The Blank-Page Technique: Reinvigorating

Paper Prototyping in Usability Testing

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Abstract – *Arguably, usability testing is most effective when integrated into the user-centered design process. One way to encourage this integration is to re-emphasize the value of paper prototyping. In a recent test of a university library web site, we married low fidelity paper prototyping with medium fidelity wireframe prototyping. When user navigation led to non-existing pages or dead-ends, users were encouraged to create what they thought should be where there was nothing. By employing this blank-page technique, we acquired insights into users' mental models regarding site content and design, providing developers with useful data concerning how users conceptualized the information encountered.*

Key Words – *Usability testing, user-centered design, paper prototyping, wireframes, medium level prototyping*

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Lane Becker has suggested usability evaluation is not especially effective, or consistent, when employed in a single instance, as a validation tool, late in the design process. Testing like this, Becker writes, “results in a thick document that outlines everything that’s wrong with a web application…that can’t be fixed in the few weeks left before launch” [1].

Becker asserts usability testing is most effective when integrated into the user-centered design process. Rather than happening once, used as a quality assurance tool to evaluate a “snapshot” of the product, it offers more positive feedback when employed as early and often as possible. Genov echoes this, writing that if we think of a product’s design as a controlled system, like a thermostat, requiring constant feedback throughout its process to insure effective production, then usability testing is more effective when broken into a series of smaller, iterative tests occurring throughout system development and even afterwards when it is “live” or available to its intended audience(s) [2].

One way to encourage the kind of integration is to re-emphasize the value (and flexibility) of paper prototyping. As Snyder states, “One benefit of paper prototyping is that it imposes relatively few constraints on a design” [3, p. 50]. In fact, it enables users to be proactive producers and, therefore, key contributors to the design process. Paper prototyping allows users to fully express their conceptualizations, and thus reveal their mental models of a proposed design. It also helps to mitigate risk because big changes can be made without a significant cost investment [4]. Team-building is encouraged, promoting communication among various stakeholders, including users [5], [6]. Still further, because nothing is hard-coded yet, designers are willing to make changes, and users are more comfortable suggesting them [7], [8]. The result is that real users have a

more substantial say, beginning early on, about the products designed for their use, and this almost always translates to better usability, fostering an environment that sees users as a key part of the design process.

Of course, the speed of the development process and limited funding available for testing have relegated paper prototyping to the category of under-used usability methods. Also, some regard paper prototyping as less useful than more developed prototypes because a paper-based design is not accurately reflective of the final product [9]. The actual process of playing the role of computer, of shuffling paper around based upon different user requests while testing with paper, has also been singled out as too time-consuming and awkward to be effective. Leone, Gillihan, and Rauch note, "presenting and updating the mock-ups after the user makes a navigational decision needs to be done in a timely fashion or the users lose their flow of concentration" [8, p. 233]. Paper prototyping, they argue, results too often in "activity overload." Consequently, a method ideally tooled for conceptual contribution is increasingly being left out of testing; this is reflected in the limited amount of recent literature discussing paper prototyping.

Medium level prototypes, sometimes referred to as wireframes, are used frequently as a compromise between low and high fidelity [10]. They are more tangible than paper prototypes because they are often presented on the screen and clickable. But at the same time they are not yet substantially coded, so they can be generated quickly, and changes can still be made to them that would be too expensive or time-intensive for higher fidelity prototypes. Still, for all of the positive benefits of medium fidelity prototyping, users are primarily relegated to a reactive role when interacting with them. Any natural, user-driven navigational paths are often met with dead-ends where no

content has been built or links do not exist. In addition, because wireframes have a look and feel meant to mirror the final product (albeit without everything wired together), the ability of the design to grow based upon user input is lessened. Developers have made many of the decisions already and thus have created what Arnowitz, Arent, and Berger call an “overachieving prototype” really meant to be evaluated, not designed, by the user [11].

But if the real strength of usability evaluation lies in the multiple opportunities, at all stages of the process, it affords users to contribute to a product’s development, how can we enable users to contribute to a product’s design beyond the earliest stages of that process? How can we extend the effective depth of medium fidelity so that dead-ends can become productive means for users to aid in design of content? How can we effectively tap into users’ mental models within the context of a wireframe mockup?

In a recent case study we explored these issues by marrying low fidelity paper prototyping with medium fidelity wireframe prototyping. Because the terms “paper prototype” and “wireframe” have become somewhat ambiguous over the years, it is useful to elucidate here that our definitions of these concepts are consistent with those expressed by Snyder, with one reservation [3]. The wireframes also contained visual elements similar to those of comps, like color, artwork, and some use of nonsense words and pictures to illustrate potential layout. However, the prototype was primarily a working wireframe, so we will adhere to this terminology throughout.

The focus of our research was a university library web site. Fifteen users representing three client-defined groups (faculty, graduate, and undergraduate students) performed a series of tasks using a wireframe prototype of the new library web site. In

those instances where user navigation led to non-existing pages or dead-ends, users were encouraged to create, either by writing or drawing, what they thought should be where there was nothing. Importantly, this creation process was carried out within the context of the wireframe, which increased the relevance of user suggestions to the current application (for a discussion on the importance of context in general, see Maguire [12]). Additionally, we are not proposing a strictly participatory design process in this reporting, although it can be quite useful (for a seminal paper, see Muller [13]), and it typically overlaps conceptually with paper prototyping [3]. The potential benefits of the proposed BLANK-PAGE TECHNIQUE can be evident in even one phase of testing, as in the case study to be discussed, or throughout development, as would be the case in a participatory design approach. How we carried out this Blank-Page Technique to extend medium fidelity and re-purpose low fidelity testing will now be addressed, followed then by some of the results illustrating the technique's effectiveness.

BACKGROUND

The University Library formed a web re-design team in 2006 to begin the process of overhauling their web site. The re-design team was primarily interested in obtaining a better understanding of their users, investigating existing content and design, and gathering ideas for content not yet developed in the prototype. At that time they concluded usability testing would be necessary but did not know how to implement it. They also anticipated the need for only one round of testing, planned toward the end of the process.

After meeting with library representatives at an open house we hold every semester to show the facilities available for use in our usability research lab, we held

additional discussions that led to a contract for services in 2007. The agreement was that we would conduct three rounds of testing, beginning first with the medium fidelity wireframe prototype of the new library web site that had already been constructed. We would have preferred to begin testing earlier in the process, starting with a paper prototype test that joined the library design team with representative users. However, the trend already noted is that paper prototyping is not widely relied upon. Very often, too, it is the case that as providers of testing services you have to work with the client's schedule and meet its goals. Still, we felt it was valuable to solicit user feedback on the proposed design even when working with a wireframe prototype. We discussed our plans for utilizing paper prototyping within the context of the existing wireframe prototype to gather data on areas where navigation or content had not yet been developed. The clients showed immediate interest and agreed to the proposal.

