

## **Innovative Data-Driven Methods to Improve Digital User Experience**

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**Abstract:** Digital user experience (DUX) is a combination of art and science. From an artistic point of view, DUX should provide a simple, clean and engaging web or mobile interface. In order to design such an artistic interface which guarantees the best user experience, scientific user research must be conducted to better understand users' needs, their motivation to use websites, as well as their web behavior. This paper explores qualitative and quantitative user research methods in each DUX stage in order to build excellent user experience on the library website. In general, DUX is comprised of 6 stages: planning, user research, design, development, launch, and quality control. At Indiana University – Purdue University Indianapolis (IUPUI) University Library, a variety of qualitative and quantitative usability research was conducted in different settings. This, along with data from Google Analytics and Google Webmaster Tools, were used before launch in order to know the users. After launch, user experience research was conducted during multiple library instructional sessions to ensure that users had a good experience on the website. This paper addresses diverse user research methods and discuss tools used during DUX research conducted from January 2014 to December 2015. In addition, the paper will compare pros and cons of DUX methods; discuss practical tips on how to apply data gathered from user research to design and improve websites; and share lessons learned such as DUX research planning, challenges, and effective methods in each DUX stage.

**Keywords:** Digital user experience; DUX; User-centered design; Qualitative UX methods; Quantitative UX methods; Academic library website

### **1. Introduction**

Understanding users is key to the design of any service or product that academic libraries provide. Their experience plays a critical role in their decision of whether or not to reuse them. Library websites are no exception and that's why it should be the first step to identify users' needs, their motivation to use websites, their web behavior and etc. in order to improve digital user experience (DUX). Libraries have applied user-centered design methods to their websites: user research & analysis, design, and evaluation. Each step involves at least one

DUX method to identify, verify, and certify users' needs and design. These processes are iterative and continuous through the website lifecycle. In this paper, the authors introduce quantitative and qualitative DUX methods used at Indiana University – Purdue University Indianapolis (IUPUI), compare and contrast them, discuss how both types of data were applied to web development, and share lessons learned.

### **Background**

The Digital User Experience (DUX) Working Group at IUPUI University Library (UL) initiated a project of the redesign of the UL website in 2014. User research with various methods – surveys, individual interviews, usability testing, Google Analytics and Google Webmaster Tools – was intensively conducted in the period of 2014 in order to know who the main users were, what their needs and wants were and how they interacted with the UL website. The findings and results of the data analysis from user research were applied to a new design which was also tested with A/B method. The new website was launched in July 2015 and additional user research was conducted in the fall semester of 2015 in order to measure DUX and evaluate the new website. The DUX Working Group consists of a digital user experience librarian, a lead technology analysts/programmer and a digital scholarship collections specialist.

## **2. Literature Review**

According to ISO, user experience (UX) is defined as “a person’s perceptions and responses that result from the use or anticipated use of a product, system, or service.” Bevan (2009) argues that although this definition can be interpreted as satisfaction in usability, differences exist between usability and UX by their objective. Usability tests focus on improving human performance, while UX evaluation methods try to enhance not only performance but also overall experience, such as how users feel. That’s why Roto, Obrist, & Vaananen-Vainio-Mattila (2009) insist that UX is subjective and very context-dependent.

There have been efforts to develop UX evaluation methods. Although it is not realistic to apply all of the UX research methods to a project, it is important to know when to use what (Rohrer, 2014). Roto, Obrist, & Vaananen-Vainio-Mattila (2009) reveal that the most used UX methods are field studies where a participant is observed, interviewed, or self-reporting her/his experience. Vermeeren et al. (2010) also support the argument that field studies are preferable because these allow the collection of UX data in real contexts of use. However, both authors confirm that lab studies or mixed methods are also often conducted in order to efficiently collect rich data from users.

Vermeeren et al. (2010) and Rohrer (2014) attempt to categorize existing UX methods. According to Vermeeren et al., these can be categorized by origin of the method (academia vs. industry), type of collected data (quantitative vs. qualitative), information sources (actual user vs. expert), period of experience (single episode vs. sessions vs. momentary), and development phases. The

authors find that most of the methods originate from academia and UX professionals equally use either type of data or both collected from actual users. The UX methods have been mostly used in the later development stage with functional prototype or product in the format of either single behavioral episode, test session, or momentary.

Rohrer (2014) focuses on a 3-dimensional framework: attitudinal vs. behavioral, qualitative vs. quantitative and context of use. In terms of the attitudinal vs. behavioral dimension, he distinguishes them as “what people say” versus “what people do.” Surveys are a good tool to measure attitudes while field studies are one of the most popular methods to capture behavioral data. Furthermore, he claims that in UX, qualitative data are generated by observing behaviors or attitude directly while quantitative data are collected indirectly through a survey or analytics tool. UX research can be deployed in the natural setting where the product is actually used, like ethnographic field studies or analytic tools. The scripted study is conducted for specific usage aspects in the usability lab setting. Studies can also be done without the actual product being used in order to examine users’ needs or test out concepts.

