Developing In–House Digital Tools in Library Spaces

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Chapter 6

Developing In-House Digital Tools: Case Studies From the UMKC School of Law Library

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ABSTRACT

The author describes his experiences working in the Leon E. Bloch Law Library designing and prototyping in-house digital tools to improve communication among internal and external stakeholders. The projects discussed include a custom study room schedule application syncing university calendar to affordable tablets to increase staff productivity, an online data visualization dashboard to help digest large and complex sets of data for better understanding and decision making, and a mobile application to offer students and community an easy access to library resources and services. In addition, the author calls for the need to engage in innovative and experimental practices in libraries by encouraging collaboration with external partners to help develop new services and improve existing ones.

INTRODUCTION

Makerspaces, innovation labs, and Do-It-Yourself (DIY) movements became in the recent years one of the important development in technology for academic and research libraries (Johnson, et al., 2015). Perhaps it is due to their ability to engage and allow for hands-on exploration and participatory learning. In their short existence,
however, they have demonstrated how libraries can reach new constituencies by redefining themselves as community spaces and intellectual hubs and not just a print warehouse.

In the age of information abundance, libraries learned to adapt to cultural, technological and educational shifts to meet the needs of their communities. By bringing innovation into libraries, users now have a place to build, learn, and experiment in a new collaborative and engaging environment. However, innovation in libraries should not be limited to physical spaces and services we provide to our users. Libraries should also adopt innovation into their operations and practices by building, learning, and experimenting with new services and workflows that can support their communities and increase staff productivity.

In this chapter, we describe three prototypes launched with the help and in collaboration with computing and engineering students. Among the projects highlighted are: a custom study room schedule display, an online data visualization dashboard, and a mobile application. While these prototypes are still in their early development stages, they nevertheless demonstrate how working with partners outside of your library and school can open the door to new opportunities for professional and personal growth and success.

Bringing innovation to your library is not clear or easy path. Engaging in developing new, untested and unproven services is often risky (Bieraugel, 2015). In this chapter, we share the experience we gained through successes and failures while exploring the projects libraries can engage in without necessarily benefiting from an institutional “top-down” approach to innovation but rather a “bottom-top” push for the sake of our users and profession.

ABOUT THE LEON E. BLOCH LAW LIBRARY

The Leon E. Bloch Law Library is located within the University of Missouri-Kansas City School of Law, the urban law school of the University of Missouri System. It supports the School of Law’s mission of providing students with a comprehensive and affordable legal education. It aims at improving the legal information and technological literacy of law students and faculty while also providing access to its legal resources to members of the public. The law librarians are heavily involved in the educational programs by supporting the pedagogical needs of law school faculty curriculum and teaching in the first-year program and upper-level advanced research courses. Facing a rapidly changing landscape of library services and infrastructures, the library created in 2013 a new librarian position, the Digital Communications and Learning Initiatives librarian, to be responsible for the law school’s website and
Developing In-House Digital Tools

intranet, its digital collections, and facilitating students, faculty and staff access to various educational technologies.

Although the law librarians have a strong relationship with the university library system in terms of continual collaboration on ideas addressing common challenges, the Leon E. Bloch Law Library is autonomous from the main library and is governed entirely by the Dean of the School of Law and the Director of the Law Library. Its budget is part of the law school’s budget and the Dean and the Director of the Law Library determine library policies with the advice of the Faculty Library Committee.

The UMKC School of Law declared 2016 the Year of Technology highlighting several initiatives and programs to support and train tomorrow’s lawyers by introducing them to top of the line technologies, new technology-based courses, and opportunities to engage in events and conferences that connect our faculty and students with legal technologists, other law schools, and cities.

As early as 2014, the library helped establish the first Law, Technology, and Public Policy class in collaboration with Brooklyn Law School and MIT Media Lab. The course gives students a hands-on experience with technology and law by working on real projects. It brings together law students, and students from the management and engineering schools, city officials, and the civil society to develop and prototype projects aiming at improving the way citizens interact with Kansas City’s government and communities. The library is also involved in organizing and hosting several conferences introducing students and new graduates to emerging law fields and concepts such as electronic discovery, open data and sharing economy to prepare them to face the 21st century’s challenges requiring new technological thinking and ability to work collaboratively across disciplines.