Previous surveys and other pertinent data, such as web use logs, focus group results, and a heuristic analysis of comparable university library sites were all made available to us in the discovery stage of the testing process to determine representative users and tasks. As already noted, the client insisted we test three distinct groups: faculty, graduate, and undergraduate students. To gain a better understanding of these groups beyond the data already provided to us, we also conducted site visits. With user profiles and task analyses completed, we began user recruitment and formulated a test plan.

There were several goals of the case study. First, the client wanted to investigate whether the labeling, search feature, and navigation elements on the prototype were usable. Additionally, the client was interested in testing the usefulness of two secondary homepages which were created to represent the user groups, one for faculty and the other

for students. Another goal was to help the client gather information for portions of the prototype that had not yet been developed (i.e., the blank pages, new search feature, etc.). It was for this goal that the Blank-Page Technique was employed. A final goal was to identify benefits and possible drawbacks from using the Blank-Page Technique.

METHODS

Participants We began our study, approved by our institution's IRB, with a pre-screening questionnaire used to collect demographic data (see Table 1). There were 15 participants (10 female) from a variety of disciplines, including English, Information Systems, Psychology, Agriculture, Natural Resources, and Technical Communication. Participants, all of whom gave written informed consent, were volunteers solicited with university-wide, departmental, and classroom announcements. Refreshments and small gifts (i.e., pens, T-shirts, etc.) were offered after testing. Faculty members (3 female and 2 male) ranged in age from 31 to 40 (1 participant), 41 to 50 (3 participants), and 51 and over (1 participant). Graduate students (3 female and 2 male) ranged in age from 21 to 30 (1 participant), 31 to 40 (3 participants), and 41 to 50 (1 participant). Undergraduate students (4 female and 1 male) ranged in age from 21 to 30 years.

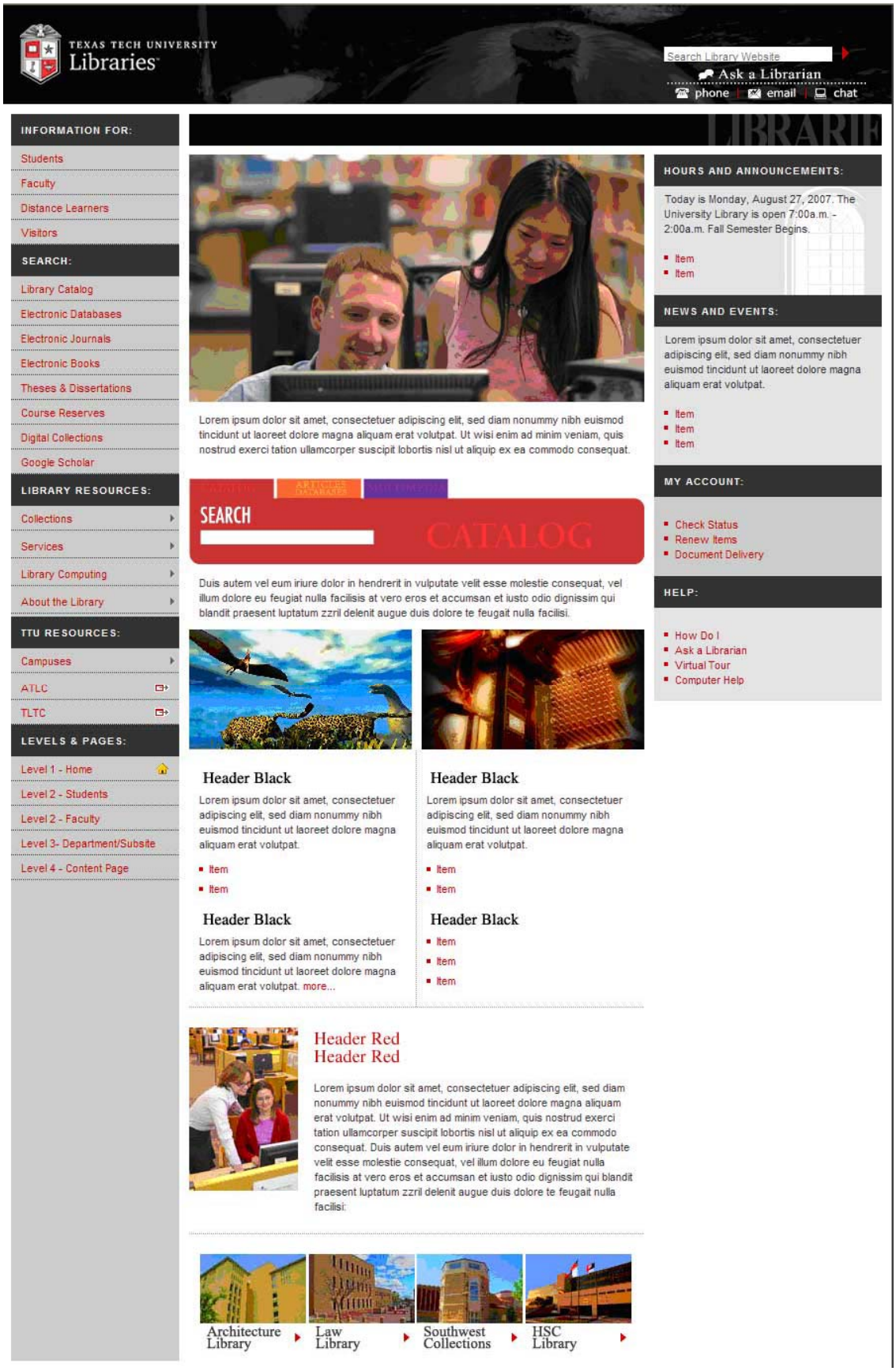
Regarding frequency of use of the library web site, pre-screening responses from all user groups ranged from daily use to almost never (Table 1). Faculty used the site slightly more often than graduate students and both groups more than undergraduates. Ratings for ability to find information on the current site ranged from 2 to 6, on a scale of 1 to 6; Faculty and graduate students averaged 4.2, and undergraduates 3.6. While ratings of the ability to find information appear to correlate somewhat with frequency of use of

the site, responses overall tended to hover around the middle area of the scale, from 3 to 5.

Table 1. Pre-screening responses.

		Faculty	Graduates	Undergraduate
Age	21-30	0	1	5
	31-40	1	3	0
	41-50	3	1	0
	51-	1	0	0
Gender	Female	3	3	4
	Male	2	2	1
Frequency of use of library website	Almost never	0	0	2
	< Once/month	0	1	0
	Monthly	2	1	1
	Weekly	3	3	2
Self-rated ability to find info on library website (1-no experience, 6-very experienced)	1 no experience	0	0	0
	2	0	1	0
	3	1	0	2
	4	3	1	3
	5	0	3	0
	6 very experienced	1	0	0

Wireframe Prototype Wireframes provided by the client are shown in Figures 1 and 2. The proposed design included one primary home page (Figure 1) and three secondary home pages. The secondary home pages were tailored for three prospective user groups: faculty, students, and distance learners. The faculty homepage displayed in Figure 2 provides an example. Distance learners were not tested during this phase and the homepage for this user group was excluded.


