Mobile Technologies & Academics: Do Students Use Mobile Technologies in Their Academic Lives and are Librarians Ready to Meet this Challenge?

Angela Dresselhaus and Flora Shrode

ABSTRACT

In this paper we report on two surveys and offer an introductory plan that librarians may use to begin implementing mobile access to selected library databases and services. Results from the first survey helped us to gain insight into where students at Utah State University (USU) in Logan, Utah, stand regarding their use of mobile devices for academic activities in general and their desire for access to library services and resources in particular. A second survey, conducted with librarians, gave us an idea of the extent to which responding libraries offer mobile access, their future plans for mobile implementation, and their opinions about whether and how mobile technologies may be useful to library patrons. In the last segment of the paper, we outline steps librarians can take as they "go mobile."

PURPOSE OF THE STUDY

Similar to colleagues in all types of libraries around the world, librarians at Utah State University (USU) want to take advantage of opportunities to provide information resources and library services via mobile devices. Observing growing popularity of mobile, Internet-capable telephones and computing devices, USU librarians assume that at least some users would welcome the ability to use such devices to connect to library resources. To find out what mobile services or vendors' applications USU students would be likely to use, we conducted a needs assessment. The lessons learned will provide important guidance to management decisions about how librarians and staff members devote time and effort toward implementing and developing mobile access.

We conducted a survey of USU's students (approximately 25,000 undergraduates and graduates) to determine the degree of handheld device usage in the student population, the purposes for which students use such devices, and students' interests in mobile access to the library. In addition, we surveyed librarians to learn about libraries' current and future plans to launch mobile services. This survey was administered to an opportunistic population

Angela Dresselhaus (aldresselhaus@gmail.com) was Electronic Resources Librarian, ***Flora Shrode*** (flora.shrode@usu.edu) is Head, Reference & Instruction Services, Utah State University, Logan, Utah.

comprised of subscribers to seven e-mail lists whom we invited to offer feedback. Our goal was to develop an action plan that would be responsive to students' interests. At the same time, we aim to take advantage of the growing awareness of and demand for mobile access and to balance workloads among the library information technology professionals who would implement these services.

USU is Utah's land-grant university and the Merrill-Cazier Library is its primary library facility on the home campus in Logan, Utah. While USU has had satellite branches for some time, a growing emphasis on expanding online and distance education courses and degree programs has resulted in a considerable growth of its distance education programs in the last five years. Mobile access to university resources makes especially good sense for the distance education population and for students who may reside close to the main USU campus but who also enroll in online courses. The library has an information technology staff of 4.5 FTE professionals who support the library catalog, maintain roughly 250 computer workstations in cooperation with the director of campus student computer labs, and oversee the computing needs of library staff and faculty members.

LITERATURE REVIEW

Mobile access to library resources is not a new concept; in fact, the first project designed to deliver handheld mobile access to library patrons began eighteen years ago, in 1993, the time of mainframe computers and Gopher. The "Library Without A Roof" project partners included the University of Southern Alabama, AT&T, BellSouth Cellular, and Notable Technologies, Inc.[1] Library patrons at participating institutions could search and read electronic texts on their personal digital assistants (PDAs) and search the library catalog while browsing in physical collections.

As reflected in the literature, interest in PDA applications for libraries started to pick up around the turn of the twenty-first century. Medical librarians were among the first to widely recognize the potential impact of mobile technologies on librarianship. A 2002 article in the *Journal of the Medical Library Association* and a monograph by Colleen Cuddy are among the first publications that focus on PDAs.[2] A quick perusal of the medical category on the iTunes store reveals several professional applications, ranging from *New England Journal of Medicine* tools to remote patient vital-sign monitors. As an example of the depth of mobile-device penetration in the medical field, in 2010 the Food and Drug Administration approved the marketing of the AirStrip suite of mobile-device applications. These apps work in conjunction with vital-sign monitoring equipment to allow instant remote access to a patient's vital signs.[3] These examples illustrate the increasing pervasiveness of mobile technology in everyday life.

Mobile learning in academic areas outside of medicine has increased recently as more universities have adopted mobile technologies.[4] A sampling of current projects at academic

institutions is provided in the *2010 Horizon Report.*[5] According to the 2010 Educause Center for Applied Research (ECAR) study, 49 percent of undergraduates consider themselves mainstream adopters of technology.[6] Locally, Utah State University students have adopted smartphones at the rate of 39.3 percent and other handheld Internet devices at the rate of 31.5 percent. These statistics indicate that skills are increasing and the technological landscape is changing quickly. The ECAR study reports that student computing is rapidly moving to the cloud, another indication of the rapid change in the use of technology. "USB may one day go the way of the eight-track tape as laptops, netbooks, smartphones and other portable devices enable students to access their content from anywhere. They may or may not be aware of it, but many of today's undergraduates are already cloud-savvy information consumers, and higher education is slowly but surely following their lead."[7] Similarly, USU students show interest in adopting new technology. While USU students are less likely to own mobile devices, 70.2 percent of respondents indicated that they would be likely or very likely to use library resources on smartphones if they owned capable devices and if the library provided easy access to materials.

Bridges, Gascho Rempel, and Griggs published a comprehensive article, "Making the case for a fully mobile library web site: from floor maps to the catalog," detailing their efforts to implement mobile services on the Oregon State University campus.[8] Their paper highlights the popularity of mobile phones and smartphones/web-enabled phones. The authors discuss mobile phone use, library mobile websites, and mobile catalogs, and they describe the process they used to develop their mobile library site. They note that mobile services will certainly be expected in the coming years, and we have learned that USU students share this expectation.

