Making the Invisible Visible: Personas and Mental Models of Distance Education Library Users

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ABSTRACT

Gaps between users' and designers' mental models of digital libraries often result in adverse user experiences. This article details an exploratory user research study at a large, predominantly online university serving non-traditional distance education students with the goal of understanding these gaps. Using qualitative data, librarians created personas and mental models focused on users' perceptions and obstacles in using a digital library and conducting research. The findings provided insight into the research habits and challenges of library users, thus allowing the library to make evidence-based decisions about designing digital learning objects and the library website.

Introduction

Usability issues are not a new phenomenon when it comes to the design of library systems, particularly library websites and online databases. Users often have adverse experiences using systems designed by library professionals and information technologists such as the Dewey Decimal System, the Library of Congress Classification System, and keyword driven online databases due to the systems' non-intuitive nature. Even as the usability of online library databases and discovery services improves, users continue to struggle to understand and maximize these systems. At the University of Georgia, Roussea, Jamieson, Rogers, Mead, and Sit (1998) used self-reported data to analyze the challenges that library systems present to users. The researchers found that 52% of students and faculty struggled to produce the right subject terms or phrases to get what they wanted from the online library system (Roussea et al., 1998). A more recent study done by Steven Bell, a librarian at Temple University, addresses the complexity of library systems. Bell (2014) advocates for a renewed and diligent focus on user-centered design in the library community, specifically to "present the complexity of library systems in as simple a way as possible to eliminate confusion and failure" (p. 370). Perhaps the most obvious evidence of the complexity of library systems and the lack of usability of online databases is

the ongoing need for library instruction at nearly all universities and colleges. This instruction on how to do research, use databases, and find academically appropriate materials online demonstrates the relentless pursuit to reduce the complexity of library systems and gain the confidence of users.

In addition to the complexities of library systems, librarians are faced with other challenges that affect the user experience. One prominent challenge is that users have patterned on "searching" in a single fashion. Essentially, users enter what they want into a search box, let the system do the work, and choose something from the results list that matches what they think they need. In short, users have acclimated to the path of least effort. Research done by Liu and Yang (2004) supports this sentiment. They found that distance education students frequently resorted to the path of least effort, or Internet searching when looking for sources (Liu & Yang, 2004). They also found that about 19% of the respondents "very often or often experienced the difficulty [using the university library system] (Liu & Yang, 2004).

Background

The Ashford University Library, a predominantly online library serving distance education adult students, observed their users (students and faculty) struggling with navigating the library Website and retrieving information from the library databases. For this study, the researchers only looked at distance education students since they make up the majority of the student body. The study was born from a need to better understand the reasons behind frequently asked questions and frustrations experienced by users. Users contacting the library often experienced the same issues and confessed to being "totally lost" in the library. While these interactions made it clear that there were usability issues with the library Website and the databases, the variables that affected the usability remained unclear. The ambiguity left user behavior open for interpretation, leading librarians to form their own mental models of the user's relationship with a digital library. These mental models generally consisted of the belief that the users understand or have the ability and time to teach themselves to navigate library systems. Many of the librarians also subscribed to the idea that library users are comfortable seeking help if they have trouble finding the information they need. Yet, the repetition of questions and evident struggle from users contacting the library attested to a gap between the mental models of the librarians and users.

To address these gaps, two Ashford University Librarians conducted an exploratory research study to generate user personas and map mental models of distance education students' and faculty's relationships with the digital library and extending information ecosystem. While research has been conducted on user interaction with computers, Websites, and libraries in general, little research has been conducted on how users' mental models of library databases and the associated research processes affect students' ability or motivation to conduct research. Furthermore, very little research has been conducted on the mental models of non-traditional distance education students,

the primary users that Ashford University serves, and their interactions with online or digital libraries. One of the few related studies, conducted by Makri, Blandford, Gow, Rimmer, Warwick, and Buchanan (2007) compared Master's degree students' mental models of digital libraries and physical libraries. The participants were asked to conduct a search on a familiar topic and describe their process out loud to the researcher followed by a debriefing interview with each participant. While many participants felt that using the digital library helped them retrieve information faster than possible in a traditional library, the researchers discovered that the participant's mental models of how the digital library systems retrieve information or how to query the system to get the desired results were limited (Makri et al., 2007). Although the participants were students who were familiar with such systems, they frequently failed to perform searches that would yield the most desired results (Makri et al., 2007). This study suggests a need to further understand the mental models of users and to either continue to educate users on how to use existing systems or change the design of the system itself to better align with users' expectations. The study also demonstrates how important it is to focus on users who are only using digital libraries.