TEXAS TECH UNIVERSITY
Libraries
Search Library Website
Ask a Librarian
phone | email | chat
INFORMATION FOR:
Students
Faculty
Distance Learners
Visitors
SEARCH:
Library Catalog
Electronic Databases
Electronic Journals
Electronic Books
Theses & Dissertations
Course Reserves
Digital Collections
Google Scholar
LIBRARY RESOURCES:
Collections
Services
Library Computing
About the Library
TTU RESOURCES:
Campuses
ATLC
TLTC
LEVELS & PAGES:
Level 1 - Home
Level 2 - Students
Level 2 - Faculty
Level 3- Department/Subsite
Level 4 - Content Page
Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat. Ut wisi enim ad minim veniam, quis nostrud exerci tation ullamcorper suscipit lobortis nisl ut aliquip ex ea commodo consequat.
SEARCH
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Architecture Library
Law Library
Southwest Collections
HSC Library
HOURS AND ANNOUNCEMENTS:
Today is Monday, August 27, 2007. The University Library is open 7:00a.m. - 2:00a.m. Fall Semester Begins.
Item
Item
NEWS AND EVENTS:
Lorem ipsum dolor sit amet, consectetuer adipiscing elit, sed diam nonummy nibh euismod tincidunt ut laoreet dolore magna aliquam erat volutpat.
Item
Item
Item
MY ACCOUNT:
Check Status
Renew Items
Document Delivery
HELP:
How Do I
Ask a Librarian
Virtual Tour
Computer Help

Figure 1: Library Homepage Prototype.

To remain consistent with the main university web site which does not include a distinction for graduate students, a homepage for graduate students was not created. Each of the secondary home pages prominently displayed information that was thought to be most relevant for each user group. The goal of the proposed design from the client's perspective was to facilitate the acquisition of user-specific information through the construction of sub-sites.

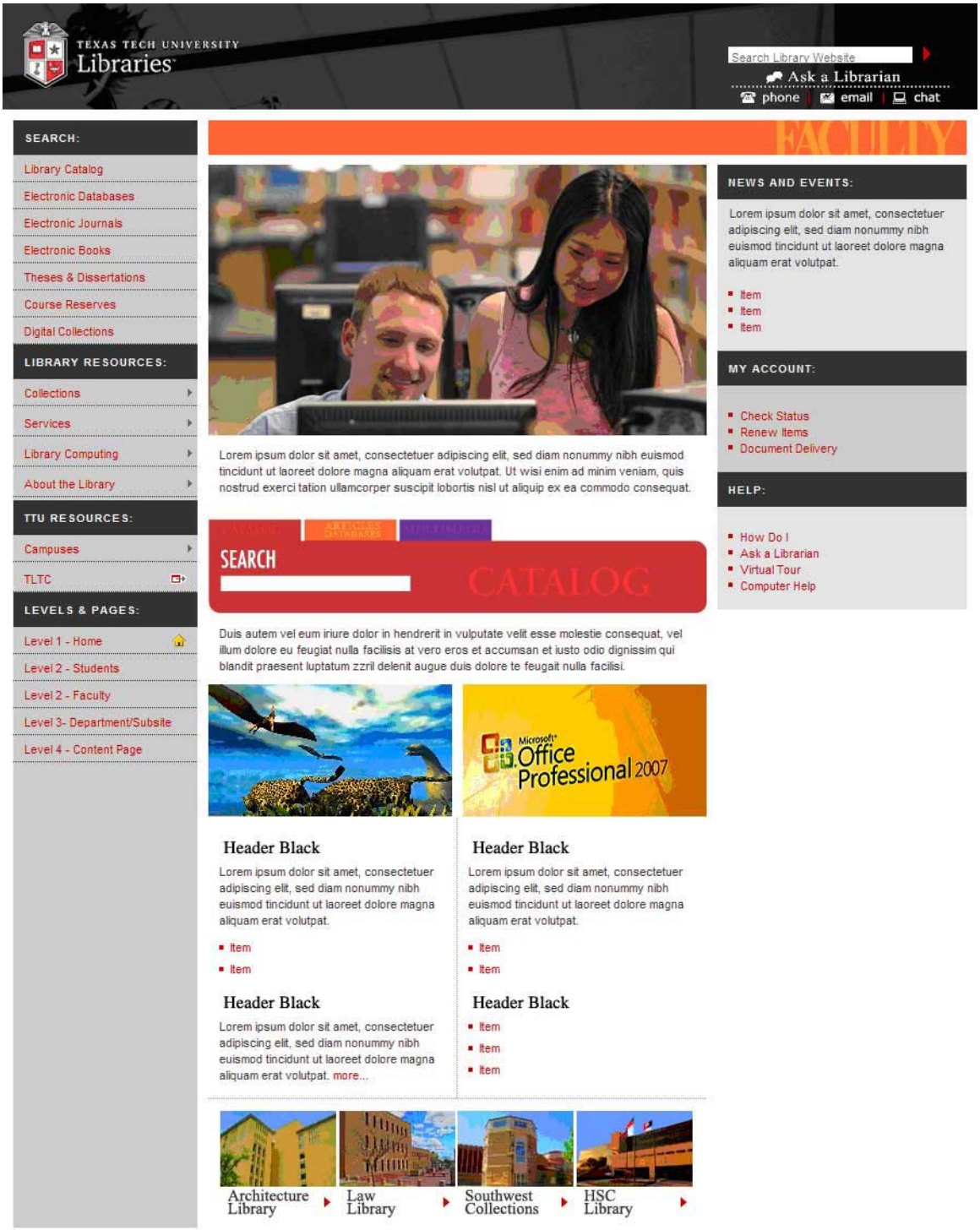

Figure 2: Faculty Homepage Prototype.

The wireframes possessed a limited degree of functionality. Users could click on all main navigation links in menus on the left and right sides of the pages. However, links off the main page, often appearing in dynamic dropdown menus, were in many cases not active. The search box, featured prominently in the center of the screen, also was not functional. For all those instances when users clicked on links that were not active, or attempted to perform searches, the typical dead link page or "404 error" screen was replaced. Rather than redirecting the user back to navigation that worked, which is typical in wireframe testing, the users were shown the following message on the screen:

> This section of the site you have now selected hasn't been developed.
> We would like your help. Please tell or show us, writing or drawing,
> what you would expect to find on this page.

The facilitator then provided the test participant with an 8 ½" X 11" blank sheet of paper and a writing instrument. The participant was encouraged to create the page as they would expect it to look; in most cases, this included what the page would probably look like, as well as recommendations for what the page should look like. For example, participants might explain, "I would expect the page to look like this. But, I would rather the page look like this."

Think-Aloud Protocol, adhering to Boren and Ramey's approach [14], was encouraged throughout all phases of testing. When the message screen was encountered, participants provided commentary of their thinking while they created the page they expected to see. Then, at the conclusion of their page creation, they were navigated back to the most recent active page for which content had been developed.