SURVEY RESEARCH

In recent years librarians have conducted surveys on mobile technology in libraries. In a 2007 study, Cummings, Merrill, and Borrelli surveyed library patrons to find out if they are likely to access the library catalog via small-screen devices.[9] They discovered that 45.2 percent of respondents, regardless of whether they owned a device, would access the library catalog on a small-screen device. Mobile access to the library catalog was the most requested service in the USU student survey, although it accounted for only 16percent of the responses. Cummings, et al. also discovered that the most frequent users of the catalog were also the least willing to access the catalog via mobile devices, an interesting observation that merits further research. Their survey was completed in June of 2007, just five months after the January 9th release of the original iPhone. The release of the iPhone is significant as the point where the market demographics of mobile device users began to shift to people under thirty, the primary age group of undergraduate students.[10]

Librarians Wilson and McCarthy at Ryerson University conducted two surveys to measure

the usage of their catalog's feature to send a call number via text or email (initiated in 2007) and their "fledgling mobile web site" (launched in 2008).[11] The first survey indicated that 20 percent of respondents owned Internet-capable cell phones, and over half said they intended to buy this type of phone when their current contracts expired. The survey respondents indicated they wanted the following services: "booking group study rooms, checking hours and schedules, checking their borrower records and checking the catalogue."[12] The second survey was conducted a year after the library had implemented a group study room reservation system, catalog and borrower record services, and a computer/laptop availability service. Results of the follow-up survey show a drastic increase in ownership of Internet-capable cell phones (from 20% to 65%). Respondents desired two new services: article searches and e-book access. Wilson and McCarthy found that very few library patrons were accessing the mobile services, but "60% of the survey respondents were unaware that the library provided mobile services."[13] The authors conclude that advertising should be a central part of mobile technology implementation. They also detail how the library contributed expertise and leadership to their campus-wide mobile initiatives.

Seeholzer and Salem conducted a series of focus groups in the spring of 2009 to determine the extent of mobile device use among students at Kent State University.[14] Notable among their findings are that students are willing to conduct research with mobile devices, and they desire to have a feature-rich interactive experience via handheld devices. Students expressed interest in customizing interactions with the library's mobile site and completing common tasks such as placing holds or renewing library materials.

NATIONWIDE SURVEY OF LIBRARIANS

We asked colleagues who subscribe to e-mail distribution lists to respond to a survey about their libraries' implementation of mobile applications for access to library collections and services. Invitations to take the survey were sent to seven lists (ACRL Science & Technology Section, ERIL, Information Literacy Instruction, Liblicense-L, NASIG, Ref-L, and Serialist), and 289 librarians and library staff members responded to the survey. The population of subscribers to the e-mail lists we used to solicit survey responses is dynamic and includes librarians and staff who work in academic and other types of settings. While our findings cannot be generalized in a statistically reliable manner, we nonetheless believe that the survey responses merit thorough analysis.

We chose to conduct two surveys to avoid some of the problems we noted in a 2007 study conducted by Todd Spires.[15] Spires' survey questions focused on librarians' perceptions rather than on empirical data. We developed separate surveys for librarians and students in hopes of avoiding problems that could arise from basing assumptions on perceived behavior or from the complexity of interpreting and generalizing from perceptions. A survey of library patrons should provide more accurate insight into the ways that patrons are using the library

via handheld devices.

In the libraries that currently provide mobile access to resources, the library catalog is most commonly offered. Article databases and assistance from a librarian tie as the second most frequently provided services. Figure 1 shows a snapshot of the resources and services librarians reported that they provide. We also asked how long libraries have provided mobile access, and the time periods ranged from a few weeks to more than ten years. Five librarians indicated that they have provided mobile access for six to ten years, and it is possible that these respondents may work in medical or health science libraries, as our literature review indicated that access to medical information and journal articles via PDAs has been a reality for several years.

Figure 1. Librarians' Responses: Does Your Library Provide Mobile Access to the Following Library Resources?

Librarians were also asked what services and resources they believe libraries should provide via mobile devices. Of one hundred seventy-eight responses, 71 percent indicated that "everything" or a variety of library resources should be made available. A few of the more interesting suggestions include a library café webcam (similar to a popular link from North Carolina State University), locker reservations, a virtual suggestion box, alerts about database trials, an app that lists new books, and using iPads or other mobile devices for roving reference. Roving reference with tablet PCs was evaluated by Smith and Pietraszewski at the west campus branch library of Texas A&M.[16] As tablet computers become increasingly popular with the release of the iPad and other tablets,[17] roving reference should be reconsidered. Smith and Pietraszewski note that "the tablet PC proved to be an extremely useful device as well as a novelty that drew student interest (anything to make reference librarians look cool!)"[18] Using the latest technology in libraries will help raise awareness that libraries are relevant and adapting to changing user preferences.

We asked librarians to indicate who had responsibility for implementing mobile access in their library. The 184 responses are summarized here:

- 63 percent answered that a library systems or computing professional does this work;
- 26.1 percent indicated that the electronic resources librarian has this role;
- 17.9 percent rely on an information professional from outside of the library;
- 22.8 percent chose "other," and we unfortunately did not offer a space for comments where survey respondents could tell us the job title of the person in their library who implements mobile access.

The results from our sample of librarians are consistent with a larger study by the *Library Journal.*[19] The LJ study found that the majority of academic libraries have implemented or are

planning to implement mobile technologies.

STUDENT SURVEY

In January of 2011 we sent out a thirteen-question survey to students (questions are available in appendix A). USU's student headcount is 25,767, and 3,074 students responded, representing 11.9 percent of the student population. We asked students to identify with colleges so that we could evaluate the survey sample against the enrollment at USU. The rate of response by college clustered between 12–19 percent with the lowest response rate (8 percent) from the College of Education. The highest response rate came from the College of Humanities and Social Sciences.