INNOVATION IS A NECESSITY

American legal education and the legal profession still haven’t recovered from the 2008 financial crisis and its impact on declining job opportunities for new law graduates (Joy, 2014). According to the American Bar Association Employment Summary Report of 2012, only 56 percent of the class of 2012 had long-term, full-time employment requiring bar passage nine months after graduation (Joy, 2014). Strong competition among law graduates for fewer employment positions still remain an issue and is expected to persist for the years to come despite the declining number of applicants to law schools. The number of students entering the American Bar Association approved law schools over the years of 2012, and 2013 have declined by 10 and 14 percent respectively from the years prior (Joy, 2014). The UMKC School of Law is not immune from those challenges. As of 2016, the number of applicants
Developing In-House Digital Tools

for the 2016 entering class was down by 12 percent compared to applicants in 2015 (UMKC School of Law, 2016) and only 62 percent of 2015 graduates secured a long-term, full-time employment requiring bar passage nine months after graduation (UMKC School of Law, 2016). This situation left law schools facing increasing criticism and bad publicity for the past several years arguing that pursuing a law degree is “either a costly, risky proposition or simply a bad idea” (Joy, 2014).

However, higher education is facing more than just workforce shifts and economic instability. Other issues such as growth of technology, changing student demographic, competency based education, assessment, accreditation, and cost are threatening the future of higher education and the traditional educational delivery (Bryan & Holly, 2015).

For academic libraries, these challenges mean large-scale reorganization and resource reallocations take place (Mathews, 2012). Unless librarians engage in new opportunities to advance teaching, learning service, and research, libraries are vulnerable to “becoming just another campus utility like parking, dining services, and IT rather than the intellectual soul of the community” (Mathews, 2012). Whether libraries are still needed always come up when facing growing and changing demands. Long before the internet and web 2.0 revolutions, when “paperless society” and users being “able to search the library files electronically and receive a printout of specific information or facsimile copy of a desired document” was perceived as “extreme and painful”, libraries back then recognized the need to adapt and innovate by using technology to their benefit to “provide more responsive service” (Drake, 1979). Today the challenges are different but the fear is the same: how to justify the existence of libraries when struggling to meet the expectations of our users. Today, library users expect a Google-like search capabilities to retrieve information across all formats and sources then access it with iTunes-like interface anytime, anywhere, on any device (Mathews, 2012).

Instead of chasing the next feature or service, libraries should take time to “zoom-out” (Mathews, 2012) and innovate to become more effective in gaining new users and retaining existing ones (Bieraugel, 2015; Bieraugel, 2015; Bieraugel, 2015). According to the 2016 NMC Horizon Report, among the trends to drive technology decision-making and planning in 4 to 5 years is the advancement of cultures of innovation among higher education institutions (Johnson, et al., NMC Horizon Report: 2016 Higher Education Edition, 2016). This trend reflects the role of the university in fostering innovation, creativity, and entrepreneurial thinking not only in the curricula but also for institutional leadership to stimulate top-down change (Johnson, et al., NMC Horizon Report: 2016 Higher Education Edition, 2016). Many of today’s high profile companies have seen their debut in university dorms and
classes. In the same manner, non-profit higher education institutions are credited for most of the learning tools now promoted by for-profits and education technology startups such as online education, MOOCs, adaptive learning, and competency-based education among other learning tools (Bryan & Holly, 2015).

The argument for innovation in higher education is often hard to make. It is difficult to move away from the comfort of what is known and adopt new approaches that are yet to be proven as effective (Bryan & Holly, 2015). Drake (1979) relates the barriers to innovation in academic institutions and libraries to psychology, organizational factors, perceptions of the future, and economic factors. For library staff, resistance to changes coming from other people who don’t speak their language, may be based on fear of change, threat of being manipulated, conflict with their interests, constrain to their freedom of choice, or failure to see the value of the innovation (Drake, 1979). Many of the challenges depicted 37 years ago are still present today. Many of our users and staff are still wary about any new technology or policy changes that might threaten their established ways of doing things.

Other organizational factors constraining innovation in academic libraries presented by Drake (1979) are the difficulty to measure their successes and contributions in social values produced by access to information and knowledge. Unable to provide the needed justification for capital investment, the value of librarians is perceived in the salary paid rather than the value produced (Drake, 1979).

In the absence of a “top-down” process for innovation through policies, leadership, resources and procedures, individuals and groups create a “bottom-up” push acting alone and often without explicit permission experimenting within their immediate environment and users (Bryan & Holly, 2015).

