Torres-Pérez, P., Méndez-Rodríguez, E. & Orduna-Malea, E. (2016). Mobile Web Adoption in Top Ranked University Libraries: A Preliminary Study. The Journal of Academic Librarianship, 42 (4), pp. 329–339

DOI: 10.1016/j.acalib.2016.05.011

Mobile Web Adoption in Top Ranked University Libraries: A Preliminary Study

Paula Torres-Pérez [1], Eva Méndez-Rodríguez [2,*], Enrique Orduna-Malea [3]

[1] *Fundación MAPFRE, Documentation Center, C/ Bárbara de Braganza 14, 28004, Madrid, Spain*
[2] *Library and Information Science Department, Universidad Carlos III de Madrid. C/ Madrid, 128, 28903 Getafe, Madrid, Spain*
[3] *EC3 Research Group, Polytechnic University of Valencia, Camino de Vera s/n, 46022 Valencia, Spain*

This paper aims to study the level of adoption of mobile access to the academic libraries in the best universities in the world as well as the quality of services offered in order to ascertain if the quality of academic apps and mobile websites are at the level of the overall web impact of world-class universities. For the top 50 universities according to the Ranking Web of Universities (2014), we determined whether there is a mobile website or app for their libraries. Finally we evaluated the services offered against a list of 14 indicators. The results show that 88% of the libraries studied (44) offer mobile access via web or app, showing a high level of mobile adoption in elite universities. The form is clearly uneven: 80% (40) offers mobile web access while only 34% (17) has an app. As to the content, no library offered all 14 points evaluated, and the results are varied. Only 50% of apps meet at least half the indicators.
In the case of mobile web this figure improves notably to 74.3%. We can note a high level of mobile web adoption in the world's best universities, although the quality does not reach their level of excellence.

Mobile applications - Apps- Mobile web - Web Ranking of Universities University libraries

INTRODUCTION

Using web indicators to study the impact of universities (principally through analysis of university websites) provides extremely useful information. These indicators can provide detailed measures, sensitive to geographic, linguistic and cultural factors (Thelwall, 2004). Moreover the web allows us to study the impact of a university's missions, not just those related to research (almost the sole measure in the main interna-tional rankings of universities (Aguillo, 2009). The web permits us to consider teaching (in the form of open educational resources online), knowledge transfer (in the form of patents, university-business links) and other areas complementary or subsidiary to research (Kousha & Thelwall, 2008; Thelwall & Kousha, 2008).

Further, the entities for governance, administration and services can be quantified, making the website a complex system able to reflect legal and functional activities (Orduña-Malea & Ontalba-Ruipérez, 2013). Among these entities are services responsible for the creation, diffusion and consumption of a significant amount of information, directed at students, professors and researchers. In particular we highlight academic libraries, a fundamental node to the transition to the electronic university (Lewis, 2015; Orduña-Malea & Regazzi, 2013).

Given the functions of university libraries, including development, maintenance and distribution of information-rich products (catalogues, digital collections or institutional repositories), they should be one of the principal nodes of access from universities to the network. A priori, this should particularly be the case for universities who lead the international rankings (supposedly those with the best researchers, professors, students, services and infrastruc-ture). It would be logical to expect that libraries in world-class uni-versities should be the most technologically advanced, offering access to high quality scientific information through the web to allow researchers access to the best information anywhere anytime, and receiving high web impact. This should reinforce the scientific production, and therefore the position in international rankings of these universities.

However, despite the high percentage of content that the academic library brings to the website of the university, its visibility is still low. The reasons are mainly two:

1) the technical problems with the information organization ; 2) because more and more information is generated outside the library website, relegating its principal function as indicated in the NMC Horizon Report 2012 (Johnson, Adams Becker, & Cummins, 2012; Orduña-Malea & Regazzi, 2014). This last circumstance suggests the need to consider new ways to generate interest in the library to make its resources more acces-sible and visible. Thus moving towards the mobile web and/or the use of apps is a fundamental step (Lippincott, 2010). Mobile devices are increasingly used to search for information and libraries cannot ignore

* Corresponding author at: Library and Information Science Department, Universidad Carlos III de Madrid, C/ Madrid, 128 (office 14.2.17), 28903 Getafe, Madrid, Spain.
E-mail addresses: paulape@fundacionmapfre.org (P. Torres-Pérez), emendez@bib.uc3m.es (E. Méndez-Rodríguez), enorma@upv.es (E. Orduna-Malea).

the multiple benefits these devices bring their users (Arroyo, 2011; Hill, 2015; Murphy, 2010).

The university in general and the academic library in particular already offer information and services to their users through various web channels including virtual campus, discussion fora, news, email, etc. Nevertheless, creating a mobile website or developing an app can be a complementary means to offer users this information in a simpler faster way with greater flexibility.

Through its app or website, libraries can offer a personal account where one can consult loan information, reserve materials, and access other traditional library services. Equally, access to databases or documents can offer the great advantage of rapid access to information required at a given moment (Kroski, 2008). Thus the development of a mobile application should be an important part of access to the information held by the university library, permitting it to compete with external sources of information.

There is no doubt that the mobile websites of academic libraries can provide great value to both universities and their academic and research libraries. Measuring their content and services (and their visibility, use and quality) would also allow us to obtain indicators reflecting their impact on the web, complementing the value of indicators from the non-mobile web, and demonstrating the online visibility of the academic library and its contribution to the academic website of the institution.

Nonetheless, the web impact measurement for mobile websites is complex, especially in the case of apps. For this reason, evaluating both contents generated and services offered by those mobile websites may serve as a useful proxy. In this sense we can assume that better mobile websites can potentially generate higher web impact, not only for the library but for the university. Therefore, we could expect to find a positive correlation between these variables (quality and web impact), especially if the top world-wide universities are considered.

Few studies have analyzed to date the characteristics or offerings of mobile web or apps for the world's top universities and their libraries. Highlights include some country-focused studies such as Aldrich (2010), based on libraries and universities belonging to the Association of Research Libraries (ARL); Canuel and Crichton (2011), who focus in the Association of Universities and Colleges of Canada (AUCC); or Liu and Briggs (2015), who analyze the top 100 US universities based in the U.S. News & World Report's national university rankings. Even so, the compar-ative evaluation of mobile web and app quality among the libraries of top worldwide universities is lacking, as is analysis of the relationship between their quality and web impact on the universities that host them. Thus the main goal of the present work is to ascertain if the quality of academic apps and mobile websites are at the level of the overall web impact of world-class universities.

The following specific objectives are proposed:

- Determine the level of adoption of apps and mobile websites in the libraries of world-class universities
- Evaluate the quality of services offered through mobile websites and apps by those libraries
- Rank university libraries by the quality of their apps and mobile websites
- Compare the quality of university libraries' mobile websites and apps with the web impact of those universities, measured through web indicators.

STATE OF THE ART

"Mobile devices" are small computers with processors, limited memory and internet connection. They include smartphones, PDAs and tablets. The variety of devices available and the ability of users to adopt them and adapt them to their daily needs have led to rapid growth in their use.