We examined survey response rates from USU undergraduate and graduate populations; 54 percent of undergraduates and 50 percent of graduate students use mobile technology for academic purposes. We believe that our sample is sufficiently representative of the overall population of USU.
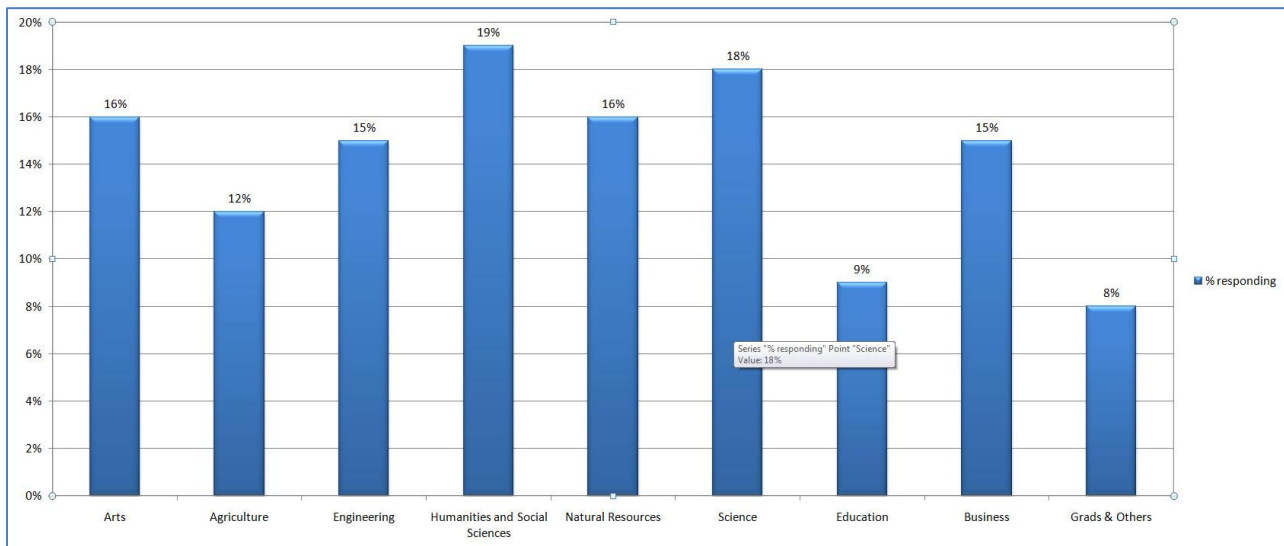

Figure 2. Student Response Rates by College

In order to understand the context of survey questions that specifically address mobile access, we asked students how often they used library electronic resources. The majority of students used electronic books, the library catalog, and electronic journals/articles a few times each semester. Only 34.4 percent of students never use electronic books, 19.6 percent never use the library catalog, and 17.6 percent never use electronic journals/articles. We made comparisons between disciplines and found no significant difference in electronic resource use between fields in the sciences and those in humanities. Further data will be collected in fall 2011 about use of print and electronic materials.
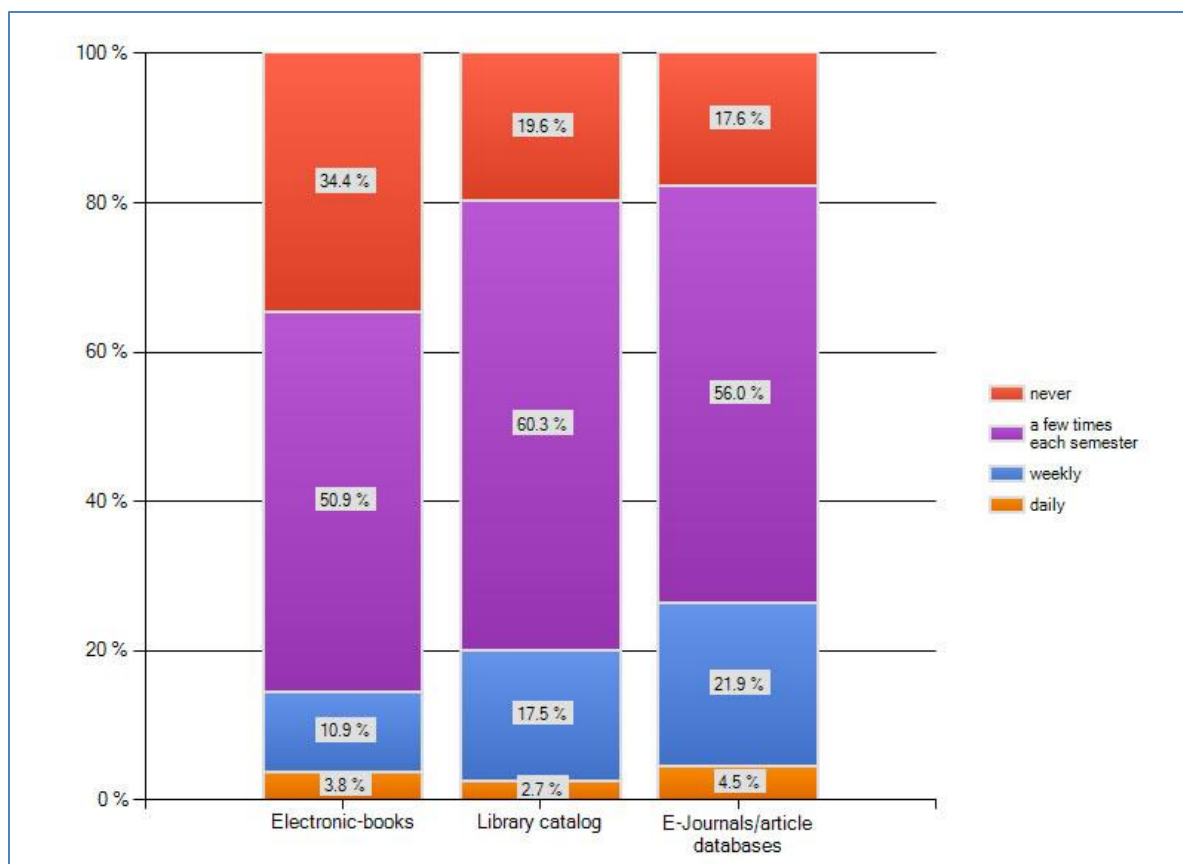
Figure 3. Electronic Resource Use Among Students

