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USER EXPERIENCE (UX) IN THE CIS CLASSROOM: BETTER INFORMATION ARCHITECTURE WITH INTERACTIVE PROTOTYPES AND UX TESTING

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ABSTRACT

The user experience (UX) is becoming increasingly important because consumers are gaining experience rating apps they download which can affect sales and increase their expectations of app performance. This can lead to greater expectations of user experience with workplace software too. This need for increased UX skills requires courses at the college level. This research will explore how class activities involving interactive prototyping and user experience testing can be used in a computer information systems course to improve mobile app and website design for end users. Course design with individual and group assignments are described, student reaction to the course is discussed and suggestions for improvement for the successful course are offered.

Keywords: User Experience, UX, Interactive Prototypes, User Studies, Usability, User Testing

INTRODUCTION

"I learned how much testing helps developers and how much it takes to make a website navigable and successful"
"The knowledge of all the software as well as how to read and use the data really bettered my technical ability as well as critical thinking"
"The concepts of UX were a great asset to learn, which can be very valuable to employers"
Students in Elective Computer Information UX Course

The User Experience (UX) and User Interface Design and Development skill was chosen as the #1 hot IT job skill for 2016 (Florentine, 2015). This fairly new area allows designer and developer teams to work together to ultimately create a user-centered design tested with real users before passing the design specification on to developers to put into production. Developers are not used to consulting users on site organization or what to call menu items, and in a classic study, researchers at Bellcore demonstrated just how infrequently programmers and users agree on what to call computer actions that might be found in a menu (Furnas, Landauer, Gomez, & Dumais, 1987) which was called the "vocabulary problem." While industry demands increased UX skills to solve the vocabulary problem, limited pedagogical literature exists to describe course experiences or assist with UX course design. Further, UX design is inherently multidisciplinary, being part engineering, part IT, part business, among others (Getto & Beecher, 2016). College classes are much less multidisciplinary so it can be difficult to design a UX course for a single discipline. This research explores how interactive prototyping and user experience testing activities are used in a computer information systems elective special topics course to improve the user experience of mobile and desktop apps.

LITERATURE REVIEW

User Experience refers to everything experienced by users of a design or service (Ferrell & Nielsen, 2013) whereas usability deals with several attributes of the user interface including learnability, efficiency, memorability, errors and satisfaction (Nielsen, 1993). UX topics have been featured prominently in recent articles produced by IT research firm Gartner. First Gartner advised firms to implement a user-centered design process (Valdes & Prentice, 2012) and set up UX teams (Revang, 2014) with later advice on incorporating UX into agile software development teams (Revang, Wilson, & West, 2015) and in mobile app development (Leow & Baker, 2017). While the UX process produces many deliverables for developers, clients and internal managers, interactive prototypes were rated as the most important to them. Developers and managers were also interested in static wireframes while clients and

managers were interested in competitive analysis reports and usability/analytics reports (Laubheimer, 2015). While the ability to analyze and interpret data and associated diagrams, and to produce reports is highly valued in the workplace (Malamitsa, Kokkotas, & Kasoutas, 2008), it can present problems for students who have trouble with reading and interpreting results from studies they conduct (Zhou, Han, Koenig, Raplinger, Pi, Li, & Bao, 2016). Student perceptions are that studies generally take a long time which can cause motivation problems (Johnes, 2006). However, reknowned usability researcher and consultant Jakob Nielsen, shows that useful results can be obtained from as few as five users (Nielsen, 2000; Nielsen 2012), so UX is ideal for conducting tests quickly, which is ideal for use in a college classroom. UX courses can take different forms and use different tools. For example, McCrigler (2016) suggests hands-on practice in a real-world context reflects the best way to learn to UX design and had student post work on the iFixit website, which showcases student-designed user manuals for their 85 million annual users. McCrigler (2016) found student motivation to perform well increased when their work was viewable by teachers, iFixit employees and worldwide site visitors, like prospective employers. While students received feedback via email from iFixit employees, it can be valuable to receive feedback from end users in more structured test settings. This study aims to fill that gap by describing an elective UX course that utilizes free rapid prototyping and user testing tools to determine the design and usability of application information architectures and page designs.