Among mobile devices, smartphones lead in number of units sold. In 2013 estimates of sales exceed 1 billion, an increase of more than 300 million over 2012, with China the greatest buyer globally (26.5% of smartphones sold), more than 8% ahead of the USA since 2012. According to the whitepaper "2013 mobile future in focus", 54% of the mobile audience in the USA use smartphones, principally for sending text messages, compared to the tablets whose major use is search. In Europe, adoption of mobile devices is led by Spain (66%), followed by the UK (64%)(Donovan, 2013; Fundación Telefónica, 2014; Idc, 2013).

The growth in sales and use of smartphones to access the internet brings with it an increasing use of apps. These applications have grown in popularity since 2008, when the main online application stores began operations: Google Play https://play.google.com and Appstore https://www.apple.com/itunes/charts/free-apps, each hosting around 1.3 million active apps in August 2014. Globally more than 1.2 billion people were estimated to use mobile apps globally at the end of 2012 (Portio Research Mobile Factbook, 2013).

MOBILE WEB VERSUS APPS

A mobile website can be described as a version or adaptation of a website specifically created to work well on mobile devices, offering rapid download and respecting the screen sizes of devices to meet users' interaction expectations.

An app is a program developed to be installed in mobile devices, designed for use in a particular task or to offer a particular functionality. Apps aim to provide additional value over the mobile web, offering information and services with a single touch. Their immediacy, 24/7 availability and the privacy that a mobile telephone offers are their principal advantages.

When choosing to develop an app or adapt a website for mobile web, different factors need to be considered:

- The mobile web generally has the advantage that developing a single application correctly will make it available on all mobile devices, where-as apps need to be developed specifically for each operating system, limiting the number of devices that can use them (Hu & Meier, 2010).
- The advantage of building an app is that devices often have capabilities which are not available (or available later) to a web application (e.g., payment facilities).

USABILITY AND ACCESSIBILITY OF APPS

In the early days of the mobile web users preferred where possiblea "normal" website rather than a parallel version developed for mobile, but as the usability and functionality (and cost) of mobile devices has improved, this tendency has changed (McCathieNevile, 2009). In January 2014, mobile apps have overtaken PC internet usage in the US (CNN Money, 2014).

The main limitations of mobile devices are related to the screen size, the usability of the interface, battery consumption and the necessity to adapt content to the mobile web or an app (Hernández-García, Iglesias-Pradas, Chaparro-Peláez, & Pascual-Miguel, 2009). Further the use of any mobile website or app in a smartphone varies according to the char-acteristics of the device itself. It is therefore important to take into account the operating system(s) with which to work (iOS, Android, Blackberry, Windows, etc.) as well as different screen sizes which can alter the visualization and optimal user interaction.

MOBILE SERVICES IN ACADEMIA: UNIVERSITIES AND LIBRARIES

Websites and apps help provide services related to teaching and research, key to the learning processes of students and professors (Kroski, 2008). The NMC Horizon Report 2012 identifies apps as part of the near-term horizon in superior education, a theme repeated in the 2014 report (Johnson et al., 2012; Johnson, Adams Becker, Estrada, & Freeman, 2014). Yet adoption in universities and their libraries is

slow. According to "Mobile connections to libraries", only 13% of youth over 16 has accessed a library via a mobile device, increasing to 18%if the age range is focused to 18–29 — the normal age of university students (Rainie, 2012). Thus Jensen suggests that while mobile technology is very attractive in commercial or entertainment applications, it is perceived differently in the field of education, necessitating deeper analysis on the part of universities and libraries (Jensen, 2010).

The first universities to launch mobile versions were Massachusetts Institute of Technology (MIT) and Stanford University, in June and Octo-ber 2008 respectively, when the adoption of smartphones by students was still low (Aldrich, 2010; Wilson & McCarthy, 2010). The studies of mobile websites in universities and libraries carried out since then had been focused on design and description of service both in general and specific aspects such as usability and accessibility or identifying trends (Abarca Villoldo, Lloret Salom, Pons Chaigneau, Rubio Montero, & Vallés Navarro, 2012; Arroyo Vázquez, 2015; Arroyo, 2011; Kroski, 2008; Lippincott, 2010; McKlernan, 2010; Paterson & Low, 2011).

In parallel, analysis emerged focused on case studies, such as the pioneering study by Mills on the role of libraries at the University of Cambridge. This study includes web services, identifying the principal services necessary for users in this environment: Opening hours, library catalog, map of the library, and contact information (Mills, 2009). Also relevant is the report of Seeholzer and Salem, identifying the services that Kent State University Library users want to access through their smartphones, highlighting services related to finding scientific informa-tion (Seeholzer & Salem, 2011). The different results of these two studies confirm the influence of the environment (type of university) on user needs. Linguistic and cultural difference are equally evident as seen in work done in China or Spain, countries with a high rate of mobile web adoption (Li, 2013; Merlo Vega, 2012; Shuiqing, 2008; Xiaoyan & Mingyang, 2010).

In terms of work analyzing large samples of universities or libraries, special attention should be paid to the seminal study of Aldrich who analyzed through a set of 22 indicators the mobile web versions of the 111 universities (and their libraries) belonging to the ARL (Association of Research Libraries) (Aldrich, 2010). The results showed that at the time of the study only 39 universities offered mobile access, and only 14 had mobile access to their libraries, with opening hours, location in-formation and access to the catalogue most commonly available. Later, Canuel and Crichton analyzed the 95 academic libraries belonging to the AUCC (Association of Universities and Colleges of Canada). The au-thors only found a mobile version in 13 of them (Canuel & Crichton, 2011).

Recently, Liu and Briggs analyzed the top 100 university libraries' mobile services (based on the U.S. News & World Report) through in-depth website visits and survey questionnaires. Nonetheless, this study is focused only on the United States and does not attempt to measure the online visibility of the mobile websites, instead describing the state of mobile services among US academic libraries and the experiences of these libraries (Liu & Briggs, 2015).

Given the pace at which this technology evolves, there is a lack of recent study covering the best universities world-wide. There is a need not only to measure the existence, but the quality of mobile access and what it brings to the university in question, which is the focus of the thisstudy.

METHODOLOGY

The method can by divided into the following steps: sample gathering, sample evaluation, and statistical analysis.

SAMPLE GATHERING

The first step consisted of the selection of the world-class universities to comprise the sample for the analysis. To do this, we began with the selection of the 50 top universities according to the Web Ranking of Universities (Webometrics, July 2014 edition), produced since 2004 by the Cybermetrics Lab (Laboratorio de Cibermetría) of the Spanish National Research Council (CSIC) (http://webometrics.info). This ranking is devoted to the analysis of universities' websites in order to get insights regarding to their overall web impact through the application of four indicators (Presence, Impact, Openness, and Excellence). These 50 universities, with their corresponding indicators, are given in Appendix A, where the scope of each indicator is offered as well. The ranking of universities was chosen instead of possible alter-natives such as ARWU-Shanghai, THE (Times Higher Education), QS Ranking, Leiden Ranking, etc. because it is based on web indicators (especially Presence, Impact and Openness), thus allowing measurement not only of academic excellence but also innovation and policies for use of new technology on a global scale (Aguillo, Granadino, Ortega, & Prieto, 2006). Mobile websites and apps offer access to large amounts of web information and imply the adoptions of new technologies by the universities.