Students were asked how often they use a variety of handheld devices. We decided to emphasize access over ownership in order to allow for a variety of situations. Responses show that 39.3 percent of our students use a smartphone with Internet access on a daily basis. Another 31.5 percent of students use other handheld devices like an iPod touch on a daily basis. Very few students use iPads or e-book readers, with 3.9 percent and 5.4 percent indicating daily use, respectively. We view the "Other handheld device" category as an important segment of the mobile technology market because of the lower cost barrier, since such devices do not require a subscription to a data plan. The ECAR study also noted the possibility of cost factors influencing the decision of some students not to access the Internet via a handheld device.[20]
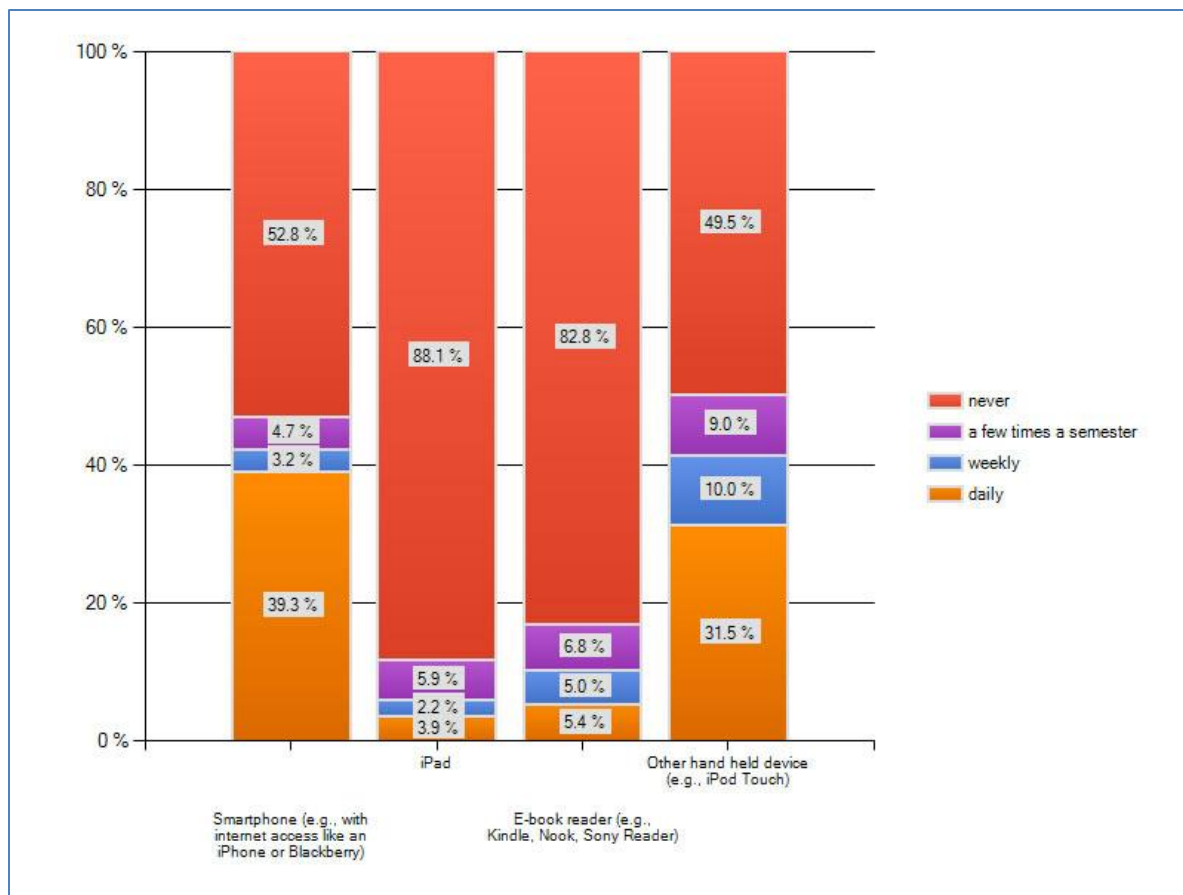
Figure 4. Mobile Device Usage

Students were asked if they use their mobile device or phone for academic purposes (e.g., Blackboard, electronic course reserves, etc.). This question was intentionally worded broadly in order to gather general information. We used skip logic to direct respondents to different paths through the survey based on their response to earlier questions. In response to a question about how students use their mobile devices, 54 percent of respondents indicated that they use their mobile devices for academic purposes. We analyzed the results by discipline and noted a few variances. Among students responding from the School of Business, 63 percent said that they use their mobile device for academic purposes, and 59 percent of engineering students use their devices for school work. The respondents from the other colleges reported use under 50 percent, most likely because of more limited adoption of mobile technology by USU faculty in those fields or lack of personal funds (or unwillingness to spend) to acquire devices and data plans. The 2010 ECAR report also noted higher exposure to technology in these fields, indicating that the situation at USU is in line with results from a national study.[21]

College	Yes	No
School of Business	63%	37%
College of Engineering	59%	42%
College of Natural Resources	54%	46%
College of Science	53%	47%
College of Humanities and Social Sciences	53%	47%
College of the Arts	49%	51%
College of Agriculture	47%	53%
College of Education	47%	53%