At the UMKC School of Law, our experience can be described in what Bryan and Holly (2015) described as “an innovator’s way of being”:

What is that innovators do?

- **Grab and Apply What They Can:** Innovators leverage existing, new, proven or unproven methods or tools to improve practice, solve persistent problems or create a new offering, service, solution, product or idea.

- **Do Not Shy Away From Choices:** Innovators make important choices and trade-offs throughout their process.

- **They are Inspired by Their World and Use It:** Innovators identify tools, ideas, strands or practices from other fields and apply it to a new context.

- **Try, Try, and Try Again:** They don’t view innovation as “right or wrong,” “a failure or success,” instead all approaches are considered, tested, prototyped and learned from. (Bryan & Holly, 2015)
COLLABORATION WITH GREADUATE STUDENTS

Student workers have always been part of academic libraries. Their duties have been traditionally limited to support roles such as shelving books, answering phone calls, or staffing the circulation desks when libraries are facing staffing shortage. However, many academic libraries are using the untapped resources of skilled student workers by expanding their roles into positions with greater responsibility and requiring far more training such as graphic design and web development (Draper, Oswald, & Renfro, 2007).

Before reaching out to graduate students from the engineering and computing school, we used to handle all the development needs internally at the law library or with the help of the main campus programmers. However, it is difficult to justify the time and the expenses needed when working on experimental projects. We faced this limitation in 2015 when we decided to investigate the potential of wearable devices in academic libraries by acquiring the newly released Google Glass. However, without developing custom applications for the device to make a good use of its advanced capabilities we were limited to hands-free videos or the out of the box applications. This experience, made us realize that if we want to continue to investigate new technologies to improve the services we provide to our users, we must look for resources beyond the wall of our library and find new opportunities to collaborate across disciplines with external partners.

In spring 2016, we opened our first position of Web and Mobile Applications developer in the university’s careers network targeting graduate students enrolled in the Engineering and Computing School. Among over 50 applicants who expressed their interest in this position, we selected two graduate students to work on new and experimental projects to help us improve access to our resources and to investigate new ways of accessing and sharing information.

Our initial objective was to work on small projects that can be completed or near completion within one semester. However, graduate students are more likely to seek internship during their final semesters to help them secure a job after graduation. Therefore, we couldn’t engage on long-term projects requiring longer commitment.

The potential high turnover, besides not necessarily understanding all the coding and programming aspects of our projects, left us aware of the importance of documentation as an essential part of managing our projects and establishing traceability regarding what has been done, who has done it, and when it has been done.

Once a student joins our team, they are granted access to an online collaboration platform in which they can access all essential information regarding a specific project and quickly understand what has been done prior. The same platform is used to store all project-related documents such as meeting minutes, wireframes, tutorials, usability testing results, and source code.
Developing In-House Digital Tools

Our students maintain flexible work schedules based around their classes. However, they often work remotely from home or from other locations on campus. Due to the nature of the projects and the convenience provided by online collaboration platforms, we don’t see the need of having the students work exclusively at the library. We have weekly meetings where we all meet to discuss on-going projects and pending items. When needed, we work together to brainstorm new ideas or work on design and coding challenges.

The students report to the Digital Communications and Learning Initiatives Librarian who is assisted by one staff member represent the ad-hoc committee in charge of this initiative.

STUDY ROOM SCHEDULE DISPLAY

The Leon E. Bloch Law Library provides several individual and group study rooms to students on first-come first-served basis. While reservation is not required, the rooms are often reserved for orientations, meetings, make-up exams, or other collaborative purposes. Traditionally, the library’s administrative assistant is to take reservations, usually over the phone, and makes sure the weekly schedule is printed and posted in the study rooms. However, when a meeting is canceled or updated, the schedule often remains outdated. In addition, students are in the habit of just using the room when it is vacant without paying attention to upcoming meetings posted on the schedule. It is on the next user to ask for the room to be vacated or simply move to a different room.

The goal of this project is to prototype an efficient system to manage the library study rooms while providing an agreeable experience to our users.

Conference room signage is common in large facilities such as hotels and conference centers. They provide an easy and attractive way to display information specific to each room. However, the price tag associated with them is often prohibitive. Recently, several affordable alternatives are now available to users based on low cost tablets and ready to use mobile applications. Several free and paid applications are available for Android and iOS that work with popular calendars such as Google Calendar or Microsoft Exchange Server. These applications can be installed in many tablets to meet the functionality and budget needs of all users.