COURSE STRUCTURE

Unit 1: UX Introductory Reading Materials

The elective course used current UX materials, industry standard UX software and UX testing methods that allow for result interpretation and presentations. A standard text book was not used in the class. Instead, for the first three weeks of class, presentations created from articles from IT research firm Gartner, Inc. (Valdes & Prentice, 2012; Revang, 2014; Revang, Wilson & West, 2015) and from the Nielsen Norman Group consulting firm (Laubheimer, 2015, Nielsen, 1993; Nielsen 2000; Nielsen 2012; Farrell & Nielsen, 2014) were used to introduce students to the UX career, the topic of usability, careers in UX, and user experience testing, and to show its value to industry.

Unit 2: Interactive Prototyping Software

Balsamiq: Originally used for static wireframes but now with interactivity, Balsamiq has an excellent mobile bank application tutorial (see figure 1), which students completed in two hours either as is for a grade of "B" or including extra linked screens for an "A". Balsamiq is available free for use in classes and lab rooms (Can I get Mockups for free?).

Figure 1. Student Mobile Banking App Produced Using Balsamiq Mockups

Axure RP 8: Enterprise-level software for interactive prototypes and documentation, students completed Axure's RP 8 training modules in two class days and then re-created their Bank application with extra pages for a grade of "B" and with additional training techniques for an "A" (see figure 2). Axure is available free for use in classes and lab rooms (Free licenses).

Figure 2. Student Mobile Banking App Produced Using Axure RP

InVision: Easy-to-use and free (InVision education edition), InVision requires near retina quality graphics, which made it impossible to create the bank app for an assignment. A set of graphic images from InVision was used so students could create a news app using skills they learned from training videos.

Unit 3: Better Information Architectures With UX Testing

UX testing software, Optimal Workshop has free software and excellent training materials so students can conduct various types of tests that can result in improved website and app information architectures. The tests include: open and closed card sorts (to create and test user-provided category structures); Treejack studies to test the proposed information architectures; and Chalkmark to conduct first-click studies of page designs.

Open Card Sort: This study helps students determine how information on websites or mobile applications, called cards, are categorized by users and what users call the categories. Results include a similarity matrix showing the frequency of card pairs that participants placed together in the same group (see figure 3).

Figure 3. Similarity Matrix Showing Card Pair Frequencies

Results also show cards and all user-named categories they were in and the frequency with which users placed the card in the same category. For example, users placed the card *3G Coverage* in categories like *Internet*, *Cell Phones, Account,* or *Service*. In addition, results include a participant centric analysis showing popular groupings of categories with their associated cards and a dendogram showing larger groupings of pages (see figure 4).

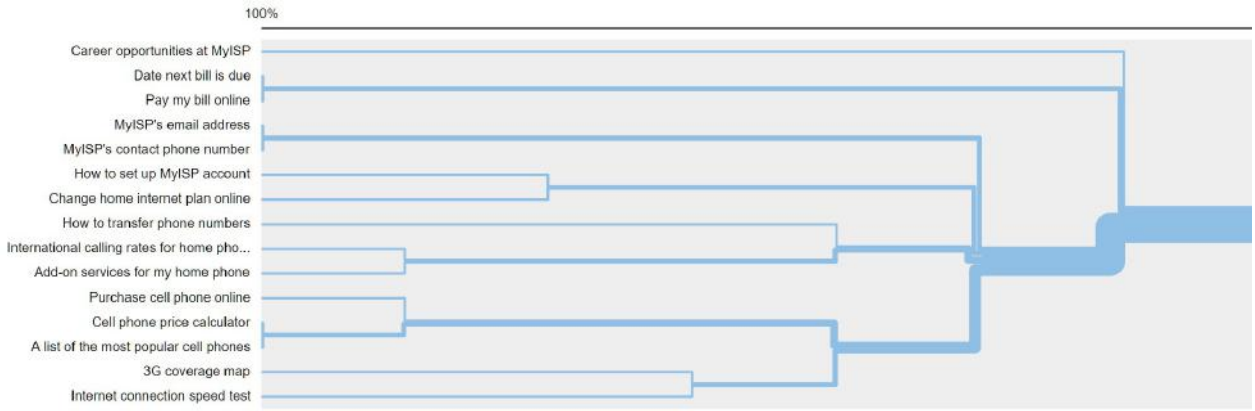

Figure 4. Open Card Sort Dendogram Showing Cards and Their Hierarchical Cluster Groupings

Closed Card Sort: These studies allow users to sort cards into categories but not name them. Participants in a closed card sort study sort cards into existing categories suggested by prior open card sort results (see figure 5).