Table 1. Device use for Academic Purposes by College

We asked the students, "If library resources were easily accessible on your mobile devices, and if you had such a device, how likely would you be to use any of the following for assignments or research?" Responses to this question allowed us to gauge interest without concerns about cost of technology or the current state of mobile readiness in our library. Among the survey respondents, 70.2 percent are likely or very likely to use resources on a smartphone; 46.9 percent are likely or very likely to use resources on an iPad; 45.9 percent are likely or very likely to use resources on an e-book reader; 63.2 percent are likely or very likely to use resources on other devices. We included an option for respondents to select "not applicable" as distinct from "not likely" to allow for those students who may welcome use of a mobile device but who may currently use a device different from the types we specified.
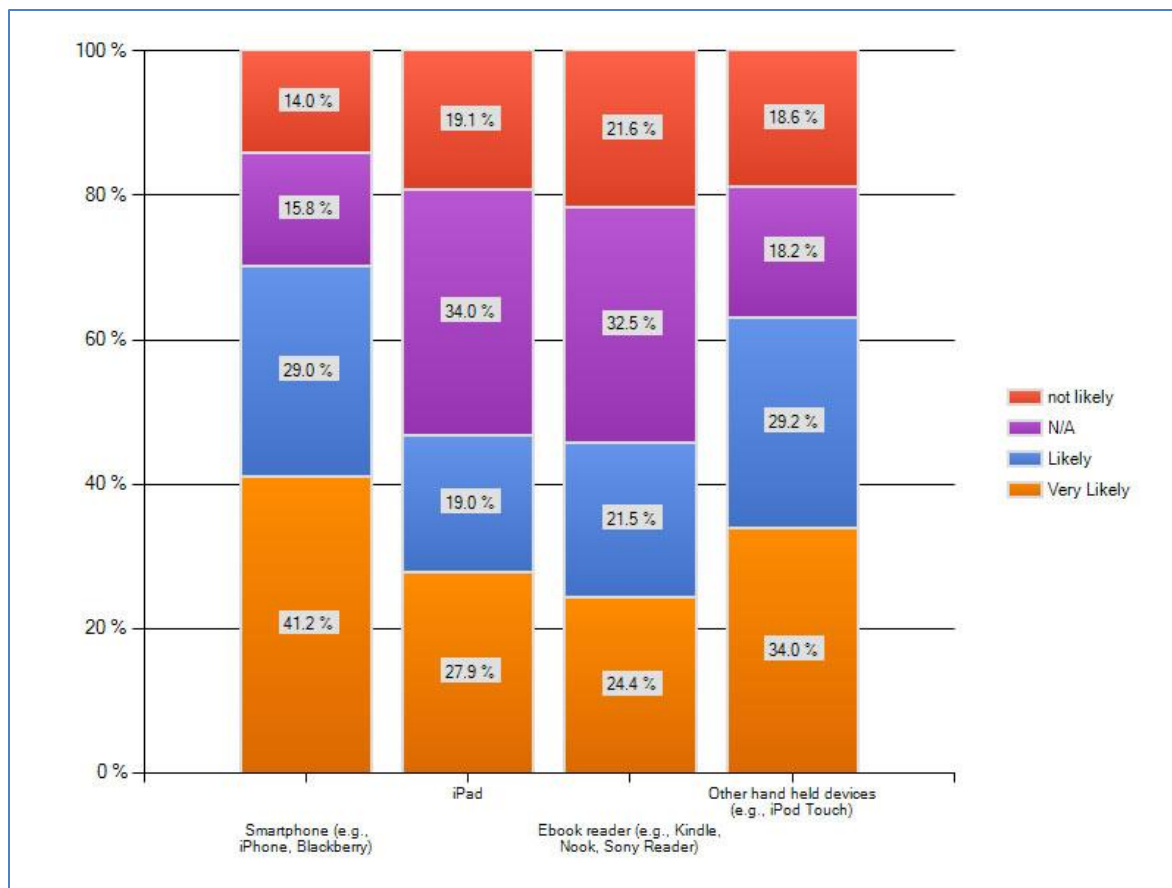
Figure 5. Likelihood of Using Library Resources on Mobile Device if Easily Available

We are unsure how to account for the dramatic difference in interest between smartphone and iPad usage. Survey responses indicated that only a small number of students have access to an iPad, and it is possible that students have had little opportunity to see their classmates or others use iPads in an academic setting.

Students were asked in a free-text question to list the services the library should offer. The comments were varied and often used language different from the vocabulary that librarians typically use. In order to gain an understanding of trends and to standardize the language, we coded the survey comments. After coding, trends began to emerge. Access to the library catalog was mentioned by 16 percent of respondents. Mobile services in general were specified by 11 percent of survey respondents, 10 percent wanted articles, and 9 percent wanted to reserve study rooms on their mobile device. The phrase "mobile services" represents a catch-all tag designated for comments that indicated that a student desired a variety of services or all services that are possible. For example, only 9 percent of respondents indicated they had used text to contact the library and 15percent had used instant messaging. Several students indicated they might have used these services but did not know they were available, indicating a need for advertising. While we learned much

about students' desires for mobile services from this important subset of comments in response to the free-text question, they did not prove especially useful to guide librarians' plans for the next stages of implementing mobile technology.
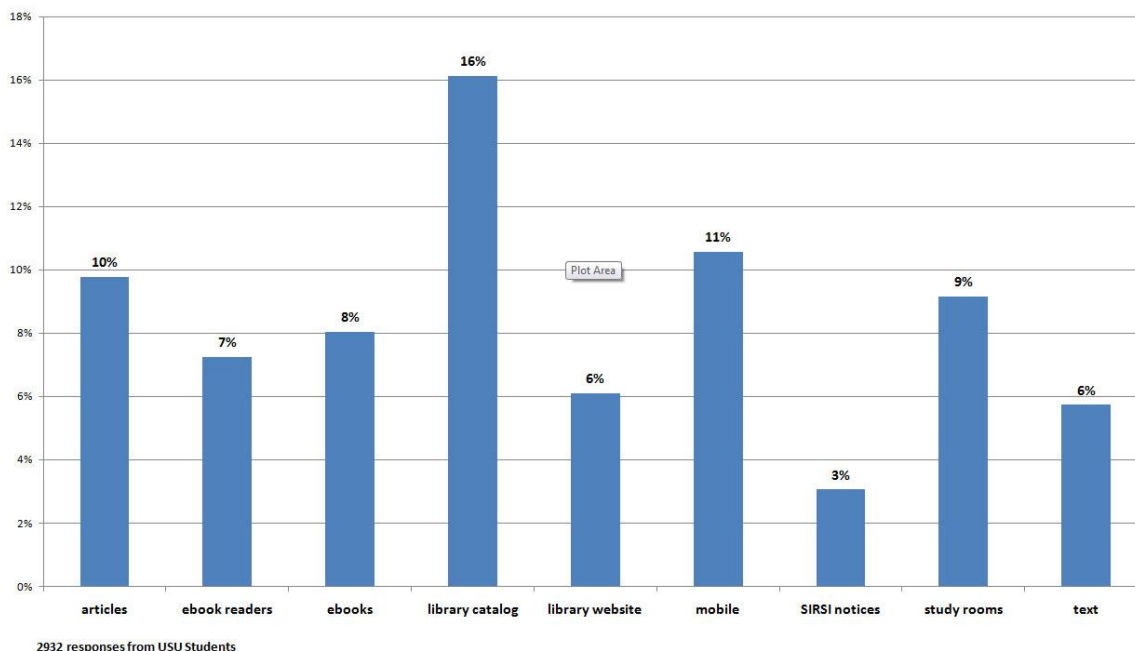