There was no limit placed on the number of blank-pages that could be encountered. Users were allowed to navigate the wireframe prototype according to the paths they determined.

Tasks Five scenarios and tasks were created for each user group (Table 2). Some tasks overlapped between user groups to allow for group comparison. There was no time limit for task completion, since at this beginning stage of the testing process no heuristics had been formulated suggesting optimal task completion times. We also did not wish to interfere with the thought processes of participants as they worked to create pages.

Table 2: Scenarios and Tasks

	Faculty	
	Scenarios	**Tasks**
1	You would like to include all of the library hours on your syllabi for your students, but are unsure what they are.	Locate this information on the Library Web site.
2	You gave books checked out to you to your graduate student to return to the library. You want to verify that the books were returned.	Use the Library Web site to find out if they have cleared your record
3	You are interested in knowing the entire list of journals the library holds in your discipline, in both print and electronic formats.	Locate that information on the Library Web site.
4	You have submitted an article to a journal in your discipline and are told that you need to make significant revisions. The revisions require you to find additional information to back up your findings.	Use the Library Web site to assist you in making these necessary revisions.
5	While reading an article in your discipline you find a citation for a resource that would back up your research. You find that the Texas Tech Libraries do not have this specific resource, but you have heard that the library can get this from another library.	Using the Library Web Site, locate information on how you would obtain this item.
	Graduate Students	
1	You have submitted an article to a journal in your discipline and are told that you need to make significant revisions. The revisions	Use the Library Web site to assist you in making these necessary revisions.

	require you to find additional information to back up your findings.	
2	While reading an article in your discipline you find a citation for a resource that would back up your research. You find that the Texas Tech Libraries do not have this specific resource, but you have heard that the library can get this from another library.	Using the Library Web site, locate information on how you would obtain this item.
3	The professor that you TA for has heard of a database in the library that would be useful to your students. He would like you to schedule a demonstration of this database for the students.	Using the Library Web site, schedule a demonstration for your class.
4	You have heard from other grad students that you can reserve a study carrel in the library for the entire semester, and you're interested in doing that.	Locate information on the Library Web site about reserving a carrel.
5	You have written a report for a class, which must be posted on WebCT. You want to change the format from Word to PDF.	Use the Web site to see if this can be done at the Library.
	Undergraduate Students	
1	You must write a research paper for a Business Administration class. The assignment requires 8-10 references from the scholarly journal literature on an administration-related topic of your choice.	Use the Library Web site to begin your research for this assignment.
2	For your Introduction to Social Psychology class, you are responsible for reading three articles corresponding to different units within the class. The instructor states in the syllabus that the articles are available electronically through the University Library Web site.	Locate the information on the Web site.
3	You have heard from your roommate that the Library has copies of textbooks for large freshman and sophomore level classes. Since the bookstore is out of the text for your Linear Algebra class.	Use the library website to see if the Library has a copy of it.
4	A group of students from one of your classes is getting together to study at the library.	Use the Web site to find out what hours the library is open on Sunday.
5	You have written a report for a class, which must be posted on WebCT. You want to change the format from Word to PDF.	Use the Web site to see if this can be done at the Library.

Testing The testing personnel included faculty, graduate students, and two staff members from the library. We elected to administer only one user per test. A facilitator worked with participants inside the testing area, while other team members observed discretely from the control room behind a one-way mirror. As participants completed tasks, video and audio data were gathered.

Once testing was completed, users were given a brief post-test structured interview (video and audio were also recorded during the interview). The interview consisted of 10 questions (4 ratings scales and 6 open-ended) focusing on issues related to satisfaction, ease of use, and navigation. Users were also asked if they felt the testing process was too time-consuming or "activity intensive," since research discussed previously had suggested that one of the drawbacks to paper prototyping was that it was often too overwhelming for participants, as well as administrators, in terms of the complexity of operations that had to be performed. Interestingly, no test participants considered the process to be "activity overloaded," which counters conclusions drawn by Leone, Gillihan, and Rauch [8].

Pilot Study In a pilot study conducted prior to actual testing, data from six participants provided us with two important pieces of information. First, participants in the pilot study did not express any difficulty in understanding the nature of the blank-page creation process, specifically, or the tasks to be completed, in general. This helped to verify that the methodology of the proposed technique was not too difficult to implement with real users. Second, each of the six participants completed the full round of testing in less than one hour. This confirmed that it was not necessary to impose a time limit on tasks, and also facilitated the scheduling of participants for the actual study.

RESULTS

The results from actual testing are broken into two major sections: wireframe testing and blank-page data. After a brief presentation of the overall task times, we will relay some of the principal findings from the wireframe testing, followed by the data generated from the Blank-Page Technique.

As displayed in Table 3, task completion times ranged from 3.7 minutes to 6 minutes on average across the 5 tasks and 3 user groups. Because the tasks are not necessarily the same across user groups, it is not meaningful to compare the task times directly. However, it is useful to recognize that users in the faculty, graduate, and undergraduate groups took, on average, very close to the same amount of time to complete all five tasks, at 21.6, 23.6, and 22.1 minutes, respectively. The total testing time, including introductions and post-test interviewing, fell between 45 minutes and 1 hour for all participants.

Table 3. Task and test completion times, rounded to the tenth of an hour.

Tasks	Faculty	Graduates	Undergrads	Average Task Time
Task 1	4.0	5.1	5.4	4.8
Task 2	3.8	3.7	4.1	3.9
Task 3	4.8	6.0	4.0	5.0
Task 4	4.0	5.0	3.7	4.2
Task 5	5.0	3.7	4.9	4.5
Average Test Time	21.6	23.6	22.1	22.4

Wireframe Testing Task analysis, observations and think-aloud protocol data, as well as post-test interview results, allowed us to identify several key usability issues for the client. For example, we learned that participants experienced difficulty with some of the headings/labels. Several headings, such as Digital Collections, Document

Delivery/ILL, and Library Computing, were not intuitive. Users did not know how to use these links to complete the navigation required for successful task completion.

Hours of operation were also not sufficiently detailed, and users were further confused by the different prompts encouraging online help, namely "Ask a Librarian," "How do I?" and "Computer Help." They had problems disambiguating the differences amongst the terms.

Photos were considered to be unhelpful, especially at levels beneath the home page. Users wanted more details that provided answers to task prompts on deeper-level pages, although they believed the home page, despite its prominence in branding the library's mission, should have less photos as well. As one user commented, "I know what a university library web site is for and who uses it. Why do I need so many photos of people showing me what I already know about?"

Not all users believed the library should divide its site into role-driven sections, namely the faculty and student areas, and three of the graduate students were unsure of which they should be using. However, if secondary homepages were necessary, some strongly suggested that content in these areas be aimed more directly at fulfilling the interests of those that are represented by the area. In particular, two of the faculty participants expressed that they wanted more functionality to be exposed, and they did not like that so much of the content-space was filled with pictures, what one referred to as "non-pertinent information" (see Figure 2).