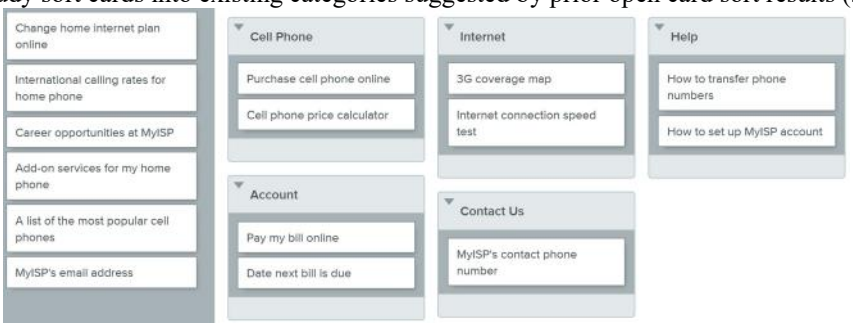

Figure 5. Cards Partially Sorted Into Pre-Determined Categories

Results include statistics on cards and their categories; and popularity matrices showing numbers and percentages of subjects sorting cards into particular categories (see figure 6).

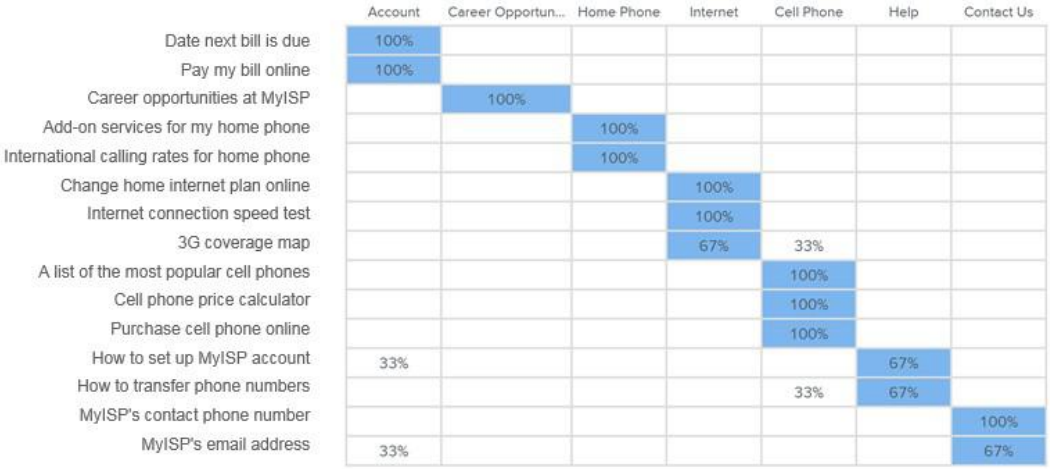

Figure 6. Popular Placements Matrix Showing Percentages of Subjects Sorting Cards into Particular Categories

Treejack (Information Architecture): To set up these studies, input a tree-structure from closed card sort results (see figure 7), and typical tasks users would be expected to accomplish on the site or app (like determining whether you can access mobile broadband from your home).

Figure 7. Partial Tree For Set-Up of Treejack (Information Architecture) Study

Users complete tasks by clicking parent tabs on the Homepage (like Cell Phone or Internet) and then determining if they would find information on any of the child menu tabs (like Internet connection speed tests or 3G coverage map). They are free to navigate up the tree and down another path. Results for each task show direct and indirect success and failure, where participants clicked first or during each task, a participant destination table (see figure 8)

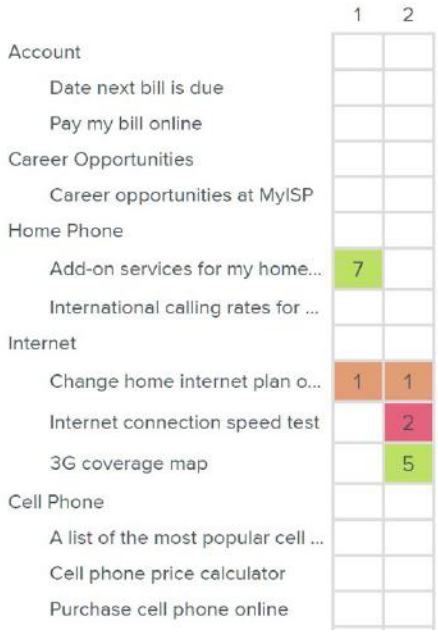

Figure 8. Participant Destinations for Two Tasks

For each task, a path diagram shows paths up and down the tree that participants took as well as the destination where participants thought they would find information requested by the task (see figure 9).