Next, for the 50 universities chosen, we identified the mobile websites and apps of their libraries, and determined whether these were indepen-dent of, or formed part of, the institutional web presence of the university as a whole. This information generally came directly from the sites of the universities. When it was impossible, direct communication with the institutions through email, chat, or online reference services such as "Ask a librarian" were used to get the necessary information.

SAMPLE EVALUATION

The second step consisted in the evaluation of each mobile website or app identified in the previous step, assessing which services, functionality or information they provided. For this purpose, we designed an evaluation model composed of 14 indicators (Table 1), based basically on the combination and an update to the models already proposed by (Aldrich, 2010; Méndez Rodríguez, 1999; Paterson & Low, 2011).

The evaluation of each mobile website or app consisted in determining the existence of each service, such that presence of a given service counted for one point toward a score (for a possible maximum of 14 points). This evaluation was done in August 2014.

STATISTICAL ANALYSIS

The scores obtained for each mobile website and/or app through the application of the evaluation model were uploaded to a spreadsheet to be statistically analyzed. Finally, in order to compare the quality of the mobile website/app with the web impact of each university, we compared the score of each mobile website/app to their position in the Web Ranking of Universities through the coefficient of correlation of Pearson ($\alpha = 0.1$).

Table 1
App/mobile web evaluation model.

Ref	Indicator
1	Library hours
2	Library directory
3	Library catalog
4	Contact us
5	Main library
6	Ask a librarian
7	Library news
8	Renew material
9	My account
10	Computer availability
11	Floor plans/maps
12	Databases
13	Loan periods
14	Reserve study

RESULTS

LEVEL AND TYPE OF ADOPTION OF THE MOBILE WEB

Eighty percent of universities studied (40) have a mobile website for their library (the URLs are in Appendix B). However, only 34% (17 universities) have an app, while in 26% (13) a mobile version and an app coexist. Of the apps, in seven universities they are available both for iOS and Android, while nine only have iOS apps and in one (Utrecht University), there is only a version for Android.

Fig. 1 shows the distribution of mobile websites for the 50 universities studied, by type of presence offered (mobile web, app, both, neither).

As seen in Fig. 1, in the category "Mobile web" we have included cases where the web of the library is navigable with a mobile device (responsive design), but without a specific mobile website nor app. These universities are the University of Washington and the University of Minnesota. Meanwhile, in as many as six universities there is neither a mobile version nor app for the library, and the website is not designed to facilitate navigation on a mobile device. Those universities are: New York University, Pekin University, Purdue University, Stanford University, Tsinghua University China and University of Sao Paulo.

Finally, we tested whether the mobile web or app of the library was independent or integrated into the university's mobile web presence. The data (Fig. 2) show different results according to the type of presence (mobile web or app). The complete data by university are available in Appendix C.

For libraries with a mobile website in Fig. 2 we see the majority (32; 64%) maintain a web presence independent of the university, while in only 3 universities (Harvard University, MIT and University of Oxford) is the library's presence integrated in the mobile web space of the host institution.

With apps the opposite occurs, with 14 of the 16 libraries' apps integrated in the university's app, while only two (University of Southern California and Utrecht University) are independent. In the case of the National Taiwan University we found a mobile website as well as an app, although the latter was in beta when we were carrying out the study and could not be evaluated. So, the results of this university have been removed from Fig. 2.

Finally we highlight a special category of four universities (Princeton University, University of California-San Diego, University of Pittsburgh and University of Southern California), where an independent mobile website lives alongside one integrated into the university's.

EVALUATION OF SERVICE

Fig. 3 shows the level of implementation for each mobile web service of the 14 proposed in Table 1. We can see that, surprisingly, none of the 14 services are offered by 100% of the libraries evaluated.

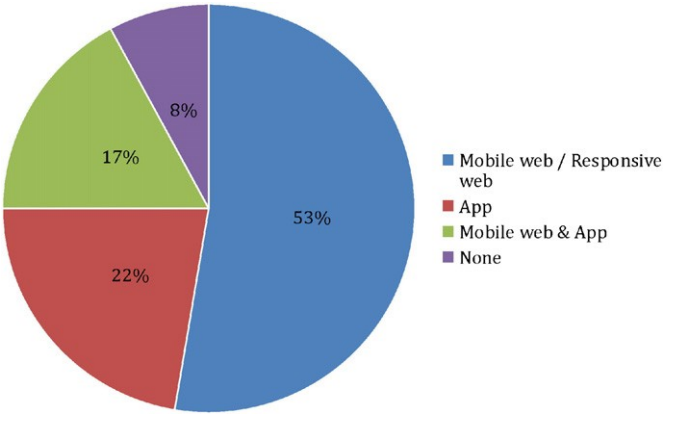

Fig. 1. Distribution of academic libraries by type of presence.

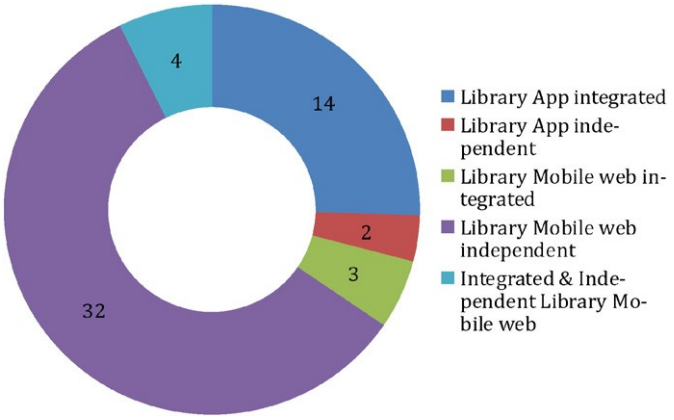

Fig. 2. Integration of the libraries' mobile web presence.

For mobile websites (n = 40), the services available in most libraries are "Library hours" (36), "Contact us" (33) and "Main Library" and "Floor maps" (both in 28 libraries). On the other hand, "Renew material" (10) and "Loan periods" (6) are by a large margin the services least offered in the libraries analyzed.

For apps (n = 17), the services implemented most are "Library hours" and "Floor plans" (12 each), followed by "Library catalog", present in 11 apps. "Computer availability" and "Loan periods" are the least implemented (each by only 2 universities).

Despite notable differences between app and mobile web versions, (for example the use of geolocalization to generate maps, or access to the catalog are better in apps, while information about the library or its databases is better in mobile websites), the correlation between the two is significant ($r = 0.7$; $\alpha = 0.5$).