Interestingly, it came as a surprise to the client design team when they learned that on only two occasions users ever began navigation according to their roles by using the secondary home pages in their search for information (see Figure 2). When these

users did take these expected navigational paths they quickly became confused. They then returned to the main home page to re-orient themselves and continue the task. Occasionally, users avoided traditional navigation with links and used instead the search box of the site, even though they had been informed that it was not functional. More (8, in fact, or a majority of test participants) indicated they would have done this right away as well but they expressed frustration that the main search feature was not easily found on the page, hidden by too many photos or other content clutter. They also regarded the tabs above it, which included catalog, articles/database, and multimedia, as confusing (see Figures 1 and 2). In all, 12 participants (5 faculty, 4 undergraduate, and 3 graduate students) initiated searches using one of the search engines (the main search feature in the center, or the "Search Library Website" feature in the upper right-hand corner) during testing. At the request of the client, we rerouted participants who used the "Search Library Website" feature to the homepage because this element was under the control of a third party.

Blank-Page Technique As users clicked on the search box or navigated to a page that did not exist, they were directed to a blank-page with the message indicating that the page was not complete but they could help us design it with their comments or drawings. Given how participants navigated, often at odds with expected navigational routes that the wireframe allowed for and heavily reliant on search as a first, not a last, resort, they encountered 77 blank pages during testing. Normally, of course, participants would be re-directed back to a navigation path that would allow for task completion. But for our testing we asked users to provide their input on the blank-pages, and the recorded comments yielded substantial insights.

Blank-Page Data: The frequency of blank-page selection was comparable across the user groups (see Table 4), with faculty, graduate, and undergraduate students selecting blank-pages on 28, 23, and 26 occasions, respectively. Not surprisingly, the blank pages selected most often (Library Hours, Articles/Database tab on Search, Check Status in My Account, and Course Reserves) were directly related to tasks being conducted. Therefore, blank pages were nearly always selected only when users sought to perform tasks representative of those typically performed by all faculty and students of the library web site.

Table 4. Blank-pages encountered by user group.

No.	Blank-pages	Faculty	Graduate	Undergrads	Totals
1.	Electronic Databases	1	2	1	4
2.	Electronic Journals	2	0	2	4
3.	Hours	5	0	3	8
4.	How Do I?	1	1	3	5
5.	Computing Help	0	1	0	1
6.	Workstations	0	1	1	2
7.	Articles/Database tab	2	3	3	8
8.	Check Status in My Account	5	0	1	6
9.	Collections	0	0	1	1
10.	Printing in Library Computing	0	0	2	2
11.	Document Delivery	3	1	0	4
12.	Instruction Tours	0	4	0	4
13.	Interlibrary Loan	2	2	0	4
14.	Software page of Library	0	1	0	1
15.	Ask a Librarian	1	0	0	1
16.	Course Reserves	0	4	5	9
17.	Library Catalogue	5	2	3	10
18.	Technology	0	1	0	1
19.	Theses and Dissertations	1	0	0	1
20.	Tour and Announcements	0	0	1	1
	Totals	28	23	26	77

Much of the user-suggested content for the blank pages, especially when the pages were drawn out, cannot effectively be represented quantitatively. However, in

some cases, we were able to tally items that were suggested as content. For example, the items listed in Table 5 represent user-suggested content for the Articles/Database tab on Search.

Table 5. Written/Verbal comments provided for Articles/Database tab on Search.

Information on how to find an article
Just like current Web page design
Participant assumes it has articles (x2), journals (x2), and databases
A full list of everything subscribed to
Organize journals according to search
Wants to select databases to search
Search box (x2)
To search for databases based on a particular subject (i.e., keyword, search term)
More specific search box to narrow search terms
Boolean capabilities
Search Results (x4)
"Your search for 'search term' returned…"
First would expect to see a list of databases resulting from the search
List of citations (x4) with first few lines of text (x2)
Linkable title (x2)
Sort by Author, Date, Title (x2)
Bolded or highlighted search terms (x2)
Ranked by relevance (in percentage) to search terms (x2)
Use color for links to signify format (i.e., PDF, HTML, etc.)
Icons for full text results (x2), PDF, HTML, etc.
Want to know readily if results are full text
Want to know if items are available in holdings
Separate results by full text or not availability

"Request" button for items not in holdings
Date

In many cases more than one user had the same suggestion. For example, two users suggested a search box for the Article/Databases page, and three additional items were suggested regarding the search box. Some comments focused on how the search should be structured, suggesting it possess "Boolean capabilities." Others suggested how items should be displayed after searching, writing "First I would expect to see a list of databases resulting from the search." Still others focused on the design of the page, writing that the search returns page should "use color for links to signify format (i.e., PDF, HTML, etc.)."

In total, 189 user-suggested content items were generated using the Blank-Page Technique. These focused on a variety subjects, ranging from electronic journals ("If I login, it should recall my previous searches") and work stations ("what kinds of programs are installed?") to document delivery ("there needs to be some sort of tutorial to walk us through how to use it") and instructional tours ("these should be divided up and categorized according to discipline and/or role").

Yet another example of the data blank-page commenting mined can be found when focusing on the multimedia tab found above the search box in the middle of the prototype screen. Developers had not yet determined what content should be placed there, so all of the insights provided by way of the blank pages were helpful for the client in conceptualizing just what was meant by a multimedia search. Figure 3 below lists the content suggested for multimedia, broken down by user group.

Several items were repeatedly suggested as content for the multimedia search, including Video (10 participants), Equipment available (8 participants), Availability of multi-media resources (4 participants), Video Courses, Lectures (4 participants), and Podcasts (3 participants). We believe these suggestions were facilitated by the Blank-Page Technique. That is, by having to realize their suggestions through drawings, participants were better able to express what information they felt would be provided on this page.