Figure 6. Services Requested by Students

As is common at many institutions, funding at USU is limited and any development in the area of mobile access implementation must be strategic. Our survey indicated that USU students are using mobile devices for their academic work and would like to further integrate library resources into their mobile routine. The next section of this paper outlines the steps we are taking toward mobile implementation.

Going Mobile

The USU Library joins many other academic libraries in the beginning stages of implementing mobile technologies. Survey responses from students indicate that they use mobile devices for academic purposes, and until options to use the library with such devices are available and advertised, we will not have a clear understanding of students' preferences.

Klatt's article, "Going Mobile: Free and Easy,"[22] outlines a way to get started with mobile services with small investments of time and money. Articles by Griggs,[23] Back,[24] and West,[25] and books by Green, et al.[26] and Hanson[27] also provide guidance in this area. Here we offer suggestions to establish an implementation team, conduct an environmental scan, outline steps to begin the process, and shed light on advertising, assessment, and policy issues.

Implementation Team

For a library seeking to provide mobile access to online resources, a diverse and talented implementation team is important. Public services personnel in an academic library staff are on the front lines and often field students' questions. They may also have the opportunity to observe how students are using mobile devices in the library. If librarians track reference interactions, they may find evidence that students are attempting to use their mobile devices to access library services. The electronic resources/collections specialist will also play a key role in mobile development. These specialists are often in contact with vendors, and their advocacy is important in encouraging mobile web development in the vendor community. A web site coordinator interested in mobile services and knowledgeable in current web standards will bring essential talent to the team. Arguably, a mobile-optimized web site should become a standard level of service. Web sites that are optimized or adapted specifically for mobile access are device agnostic and do not require advanced knowledge of smart phone operating systems. Therefore existing web development staff can apply their current skill set to expand into mobile web design. In order to launch advanced interactive access to library resources, a programmer who is interested in developing mobile apps on a number of platforms is needed. Device-specific applications allow for the use of phone features such as GPS and orientation sensing via an accelerometer and provide the basis for augmented reality technologies.

Environmental Scan

Librarians can learn about mobile usage in their community by gathering information to guide future development. At USU we interpret the numbers of students who use mobile devices for academic purposes as justification for implementing mobile library access, but we have not set a benchmark for a degree of interest that would trigger more development. Some of the mobile implementations described at the end of this paper required minimal time or were investigated because of the electronic resources librarian's interest for their relevance to her role as music subject librarian. In the survey we administered to students, we considered it important to include a wide range of devices, including iPod touches and similar devices that have many of the same possibilities for academic use as smartphones but which do not require a monthly contract. Laptops are also considered a mobile technology, and while we did not emphasize this class of devices, some student comments referred specifically to laptop computers. We will monitor use of the mobile applications that we implement and likely conduct a follow-up survey to assess students' satisfaction and to find out if there are other services they would like for the library to provide.

While librarians may gather useful information from a user study, there are other ways to determine if students are, in fact, using mobile devices in the library. One approach is to review logs of reference questions to determine if students are inquiring about access to library resources via mobile devices. Recently, a few mobile-related questions have surfaced

at USU in the LibStats program used to track reference interactions. This is also an area where training reference staff to recognize and record questions about mobile access could be helpful to detect demand in the library's community. If vendors provide statistics about use of their products from mobile devices, this information could also contribute to assessing need. Finally, in libraries that use VPN or other off-campus authentication methods, consulting with IT support staff to see if they field questions on setting up remote access on smartphones or other devices may factor into decisions regarding mobile access. The USU Information Technology website provides a knowledgebase that includes entries on a variety of mobile device queries. This indicates to librarians that people in the university community are using their mobile devices for academic functions. Before we conducted the survey of USU students, we knew little about the exact nature of their mobile use.

Getting Started

After identifying the needs on campus, the next step is to create a plan for mobile implementation. An important aspect of anticipating the needs of a library's user population is to understand the likely use scenarios, goals, tasks, and context as outlined in "Library/mobile: Tips on Designing and Developing Mobile Web Sites."[28] Building on services that incorporate tasks that people already perform in non-academic contexts provides a logical bridge for those who are familiar with everyday use of a mobile device to recognize how such devices can serve academic purposes.

Gathering information from each vendor that supplies content to the library is an important early step in planning. This information can serve as the basis of a mobile web implementation plan and, in the case of EBSCO, creating a profile is necessary in order to allow access to a mobile-formatted platform. At USU our online catalog provider has developed an application for Apple's iOS platform. If a library's catalog vendor does not offer a dedicated application or mobile site, Samuel Liston's comparisons of three major online catalogs on three popular mobile devices is helpful in gaining an understanding of how OPACs display on smartphones. His article also outlines a procedure for testing OPACs and usability.[29] At USU we can also take advantage of Serials Solutions' mobile-optimized search screen and a variety of applications provided by other vendors. Jensen noted that librarians should not rely solely on vendor-created applications due to vendors' tendency to develop applications that are usable by only a segment of the overall mobile device user population.[30] He adds that libraries should also avoid developing applications for limited platforms. In addition, Jensen provides a simple step-by-step process for converting articles retrieved from a vendor database to a format that can be downloaded from electronic course reserves and read on a variety of handheld devices.

While using vendor-developed applications is an important strategy, most libraries will find that developing a mobile-compatible library website is necessary.