RANKING BY SERVICES (APPS AND MOBILE WEB)

Here we evaluate the offering of services for each university. The complete data for apps and mobile web is available in Appendix D. The top ten universities by number of services included in the library's app is shown in Table 2 (The complete ranking is available in Appendix E). The University of Washington tops the ranking (13 services). Curious- ly, the only service of the 14 examined that is not included is "Floor maps/ plans", one of the most common for apps in the sample. In second place is the University of Illinois-Urbana Champaign (10) with Harvard University and MIT third (9 services each).

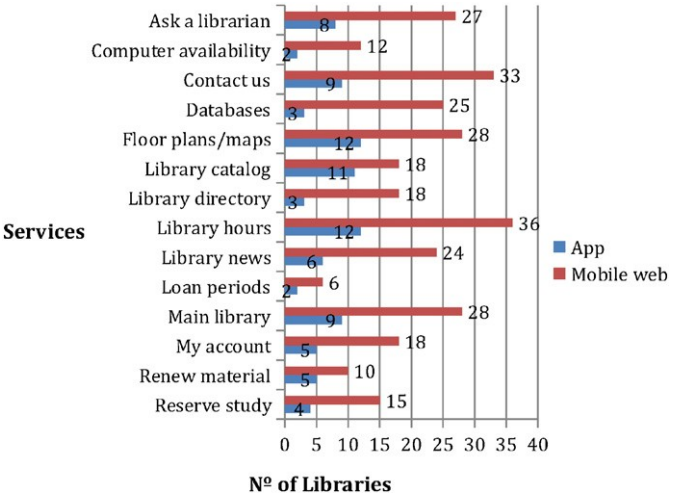

Fig. 3. Services provided by apps or mobile web in the libraries evaluated (n = 50).

Table 2
Top 10 Academic Library ranking according to app services deployed.

Rank	University	App score
1	University of Washington	13
2	University of Illinois-Urbana Champaign	10
3	Harvard University	9
3	Massachusetts Institute of Technology	9
5	University of California-Berkeley	8
6	Columbia University New York	7
6	Texas A&M University	7
6	University of Toronto	7
9	University of California-Los Angeles UCLA	6
9	University of Chicago	6

The top ten universities by number of services included in the mobile web version of the library is shown in Table 3 (the complete ranking is available in Appendix F).

The University of Washington is again in first position with the same score as its app (offering the same services), this time tied with the University of Minnesota, which despite having pioneered other Internet technologies (gopher), offers no app. In third place is the University of Southern California (12), whose app was among the lowest scoring (offering only 5 services). This difference between the score of an app and the mobile web for the same university shows inequality in their development. If we consider the 13 universities who developed both an app and a mobile web, the correlation of rankings is low ($r = 0.46$).

Finally, comparing the positions of universities in the two rankings generated (Appendix E and F) with their positions in the Web Ranking of Universities (WR), we again see divergence between mobile websites and apps. On one hand there is a significant positive correlation between the ranking of library apps and the global position of the universities in the WR ($r = 0.77$), although there are particular cases where this does not apply, especially the University of Illinois-Urbana Champaign (second in the apps ranking, but 22nd in the WR) or the University of Chicago (ranked ninth for apps, 39th in the WR). If the WR positions are standardized from 1 to 16 (in order to compare with the same range of apps), the correlation obtained is similar ($r = 0.73$; $\alpha = 0.1$). On the other hand the results for mobile websites show a lack of correlation ($r = 0.23$). If the WR positions are standardized from 1 to 40 (in order to compare with the same range of mobile websites), the correlation obtained is similar ($r = 0.24$; $\alpha = 0.1$).

DISCUSSION

These results should be treated with caution, for reasons we shall discuss here.

Table 3
Academic Library ranking by mobile web services deployed.

Rank	University	Mobile score
1	University of Minnesota	13
1	University of Washington	13
3	University of Southern California	12
4	University of British Columbia	11
4	University of Maryland	11
4	University of Wisconsin Madison	11
7	Cornell University	10
7	University of Illinois-Urbana Champaign	10
7	Yale University	10
10	Duke University	9
10	Harvard University	9
10	Massachusetts Institute of Technology	9
10	Michigan State University	9
10	Princeton University	9
10	University of Virginia	9
10	Utrecht University	9

BIAS OF THE SAMPLE

Of the universities considered (top 50), we find 37 in the US, only 3 in the UK, 2 from Canada and China and 1 each from Brazil, South Korea, Switzerland, Taiwan, Holland and Finland. The leadership of US universities in the rankings could bias the sample. A greater sample that showed the situation clearly for other countries would be interesting, although the fundamental goal of this study was to consider only the world's universities irrespective of nationality.

CHANGE AND OBSOLESCENCE

The functionality of mobile websites can change very rapidly, as does the technology. Hence this study should be considered as a snapshot reflecting the adoption of mobile website and apps by libraries of the world's best universities at a given moment (August 2014).

EVALUATION MODEL

The evaluation model used considers 14 principal functionalities that should be present in a library's mobile website or app. Thus the results partially concur with those previously obtained by Mills, Aldrich, and Liu and Briggs (Aldrich, 2010; Liu & Briggs, 2015; Mills, 2009). However in the future it would be desirable to consider new indicators, enriching the model and adapting it to new services which may appear.

WEIGHTING OF INDICATORS

The scoring in this study does not consider differences between indicators, although some services are probably more important than others. Accordingly, it would be possible to provide a system of weighting. However the purpose of this study was merely to examine the existence or absence of basic functionality.

DISTINCT NATURES AND CORRELATIONS

Finally the correlations observed should be treated cautiously, given that the indicators used are of distinct natures, and the sample sizes are different (17 apps and 40 mobile websites of the 50 universities analyzed).

CONCLUSIONS

A good proportion of the university libraries studied 88% (44) are accessible through mobile devices (through an app or mobile web), showing a high level of mobile web adoption in universities. The form of adoption varies: 80% (40) of the libraries studied provide access through a mobile website while only 34% (17) offer an app, showing the development of apps is yet to be widespread in this area. It is hard to determine why universities have not implemented apps, especially in the cases studied (institutions of recognised prestige with no apparent problem developing the technology).

The integration of content appears to depend on the form adopted. Libraries' mobile webs tend to be independent of the university's institutional mobile web (as seen in 82% of cases), while libraries' apps are generally integrated into that of the university (87.5% of apps analyzed). We consider the integration positive, as users should have a single app offering access to all the information the university provides, including the library, rather than one for each possible service.

Regarding evaluation of the content, no library provided all 14 services, and the results are quite varied. Fifty percent of apps show less than half the indicators met (i.e. offer fewer than 7 services). This figure improves for mobile websites, with 74.3% offering at least half.

As for the services these apps and mobile webs provide, we can conclude that among the most common are those giving information about library opening hours, although certain services are likely to be

offered depending on whether the library has a mobile website (e.g. contact information or information about the library) or app (e.g. catalog access, geolocalization).