Another relevant study performed by Mlilo (2014), evaluated users' mental models of Web search engines (WSE) and analyzed how users perceive search systems. Mlilo (2014) examined how users' mental models of WSEs changed over a ten year period. The study, while not directly related to library systems, provides useful insight into how users interact with information interfaces and searching in general. This study also used a broad set of users ranging from high school students to adult skilled workers and professionals, which is more aligned with the student body at Ashford University. Each participant was given a search task to complete while their sequences were recorded by a screen capturing software. The recorded sequence was then played back for the participant while the researchers asked questions about the participant's choices. Mlilo (2014) found that the participants showed "a distinctly simple understanding of how WSEs work with very little understanding of many salient features" (p. 59). He also cited, in the conclusion, that while mental models have become more complex and aligned with WSE's capabilities, many users were not aware of the effect of search terms on the results. Interestingly, Mlilo (2014) also acknowledged that WSEs such as Google have been redesigned with the user in mind. For example, many WSEs offer search correction, automatic boolean operators, and algorithms based on the relevance principle that allow users to "get the most out of searching without fully comprehending much about the underlying mechanics" (Mlilo, 2014, p. 62).

The librarians (a.k.a. "designers") at the university felt that they could implement a better user experience by learning more about the motivations and behavior of library users and understanding their mental models of online libraries and the research process. With this new understanding, the designers could establish a foundation to make informed decisions about the design of learning objects and the library Website.

The most relevant definition of a mental model for the purpose of this study stems from the field of Human Computer Interaction. Usability expert Dr. Jakob Nielsen provides the following description: "A mental model is based on belief, not facts: that is, it's a model of what users know (or think they know) about a system such as your website" (Mental Models and User Experience Design, para. 1). Nielsen (2010) also explains why understanding the mental models of users is so important,

> Understanding user mental models help us to begin to understand the gaps between how users think a system is going to function or how they are going to be able to interact with it and how the designers think a user is going to interact or use a system. When you see people make mistakes on your site, the reason is often because they've formed an erroneous mental model. Although you might be unable to change the UI at that point, you can teach users a more accurate mental model at an earlier stage of the user experience. Or, you might have to acknowledge that users won't understand certain distinctions and then stop making those distinctions (Acting on Mental Models, para. 1).

To create the most useful personas and mental models, the researchers approached persona creation and mental model mapping from an engaging perspective (Nielsen, 2004), which is the creation of a fictitious individual using narrative to project depth, complexity, and to view a user within a scenario rather than just looking at the scenario. The engaging persona is based on empathy, which the researchers valued as a central component of user-centered design. To harness empathy for users, the designers aggregated user data to create a small group of complex and realistic personas for whom the designers would design. Each persona's primary focus is an individual's story, motivations, and pain points. Their relationship with information literacy, the library, and research is also included, but much more defined in the mental model.

Project design and methodology

This exploratory research study consisted of several data collecting methods including coding and analyzing email and chat transcripts of librarian reference interactions with students and faculty, gathering student demographic data, and extracting narratives from student and faculty posts in the institution's learning management system (LMS). Additionally, the researchers conducted five student interviews with distance education students to further investigate how students use the library and their research processes. Faculty data also came from a survey administered in 2013.

Coding reference interactions

Student data. Researchers analyzed chat and email reference interactions between librarians and students. Email interactions from April 15 to May 15, 2014, and chat interactions from April 1 to May 2, 2014, were collected and analyzed resulting in 181 total coded interactions. The researchers chose this month, because, historically it is one of the busiest months for the library. The Nielsen Norman group, a user experience research consulting research group, recommends gathering data from

only 10–20 users for persona and mental model creation (Nielsen 2012). There-fore, the researchers of the current study felt confident they could extract deeper information about students who have similar characteristics and create personas and mental models to inform design decisions from the sample size of 181 reference interactions.