However, our school uses a proprietary schedule calendar that can’t work with off-the-shelf scheduling applications but require a custom-built application to feed the occupancy status back to a tablet. Due to the nature of the content displayed requiring minimal processing power and bandwidth, we prefer to use generic Android tablets instead of high-end alternatives such as Samsung Galaxy Tab or Apple’s iPad.
Developing In-House Digital Tools

Equipped with this initial understanding of our needs and options, we developed this list of features and requirements:

- Possibility to sync data with the school’s calendar
- Display occupancy status in real time
- Access upcoming event
- Security measures to prevent tempering with the application

The work on the Study Room Schedule Display started in spring 2016 with one graduate student. His task was to deliver a working prototype of a mobile application that sync and display a study room schedule on an Android-powered device by the end of the semester.

The first document delivered by the student was a detailed scope of work describing the time and resources for this project. The initial estimated time of accomplishment of the programming portion of this project was 78 hours comprising the preliminary research and requirement analysis of the project, design and branding, development, and initial testing.

Since we anticipated using Android devices exclusively for this project, the development was done on Android Studio, the official integrated development environment for Android platforms. The development and initial testing was done on a $50 Android tablet (Dragon Touch Y88X Plus 7’’) running on version 4.4 KitKat of the operating system.

AdAstra, is an online scheduling software provided by the university and popular among higher education institutions. This system syncs automatically with the university course schedules and offers a secure access to its Application Program Interface (API) allowing a seamless integration with third-party applications.

We kept the interface design to its minimum while focusing on having a better user experience. The home screen of the application offers access to all its features: real-time occupancy status, upcoming reservations, monthly schedule, reservation request form, and access to the secured admin section (Figure 1).

The secured admin section is used to customize the application to each study room. An authorized user can assign the tablet to a specific room, enable or disable the reservation feature, update the contact information and change the schedule synchronization interval (Figure 2).

The students worked ten hours per week exclusively on this project. With the estimated time of accomplishment of 78 hours, we were expecting to have a working prototype before the end of the semester. However, we neglected to take in consideration time off during semester breaks and exam periods. In addition, students approaching graduation are more likely to be actively looking for job opportunities.
Developing In-House Digital Tools

Figure 1. Home screen of the study room schedule application

Figure 2. Secured admin section of the study room schedule application

requiring them to take additional time off. With a little delay, we had a working prototype of the room schedule application on the final week of spring semester.

During the programing period, we were testing the application and sharing feedback with our student developer. This quick and ongoing testing, addressed on the Lean Startup methodology as part of the “build-measure-learn” process help
Developing In-House Digital Tools

organizations expedite product development by presenting new services or ideas to users for feedback and gradually building upon them (Bieraugel, 2015). In our situation, we felt confident that the working prototype, while not perfect, was good enough to be tested among our students and staff allowing us to quickly discover programming bugs and usability issues.

While most students leave the school in summer to take a break or an internship, others return for classes. This group, while not big enough, it represents a good sample of our student body to invite to the first usability testing.

Our partner for library-related surveys and usability testing is our main library, Usability Testing team lead by an outcomes and assessment librarian. The team derived from librarians and library specialists performed several Key Task Assessment, Heuristic Evaluation, and surveys to help the library make informed decisions regarding the design of its online resources and purchase of new furniture among other tasks where direct feedback from end-users was necessary. Due to our time constraints and limited number of students available to test the application in summer, we performed a popup usability testing right were the end-users are instead of a traditional usability study requiring to watch and record users performing specific tasks on the application.

Helped by the usability testing team, we developed a test plan detailing the goals and purpose of the test, the targeted audience and its characteristics, the test methodology and the list of tasks to be performed by the participants, the environment and logistics needed to perform the tasks, the data to be collected, and the research questions.

Our usability test was based on three simple and measurable questions regarding the Study Room Schedule Display:

1. Is it easy to use?
2. Is it easy to read?
3. Would you use it?

Using a large box, we divided into three sections with a whole on each one, users can use two set of ping-pong balls we painted green and red. If their answer is no, they can put a red ball into the hole near to the question, if the answer is yes, they can use a green ball.

We placed a short description of the project near the box and installed the tablet running our prototype application at the faculty and staff break room for one week.

We did the same usability testing the following week with the students at the student lounge (Figure 3).
The staff and faculty group seemed more engaged with the tablet, actively testing all its features and answering the survey questions. Few members also left additional suggestions and comments in the box or shared them directly with us.

