic in format, it can be challenging to identify and remind students in the library of how to get to all that content. The QR codes enable students to identify relevant content and to access it quickly, without having to click through layers of the library web site. The posters may be

further designed to e.g. invoke moods or utilize different associations to better serve different learning styles of the students visiting the physical site (see e.g. Kolb & Kolb, 2005).

Communicating about the time dimensions of library services and different mobile workflows should be also investigated further. When ubiquitous technology functions as the mediator of services, the expectations about the delivery time may be blurred. The dimension of delivery time could also be integrated into the visual (physical, poster-like) representations of digital resources. It is also important to acknowledge the different workflows of mobile devices when compared to workstations. The user might require additional instruction when working with possibly more unfamiliar techniques.

This study also illuminates the hardships of examining user experience at the learning environment level. The first problem field resides within defining the entities of examination. This study examined the QR code portals as a single entity, consisting of the posters, landing pages and target databases. Another issues arise from the depth of examination and taking into account the different attributes of the devices (e.g. workstations, smart phones and tablets) used in accessing the services. In order to keep the depth of examination at a feasible level, a high level of abstraction was required. More research is needed that studies UX on the learning environment level.

The applying of QR codes also extends into more that is possible to discuss here. As the QR portals can be integrated into virtually any physical space, this allows using open resources in e.g. citizen science outreach conducted by the libraries. The technique also allows incorporating service products of international collaborations to be visually present in any physical library environment. We hope to see ventures within the library field utilizing the full potential of this technique in the near future.

References

Applegate, R. (2009). The library is for studying: student preferences for study space. *The Journal of Academic Librarianship. 35*(4), 341-346. doi: 10.1016/j.acalib.2009.04.004

Connoway, L.S., White, D., Lanclos, D. & Le Cornu, A. (2013). Visitors and residents : what motivates engagement with the digital information environment. *Information Research, 18*(1). url: http://www.informationr.net/ir/18-1/paper556.html#Dela09

Fernandez, Insfran & Abrahão. (2011). Usability evaluation methods for the web: a systematic mapping study. *Information and Software Technology,* 53(8), 789-817. doi: /10.1016/j.infsof.2011.02.007

Garrett, J.J. (2003). The elements of user experience – user-centered design for the web. Indianapolis: New Riders Publishing.

Gross, J. M. & Sheridan, L. L. (2011). Web scale discovery: the user experience. *New Library World: charting new developments, 112*(5/6), 236-247. doi: 10.1108/03074801111136275

Heinonen, K. (2004). Time and location as customer perceived value drivers. Doctoral thesis. Swedish School of Economics and Business Administration, Department of Marketing and Corporate Geography.

Hassenzahl, M. & Tractinsky, N. (2006). User experience – a research agenda. *Behaviour & Information Technology,* 2, 91-97. doi: 10.1080/01449290500330331

Law, E.L.-C. & van Schaik, P. (2010). Modelling user experience – an agenda for research and practice. *Interacting with Computers, 22,* 313-322. doi: 10.1016/j.intcom.2010.04.006

Majors, R. (2012). Comparative user experiences of next-generation catalogue interfaces. *Library Trends, 61*, 1, 186-207.

Manzari, L. & Trinidad-Christensen, J. (2006). User-centered design of a web site for library and information science students: heurestic evaluation and usability testing. *Information Technology and Libraries, 25*(3), 163-169. doi: 10.6017/ital.v25i3.3348

MarketLine. (2012a). Mobile phones in the United States. MarketLine Industry Profile. Reference code: 0072-0152. Available for licensed users:
http://advantage.marketline.com.libproxy.aalto.fi/Product?pid=MLIP0765-0020

MarketLine. (2012b). Mobile phones in Europe. MarketLine Industry Profile. Reference code: 0201-0152. Available for licensed users:
http://advantage.marketline.com.libproxy.aalto.fi/Product?pid=MLIP0765-0007

McNamara, N. & Kirakowski. J. (2006). Functionality, usability and user experience: three areas of concern. *Interactions, 13*(6), 26-28. doi: 10.1145/1167948.1167972

Sadeh, T. (2007). User experience in the library: a case study. *New Library World,* 109(1/2), 7-24. doi: 10.1108/03074800810845976

Tan, W., Liu, D. & Bishu, R. (2009). Web evaluation: heuristic evaluation vs. user testing. *International Journal of Industrial Ergonomics, 39*(4), 621-627. doi: 10.1016/j.ergon.2008.02.012

Wu, S.K. & Lanclos, D. (2011). Re-imagining the users' experience – an ethnographic approach to web usability and space design. *Reference Services Review, 39*(3), 369-389. doi: 10.1108/00907321111161386