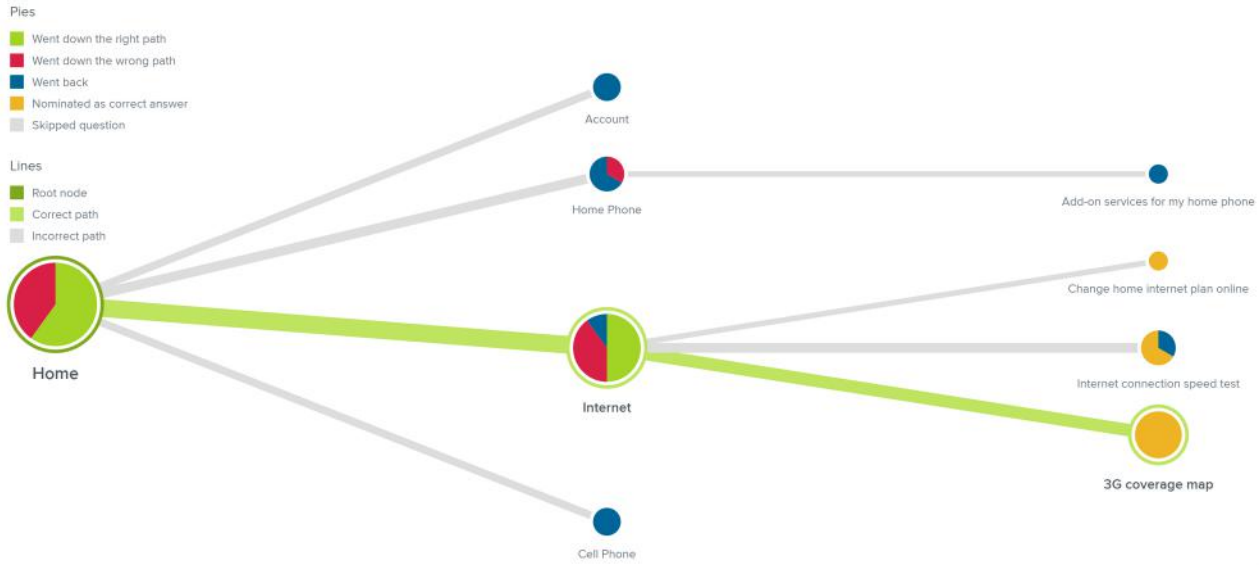

Figure 9. Path Diagram Showing Where Participants Assumed They Would Find Information for the Task : "Determine whether you can access mobile broadband from your house"

Chalkmark (First-Click)

Once the information architecture is determined with tree testing, testing of pages begins. Page design, beyond basic principles, was beyond the scope of this course. Chalkmark studies show where users click in response to various tasks so user confusion can be addressed with future designs. For each task, results include success and failure, percentages of participants who first clicked in areas on the page marked by grids, and heat maps showing where participants first clicked (see figure 10).

Figure 10. First Click (Chalkmark) Study Showing Exactly Where Users First Clicked to "Find out whether you can use 3G broadband from your home"

Unit 4: Group Project and Presentation

The 2010 model IS curriculum guidelines support the notion that IS students "should be provided opportunities to work together on team-oriented projects [and that the] group skills developed in this mode are critical to a successful information systems professional," (Topi, Valacick, Write, Kaiser, Nunamaker Jr., Sipior & Vreede, pg. 389).

Following individual interactive prototype assignments in Balsamiq, Invision, and Axure RP, and the completion of the creation, administration and write-up of four UX tests described above, students divided up into self-selected groups (3-5 students) and began work on a self-chosen business group project. These are not the only ways to set up group projects (Taylor & White, 2011).
Just after groups were chosen, an opportunity to work on the design for the university chapter of the American Association of University Women was discovered and groups were rearranged after the five female students in the class agreed to work on the AAUW local chapter website design.