While the students answered the survey questions, few tested the reservation feature. This behavior is also reflected on their answers to the survey and later when we installed the first tablet.

In total 24 users took the time to try the Study Room Schedule Display and answer the survey questions. While these numbers don’t represent an ideal sampling of the population, received valuable feedback and understanding of what to expect.

Regarding the legibility of the system, 80% of participants found it easy to read. While 79% of students found the system easy to use compared to only 72% for staff and faculty. However, 88% of faculty and staff expressed their willingness to use the system while only 63% of students will do so.

The most shared comment was regarding the small size of the tablet, a seven-inch tablet manufactured by Dragon Touch. Besides its small size, we also could not find a wall mount that fits this size. As we planned to have a real-life test of the system on the study rooms, we had to make sure it can be securely installed to eliminate any risk of injury or theft. After the users’ feedback, we resumed the development on an 8-inch tablet also manufactured by Dragon Touch for less than $100. This new tablet features a larger display area and runs on a newer operating system (Android 5.1 Lollipop). We also found several wall-mounts and secure kiosk displays that fit this size.
Developing In-House Digital Tools

At this time, we hired a new student to work on this project. Although, we made sure the original developer leaves the files and documentation to help the new developer understand the design and programming processes that took place, they nevertheless, needed to communicate with each other directly to exchange ideas and tips about the project.

Our goal during summer was to finish the programming and continue to improve the design while also requesting the installation of a tablet in one of the study rooms at the library.

Powering the tablet was the main issue we faced during the installation. After surveying the space, the facilities department suggested to power the tablet over Ethernet cables. With this method, we can run a network cable from the nearest network switch directly to an adapter then to the tablet using a regular USB cable. It is safer and inexpensive than running a power cable through the ceiling and walls. The end result is a clean installation with the visible part is the tablet inside the secured wall-mount. However, the work order had to be transferred from facilities to the networking department which resulted in a huge delay and an unwanted scrutiny from the campus information services department. However, with approval from the library director, we moved forward with the testing and installation of the tablet. While we couldn’t power the tablet over Ethernet, we used the nearest power outlet and concealed the USB cable along the door frame (Figure 4). Not exactly the installation we hoped for, but we knew it will be temporary just for the time to test the prototype by the library users during fall semester.

Having the tablet installed in a permanent location away from our constant supervision proved to be very helpful. In the first week, we discovered that students bypassed the security feature of the application. While not necessarily harmful, it shows a serious issue with the application that can be used by ill-intentioned users to access secured content or simply use the tablet to access or display inappropriate material. Another issue we encountered during this test was regarding the performance of the tablet itself. We often found the tablet in sleep mode or the application not syncing to the schedule. While we couldn’t determine the exact cause of this behavior, we identified few possibilities to investigate.

After reviewing the code to make sure it is not causing this sporadic behavior and testing the application with different versions of Android, we decided to use the built-in Power Off/On feature of the operating system to reboot the tablet daily. Shutting down apps and processes improves the device’s overall functioning. In addition, we added a new feature to automatically relaunch the application every 60 minutes making sure it remains connected and synced to the school’s calendar all the time.
The question is how many development hours we can put on this project. There is always a room for improvement. But our goal was to build a working prototype to test the possibility of using a custom-built application running on affordable tablets.

Our push to move forward with the installation of the tablet in the library resulted in an opportunity for the law school to embark in an official pilot project for a conference room schedule display with the outcome being an approved standard solution for hardware and software that can easily be replicated throughout the campus. However, the campus preferred solution is to outsource this service and delegate all installation and support responsibilities.

While having a custom-built application can make sense in the library with limited number of study rooms, it can represent many logistic, technical, and security challenges when dealing with hundreds of rooms throughout the entire campus.
Developing In-House Digital Tools

After a year of building, learning and measuring the success of the study room schedule application we wrapped-up this pilot project and shared our findings and recommendations with the campus to decide whether we can deploy and sustain this project.

DATA VISUALIZATION DASHBOARD

In 2015, the Leon E. Bloch Law Library revived a long defunct national survey of law school information technology staffing and services survey created by E. Ann Puckett, former professor and director of the University of Georgia School of Law Alexander Campbell King Law Library (Watson & Reeves, 2011). The survey in its original format gathered data about full-time employees assigned to law libraries and law schools and their responsibilities on administering various information technology related tasks and services. The survey results show the trends in IT administration from the perspective of law libraries over the years. Our interest in this survey stems from our desire to understand and assess the organization of our information technology infrastructure, as we were in a transition to a shared services agreement with our campus IT department.