Chat and email reference interaction dialogues are recorded verbatim in LivePerson chat reference transcripts and LibAnswers email system, which allows the researchers to analyze true interactions rather than interpreted or selective inter-pretations of interactions. The codes developed organically and consisted of com-mon misconceptions, problem areas, or behavioral traits exhibited by users. The codes were informally vetted by a team of colleagues made up of five reference librar-ians within the institution. Common misconceptions or problem areas included navigation [ex: choosing a database (CD) or Website navigation (WN)], difficulty forming a query [(ex: generating keywords (GK) or too many keywords (TMK)], and the user's misunderstanding of the processes used when conducting research [(ex: search strategy SS or research process RP)]. In addition, the researchers coded characteristics and/or qualities (C&Q) exhibited by users if evident or self-confessed by the student. These included HRI (high research initiative), LRI (low research ini-tiative), NLU (new library user), TSL (technology skill low), TSH (technology skill high), FS (frustrated student), and LD (life demands). For these codes, the term "research" refers to the act of finding sources for an assignment or paper. A total of 29 different codes were created based on the reference interactions. Data recorded for each interaction included the date; student ID; course; student level (undergrad-uate, graduate); primary, secondary, and additional codes; and notes if applicable. The secondary and additional codes were not weighted, but used to add dimension to the categorization of a student's struggle, needs, or behaviors. The main struggle the user exhibited or task needed to be completed was designated as the primary code, such as locating a specific article. Secondary codes and additional codes were used when a user showed struggles in multiple areas (see Figures 1 & 2).

To minimize bias, each researcher coded each set of students autonomously. The researchers then compared their code assignments with each other in order to review and come to a consensus on any interaction where there were discrepan-cies. The students who were tagged with obvious or self-confessed C&Q codes were then extracted for deeper analysis. These codes included HRI (High Research Ini-tiative): 13 students, NLU (New Library User): 20 students, and LRI (Low Research Initiative): 10 students.

These three codes (HRI, NLU, and LRI) and their co-occurring codes and pat-terns would be used to establish the foundation for student personas. A fourth cate-gory of Faculty (F) was also included as well as a fifth potential persona, Non Library User (NU). The researchers were hoping to gather data about Non Library User(s) through student interviews.

Faculty data. Because the library typically has much fewer faculty reference inter-actions, data from a year was used. Faculty reference interactions from April 2013–April 2014 were analyzed and coded, resulting in 16 total coded interactions. All

Key short	Key long	Description
AWC	Ashford Writing Center	User asks a question that falls under the scope of the Ashford Writing Center. Example: Citing
WN	Website Navigation	User exhibits problems navigating the library website
DU	Database Usability	User exhibits problems using a database (example: using "author" dropdown to find biographical information about an author
DT	Database Tools	User exhibits an issue locating or using database tools (example: downloading an article out of the database)
CD	Choosing Databases	User doesn't know how to choose a database or has chosen an inappropriate database for his or her research needs
GK	Generating Keywords	User exhibits trouble finding keywords that result in a viable list of resources.
TB	Troubleshooting	User needs technical help (example: browser error message)
TSL	Technology Skill Low	User exhibits or confesses to having low technology skills (example: user doesn't know what browser he/she uses)
TSH	Technology Skill High	User exhibits high technology skills (ex: user is able to work through new interfaces with little assistance)
LD	Life Demands	User demonstrates or states they do not have the time to devote to the research process due to busy schedule
LTS	Long Time Searching	User demonstrates or states he or she has spent way too much time trying to find something they need (example: three days to find a course reading)
LRI	Low Research Initiative	User does not demonstrate initiating or a desire to initiate the research process on his/her own
HRI	High Research Initiative	User demonstrates initiating or a desire to initiate the research process on his/her own
AI	Assignment Interpretation	User has misunderstood an assignment leading him/her to ineffectively conduct library research
FSR	Finding Specific Resource	User exhibits trouble locating a specific resource (example: a specific article assigned as a course reading)
LCR	Librarians Choosing Resources	User wants or expects the librarian to recommend or deliver specific resources for them that meet their research need
FS	Frustrated Student	User exhibits or states general frustration with how complicated he / she thinks the library is and is generally blaming or unpleasant/impatient
SS	Search Strategy	User struggles to come up with a search strategy (ex: multiple keywords, related searches)
ILL	Interlibrary Loan	User needs to get materials via Interlibrary Loan
COL	Collections	User comments on the library's collections
RP	Research Process	User exhibits a misunderstanding or misalignment with his / her research needs and the research process. (example: student needs to conduct background research to understand a topic before reading scholarly information
WCC	Website Change Confusion	User states changes to the library website are confusing
SCHOL	Understanding What Scholarly Sources Are	User is unfamiliar with the vocabulary and / or definition of scholarly
TMK	Too Many Keywords	User states he or she has entered a long phrase or sentence into a database search box resulting in no or poor results
LR	Limiting Results	User has conducted a search with too many results and is unfamiliar with how to narrow the results using limiters
MLC	Misunderstanding of Library Contents	User does not understand what kinds of content is hosted on the library website (example: user thinks blogs are hosted in the library)
NLU	New Library User	User exhibits or states they are new to using a digital library. Characteristics of a new library user include but are not limited to: unfamiliarity with general information seeking vocabulary, unfamiliarity with digital resources and hosts (databases), little or no knowledge of search techniques, fear of using new technologies
PAP	Pasted Assignment Prompt	User pasted his / her assignment prompt into an email or a chat without asking a question
GTL	Getting to the Library	User states dissatisfaction with the ease of access to the library from other digital spaces at the university