Among the least common services are loan information and renewals. Equally notable is the scarcity of information about user accounts, perhaps due to possible security issues.

We found the following limitations in services offered:

DIFFICULTY LOCATING RESOURCE

It is difficult to find, from the website of the library, an app or mobile website, as the pages do not give this information. Some sites have a banner identifying the availability of an app or mobile website, leading to information about the possibilities they offer. On other occasions, it was necessary to resort to virtual information sources, or email, which gave immediate results.

LACK OF CONNECTION TO SOCIAL NETWORKS

Although the majority of libraries studied have profiles in social networks (Facebook, Twitter, Youtube, etc.), these are independent of apps and mobile webs, which offer no, or very limited, access to that social media presence. The ability to link a social media profile with the different profiles of the library could provide a collaboration tool enabling users to continue interchanging information without needing to leave the library's app or mobile website, although certain problems with the privacy of content may limit such development.

OPERATING SYSTEMS

Most apps are only available for iOS (52.9% of apps analyzed). But if the university library wants to offer services to all, access should be available to users of other operating systems (principally Android and Windows). Equally important is that apps are also useful on tablets. The preponderant development of iOS apps could be the reason many universities opt for device adaptation or responsive design in place of apps.

Lastly, the position of universities in the Web Ranking of Universities bears no apparent relation to how many services their libraries' mobile web provides. Yet there is a significant correlation in the case of apps, albeit from a much smaller sample. Increasing the sample size would allow more accurate results.

As a final conclusion, a high level of mobile web adoption in the world's best universities is notable, although the quality does not reach the general level of excellence of these institutions. We consider the inclusion of the library in universities' apps as critical, showing the importance these institutions give to the academic library and enhancing its use for teaching and research. We therefore consider the current level of adoption (as of 2014) low.

The results of this study have demonstrated that the quality of university libraries' mobile websites does not correlate with the overall web impact of the universities. For this reason, advancement in the direct measurement of mobile websites' impact is needed. Not only to get complementary insights about the quality of these mobile websites, but also to better quantify their contribution on the web presence as well as the visibility of the university (an important issue in the development of web strategies and policies both for the library and the university).

The evaluation model proposed in this research would serve as a base for future quantitative studies of mobile websites in universities and their libraries since they will provide useful service patterns and benchmark suitable for the improvement of academic libraries' mobile web services. The incorporation of pure web indicators (e.g. web presence, visibility or usage) in the model would be necessary. The current trend towards responsive design for websites may help in the design and incorporation of such web metrics.

APPENDIX A. TOP 50 UNIVERSITIES ACCORDING TO RANKING WEB OF UNIVERSITIES (JULY 2014 EDITION)

R	University	URL	Presence	Impact	Openness	Excellence
1	Harvard University	harvard.edu	10	1	1	1
2	Massachusetts Institute of Technology	mit.edu	5	1	27	14
3	Stanford University	stanford.edu	2	3	52	3
4	Cornell University	cornell.edu	24	5	67	20
5	University of Michigan	umich.edu	37	7	59	5
6	University of California Berkeley	berkeley.edu	40	4	178	15
7	Columbia University New York	washington.edu	60	6	141	12
7	University of Washington	washington.edu	25	10	113	6
9	University of Minnesota	umn.edu	110	9	15	23
10	University of Pennsylvania	upenn.edu	42	11	109	9
11	University of Texas Austin	utexas.edu	118	8	43	51
12	University of Wisconsin Madison	wisc.edu	9	18	194	21
13	Pennsylvania State University	psu.edu	78	13	53	36
14	University of California Los Angeles UCLA	ucla.edu	64	17	317	4
15	University of Toronto	utoronto.ca	33	38	51	7
16	Yale University	yale.edu	41	12	343	19
17	University of Oxford	ox.ac.uk	39	21	295	8
18	University of Cambridge	cam.ac.uk	21	20	311	10
19	Purdue University	purdue.edu	99	16	45	87
20	Texas A&M University	tamu.edu	19	30	41	89
21	University of British Columbia	ubc.ca	127	40	24	24
22	University of Illinois Urbana Champaign	http:illinois.edu	4	58	56	43
23	Michigan State University	msu.edu	31	14	339	93
24	New York University	nyu.edu	132	15	344	44
25	Johns Hopkins University	jhu.edu	45	50	631	2
26	University of Florida	ufl.edu	76	26	180	40
27	Princeton University	princeton.edu	34	19	398	76
28	Swiss Federal Institute of Technology Zurich	ethz.ch	83	42	81	31
29	Universidade de São Paulo USP	usp.br	48	63	6	81
30	Duke University	duke.edu	223	35	219	17
31	University of California San Diego	ucsd.edu	163	29	451	13
32	California Institute of Technology Caltech	caltech.edu	17	66	125	34

APPENDIX A (*continued*)

R	University	URL	Presence	Impact	Openness	Excellence
33	University of Maryland	umd.edu	65	37	112	70
34	Seoul National University	snu.ac.kr	36	32	255	79
35	National Taiwan University	ntu.edu.tw	15	81	12	103
36	University of North Carolina Chapel Hill	unc.edu	141	25	511	27
37	Peking University	pku.edu.cn	93	44	148	49
38	University College London	ucl.ac.uk	308	64	100	11
39	University of Chicago	uchicago.edu	111	23	558	46
40	University of Pittsburgh	pitt.edu	344	59	69	28
41	Utrecht University	uu.nl	67	105	26	30
42	Ohio State University	osu.edu	183	56	132	33
43	Carnegie Mellon University	cmu.edu	90	22	179	160
44	University of Arizona	arizona.edu	227	27	327	69
45	University of Helsinki	helsinki.fi	35	112	5	101
46	University of Virginia	virginia.edu	18	28	833	95
47	Georgia Institute of Technology	gatech.edu	85	60	94	83
48	Tsinghua University China	tsinghua.edu.cn	378	41	174	45
49	University of Southern California	usc.edu	327	24	456	56
50	University of California Davis	ucdavis.edu	229	43	448	29

Impact: The indicator is the product of square root of the number of backlinks and the number of domains originating those backlinks. The link visibility data is collected from the two most important providers of this information: Majestic SEO and Ahrefs.
Presence: The total number of web pages hosted in the main web domain (including all the subdomains and directories) of the university as indexed by the largest commercial search engine (Google).
Openness: This indicator takes into account the number of rich files (pdf, doc, docx, ppt) published in dedicated websites according to the academic search engine Google Scholar. The objective is to consider recent publications (currently those published between 2008 and 2012).
Excellence: The university scientific output being part of the 10% most cited papers in their respective scientific fields. Data collected from Scopus.