While the survey deployment and making sure we get an acceptable participation rate was a challenge, we underestimated the time and effort needed to review and make sense of the large amount of data we received from over one hundred law schools.

This project started in summer with a goal of presenting the survey results in a visual format to help us understand the results and identify new patterns. The set of data was based on the results of the survey we conducted in 2015 as well as results from prior surveys which we received from our colleagues at the University of Georgia School of Law.

The following is the list of features we provided to our developer:

- Create an online dashboard
- Present each question on an appropriate graph
- Compare results by year

While building this system is not technically challenging for the graduate students who are familiar with big data analysis as part of their field of study, they nevertheless has to work on a short deadline as we planned to use the dashboard in a poster session on the same topic presented during the American Association of Law Libraries (AALL) annual meeting.

There are several online data visualization tools available enabling users to convert a set of flat statistics to many charts, graphs, maps and other visually appealing
Developing In-House Digital Tools

graphics. However, these tools, especially the free ones, are often limited to a single set of data manually provided by a user. In our case, we wanted to give users a great flexibility on viewing data while easily adding new results as they become available.

The dashboard was build using PHP, MySQL database, and Highcharts JS. Highcharts JS is a Javascript library used to generate interactive charts free of charge to non-profit organizations and for personal use under Creative Commons (CC) Attribution.

Before exporting the data to the online database, we had to make sure both survey results of 2010 and 2015 are identical and free of any duplicate entries. We also standardized the naming of the participating schools used a consistent state coding to generate an accurate geographic distributions of data.

The online dashboard included answers to all questions except any Personally identifiable information.

The choice of graphs used was based on the type of questions and information to display. Based on the addresses, we generated map chart grouping schools by their US District Courts affiliation. The chart also displays the number of schools participating in the survey from each state (Figure 5).

Other graphs used in the dashboard are bar chart to illustrate the average number of full time employees supporting IT services, and pie chart to illustrate the number of schools considering entering a shared services agreement. In each graph we added a an option to display the results by year. The year value is dynamically generated based on when the data was collected making sure new dates are added automatically to the charts.

Figure 5. Map chart used to illustrate the geographic distribution of schools by District Courts
The last section of the dashboard is regarding the question of responsibility for specific IT domains and functions. For this question, we identified 31 domains and services that can be managed by law libraries, law schools, campus, vendor, other entity, or a combination of multiple stakeholders. To better illustrate the large information in this question, we chose a stacked bar chart showing the percentage of schools for each domain and for each stakeholder (Figure 6).

As we are looking to continue to administer this survey in the future, we made the last section of the dashboard available to participating schools only in order to incentivize others to participate on the survey. For this purpose, we added an email field to automatically check if the user is a member of a participating school. If a user is from a law school that has never participated in the survey in the past, they receive a message inviting them to take the survey.

This project was finished ahead of the schedule allowing us ample time to test and improve on it before sharing it during the AALL annual meeting.

Working on the dashboard was straight-forward as expected. The bulk of the work was already done as the results of the 2015 survey were published as an infographic using the same charts but generated manually from an Excel sheet. However, our goal was to be able to repurpose the dashboard to illustrate different set of data. Using the same source code, with some minor adjustment, we were able to create another visualization dashboard for a survey we use to track students’ progresses in a variety of lawyering skills. The survey features around 200 questions and having a visual representation of the results make this complex set of data more accessible and easy to comprehend (Figure 7).

Figure 6. Stacked bar chart used to illustrate the ownership of various IT domains
Developing In-House Digital Tools

Since this survey tracks students during the first and third year of their legal education, we don’t have yet enough data to fully evaluate the dashboard. However, from the initial feedbacks we received, we think that it can also be helpful to students as a self-assessment tool.

LIBRARY MOBILE APPLICATION

Having a mobile application for your library is very tempting. However, with Web 2.0 tools and the proliferation of responsive design, it is hard to support the necessity to build a mobile application if the same information is already accessible from a web browser. In addition, distribution platforms such as Apple’s App Store can reject an application if it lacks the engagement or if it is not utilizing the features unique to mobile devices (Apple, 2016).