STUDENT RESPONSE TO INSTRUCTION-METHODOLOGY

A survey was used to measure student response to the course. Survey items covered statements about currency of reading materials and software, perceived ease of use of software used in class (Šumak, B., Heričko, M., Pušnik, M., & Polančič, 2009), presentation methods used, the value of UX in the workplace, and their overall perception of UX knowledge before and after the class. The survey was administered the last day of class.

RESULTS

Twenty-two surveys, with 25 items each, were completed by the students in the UX course. The sample contained more females (22.7%) than males (77.3%). Additionally, networking was the area of interest in Information Systems for most students (40.9%) followed by programming (31.8%), other (18.2%) and lastly, database (9.1%).

Table 1. Demographics

Gender	Main Area of Interest in Information Systems	# of Survey Responses
Female	Networking	
	Programming	3
	Database	
	Other (Business Analytics, Business Intelligence)	2
Male	Networking	9
	Programming	4
	Database	2
	Other (not sure, Help Desk)	2

Students were asked to identify how much they agreed or disagreed with the statement and rated each item using a 5-point Likert scale with "1" = "Strongly Disagree" to "5" = "Strongly Agree."

Student Perceptions of Perceived Ease of Use for Interactive Prototyping and UX Testing Software

One-sample t-tests were conducted to determine perceived ease of use of the software used in class. All items significantly differed from the neutral value and all were in a positive direction. However, frequency responses indicate that students perceived that Balsamiq, InVision and Optimal Workshop were easier to use compared to Axure RP, which is not surprising since Axure RP is known to have a steeper learning curve (See Table 2 on the following page).

Based on the differences observed, with Balsamiq appearing to have the greatest perceived ease of use, a repeated measures ANOVA was conducted to determine if the differences in student perceptions were significant. Results showed that students did in fact rate the three types of software used to create prototypes differently, $F(2, 40) = 6.858$, $p = .003$ with Balsamiq receiving the highest ratings and Axure RP receiving positive but lower ratings.

Student Perceptions of UX Course and Materials

A paired-samples t-test was conducted to compare student understanding along the semester-long course using the items "Before this class, how much understanding of the topic did you have?" and "Now the course has ended, how much understanding of the topic do you think you have?"

Table 2. Frequency Responses for Perceived Ease of Use Items for Interactive Software Used In Course

	1 = Strongly Disagree	2 = Disagree	3 = Neither	4 = Agree	5 = Strongly Agree	
Balsamiq Mockups Software						
Learning to use Optimal Workshop prototyping software in this class was easy for me	0 (0%)	0 (0%)	1 (4.8%)	8 (38.1%)	12 (57.1%)	
I find it easy to use Balsamiq	0 (0%)	0 (0%)	2 (9.1%)	7 (31.8%)	13 (59.1%)	
My interaction with Balsamiq was clear and understandable	0 (0%)	0 (0%)	2 (9.1%)	7 (31.8%)	13 (59.1%)	
It would be easy for me to become skillful using Balsamiq	0 (0%)	0 (0%)	2 (9.1%)	9 (40.9%)	11 (50%)	
Axure RP Software						
Learning to use Axure prototyping software in this class was easy for me	1 (4.5%)	1 (4.5%)	6 (27.3%)	9 (40.9%)	5 (22.7%)	
I find it easy to use Axure	1 (4.5%)	1 (4.5%)	6 (27.3%)	10 (45.5%)	4 (18.2%)	
My interaction with Axure was clear and understandable	1 (4.5%)	1 (4.5%)	4 (18.2%)	11 (50%)	5 (22.7%)	
It would be easy for me to become skillful using Axure	1 (4.5%)	0 (0%)	6 (27.3%)	10 (45.5%)	5 (22.7%)	
InVision Software						
Learning to use InVision prototyping software in this class was easy for me	1 (4.5%)	0 (0%)	2 (9.1%)	11 (50%)	8 (36.4%)	
I find it easy to use InVision	1 (4.5%)	1 (4.5%)	3 (13.6%)	7 (31.8%)	10 (45.5%)	
My interaction with InVision was clear and understandable	1 (4.5%)	1 (4.5%)	3 (13.6%)	7 (31.8%)	10 (45.5%)	
It would be easy for me to become skillful using InVision	1 (4.5%)	2 (9.1%)	3 (13.6%)	7 (31.8%)	9 (40.9%)	