Figure 1. Code key for student reference interactions.

16 of these interactions were used to establish the Faculty (F) persona. In addition, the researchers also coded data from the free text responses from a faculty survey administered in 2013 to get a better sense of how faculty perceived and used the library.

Date	Student ID	Course	Status	Primary code	Secondary co	Additional cod	Notes
4/7/2014		PSY331	undergrad	FSR	TMK		Trouble entering an entire title
4/8/2014		ACC281	undergrad	GK	TMK	DC	
4/8/2014		PSY	undergrad	DC	GK		
4/8/2014		SOC402	undergrad	FSR			
4/8/2014		OMM640	graduate	GK	DC		Didn't know where to begin or how to enter information into the database
4/8/2014		EDU371	undergrad	NLU	WN, DC	GK	Student new to the library, needed step by step guidance
4/8/2014		ANT101	undergrad	GK	CD	NLU	Student seemed very lost and overwhelmed
######		SOC313	undergrad	FSR			

Figure 2. Sample of coded student & librarian reference interactions via chat.

Building personas and mental models

Using the data from students tagged with C&Q codes, the librarians focused on learning about students' stories, life circumstances, and other variables that affected their relationship with research and using the library. To add depth to each individual profile, the librarians obtained demographic data obtained by submitting student ID's to the university's Institutional Research Department. This information included age, student status, marital status, employment status, parents' level of education, and GPA which was added to each individual profile, defining each student a little more.

Qualitative data from the Learning Management System (LMS)

Finally, and most importantly, the researchers, using each student ID, went into the LMS to learn more about each student coded with C&Q codes. The researchers gathered this information in order to construct realistic narratives in the personas and mental models. Using "cultural probing," defined as a method of ethnographic research where data is extracted from places where users tell stories about themselves (Etches & Phetteplace, 2013), the researchers tried to answer all or some of the following questions: what does the student do for a living?, what are his/ her dreams and/or ambitions?, what are his/her academic goals?, and what are his/her fears or perceived weaknesses? The researchers also looked at whether and how students used the library. The students' introductory posts in their courses were the most telling. Students often discussed why they were going to school, what they hoped to gain or what they wanted to change in their lives through education. This information was summarized, often including a significant quote from the student himself/herself, and added to each profile. The researchers also looked at papers and/or assignments completed by students who contacted that library to assess whether they were able to retain and apply the information they learned during the reference transaction and if they applied what they learned in subsequent courses (see Figure 3).

Figure 3. Student Profile. The profile includes codes, demographic data, and a narrative.

Student interviews

To supplement the month of data and narratives, the researchers conducted semi-structured interviews with five distance education students by phone. The researchers hoped to interview three students who were not library users and two who were library users. The goal in interviewing non-library users was to form a persona and mental model for Non Library Users, as all previous data came from interactions with students who did use the library. Students were recruited through the school's student portal and were asked to fill out an interest form. The researchers asked the students to identify whether they used the library or not. Students were chosen at random based on whether they used the library and whether they had filled out the form correctly. Students who did not fill out a field or who entered incorrect information in a field were not considered. The interviews were framed as casual conversations with students about their scholastic goals, their motivations for getting a degree, whether they had used the library and their processes not only for research, but also for writing papers and completing other research assignments. The researchers asked students about their commitments outside of school. Students were given freedom to tell the researchers as much or as little as they wanted about their lives and their motivations pertaining to school and their lives outside of school. If relevant, these students and their profiles were added to the C&Q group.