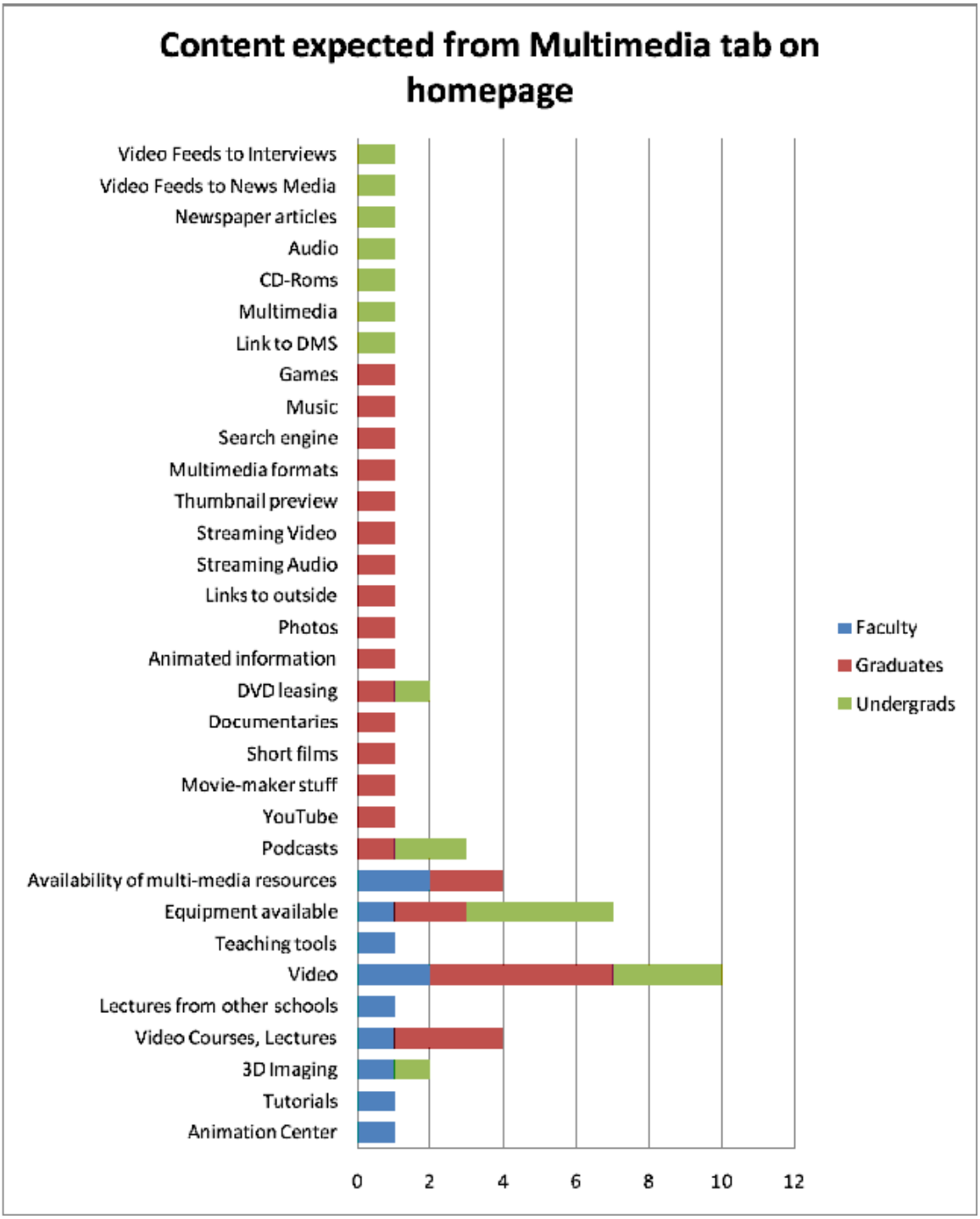

Figure 3. Content suggested for Multimedia tab.

Clearly, the number and nature of comments reveal that as useful as medium fidelity prototyping is, a great deal of user-driven information goes undiscovered in later stages of testing. By employing paper prototyping as an additional method, augmenting

the existing medium fidelity wireframe testing, user insights are acquired. This not only offers developers additional useful data regarding how users conceptualize the information they encounter, but it also encourages just the sort of positive, proactive user involvement that Becker, Genov, and others suggest is crucial for effective usability testing and, as a result, equally effective user-centered design.

User Drawings Of course, users did more than write out their suggestions. They also sketched what they expected to see. These drawings were enlightening and allowed users to act as designers, since they were not only offering verbal or written feedback but were attempting to make operational their vision [15], what they felt should be the look and feel of the blank page. However, and consistent with what others have mentioned (see Nielsen, 1993; Druin, et al., 1999; and Blomberg & Henderson, 1990), we did not attempt to solicit these drawings for use as a design proposal in any absolute sense. Rather, our goal was to push users to express their thoughts and expectations, mental models, of what they would expect to encounter. Granted, user expectations are likely affected by past experience, with sites of unknown usability, but simply soliciting aural responses, which are also likely affected by the same previous experience, would not necessarily compel users to fully realize their design suggestions and recommendations. That is, responses could be made without having to realize their implications.

Depicted below are examples of three participant drawings (Figures 4-6). These drawings were chosen to illustrate the varying levels of detail exhibited by participants. The drawing of the Library Catalog blank-page by a graduate participant (Figure 4) was much less detailed than a drawing for the same page by an undergraduate participant (Figure 5). Another drawing, created by a graduate student for the Instruction Tours

blank-page (Figure 6) illustrates a high level of complexity. Of course these distinctions are only subjective ones at this point as we have not yet instantiated a scheme to adequately and consistently categorize the drawings by levels of complexity or detail; this categorization process may be quite beneficial for future reporting, but goes beyond the present scope of introducing the Blank-Page Technique.

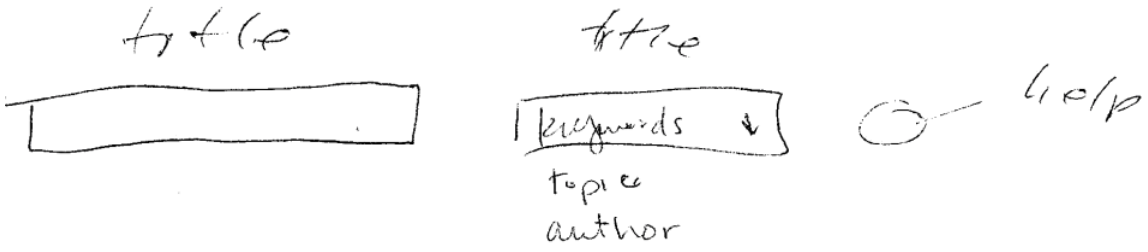

Figure 4. Participant 9 (graduate student)--Library Catalogue drawing.