APPENDIX B. MOBILE URL

	University	Mobile URL
1	Bibliotecas da Universidade de São Paulo USP	–
2	California Institute of Technology Caltech Library	library.caltech.edu/m/
3	Carnegie Mellon University Libraries	m.library.cmu.edu/
4	Columbia University New York	m.library.columbia.edu/
5	Cornell University Libraries	m.mannlib.cornell.edu/
6	Duke University Libraries	m.duke.edu
7	Georgia Institute of Technology Library	m.library.gatech.edu/
8	Harvard University Library	m.harvard.edu
9	Johns Hopkins University	webapps.jhu.edu/jhuniverse/academics/libraries/
10	Massachusetts Institute of Technology Libraries	libraries.mit.edu
11	Michigan State University Library	m.lib.msu.edu/
12	National Taiwan University Library	mobile.lib.ntu.edu.tw
13	New York University Libraries	–
14	Ohio State University Libraries	–
15	Pekin University Library	–
16	Pennsylvania State University Library	m.psu.edu/library/
17	Princeton University Library	library.princeton.edu/
18	Purdue University	–
19	Seoul National University Libraries	m.lib.snu.ac.kr
20	Stanford University Libraries	–
21	Swiss Federal Institute of Technology Zurich Library	library.ethz.ch/mobile/
22	Texas A&M University Libraries	m.tamu.edu
23	Tsinghua University Library	–
24	University College London Library	ucl.ac.uk/isd/students/mobile/ucl-go
25	University of Arizona Libraries	m.library.arizona.edu/
26	University of British Columbia Library	library.ubc.ca/
27	University of California Berkeley Libraries	mobile.lib.berkeley.edu
28	University of California Davis Library	lib.ucdavis.edu/m/
29	University of California Los Angeles UCLA Library	m.library.ucla.edu
30	University of California San Diego Library	libraries.ucsd.edu/m/
31	University of Cambridge Libraries	lib.cam.ac.uk/mob
32	University of Chicago Library	mobile.lib.uchicago.edu/
33	University of Florida Libraries	uflib.ufl.edu/mobile2/
34	University of Helsinki	hulib.hulib.helsinki.fi/mobiili
35	University of Illinois Urbana Champaign Library	m.library.illinois.edu/
36	University of Maryland Libraries	m.lib.umd.edu
37	University of Michigan Libraries	m.lib.umich.edu/
38	University of Minnesota Libraries	lib.umn.edu/mobile/
39	University of North Carolina Chapel Hill Libraries	lib.unc.edu/m/

APPENDIX B (*continued*)

	University	Mobile URL
40	University of Oxford Libraries	m.ox.ac.uk
41	University of Pennsylvania Libraries	library.upenn.edu/m/
42	University of Pittsburgh Library	library.pitt.edu/
43	University of Southern California Libraries	usc.edu/libraries/mobile/
44	University of Texas Austin Libraries	lib.utexas.edu/m/
45	University of Toronto Libraries	–
46	University of Virginia Library	m.library.virginia.edu/
47	University of Washington Libraries	washington.edu/mobile/
48	University of Wisconsin Madison Libraries	m.library.wisc.edu/
49	Utrecht University Library	m.library.uu.nl
50	Yale University Library	library.yale.edu/m/

APPENDIX C. LIBRARY MOBILE WEB/APP INTEGRATION WITH UNIVERSITY

University	Mobile web		App	
	Independent	Integrated	Independent	Integrated
Harvard University		•		•
Massachusetts Institute of Technology		•		•
Stanford University				
Cornelll University	•			
University of Michigan	•			
University of California Berkeley	•			•
Columbia University New York				•
University of Washington	•			•
University of Minnesota	•			
University of Pennsylvania	•			
University of Texas Austin	•			
University of Wisconsin Madison	•			
Pennsylvania State University	•			
University of California Los Angeles UCLA	•			•
University of Toronto				•
Yale University	•			
University of Oxford		•		•
University of Cambridge	•			•
Purdue University				
Texas A&M University	•			•
University of British Columbia	•			
University of Illinois Urbana Champaign	•			•
Michigan State University	•			
New York University				
Johns Hopkins University	•			
University of Florida	•			
Princeton University	•	•		
Swiss Federal Institute of Technology Zurich	•			
Universidade de Sao Paulo USP				
Duke University	•			
University of California San Diego	•	•		
California Institute of Technology Caltech	•			
University of Maryland	•			
Seoul National University	•			
National Taiwan University				
University of North Carolina Chapel Hill	•			
Pekin University				
University College London				•
University of Chicago	•			•
University of Pittsburgh	•	•		
Utrecht University	•		•	
Ohio State University				•
Carnegie Mellon University	•			
University of Arizona	•			
University of Helsinki	•			
University of Virginia	•			
Georgia Institute of Technology	•			
Tsinghua University China				
University of Southern California	•	•	•	
University of California Davis	•			

APPENDIX D. EVALUATION OF SERVICES ACCORDING TO UNIVERSITY

University	Type	01	02	03	04	05	06	07	08	09	10	11	12	13	14	Score
Harvard University	App	x	x	x	x	x	x	x				x	x			9
	Mobile web	x	x	x	x	x	x	x				x	x			9
MIT	App	x		x	x	x	x	x		x		x		x		9
	Mobile web	x		x	x	x	x	x		x		x		x		9
Stanford University																
Cornell University	Mobile web	x	x	x	x	x	x	x			x	x			x	10
University of Michigan	Mobile web			x	x	x	x	x				x	x			7
University of California-Berkeley	App	x	x	x	x	x	x	x				x				8
	Mobile web	x	x	x	x	x	x	x				x				8
Columbia University New York	App	x		x	x		x	x				x			x	7
University of Washington	App	x	x	x	x	x	x	x	x	x	x		x	x	x	13
	Web responsive	x	x	x	x	x	x	x	x	x	x		x	x	x	13
University of Minnesota	Web responsive	x	x	x	x	x	x	x	x	x	x	x	x		x	13
University of Pennsylvania	Mobile web	x	x	x	x	x	x	x					x			8
University of Texas Austin	Mobile web	x		x	x	x	x						x	x		7
University of Wisconsin Madison	Mobile web	x	x	x	x		x	x		x		x	x	x	x	11
Pennsylvania State University	Mobile web			x	x	x				x	x		x			6
University of California Los Angeles UCLA	App	x		x		x	x				x	x				6
	Mobile web	x		x		x	x				x	x				6
University of Toronto	App	x		x	x	x		x	x			x				7
Yale University	Mobile web	x	x	x	x		x	x		x		x	x		x	10
University of Oxford	App	x		x	x							x				4
	Mobile web			x						x						2
University of Cambridge	App	x		x					x	x		x				5
	Mobile web	x		x					x	x		x				5
Purdue University																
Texas A&M University	App	x			x	x	x					x	x		x	7
	Mobile web	x			x	x	x					x	x		x	7
University of British Columbia	Mobile web	x		x	x	x	x	x	x	x		x	x		x	11
University of Illinois Urbana Champaign	App	x		x	x	x	x		x	x		x	x		x	10
	Mobile web	x		x	x	x	x		x	x		x	x		x	10
Michigan State University	Mobile web	x	x	x	x	x	x	x				x	x			9
New York University																
Johns Hopkins University	Mobile web	x		x	x							x	x		x	6
University of Florida	Mobile web	x		x		x		x	x		x		x			7
Princeton University	Mobile web	x	x	x	x		x	x	x			x	x			9
Swiss Federal Institute of Technology Zurich	Mobile web	x		x	x	x		x		x		x	x			8
Universidade de Sao Paulo USP																
Duke University	Mobile web	x	x	x	x		x	x		x		x		x		9
University of California San Diego	Mobile web	x		x	x	x	x				x	x	x			8
California Institute of Technology	Mobile web	x		x	x	x	x	x				x	x			8
University of Maryland	Mobile web	x	x	x	x	x	x			x	x	x	x		x	11
Seoul National University	Mobile web	x		x	x			x		x		x	x		x	8
National Taiwan University	App															
	Mobile web															
University of North Carolina Chapel Hill	Mobile web	x	x		x			x	x	x			x		x	8
Pekin University																
University College London	App		x						x	x		x				4
University of Chicago	App	x		x		x	x				x				x	6
	Mobile web	x		x		x	x				x				x	6
University of Pittsburgh	Mobile web	x	x	x	x		x						x			6
Utrecht University	App								x	x				x		3
	Mobile web	x		x	x	x		x	x		x		x	x		9
Ohio State University	App	x		x								x				3
Carnegie Mellon University	Mobile web	x		x	x	x						x				5
University of Arizona	Mobile web	x	x	x	x	x	x					x			x	8
University of Helsinki	Mobile web	x		x	x	x		x				x				6
University of Virginia	Mobile web	x	x	x	x		x	x		x		x	x			9
Georgia Institute of Technology	Mobile web	x		x	x	x		x			x					6
Tsinghua University China																
University of Southern California	App				x	x		x		x						4
	Mobile web	x	x	x	x	x	x	x	x	x	x	x			x	12
University of California Davis	Mobile web	x	x	x		x	x			x		x				7