Furthermore, Vermeeren et al. (2010) and Rohrer (2014) consider associating UX methods to the phase of product development. While Vermeeren et al. assert that there is a demand to develop UX methods especially in the early stage, Rohrer describes that the methods can vary in this phase. He summarizes that in the early stage of development, qualitative and quantitative studies with attitudinal and behavioral elements should be utilized in order to explore new opportunities. Qualitative studies such as field studies, paper prototype, and usability studies are a great help to design while quantitative data through surveys serve evaluation or assessment of a product or service.

### **3. User Research Methods**

The DUX Working Group had to first develop a project management plan for the redesign of UL website. Since this was a newly formed group at UL, a heuristic evaluation and staff survey were conducted as a first step. This was done for two key reasons: it allowed the Group to become familiar with the UL website and to identify major usability issues which should be fixed. Since there was no user involvement in these two methods, there was no need to undergo IRB review and approval which are often needed before conducting UX research. Therefore, these processes enabled the Group to quickly yet efficiently prioritize tasks in the project management plan.

#### **3.1 Identify Users**

A mix of user research methods were applied in order to identify users and understand their behavior. The first method used was a user survey via the SurveyMonkey online tool. The survey was open from April 7, 2014 to May 16, 2014 and it was available on the UL website, UL’s social media (Facebook and Twitter), in addition to UL’s public computer workstations. In order to reach out

participants who were members of the IUPUI community but didn't use the website, the survey invitation link was also sent out through UL email communication as well as JagNews, a campus-wide newsletter at IUPUI. The survey was comprised of 21 – 24 questions and the total number of participants were 282, 18 of which declared that they had never used the UL website. From the survey, quantitative data were collected in order to “evaluate the UL website, discover why they used and what they did on the website, and find out what they expected” (Lee, 2014a).

The DUX Working Group assessed the data available from Google Analytics from the period of January 2013 to April 2014. Google Analytics provided massive amounts of quantitative data such as pageviews, average time on site and bounce rate. Additionally, the data sets from Google Analytics contained rich information about the top 100 most visited webpages, top 100 organic search keywords, top 100 site search keywords, and behavior flow. The authors used Excel to analyze the data sets at that time, but later R was used as an analytical tool. From this method, the authors were able to find what resources, content, and information were mostly used, what keywords users typed either in the search engines or on the UL website, and the ways they navigated the UL website (Lee, 2014b; Lee, 2014c).

In order to gather qualitative data on how users behave in the context of actual use of the website, the Group collaborated with a science librarian and conducted studies of students during his library instructional sessions. The study was conducted in the fall 2014 semester during library instruction as part of an introduction to science course for freshmen. There were 27 students in Group 1 and 21 students in Group 2 and the students in both groups were asked to perform the same 20 information seeking tasks before and after library instruction. The students' behavior was captured using Verify, a usability tool. Overall, the study led the authors to conclude that “library instruction plays a key role in web usability” as it was observed that library instruction strongly affected the ways students looked for information. Moreover, it was discovered that, although students are familiar with search-based navigation like Google, they are more likely to browse through menus first than search when using the library website (Lee, & Snajdr, 2015).

*Table 1 User research methods used for identifying users at UL (Adapted from Rohrer, 2014)*

Behavioral	* Usability in library instruction	<ul style="list-style-type: none"> <li>○ Google Analytics</li> <li>○ Google</li> <li>Webmaster Tools</li> </ul>

<b>Attitudinal</b>	✦ (Informal) Interviews	✦ Survey
	Qualitative (Direct)	Quantitative (Indirect)

Key for context of website use		
✦ Scripted use of UL website	● Natural use of UL website	✦ Not using the UL website

### 3.2 Design

In the design phase, the DUX Working Group concentrated on developing information architecture, homepage and content page layout based on the design goals. The design goals were defined as easy access to resources, mobile friendliness and unified presence. The survey analysis was useful when defining them since it disclosed rich information about motivation to use the website as well as user expectations. The Group developed a range of design options from low-fidelity wireframes, mid-fidelity mockups to high-fidelity prototypes.

The card sorting method is often used to establish or evaluate information architecture as it allows participants to organize topics into categories or label them in a way that makes sense to them. However, due to time constraints, the Group instead developed information architecture using Google Analytics data analysis as well as user research conducted during library instructional sessions. The Google Analytics data analysis contained behavior flows as well as keywords that users typed in order to locate certain information. Both data sets indicated users' natural language for specific topics as well as ways they navigate the UL website. Although a large sample is not necessary in the DUX field, the volume of data provided by Google Analytics enhanced our accuracy. From the user research conducted during library instruction, the authors were able to identify which sections of the menu students utilized when looking for information in order to complete a series of pre-determined information seeking tasks. These two methods enabled the Group to organize web content such that users can easily find what they are looking for on the website.