Mobile website development can be accomplished in a variety of ways. At USU we plan to offer a version of our regular website by employing cascading style sheets (CSS). This method is described in the paper by Bridges, et al.,[31] and standard guidelines can be found in the Mobile Web Best Practices 1.0.[32] This method will allow the content to be reformatted at the point of need for a variety of platforms. Results from the USU student survey indicate a desire to be able to use a mobile device for access to the library catalog, to use services like reference assistance, find articles, and make study room reservations. The library plans to include hours and location information, access to existing reference chat and text features, and links to databases with mobile friendly websites or vendor-created applications in addition to the resources requested by students. We are still unsure of the best way to provide links to applications and how to explain the various authentication methods required by each vendor. While VPN and EZproxy are possible methods to authenticate via mobile devices, vendors are content at the moment to allow students to access their resources by setting up an account that is based on an authorized e-mail domain or through a user account created on the non-mobile version of the resource. In a few cases at USU, mobile applications from vendors allow access to categories of users such as alumni because they have a usu.edu e-mail address, although the library does not typically include these patrons in our authorized remote user group.

Advertising, Assessment, and Policy

Creating a mobile website and offering mobile services are only the beginning of the effort to provide access to library materials for mobile users. As Wilson and McCarthy found, advertising is essential;[33] students won't use a service they don't know about. Crafting a marketing plan with both online and print materials is essential. Educating library staff members, especially those on the public services front line, is an essential part of promoting mobile services.

Assessment strategies must be developed in order to focus development strategically. Periodic surveys and focus groups can inform future development of mobile services and gauge the impact of currently offered services. Librarians should encourage vendors to provide usage data for their mobile portals or applications, and libraries can track use data from their own information technology departments.

Implementation of mobile web services creates the need to develop new policies and to educate staff. Privacy concerns and the complexities of digital rights management have the potential to transform the role of the library and its policies.[34] Patrons will need to be aware that the library has less control over maintaining privacy when materials are accessed via third-party mobile applications. Libraries will need to consider how new developments in pricing models may affect expanding mobile access; one example is HarperCollins' announcement in early 2011 about a policy requiring libraries to repurchase individual e-

book titles after a cap on check-outs is reached.[35]

Librarians' desire to offer reference services or other assistance via mobile devices follows naturally from their long-standing efforts to enable patrons to ask questions via e-mail, chat, instant messaging, or SMS text. Instant messaging, chat, and text lend themselves to mobile access because they are designed for the relatively short exchange that people typically use when communicating with a handheld device. Offering reference services using SMS text and chat in particular are relatively easy for libraries to employ because there are many free services to support them. In some cases, a systems administrator or IT expert may be helpful in navigating the set-up of chat and text services and to integrate them so that, for example, when a text message arrives during a time when no one is monitoring the service, a voicemail message automatically appears in library's e-mail account. Librarians can find an enormous amount of advice on the web and in the literature about how to begin offering mobile-friendly reference, how to expand the virtual reference services they currently provide, and how to choose among free and fee-based services for their library's needs and budget. Two efficient places to begin are Cody Hanson's special issue of *Library Technology Reports*, which provides a thorough overview of mobile devices and their capabilities and straightforward suggestions for planning and implementation, and M-Libraries, a section of Library Success: a Best Practices Wiki. [36]

CONCLUSION

In light of trends toward more widespread use of mobile computing devices and smartphones, it makes sense for libraries to provide access to their collections and services in ways that work well with mobile devices. This case study presents the situation at the Merrill-Cazier Library at Utah State University, where students who responded to a survey indicate they are very interested in mobile access, even if they have not yet purchased a smartphone or find data plans to be too expensive at this point. As is only reasonable for any library, at USU we have begun by implementing mobile applications that are available from vendors of our online catalog and databases because these require minimal effort and no additional cost. We present ideas for establishing an implementation team and advice for academic libraries who wish to "go mobile." We aim to have a concrete plan for the work that will be required to optimize the library's website for mobile access by the fall of 2011. A significant step is hiring a digital services librarian to work closely with the webmaster, electronic resources librarian, and others interested in promoting access to resources and services via mobile devices. Our vision is to be on track to offer an augmented-reality experience to our patrons as the *2010 Horizon Report* indicates will be an important trend in the next two to three years. We aim to create an environment in which students can use their mobile device to gain entry to a new layer of digital information, enhancing their experience in the physical library.

REFERENCES

1. Clifton Dale Foster, "PDAs and the Library Without a Roof," *Journal of Computing in Higher Education* 7, no. 1 (1995): 85–93.

2. Russell Smith, "Adapting a New Technology to the Academic Medical Library: Personal Digital Assistants," *Journal of the Medical Library Association* 90, no. 1 (2002): 93–94; Colleen Cuddy, *Using PDAs in Libraries: A How-to-Do-It Manual* (New York: Neal-Schuman Publishers, 2005).

3. Andrea Jackson, "Wireless Technology Poised to Transform Health Care," *Rady Business Journal* 3, no. 1 (2010): 24–26.

4. Alan W. Aldrich, "Universities and Libraries Move to the Mobile Web," *EDUCAUSE Quarterly* 33, no. 2 (2010), www.educause.edu/EDUCAUSE+Quarterly/EDUCAUSEQuarterlyMagazineVolum/UniversitiesandLibrariesMoveto/206531 (accessed Mar. 30, 2011).

5. Larry Johnson, Alan Levine, R. Smith, and S. Stone, *The 2010 Horizon Report* (Austin, TX: The New Media Consortium, 2010), www.nmc.org/pdf/2010-Horizon-Report.pdf (accessed Mar. 31, 2011).

6. Shannon D. Smith and Judith Borreson Caruso, with an introduction by Joshua Kim, *The ECAR Study of Undergraduate Students and Information Technology, 2010* (Research Study, Vol. 6) (Boulder, CO: EDUCAUSE Center for Applied Research, 2010), www.educause.edu/ecar (accessed Mar. 31, 2011).