01: Library hours; 02: Library directory; 03: Library catalog; 04: Contact us; 05: Main Library; 06: Ask a librarian; 07: Library news; 08: Renew material; 09: My account; 10: Computer availability; 11: Floor plans/maps; 12: Databases; 13: Loan periods; 14: Reserve studies.

APPENDIX E. ACADEMIC LIBRARY RANKING ACCORDING TO APP SERVICES DEPLOYED

Rank	University	Score
1	University of Washington	13
2	University of Illinois Urbana Champaign	10
3	Harvard University	9
3	Massachusetts Institute of Technology	9
5	University of California Berkeley	8
6	Columbia University New York	7
6	Texas A&M University	7
6	University of Toronto	7
9	University of California Los Angeles UCLA	6
9	University of Chicago	6
11	University of Cambridge	5
12	University College London	4
12	University of Oxford	4
12	University of Southern California	4
15	Ohio State University	3
15	Utrecht University	3
17	National Taiwan University	–

APPENDIX F. ACADEMIC LIBRARY RANKING ACCORDING TO MOBILE WEB SERVICES DEPLOYED

R	University	*M*-web score
1	University of Minnesota	13
1	University of Washington	13
3	University of Southern California	12
4	University of British Columbia	11
4	University of Maryland	11
4	University of Wisconsin Madison	11
7	Cornell University	10
7	University of Illinois Urbana Champaign	10
7	Yale University	10
10	Duke University	9
10	Harvard University	9
10	Massachusetts Institute of Technology	9
10	Michigan State University	9
10	Princeton University	9
10	University of Virginia	9
10	Utrecht University	9
17	California Institute of Technology Caltech	8
17	Swiss Federal Institute of Technology Zurich	8
17	University of Arizona	8
17	University of California Berkeley	8
17	University of California San Diego	8
17	University of North Carolina Chapel Hill	8
17	University of Pennsylvania	8
24	Seoul National University	7
24	Texas A&M University	7
24	University of California Davis	7
24	University of Florida	7
24	University of Michigan	7
24	University of Texas Austin	7
30	Georgia Institute of Technology	6
30	Johns Hopkins University	6
30	Pennsylvania State University	6
30	University of California Los Angeles UCLA	6
30	University of Chicago	6
30	University of Helsinki	6
30	University of Pittsburgh	6
37	Carnegie Mellon University	5
37	University of Cambridge	5
39	University of Oxford	2
40	National Taiwan University	–

REFERENCES

Abarca Villoldo, M., Lloret Salom, A., Pons Chaigneau, D. M., Rubio Montero, F. J., & Vallés Navarro, R. (2012). Tecnologías móviles en bibliotecas : aplicaciones en la biblioteca de la Universitat Politècnica de València. Retrieved from http://riunet.upv.es/handle/10251/14793

Aguillo, I. (2009). Measuring the institution's footprint in the web. *Library Hi Tech*, *27*(4), 540–556. http://dx.doi.org/10.1108/073788309.

Aguillo, I. F., Granadino, B., Ortega, J. L., & Prieto, J. A. (2006). Scientific research activity and communication measured with cybermetrics indicators. *Journal of the American Society for Information Science and Technology*, *57*(10), 1296–1302. http://dx.doi.org/10.1002/asi.20433.

Aldrich, A. W. (2010). Universities and libraries move to the mobile web. *Educause Quarterly*, *33*(2) Retrieved from http://www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/UniversitiesandLibrariesMoveto/206531 Arroyo, N. (2011). *Información en el móvil.* ((UOC, Ed.). Barcelona).

Arroyo, N. (2015). Tecnología móvil y bibliotecas en 2014: ampliando el concepto de movilidad. In T. Baiget, & I. Olea (Eds.), *Anuario Think EPI 2015. Informes ThinkEPI sobre documentación y comunicación*.

Canuel, R., & Crichton, C. (2011). Canadian academic libraries and the mobile web. *New Library World*, *112*(3/4), 107–120. http://dx.doi.org/10.1108/03074801111117014.

Donovan, M. (2013). *Comscore, 2013 mobile future in focus.* Retrieved from http://www.comscore.com/Insights/Presentations-and-Whitepapers/2013/2013-Mobile-Future-in-Focus2

Hernández-García, Á., Iglesias-Pradas, S., Chaparro-Peláez, J., & Pascual-Miguel, F. -J. (2009). La Web en el móvil: tecnologías y problemática. *El Profesional de La Informacion*, *18*(2), 137–144 (http://doi.org/10.3145/epi.2009.mar.03).

Hill, K. (2015). Mobile devices: A practical guide for librarians. *Australian Academic and Research Libraries*, *46*(4), 315. http://dx.doi.org/10.1080/00048623.2015.1109016.

Hu, R., & Meier, A. (2010). Mobile strategy report: Mobile device user research. *Strategy* Retrieved from http://www.cdlib.org/services/uxdesign/docs/CDL_Mobile_Device_User_Research_final.pdf

Idc (2013). *Worldwide quarterly smart connected device tracker.* (Retrieved from IDC Worldwide Quarterly Smart connected device tracker).