The Leon E. Bloch Law Library mobile application is one of the first projects we started hoping to have working prototype in one semester. The goal was to give students and community users access to the law library resources directly from their mobile devices.

Based on our understanding of how our users interact with the library, we developed this list of features we wanted to provide through the mobile application:

- Access the library catalog and research guides
Developing In-House Digital Tools

- Library and reference hours
- Computer lab occupancy status
- Library floor map and resource locator
- QR scanner
- Beacon proximity notifications

Before sharing our requirements with the student developer, we met with the department in charge of developing mobile applications for the university, to share our plan and to also learn more about the process involved with deploying mobile applications. We learned that for Apple iOS applications, we must work with the campus as Apple allows one developer account per organization. We also learned that we need to have a detailed ongoing maintenance and support plan highlighting the steps to be taken to make sure the application remains functioning after each operating system update, which happens frequently. The last point discussed was the copyright of all graphic and third-party coding elements used in the mobile application.

The estimated time of accomplishment of this project is 130 hours comprising the preliminary research and requirement analysis, design and branding, development, and testing. As with all our projects, we scheduled weekly meetings to discuss the progress and walk through any issues or challenges we might face. During the early meetings, we mainly discussed the feasibility of the features and we decided which one we should tackle first.

As of 2016, 65% of mobile devices in the U.S. run on Google’s Android operating system while 31% run on Apple’s iOS (Kantar Worldpanel, 2016). These numbers are different regarding adoption of mobile devices in higher education. But, nevertheless, they show what platform we should focus on. However, building native applications for each operating system can be difficult and lengthy. Thankfully, there are other alternatives to design hybrid applications to run cross platforms using web technologies such as HTML, CSS, and Javascript.

Based on the requirements of this project, the developer suggested to use Ionic Framework which offers a ready to use front-end design built on top of AngularJS and Apache Cordova as the foundation of the application. Hybrid applications combine the flexibility of web-based layout rendering and access to native features in mobile devices. The result is a single application that run on most mobile devices.

As we started working on the application, we quickly realized that this project won’t be as easy as we anticipated. Our goal from the beginning was to provide a unique mobile experience to our users without having to duplicate content and services already available through the library website. However, without having access to third-party application program interfaces (API) in the case of the library catalog or the absence of customizable API for the library research guides, we
Developing In-House Digital Tools

were limited to mobile friendly features which are already accessible from a web browser. Another feature we quickly abandoned was the reference desk live status. While the library is open for an extended period of time during regular sessions, the reference desk is only staffed from 10 a.m. to 4 p.m. Having the status of the reference desk in the mobile application would be a helpful feature. Especially for members of the public who wish to represent themselves before a court and need assistance from the law librarians.

Inspired by the computer lab widget, which displays the occupancy status on the library website by monitoring the logon sessions, we wanted to duplicated the same feature at the reference computer. However, we omitted the simple fact that reference librarians do not necessarily use the computer while helping patrons. This is the first lesson we learned with this project, which is to engage all stakeholders early in the design process.

The features that we managed to implement without any major difficulties were the library hours which was built using a JavaScript code that compares the current date and time to an existing list of holidays and special opening hours, the resources locator which provides users with a call number and a floor map when searching for specific resource in the library, and finally a QR Code Scanner which is available as a plugin for Cordova platform.

Perhaps the only feature that can provide a unique mobile experience to our users is the near proximity notification based on iBeacon technology. iBeacon is a communication protocol developed by Apple in 2013. iBeacon compatible devices transmit low energy signal over Bluetooth to nearby mobile devices. This technology allows mobile applications to trigger specific actions when near a beacon (Wikipedia, 2016).

The beacon device we used is manufactured by Estimote. It features a waterproof silicon enclosure housing a small computer accompanied by accelerometer, temperature sensor, and a 2.4 GHz radio using Bluetooth 4.0. Estimote Beacons are energy efficient and can last over 3 years on a single battery (Estimote, 2014). We decided to implement this feature in the library mobile application in order to push targeted notifications to users. In retail, proximity notifications are used to promote sales, locate products, and provide a customized shopping experience. Libraries can also benefit from this new communication medium by using near proximity communication to promote events and services, and share location-based resources. The default range of a beacon in real life situation is between 40 and 50 meters. In order to avoid overlapping the signal in the library, we had to adjust the strength for each beacon separately. We also had to control the interval of each notification. Users will not mind receiving a notification welcoming them when they enter the library. But it can be an annoyance if they receive the same notification each time they pass through the same location in a short period of time. In addition, we had
Developing In-House Digital Tools

to think of an easy way for our staff to update the notifications as needed. The solution we came up with was a web-based interface to manage signal strength, title, description, and type of action for each message we send.