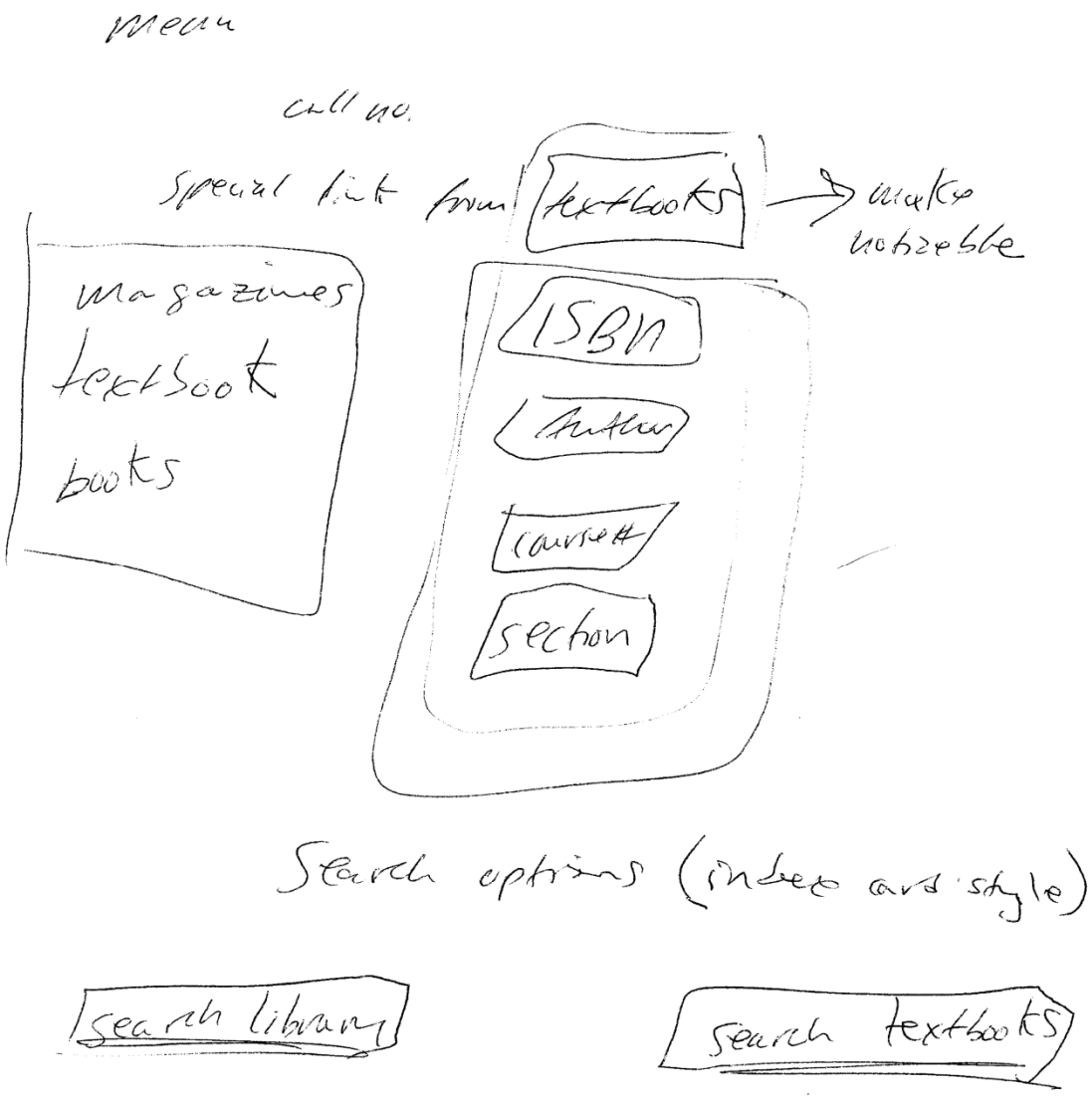

Figure 5. Participant 3 (Undergraduate)--Library Catalogue drawing.

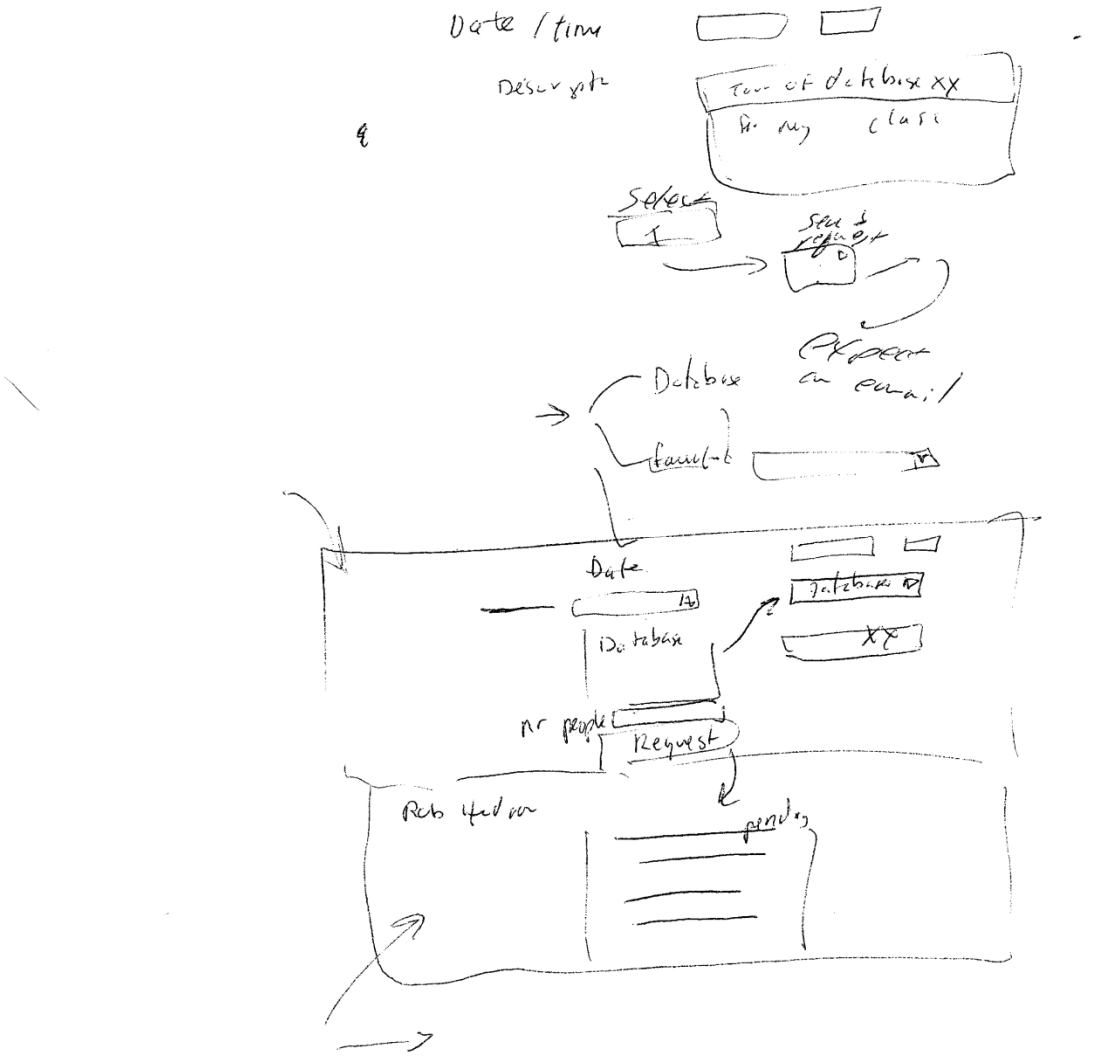

Figure 6. Participant 12 (Graduate Student)--Drawing of Instruction Tours.

Delivery to Client Key findings acquired from the blank-page drawings, along with other comments, both written and verbal, and the principal findings from the wireframe testing were analyzed using affinity diagramming. Recommendations then were made to the client on key issues discovered. In addition, all written comments and drawings were included in appendices of the final report.