Jensen, R. B. (2010). Optimizing library content for mobile phones. *Library Hi Tech News*, *27*(2), 6–9. http://dx.doi.org/10.1108/07419051011050411.

Johnson, L., Adams Becker, S., & Cummins, M. (2012). The NMC Horizon Report: 2012 higher education edition. Retrieved from http://www.nmc.org/pdf/2012-horizon-report-HE.pdf

Johnson, L., Adams Becker, S., Estrada, V., & Freeman, A. (2014). NMC Horizon Report: 2014 library edition. Retrieved from http://cdn.nmc.org/media/2014-nmc-horizon-report-library-EN.pdf

Kousha, K., & Thelwall, M. (2008). Assessing the impact of disciplinary research on teaching: An automatic analysis of online syllabuses. *Journal of the American Society for Information Science and Technology*, *59*(13), 2060–2069. http://dx.doi.org/10.1002/asi.20920.

Kroski, E. (2008). On the move with the mobile web: Libraries and mobile technologies. *October*, *44* Retrieved from http://eprints.rclis.org/15024/1/mobile_web_ltr.pdf

Lewis, D. W. (2015). Inventing the electronic university. *College and Research Libraries*, *76*(3), 296–309. http://dx.doi.org/10.5860/crl.76.3.296.

Li, A. (2013). Mobile library service in key chinese academic libraries. *The Journal of Academic Librarianship*, *39*(3), 223–226. http://dx.doi.org/10.1016/j.acalib.2013.01. 009.

Lippincott, J. K. (2010). A mobile future for academic libraries. *Reference Services Review*, *38*(2), 205–213. http://dx.doi.org/10.1108/00907321011044981.

Liu, Y. Q., & Briggs, S. (2015). A library in the palm of your hand: Mobile services in top 100 university libraries. *Information Technology and Libraries*, *34*(2). http://dx.doi.org/10.6017/ital.v34i2.5650.

McCathieNevile, C. (2009). Movilizando la Web: dónde y cómo vamos hacia una Web móvil. *El Profesional de La Informacion*, *18*(2), 121–128. http://dx.doi.org/10.3145/epi.2009.mar.01.

McKlernan, G. (2010). Worldwide Mobile Phone Adoption and Libraries. *Searcher*, *18*(3), 48 Retrieved from http://proquest.umi.com/pqdweb?did=2009125071&Fmt=7&clientId=109526&RQT=309&VName=PQD

Méndez Rodríguez, E. M. (1999). Las bibliotecas públicas españolas en la Web: ¿qué información ofrecen nuestras bibliotecas públicas en la Red? *Educación Y Biblioteca*, *11*(106), 48–54 Retrieved from http://dialnet.unirioja.es/servlet/articulo?codigo=127153&orden=342350&info=link\nhttp://dialnet.unirioja.es/servlet/extart?codigo=127153

Merlo Vega, J. A. (2012). Biblio USAL. La primera aplicación de bibliotecas nativa para dispositivos móviles realizada en España. *Mi Biblioteca*, *8*(29), 54–60 Retrieved from http://gredos.usal.es/jspui/bitstream/10366/115738/1/DBD_Merlo_BiblioUSAL.pdf Mills, K. (2009). M-Libraries: Information use on the move. Retrieved from https://www.repository.cam.ac.uk/handle/1810/221923

Money, C. N. N. (2014). *Mobile apps overtake PC internet usage in U.S.* CNN Money Retrieved from http://money.cnn.com/2014/02/28/technology/mobile/mobile-apps-internet Murphy, J. (2010). Using mobile devices for research: Smartphones, databases and libraries. *Online*, *34*(3), 14–18 Retrieved from https://www.questia.com/magazine/1P3-2037037881/using-mobile-devices-for-research-smartphones-databases

Orduña-Malea, E., & Ontalba-Ruipérez, J. A. (2013). Proposal for a multilevel university cybermetric analysis model. *Scientometrics*, *95*(3), 863–884. http://dx.doi.org/10. 1007/s11192-012-0868-5.

Orduña-Malea, E., & Regazzi, J. (2013). Influence of the academic library on us university reputation: A webometric approach. *Technologies*, *1*(2), 26–43. http://dx.doi.org/10.3390/technologies1020026.

Orduña-Malea, E., & Regazzi, J. J. (2014). U.S. academic libraries: Understanding their web presence and their relationship with economic indicators. *Scientometrics*, *98*(1), 315–336. http://dx.doi.org/10.1007/s11192-013-1001-0.

Paterson, L., & Low, B. (2011). Student attitudes towards mobile library services for smartphones. *Library Hi Tech*, *29*(3), 412–423. http://dx.doi.org/10.1108/07378831111174387.

Portio Research Mobile Factbook, 2013. (2013). Retrieved from http://www.portioresearch.com/media/3986/PortioResearch Mobile Factbook 2013.pdf

Rainie, L. (2012). Mobile connections to libraries devices. Retrieved from http://libraries.pewinternet.org/2012/12/31/mobile-connections-to-libraries

Ranking Web of Universities (2014). *Top 500 Webometrics Ranking of World Universities January 2014.* Retrieved from: http://www.webometrics.info/sites/default/files/Ediciones_anteriores/Top%20500%20Webometrics%20Ranking%20of%20World%20Universities%20January%202014.xlsx

Seeholzer, J., & Salem, J. A. (2011). Library on the go: A focus group study of the mobile web and the academic library. *College and Research Libraries*, *72*(1), 9–20. http://dx.doi.org/10.5860/crl-65r1.

Shuiqing, M. (2008). The rise and development of mobile library services. *Journal of Academic Libraries*, *1*(1), 3–6 Retrieved from http://en.cnki.com.cn/Article_en/CJFDTOTAL-DXTS200801001.htm

Telefónica (2014). La Sociedad de la Información en España 2013. Fundacion Telefónica. Retrieved from http://www.fundaciontelefonica.com/arte_cultura/publicaciones-listado/pagina-item-publicaciones/?itempubli=261

Thelwall, M. (2004). *Link analysis: An information science approach.* London: Academic Press Retrieved from http://linkanalysis.wlv.ac.uk/index.html

Thelwall, M., & Kousha, K. (2008). Online presentations as a source of scientific impact? An analysis of PowerPoint files citing academic journals. *Journal of the American Society for Information Science and Technology*, *59*(5), 805–815. http://dx.doi.org/10.1002/asi. 20803.

Wilson, S., & McCarthy, G. (2010). The mobile university: From the library to the campus. *Reference Services Review*, *38*(2), 214–232. http://dx.doi.org/10.1108/00907321011044990.

Xiaoyan, Y., & Mingyang, L. (2010). Research of actuality of mobile-based information service in libraries of China. *Researches in Library Science*, *2*(1) Retrieved from http://en.cnki.com.cn/Article_en/CJFDTOTAL-TSSS201002019.htm