The signal transmitted by the beacon includes a unique identifier. When a mobile device intercepts a signal, the application compares it to the parameters saved on the web interface and decide on the action to trigger based on the identity of the beacon received. For example, if a beacon is configured to send a notification message once a week when a mobile device is within 10 meters, the application will only trigger the notification when within the range and will only do so once every seven days.

We installed the first beacon in the main floor of the library to promote general library news and events. The second beacon is installed in the ground floor of the library and is used to promote resources for first year students. The third beacon is installed outside of the library near the Professional and Career Development Center allowing us to reach students outside of the library with general information and events (Figure 8).

During our testing, we found that the signal strength of Estimote Beacons can vary depending on the location and the environment surrounding them. The signal can also travel between floors when using high broadcasting frequencies. Therefore, we limited the signal strength to few meters to keep the notifications relevant to the locations.

Another challenge we faced with the beacons is the interval of notifications that each user might get. Storing the phone and the beacon unique IDs on our server can

Figure 8. Example of push notification received when in proximity of a beacon
Developing In-House Digital Tools

allow us to easily control the interval of notifications. However, for privacy reasons, we decided to store the data directly on the mobile devices.

We started working on the library mobile application in spring 2016 and by the end of summer we had the Android version ready for testing while we were still struggling to fix the proximity notification intervals for the iOS version. We also faced other issues after the release of iOS version 10 which resulted in unstable performance of the application.

Without having a fully working prototype for both platforms Android and iOS in a reasonable time we were unable to do any usability testing or move forward with this project.

CONCLUSION

The projects mentioned in this chapter fit with the strategic goal of the law library to build a solid communication platform capable of disseminating all type of information with internal and external stakeholders. While our approach in bringing these projects to life was unconventional, because we relied heavily on internal resources, the risk associated with developing them was minimal.

However, when we started prototyping the mobile and web applications in collaboration with the computing and engineering students, our understanding of the users’ needs and expectations were just assumptions. It’s by presenting a minimum viable product and gathering feedback we tested our hypotheses and decided where to focus our energy and resources.

The Study Room Schedule Display project which was initiated to find a better way to help library staff manage the library study room schedules and it received a positive feedback from those who will benefit from it. The prototype demonstrated the viability of this solution and its potential to improve the staff productivity. While scaling, this project will require an ongoing maintenance and improvement, we still have to decide whether this is something that the library can sustain or not. The lack of feedback regarding library mobile application and the development hiccups we faced demonstrated that our assumptions and guesses regarding users’ need to access the online resources through their mobile devices were false. One of the most common startup mistakes addressed by Mathews (2012) is the inability to validate their ideas early on. Building a working prototype and test our hypothesis allowed us to quickly discover that our concept was not viable. While the mobile application in its current version might not be feasible, there are several elements of it that we might reuse with other projects such as the near proximity communication using the iBeacon devices.
Developing In-House Digital Tools

Another lesson learned from these prototyping projects is the need to have an ongoing communication among the library stakeholders earlier in the process. New concepts must grow organically by letting potential users help nurture them rather than “cooking them up” in closed offices and meeting rooms (Mathews, 2012). In the mobile application for example, we focused on building the technology using the near proximity sensors to facilitate communication with our users while we neglected feedback from those who will create the content itself. For the application to succeed, we must plan and create new promotional content regularly. The proposed system doesn’t fit with any existing workflow we have at the library. In the other hand, the study room schedule display is based on an existing calendaring system that we are already using. In this situation, the technology doesn’t require an additional effort or learning new processes which increased its chance of success.

Finally, innovative ideas require trial and error. While the concept can be common among startups and private institutions, it is not always the case with publicly-supported ones (Coffin & Morril, 2015). Therefore, having the management trust is very important to create an environment that fosters innovation. We have been very fortunate to work with supportive managers that bring life into new ideas by facilitating access to resources and adding the weight of their own experiences to the development processes. Our colleagues have also surprised us by engaging and embracing our embryonic culture of change and sharing their innovative ideas and honest feedback with us.

We hope to continue experimenting with new ideas and processes to improve our services and empower our users one innovation at a time.

REFERENCES


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