Empathy maps and personas

Within each C&Q group (NLU, HRI, LRI), the researchers aggregated the information detailed profiles of each student to form skeleton personas. First, the librarians created empathy maps from individual students within each category, which became the aggregate emotional map for each particular group. Empathy maps are
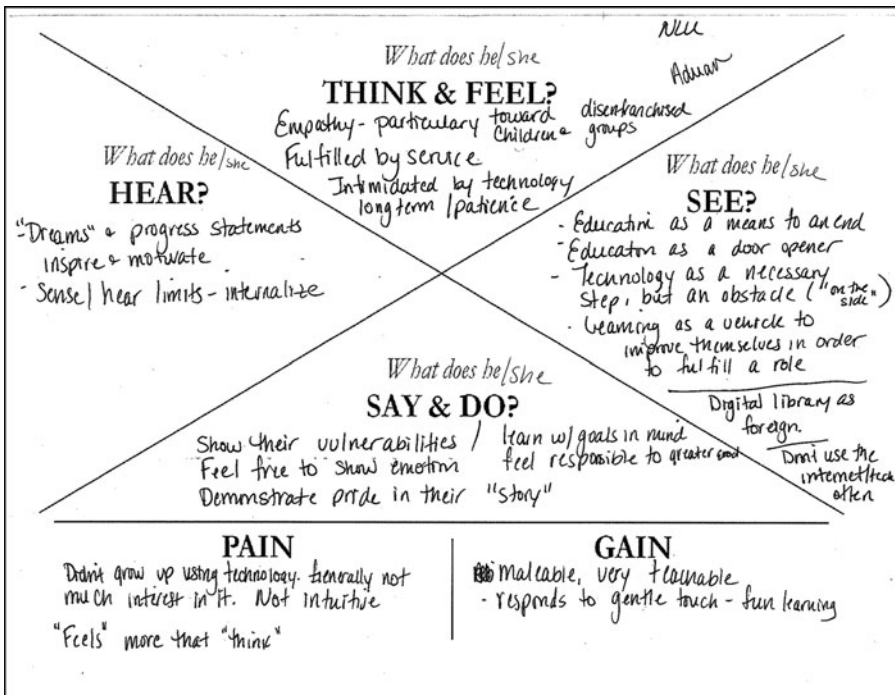
Figure 4. Empathy map. This empathy map illustrates the aggregate emotions, needs, and fears from the group New Library User (NLU).

an important part of the persona development because it "goes beyond demographic characteristics and develops a better understanding of the customer's environment, behavior, aspirations and concerns. The EM's goal is to create a degree of empathy for a specific person" (Ferreira, Silva, Oliveira, Conte, 2015, p. 1). The empathy maps defined specific emotions, motivations, fears, and needs of each persona creating a realistic representation of a specific user (see Figure 4).

To further examine each group's relationship with the library and research, the librarians entered the codes into a database and queried the database to find common-code relationships. For example, students who were tagged with NLU struggled consistently with search strategy (SS), generating keywords (GK), and Website navigation (WN). From these empathy maps and common code relationships, the librarians constructed four personas. The persona consisted of several key areas including demographic information (name, age, children, profession), motivations, goals, frustrations, areas of struggle using the library, a narrative about the student's understanding of the greater world of information, his or her relationship with education, and how the student responds to instruction. The researchers formed two primary personas and two secondary personas:

Primary:
- Adrian—New Library User (NLU): Adrian works at a grocery store, but he's tired of the grind. He is going back to school to pursue his passion of giving back to his community. He is motivated by passion, empathy, and making the

world better for others. He generally has the capacity to do well academically, communicates well through writing, but struggles with technology.

- Tina—High Research Initiative User (HRI): Tina is very intelligent and driven, but has been stuck in her position as a call center technician because she doesn't have a degree. She also has three children who keep her incredibly busy. She is an articulate writer, a fast learner when it comes to technology, and consistently has the highest grade in the course. Tina is reflective about her education and sees the intrinsic benefits of her education as well as the gains she could make in the workforce.