DISCUSSION

The Blank-Page Technique is a proponent of good user-centered design, and providing data not normally made available means that it also makes wireframe prototyping, as well as usability testing in general, more effective. The wireframes present a context within which the blank page paper prototyping takes place. This method allows for the usability testing of elements of the proposed design actuated in the wireframes, while at the same time having users contribute to the design of pages that have not yet been created. Some benefits, as well as potential drawbacks, are now discussed.

Benefits The data collection time was surprisingly fast. In fact, the greatest average amount of time expended on any one task in the case study did not exceed 6 minutes, and the overall average time spent on all 5 tasks across the three user groups was only 22.4 minutes (Table 3). This left plenty of time for pre- and post-testing, introductions, and think-aloud training. The total time that participants spent at our facility was between 45 minutes and 1 hour, which is quite reasonable, and suggests that using the Blank-Page Technique will not dramatically inflate testing times.

In this short amount of time, users revealed aspects of their mental models through the drawings on the blank pages that likely went beyond what would have been captured from aural responses. A major benefit of having users create (draw) the pages is that it forces them to think more about exactly what their expectations are. Simply asking participants what they would expect to find, on the other hand, does not necessarily put them in a position of having to realize their design suggestions. However, this is not to suggest that we should design the page in exactly the same manner as participants have drawn them. Rather, the information is useful for illustrating how a user perceives a

particular concept, or linked page in this case. It might be that one or more users perceive a certain page to contain several layers, a hierarchical design, buttons or links with specific labels and locations, or certain items of content.

Use of the Blank-Page Technique produced a large amount of data that informs this process. In all, 77 blank pages were encountered/created during testing, resulting in 189 items of user-suggested content. While other factors such as users' conceptualizations of page structures, navigational elements, and layout were not analyzed directly in the case study reported here, the raw data (drawings) were presented to the developers.

Now these developers are not trained in usability evaluation. Consequently, even though they reported to us that they regarded the raw blank-page data as useful to understanding users and reconciling design issues, we suggested to them that any changes they made based on this data should be tested further. In fact, we believe going forward that it is necessary to conduct additional usability testing on any newly designed pages if designers with limited or no usability training develop them based upon blank-page data.

As a proof-of-concept our study also hopefully suggests that paper prototyping, as realized through the Blank-Page Technique, is not only a low fidelity, early stage method of usability evaluation. It can be used at more than just the earliest stage of the development process, enabling developers when, for example, married with wireframe prototyping, to draw on additional data (that may not otherwise be gathered) about users that focuses their attention more squarely on the user, not the code. This allows them, in turn, to anticipate and then design more usable products, such as web sites, before changes are learned too late to be effective.

Consequently, the Blank-Page Technique is useful as a tool for more than just encouraging user feedback. Because such feedback is not ignored, it also works at the same time to keep developers from any type of cognitive tunneling. With the voice of users still very active in the process, developers cannot work from a perspective in which they think they know what users want and design accordingly, which is something they have a tendency to do. As Beaudouin-Lafon and Mackay write, "in our experience, programmers often argue in favor of software prototypes even at the earliest stages of design. Because they already are familiar with a programming language, these programmers believe it will be faster and more useful to write code than to 'waste time' creating prototypes" [19, p. 1008]. Paper prototyping, however, mitigates this. Developers cannot constrain their focus to see only what they feel is important when user input is facilitated at every stage so that it is a key voice to be heard.

But what about late in the process? Can the Blank-Page Technique be used effectively as an augmentation to higher fidelity prototypes, ones that are far more developed and closer to live release? Certainly any significant changes users might suggest would be difficult to implement. But if we adhere to the idea that web sites, along with all sorts of other products for use, are complex systems, as Redish [20] notes, requiring more nuanced approaches for evaluation, then allowing for opportunities for users to continue to contribute to the design of a product even at later stages of prototype development should not be discouraged. Where's the harm? Besides, as Morgan and Borns' work with Ebay's web site indicates [21], usability evaluation should not be a one-time snapshot. It starts early, continues through all phases of prototyping, and then continues even past that as user data is gathered after a site is operational.

Drawbacks Even though no users indicated they were overwhelmed by playing the roles of designer and evaluator, it is likely that the time taken to comment on all blank pages, either writing or drawing, was longer than normally would be required to complete typical wireframe testing.

Use of the Blank-Page Technique provided us with a tremendous amount of data. Although this is generally a good thing, more data often means more analysis time. This issue could be problematic if there is little turn-around time in the project environment. We propose two ways to address this. First, if time is of the essence focus should be given to the most critical areas of the site to be developed: those areas where there are the most unknowns or developers perhaps have the most questions. Second, this issue should be raised when suggesting the method to the client. Conceptual research and development always takes time, and the Blank-Page Technique is part of this conceptual process. Understanding this from the onset may alleviate some time pressures.

Besides what can be gained from qualitative feedback (via think-aloud protocol), there is also no way to measure how efficient a web site is when using the Blank-Page Technique. In that sense then this method functions very much like any paper prototype. However, it does yield supplementary, proactive data that goes beyond efficiency by showing how users conceptualize what they encounter.

FUTURE DIRECTIONS

At this point, use of the Blank-Page Technique for website design is promising. However, it is not known how or even if this technique would be useful to other realms, such as software design for instance. Also, for those who may be less technologically inclined it is not clear exactly how use of the proposed technique would affect the end

design. It might be expected that the technique would be useful for older users, for instance, because it would help them to portray their mental models of the design, which could be quite different than the conceptualizations of other user groups.

Therefore, future research is needed to test the applicability of the technique in different realms and for different user groups. Additionally, because only one case study is presented, it would be useful to compare these results to those from a follow-up study. This could reveal if there is some sort of consistency in research findings. Finally, due to time constraints, we were not able to tackle the issue of complexity in participant drawings beyond the illustrations provided earlier as examples (Figures 4-6). It would be useful to establish a methodology for quantifying the varying levels of complexity by previously discussed factors such as hierarchical design elements, buttons or links with specific labels and locations, and number of content items. It might then be possible to compare varying levels of complexity with user characteristics such as age and experience, and also possibly even with task characteristics.

The use of paper prototyping within the context of wireframes poses some specific questions that would be interesting to investigate. For instance, how does the wireframe context actually affect the paper prototyping process? To what extent does the given context shape user responses? Should blank pages include navigational elements common throughout the wireframe, such as the banner and navigation column? Or, should the pages be truly blank?

CONCLUSION

Perhaps paper prototyping cannot help to eliminate the inconsistency in results that the Molich, Ede, Kaasgard, and Karyukin article on the comparative evaluation of

Microsoft's Hotmail so eloquently demonstrates [22]. But its frequent use, beginning early and employed throughout as a means of proactive user involvement, does help to encourage a user-focused design and evaluation process. A process not meant to be a perfect panacea capable of curing all of a product's ills, but rather a process that places users front and center, that keeps them as active participants, that makes testing as much about design as evaluation, and that promotes multiple tests beginning as early as possible, monitoring the system to keep it working effectively, not with only the guidance of developers, but with sustained, in-depth feedback from those that matter most—the users.

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