Optimal Workshop Software						
Learning to use Optimal Workshop prototyping software in this class was easy for me	1 (4.8%)	0 (0%)	1 (4.8%)	10 (47.6%)	9 (42.9%)	
I find it easy to use Optimal Workshop	0 (0%)	1 (4.5%)	1 (4.5%)	8 (36.4%)	12 (54.5%)	
My interaction with Optimal Workshop was clear and understandable	0 (0%)	1 (4.8%)	0 (0%)	10 (47.6%)	10 (47.6%)	
It would be easy for me to become skillful using Optimal Workshop	1 (4.5%)	0 (0%)	1 (4.5%)	9 (40.9%)	11 (50%)	

Student understanding of the UX topic before the class (M = 2.0, SD = 0.82) was significantly different compared to after the class *(M = 3.59, SD = 0.59)* suggesting that students perceived their knowledge of the UX course topic increased by the end of the class $t(21) = -7.41$, $p < .000$.

A one-sample t-test was conducted to determine student agreement with perception of "Reading materials [Software] used in the class were current/up-to-date." Results show that students believed reading materials were current and up-to date (M = 3.82, SD = 1.01) $t(21) = 3.498$, $p = .002$ and they believed the same about software (M = 4.55, SD = 0.74) used in class $t(21) = 9.815$, $p < .000$.

Student Perceptions of Presentation Method

Students believed that their peers knew what they were talking about in their group UX presentations (M = 4.09, SD = 0.75), according to a one-sample t-test, $t(21) = 6.82$, $p < .000$. However the same cannot be said when students considered their own presentations and students were not more confident in their presentation compared to presentations in their other classes (M = 3.32, SD = 1.43), $t(21) = 1.046$, $p = .308$.

It was believed that a narrated PowerPoint presentation would result in a better live presentation due to the increase in practice time. In order understand whether students thought the narrated PowerPoint assignment specifically improved their live group presentation, a one sample t-test was conducted. Though students rated their live presentation better because they first did a narrated version (M = 3.23, SD = 1.23), the results were not statistically significant, $t(21) = .865$, $p = .397$. One reason students did not perceive that the narrated PowerPoint presentation resulted in a significantly better live group presentation could have been that they took the survey immediately after watching six presentations, some of which could have been better than their own group's presentation.

Student Perceptions of Benefit of UX in Workplace and Job Procurement

Students believed that UX course material would be beneficial in their future jobs and had a positive impact on their job possibilities. Specifically, students believed that UX course material would help them in their future workplace (M = 4.14, SD = 0.96), $t(20) = 5.44$, $p < .000$ signifying the relevance of UX skills. Additionally, students perceived that the UX course would help their chances in getting a job (M = 3.86, SD = 1.08), $t(21) = 3.74$, $p = .001$.

PLANS TO IMPROVE COURSE FOR FUTURE OFFERINGS

The course was designed with four units covering an introduction to UX topics and careers, UX tools for creating interactive prototypes, UX tools for user testing and a Group Project (see table 3 below).

Table 3. Layout of UX Course With Recommendations

Units	Time Spent	Recommendations
Unit 1: Intro to UX using Gartner and Nielsen Norman Group articles	2 weeks (with other articles presented during the semester)	Shorten to 1 week with other articles presented during the semester as needed. For example, present the need to only test with 5 users (Nielsen, 2000) during Unit 3
Unit 2: UX Tools for Creating Interactive Prototypes	1 week Balsamiq Mockups 2 weeks Axure RP 1 week InVision	Shorten to 3 weeks total with InVision possibly optional. Axure RP needs two class periods to complete training on its website before creating an interactive prototype
Unit 3: UX Tools for User Testing	1 week Competitor Analysis 1 week Chalkmark First Click 1 week Open Card Sort 1 week Closed Card Sort 1 week Treejack Information Architecture	Consider combining open and closed card sorts so that students clearly see how the open card sort results feed into the closed card sort results
Unit 4: Group Project	3 weeks focusing on: completing the four types of user tests; writing up the results in a large UX/Usability report; and creating a narrated presentation prior to a live version in class	This needed to be a week longer Add live think-aloud protocol user testing with UserTesting (UserTesting's university partnerships) where students can sign up to test other sites for pay and, as part of the partnership, students can test their group's interactive prototype with real users attempting to complete tasks via video