The main goal of design is to implement users' needs and expectations, which are determined from user research, and manifest in the format of the website. Since a homepage functions as a gateway to content and resources, the Group provides easy access to them on the new UL homepage through a menu, search boxes, the most used services, the most used resources, and highlights. The most used services and resources were identified from Google Analytics data analysis and the survey analysis. Furthermore, new UX trends such as icons, long scrolling and card layouts were applied to the new design as the user survey indicated that the original site was not visually attractive.

Since academic libraries deploy many different systems such as Drupal and LibGuides, an inconsistent design across such pages confuses users how to use

the library website effectively (Lee, 2014a). The DUX Working Group developed the standard template applied to all UL pages aligned with Indiana University design requirements. The Group took readability into consideration as the user survey revealed that users had difficulty finding key information on the web page. This led the Group to develop two-column layout so key information is highlighted in the right side. Moreover, the Group used A/B testing to compare different versions of prototypes for menu location on the page – sticky menu vs. left-side menu vs. breadcrumbs – to see which one users prefer. In order to implement the best design in the real production environment, the DUX Working Group iterated the design process from low-fidelity wireframe to high-fidelity prototype based on informal user feedback.

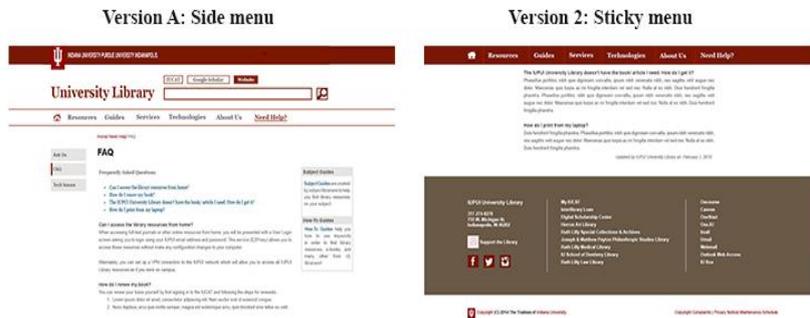


Figure 1 A/B methods

### 3.3 Evaluate

The ideal situation for an evaluation of a new website is to observe users in their context through a contextual inquiry. However, contextual inquiry is difficult to conduct effectively because it is neither just an interview nor simply an observation. Participants have to naturally demonstrate their tasks with very minimum guidelines or take an active role in leading an entire session (Ross, 2012). The DUX Working Group developed a new methodology in order to evaluate the redesigned UL website in the context of use. In other words, the evaluation was conducted in library instruction. Since undergraduate students use the UL website for their assignments or research (Lee, 2014a), library instruction was a logical place to conduct UX testing. Both attitudinal and behavior as well as qualitative and quantitative methods were combined in order to capture not only students' performance but also their overall experience.

A total of 213 students from 9 classes participated in the study during the fall 2015 semester. The classes were of varying levels (including freshmen, middle level, and senior courses). Prior to instruction, students in each of the classes were given 5 minutes to perform a series of 6 information seeking tasks during which Screencast-O-Matic, screen capture software, was used to record each student's behavior. Immediately after completing the tasks, students were given

a pre survey. This was followed by the library instructional session content and then followed by a post survey. The pre and post survey contained questions about both the library website as well as the library instructional session. This study generated rich data about students' performance, their behavior, their attitude as well as their overall experience and gave insight into what to further improve. Currently, the DUX Working Group completed data coding and is in the process of analyzing data sets from this study.

Along with UX testing in a classroom setting, the DUX Working Group periodically checks Google Analytics and Google Webmaster Tools. After relaunching the new website, Google Analytics indicates that the web traffic drops approximately 20% from the period of August 1, 2015 to February 28, 2016 compared to August 1, 2014 to February 28, 2015. There are several reasons. First, as the DUX Working Group still maintains the old website through the same domain, it causes low hits. The other affiliated websites – the Center for Digital Scholarship website, the Special Collections & Archives website, and the Herron Art Library website – were migrated either at the end of 2015 or early in 2016 and there are still several static pages to be migrated over. Second, since there is new information architecture, it causes some pages to be re-evaluated by Google; thereby dropping traffic. Third, all educational pieces of content were relocated to LibGuides whose traffic was captured as its own platform. Last, the DUX Working Group removed unnecessary pages from the user flow in order to streamline processes and optimize DUX. The removed pages, which previously earned high rankings from Google, don't exist anymore so it causes traffic to drop (LinchpinSEO, n.d.). Although the traffic drops, Google Webmaster Tools proves that search impressions and clicks gradually increase.