Secondary:

- Sharon—Low Research Initiative User (LRI): Sharon is a high risk student. She currently works as a bus driver for a local school district and stresses over finances. She sees education as a means to an end which keeps her motivated, but struggles to keep up in fast pace courses, compounded by the fact that she feels ashamed by her academic inadequacies. She tends to take the path of least resistance and hesitates to try researching or doing assignments on her own. She has trouble retaining information and applying corrections, often repeating the same mistakes course after course. She frequently demonstrates below college level grammar, comprehension, technology, and/or literacy skills.
- Diane—Faculty (F): Diane has both teaching and professional experience (she is not new to her field), has a passion for lifelong learning, teaching and helping students realize their full potential. She provides her direct phone number to students. Because she obtained higher degrees (MA/PhD) online through for-profit universities, she really understands where our students are coming from and empathizes with their needs and struggles. She lives in a rural part of Ohio, is married with two adult children, and is challenged most by time restraints and feelings of isolation as a remote faculty member (see Figure 5).

Unfortunately, there was not enough consistent data to be able to form a Non Library User persona. Of the five interviews conducted with students, three expressed that they did not use the library. Of those three, two said that their reason for not using the library was simple—they had not taken a course that required them to use the library yet. The other student was more comfortable using Internet search engines and found information faster and easier; however, this student closely fit the profile of the Low Research Initiative persona rather than standing out as a unique persona all on its own. Further research is needed to identify and determine the unique characteristics and behaviors of users who do not use the library.

Mental models

After the personas were formed, the researchers were able to use the data to construct mental models. The mental models focused on the user's ideas about research, how they believe a digital library functions, the nature of sources, the roles of librarians, and their ability to reflect on their own abilities. The researchers also mapped

out students' thought processes before, during, and after coming into the library and conducting a search, noting how the student's mental models influence his/her decisions. Faculty mental models also included perceptions about the library, how databases function, and self-perceived information literacy skill level (see Figure 6).

Discussion

Among the most common mental models about digital libraries and conducting research is the misconception about the research process (coded as SS, RP). The librarians found, particularly with the NLUs and the LRIs, that the research process was thought to be linear. For example, the students' mental model of research was that they chose a topic, found resources that answered their assignment prompts, and used the sources as "facts" they add to their paper. This type of research is reminiscent of high school research projects where often times the student simply retrieves information from a source, such as a textbook or encyclopedia article, and includes the information into a simple report. This mental model challenges library instructional designers because academic research often involves critical thinking, requiring the student to "connect the dots" through reviewing various sources of information and pulling it together to form their own arguments expressed in their own words. Critical thinking is an abstract idea and difficult to teach or explain to students. Students who exhibit this mental model tend to give up on using the library easily or use unreliable information they find through search engines.
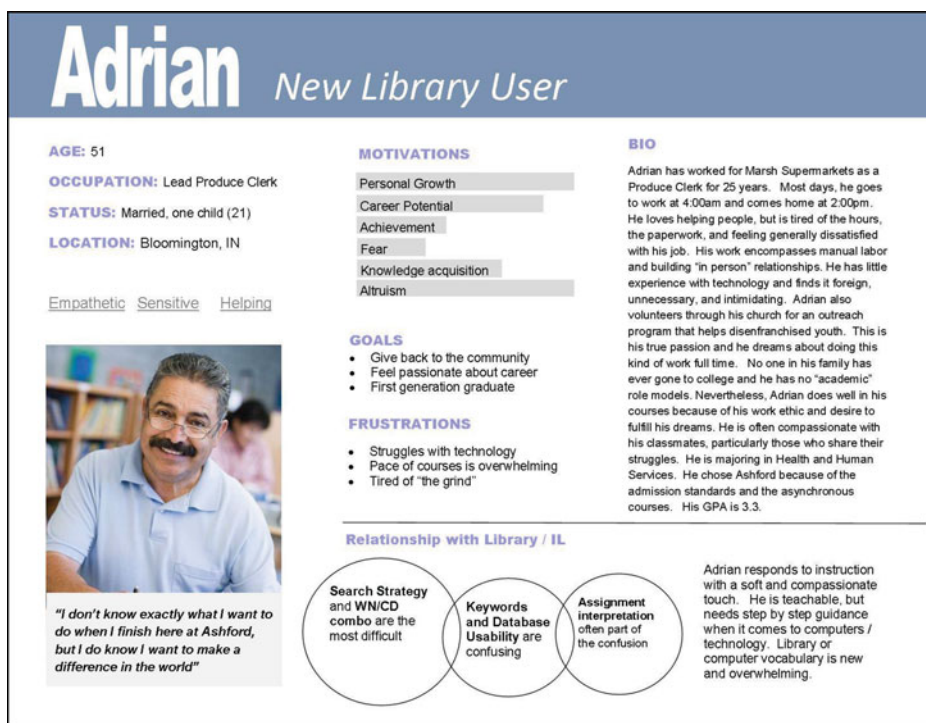