7. Smith and Caruso, *The ECAR Study of Undergraduate Students and Information Technology, 2010.*

8. Laurie Bridges et al., "Making the Case for a Fully Mobile Library Web Site: From Floor Maps to the Catalog," *Reference Services Review* 38, no. 2 (2010): 309–20.

9. Joel Cummings, Alex Merrill, and Steve Borrelli, "The Use of Handheld Mobile Devices: Their Impact and Implications for Library Services," *Library Hi Tech* 28, no. 1 (2009): 22–40.

10. Rubicon Consulting, *The Apple iPhone: Success and Challenges for the Mobile Industry* (Los Gatos, CA: Rubicon Consulting, 2008), http://rubiconconsulting.com/downloads/whitepapers/Rubicon-iPhone_User_Survey.pdf (accessed Mar. 31, 2011).

11. Sally Wilson and Graham McCarthy, "The Mobile University: From the Library to the Campus," *Reference Services Review* 38, no. 2 (2010): 215.

12. Ibid., 216.

13. Ibid., 223.

14. Jamie Seeholzer and Joseph A. Salem, "Library on the Go: A Focus Group Study of the Mobile Web and the Academic Library," *College and Research Libraries* 72, no. 1 (2011): 9–20.

15. Todd Spires, "Handheld Librarians: A Survey of Librarian and Library Patron Use of Wireless Handheld Devices," *Internet Reference Services Quarterly* 13, no. 4 (2008): 287–309.

16. Michael M. Smith and Barbara A. Pietraszewski, "Enabling the Roving Reference Librarian: Wireless Access with Tablet PCs," *Reference Services Review* 32, no. 3 (2004): 249–55.

17. Kathryn Zickuhr, *Generations and Their Gadgets* (Washington, D.C.: Pew Internet & American Life Project, 2011), http://pewinternet.org/Reports/2011/Generations-and-gadgets.aspx (accessed Mar. 31, 2011).

18. Smith and Pietraszewski, "Enabling the Roving Reference Librarian," 253.

19. Lisa Carlucci Thomas, "Gone Mobile: Mobile Catalogs, SMS Reference, and QR Codes are on the Rise—How are Libraries Adapting to Mobile Culture?" *Library Journal* 135, no. 17 (2020): 30–34.

20. Smith and Caruso, *The ECAR Study of Undergraduate Students and Information Technology, 2010.*

21. Ibid*.*

22. Carolyn Klatt, "Going Mobile: Free and Easy," *Medical Reference Services Quarterly* 30, no. 1 (2011): 56–73.

23. Kim Griggs, Laurie M. Bridges, and Hannah Gascho Rempel, "Library/Mobile: Tips on Designing and Developing Mobile Web Sites," *Code4Lib 8*, November 23, 2009, http://journal.code4lib.org/articles/2055 (accessed Mar. 30, 2011).

24. Godmar Back and A. Bailey, "Web Services and Widgets for Library Information Systems*,"Information Technology & Libraries* 29, no. 2 (2010): 76–86.

25. Mark Andy West, Arthur W Hafner, and Bradley D. Faust, "Communications—Expanding Access to Library Collections and Services Using Small-Screen Devices," *Information Technology & Libraries* 25, no. 2 (2006): 103.

26. Courtney Greene, Missy Roser, and Elizabeth Ruane, *The Anywhere Library: A Primer for the Mobile Web* (Chicago: Association of College and Research Libraries, 2010).

27. Cody W. Hanson, "Libraries and the Mobile Web," *Library Technology Reports* 42, no. 2 (February/March 2011).

28. Griggs, Bridges, and Gascho Rempel, "Library/Mobile."

29. Samuel Liston, "OPACs and the Mobile," *Computers in Libraries* 29, no. 5 (2009): 6–47.

30. R. Bruce Jensen, "Optimizing Library Content for Mobile Phones," *Library Hi Tech News* 27, no. 2 (2010): 6–9.

31. Griggs, Bridges, and Gascho Rempel, "Library/Mobile."

32. "Mobile Web Best Practices 1.0," Worldwide Web Consortium (W3C), www.w3.org/TR/mobile-bp (accessed Mar. 30, 2011).

33. Wilson and McCarthy, "The Mobile University."

34. Timothy Vollmer, *There's an App for That! Libraries and Mobile Technology: An Introduction to Public Policy Considerations* (Policy Brief No. 3) (Washington, D.C.: ALA Office for Information Technology Policy, 2010), www.ala.org/ala/aboutala/offices/oitp/publications/policybriefs/mobiledevices.pdf (accessed Mar. 31, 2011).

35. Josh Hadro, "HarperCollins Puts 26 Loan Cap on Ebook Circulations," *Library Journal*, February 25, 2011, www.libraryjournal.com/lj/home/889452-264/harpercollins_puts_26_loan_cap.html.csp (accessed Mar. 31, 2011).

36. "M-Libraries: Library Success: A Best Practices Wiki," www.libsuccess.org/index.php?title=M-Libraries, (accessed Mar. 31, 2011).

APPENDIX A. Student Survey Questions

1. Type of student?

2. Age?

3. Gender?

4. What is your college?

5. How often do you use the following electronic resources provided by your library?

6. Do you use any of the following devices?

7. Do you use your mobile device or phone for academic purposes (e.g., Blackboard, electronic course reserves, etc.)?

8. Please list what you use your device to do?

9. Have you ever used a text message to get help using the library?

10. Have you ever used Instant Messaging to get help using the library?

11. If library resources were easily accessible on your mobile devices and if you had such a device, how likely would you be to use any of the following for assignments or research?

12. What mobile services would you like the library to offer?

13. Comments?

APPENDIX B. Librarian Survey Questions

1. Type of library?

2. Your job/role in the library?

3. Years working in libraries?

4. Does your library offer mobile device applications for the following electronic resources?

5. Who in your library or on your campus is responsible for implementing or developing mobile device applications?

6. How long has your library provided access via mobile devices to electronic resources or services?

7. If you collect use data for library electronic resources, are patrons using the mobile device applications your library provides?

8. What mobile services do you believe libraries should offer?

9. Comments?