## **4. Lessons Learned**

### **4.1 Comparison**

The DUX Working Group at IUPUI aimed to balance between attitude and behavior, quantitative and qualitative, and context of use when conducting UX studies. The Group was also flexible in responding to informal approaches for which the IRB review process was not required. The informal approaches such as A/B testing were helpful during the design stage as the Group was able to get design feedback quickly in the early process. Unlike other methods, 5 informal interviews were not successful to solicit unique users' perspectives as these were similar to what the Group found from the online survey. However, it was useful to explore their general attitudes and how they thought about the UL website.

Below is the summary of UX methods used at IUPUI.

**Table 2 Comparison between UX Methods**

UX Methods	Pros	Cons	Data Type	Purpose	Context of Use
<b>Online survey</b>	<ul style="list-style-type: none"> <li>- Easy to gather data</li> <li>- Easy to analyze data</li> <li>- Easy to identify why and how types of questions</li> </ul>	<ul style="list-style-type: none"> <li>- Hard to capture what users actually do</li> </ul>	Quantitative	Attitude	No
<b>UX study in library instruction</b>	<ul style="list-style-type: none"> <li>- Test out with a large number of participants at one time</li> <li>- Observe what users actually do on the website</li> </ul>	<ul style="list-style-type: none"> <li>- Difficult to plan due to time limit of library instruction</li> <li>- Training required</li> <li>- Data coding is needed</li> <li>- Convert qualitative data to quantitative data in order to analyze</li> </ul>	Qualitative	Behavior	Yes
<b>Analytics Tools</b>	<ul style="list-style-type: none"> <li>- Massive data sets available</li> <li>- A variety of web metrics available</li> </ul>	<ul style="list-style-type: none"> <li>- Further data analysis is needed as to improve accuracy</li> </ul>	Quantitative	Behavior	Yes
<b>Heuristic evaluation</b>	<ul style="list-style-type: none"> <li>- Quick to conduct</li> <li>- Easy to identify issues</li> </ul>	<ul style="list-style-type: none"> <li>- No actual user involvement</li> </ul>	Qualitative	Identify issues	Yes
<b>(Informal) A/B testing</b>	<ul style="list-style-type: none"> <li>- Quick and easy to deploy</li> <li>- Test</li> </ul>	<ul style="list-style-type: none"> <li>- Results vary</li> <li>- Hard to make a</li> </ul>	Qualitative	Design testing	Yes

	design concepts or ideas	decision based on A/B testing			
<b>(Informal) Interview</b>	- Direct feedback - Yield data about how they think in general	- Time-consuming - Interviewer bias - Difficult to analyze	Qualitative	Attitude	No

#### 4.2 Challenges

It is neither simple nor easy to conduct UX studies. The studies should be well planned and prepared in order to collect the right data. That's why it is important to clearly define the study's questions such as what the study is for and what researchers want to know from this study. Since there were few studies about conducting UX testing in the library instruction, it was challenging to design the study from scratch. After several pilot studies, the authors had to figure out what UX methods would be better fit, study processes, and timeframe within the library instruction. Moreover, once data were gathered, the authors had to develop a data coding schema in order to facilitate analysis. The data were coded by the authors so they periodically met to make sure data consistency to minimize the chance of errors from coding.

#### 5. Conclusions

In order to build better user experience, it is important to conduct scientific user research to solicit users' needs, their motivation to use, as well as their web behavior. A variety of DUX methods exists and each method has its own advantages and disadvantages. It is not practical to apply all of them to a single project as it could never be completed. That's why it is important to know when to use what. The DUX Working Group at IUPUI explored different DUX methods for the project of the redesign of UL website and they made a conclusion that in the early development, an online survey was useful to recognize general attitudes toward the website and motivation to use it while an analytics tool was of help to discover what and how users actually made use of the website. Not only user research but also expert reviews like heuristic evaluation were helpful to identify critical UX issues. During the design phase, an informal A/B testing compared different versions of design and it enabled the Group to modify it before actual implementation. In the evaluation stage, an analytics tool along with UX testing measured not only users' performance but also overall UX experience.

The UX studies are not temporarily one-time work; rather, they are iterative and continuous because users' new needs and their new behavior constantly evolve. Therefore, the DUX Working Group plans to conduct another set of UX testing in the fall semester of 2016 to target graduate students and faculty via guerilla UX methods. Due to time limitation, the authors mainly focused on the main

user group, undergraduate students. Nonetheless, graduate students and faculty are also frequent users of the UL website and currently the Group lacks their information. In addition, once every page on the old website is migrated over, the Group will work on analytic tools to get accurate data about sessions, pageviews, and etc.

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