Figure 5. User Persona. This example shows Adrian, a New Library User (NLU).
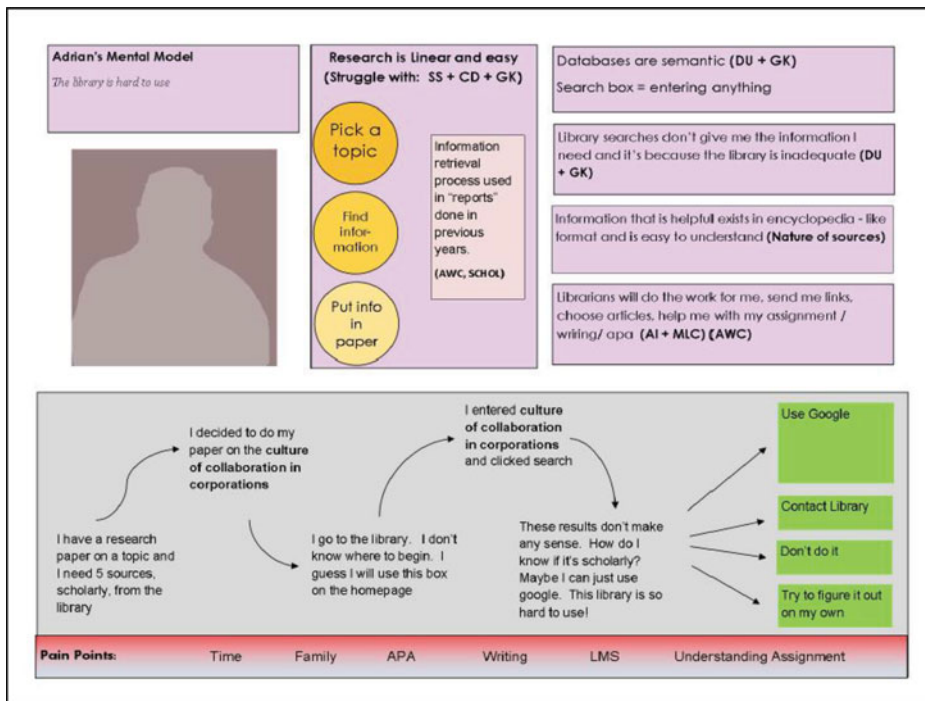
Figure 6. User Mental Model. This is the mental model for the New Library User (NLU), Adrian.

Another common misperception is that databases are semantic, evidenced by codes generating keywords (GK) or database usability (DU). These users believe the database can interpret and understand their queries, often leading the student to enter a question in the search box expecting the database to give an answer. This mental model is easier to change with instruction. Another commonality among the users was the perception that the library databases contain every kind of information source including government generated statistical data and easy-to-read encyclopedia-like articles that are scholarly in nature.

The research also gave the researchers a glimpse into what influences students' mental models before they come to the library. For example, many students work full time, are married, have dependents, or do not have a support system or role models in their lives that encourage academic pursuits. One might question, given these circumstances, how much time or energy these students can give to research or even school work in general and how it affects the student's mental model of research and using a digital library. The researchers felt this was a critically important variable to consider when designing systems and services. These life demands could influence why users are looking for information that is already tailored to their arguments or their needs for their assignment rather than skimming the body of information and adjusting their paper accordingly. These variables could also be the reason students become frustrated easily, give up or resort to easy-to-find unreliable resources. They don't need more complexity in their lives.

Other students held the mental model that librarians should provide the resources for students, interpret their assignments, or choose paths for students. Sometimes, students will paste their assignment prompt right into the search box or into an email or chat with a librarian looking for a single source that provides everything they need to complete the assignment. Often times, students are working on assignments at the last minute and do not have time or energy to do the research because of his/her life demands outside of school. These life demands do not allow the student to critically think or do in-depth research.

The mental models of faculty mainly centered on how faculty believed that the Google search experience is the standard by which the library should be measured. While many faculty were familiar with the functionality of library databases and believed that they knew how to effectively query databases to find resources, they believed that databases should function more like the Google search engine. Constrained by time limitations and competing responsibilities that often include additional work outside of teaching at the university faculty felt that using the library should be uncomplicated and intuitive. Faculty struggled most with library Website navigation, troubleshooting technical problems in the library, knowing how to access the library, and choosing a database for their research.