In terms of the reports students wrote for the class, a shortened version of government usability test report template (Report template: Usability test) was created. There was not a great deal of improvement from the individual reports to the larger group report in that students who did not write well. For example, on occasion students would interpret and write up results for cards sorts and information architecture studies information and describe results as "good" when they could make changes to better reflect the user's language and achieve better results.

One solution to this problem is to isolate and work on areas where students have difficulties, such as making specific recommendations. Instead of simply making recommendations from their own result set, a class exercise could be developed whereby students are given two sets of results and asked how their recommendation would differ for each result set (see figure 11 below).

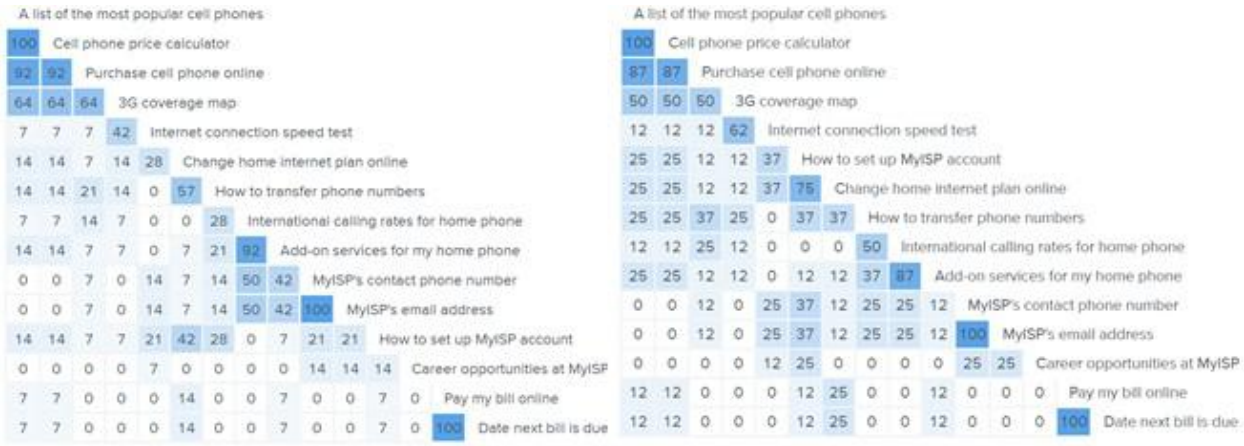

Figure 11. Alternate Result Sets that Should Lead to Different Observations / Recommendataions from Students

Another problem could have been the businesses (retail electronics, sports sites, fantasy sport sites and computer repair) chosen by students. Research has shown that learning, performance and interest in others' presentations may be increased when groups work on the same project for the same business client; and working with one business can

also be easier for the instructor (Taylor and White, 2011). Therefore, instead of choosing their own businesses, UX teams could compete to improve the current website or mobile application design for a real or simulated client for their group project.

CONCLUSIONS

Greater expectations of good user experiences, which began first with mobile applications for consumers and extended to workplace desktop applications, are driving the demand for UX skills. Due to these greater expectations, it is increasingly detrimental to the effectiveness of applications when programmers participate in "armchair" naming whereby developers name menu items without consulting users (Furnas, et al., 1987).

However, this problematic tendency for developers to name parent and child tabs in the menu what they want to call them can be overcome by integrating UX and involving actual users and user-centered design in traditional application and systems design processes. Additionally, implementing a user-centered design process can help meet business goals and drive value (Valdes & Prentice, 2012).

The demand from the consumer for a better user experience and the demand for better UX skills from industry has spurred a need in academia to provide students with greater UX skills and knowledge. Until UX is integrated into various courses in the curriculum, such as programming, database and systems analysis and design courses, it is possible to increase students' UX skills and knowledge with elective courses. Using free interactive prototyping and user-testing tools to complement computer information system students' skillsets, an elective UX course in the information systems major will help meet industry needs and benefit consumers.

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