Conclusion

Through this research study, the library was able to specifically identify action items that needed to take place to begin to close the gaps between the user and designer and improve the overall user experience for the library. First, mental models must be addressed outside the library and in conjunction with assignments and the learning process. This is particularly true for addressing database querying, where to find specific sources, and how to maximize database tools. For example, adding an interactive learning module outlining how to research for a specific assignment should be placed at the point of need, in the LMS along with the assignment instructions. The hope here is that the student will understand the research process before coming to the library, and avoid getting frustrated and giving up. Second, the researchers found that students consistently struggled with navigating the library Website or finding a starting place for their research. To address this, the Website has been redesigned creating easy pathways for students to find quality materials, help, and instruction. Because students come to the library directly from the LMS, the redesign will also include dynamic content that appears based on the student's course. This content will help students choose a database and find resources faster and more efficiently.

Overall, the personas and mental models helped solidify a group of people for whom the library will design and consider in future library decisions. Although the researchers believe that they removed a lot of the ambiguity about how users perceived the library and the research process, they also feel as though the study could be more formalized, by including additional analysis of non-library users.

A research study on library non users would require a different scope of parameters, data sources, and recruitment methods, but is imperative for a more holistic, user-centered design approach.

Another limitation of the study is the amount of time and resources it took to be carried out, which may not be realistic to replicate in many other academic library settings. Likewise, the researchers of the study are librarians with many competing responsibilities, such as reference hours, instruction duties, liaising with faculty, and other assessment projects that create significant time restraints. These restraints limited the amount and breadth of the data used, and therefore may not be representative of the user population at the university. Even so, the researchers are confident that the data gathered provides valuable insight into the university library's users and serves as an excellent starting point for making user-centered design decisions.

As technology improves and shifts so will the mental models of library users, thus requiring new studies. As Bell (2014) advocates, "It is up to librarians, perhaps working with a designer, to enable each user, within reason, to shape the work environment to deliver the best possible library experience" (p. 373). The university librarians will use the information learned about its community to continue to make user experience a top priority across all library spaces and services even when that means countering traditional library methods and systems. They also hope to inspire other departments to similarly endeavor to understand its users and design with the user in mind.

References

Bell, S. J. (2014). Staying true to the core: Designing the future academic library experience. *Libraries and the Academy*, *14*(3), 369–382.

Etches, A., & Phetteplace, E. (2013). Know thy users. *Reference and User Services Quarterly*, *53*(1), 13–17. http://dx.doi.org/10.5860/rusq.53n1.13

Ferreira, B., Silva, W., Oliveira, E., & Conte, T. (2015). Designing personas with empathy map. Paper presented at the Conference: SEKE 2015: *The 27th International Conference on Software Engineering and Knowledge Engineering*. Pittsburgh, PA USA. Abstract retrieved from: http://www.researchgate.net/publication/276207468_Designing_Personas_with_Empathy_Map

Liu, Z. & Yang, Z. (2004). Factors influencing distance-education graduate students' use of information sources: A user study. *Journal of Academic Librarianship, 30*(1), 24–35.

Makri, S., Blandford, A., Gow, J., Rimmer, J., Warwick, C., & Buchanan, G. (2007). A library or just another information resource? A case study of users' mental models of traditional and digital libraries. *Journal of the American Society for Information Science and Technology*, *58*(3), 433–445. http://dx.doi.org/10.1002/asi.20510

Mlilo, S., & Thatcher, A. (2014). Changes in users' mental models of web search engines after ten years. *Ergonomics SA*, *26*(2), 50–63.

Nielsen, L. (2004). Engaging personas and narrative scenarios (Doctoral dissertation). Retrieved from http://personas.dk/wp-content/samlet-udgave-til-load.pdf

Nielsen, J. (2012). How many test users in a usability study. Retrieved from https://www.nngroup.com/articles/how-many-test-users/

"Nielsen Norman Group." (2010). Mental models and user experience design. Retrieved from http://www.nngroup.com/articles/mental-models/

Rousseau, G. K., Jamieson, B. A., Rogers, W. A., Mead, S. E., & Sit, R. A. (1998). Assessing the usability of on-line library systems. *Behaviour & Information Technology*, *17*(5), 274–281. doi:10.1080/014492998119346