Usability Study of a Simplified eLearning Design that Integrates Google@UH Apps and the Laulima LMS

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Abstract: Navigating elearning courses that involve multiple services and access points can be daunting for learners. In the University of Hawai‘i (UH) system the “Laulima” (Sakai) Learning Management System is the standard service used for e-learning course delivery, while the Google@UH (Google Apps for Education) suite is used for “official” email and web 2.0 services. Additionally, the option to add Google "consumer apps," to Google@UH accounts has recently become available. The purpose of this usability study was to assess the user perception, efficiency, and ease of use of an e-learning course design that integrates the use of the Google@UH services with the Laulima Learning Management System (LMS) through a simplified user-centered design. Three rounds of in-person usability testing captured user interaction with the course site via a “think aloud” process and mouse movement monitoring. Pre and post surveys collected attitudinal and demographic data. Data analysis included task completion rate and both quantitative and qualitative user evaluations. The majority of usability issues were resolved over the course of 3 rounds of usability testing with revisions made to the prototype in-between each round. Major revisions included a simplified homepage with minimal text, graphic links created with universal icons, an animated course “features” video, and strategically placed links to tools and resources. The results showed an increase in user perception, efficiency, and ease of use, of this integrated by design elearning prototype.

Introduction

Navigating the typical services used to deliver online courses in the University of Hawaii (UH) system can be daunting. The services, Google@UH suite and the Laulima (Sakai) LMS, each require a separate entry point which can result in a series of “go-here, go-there” actions during the course of learning. By incorporating the use of these services through the *course design* and creating a consolidated entry point with Laulima as the landing/launchpad, user perception, efficiency, and ease of use of the e-learning experience may be greatly enhanced. The course, Hawaii Community College (HawCC) Interdisciplinary Studies (IS)101, has until now been offered solely as a traditional face-to-face class. HawCC Social Sciences Department has, however, identified a need for an e-learning version of the course. Design parameters include Course Learning Outcomes, a designated text, and content delivery in Laulima.

Today's new educational paradigm can be defined as flexible, mobile, collaborative, and participatory. Mobile device usage plays a key role in learning for many students therefore designing elearning with this in mind is both timely, relevant, and increasingly necessary (Sevillano-García & Vázquez-Cano, 2015). Additionally, the advantages of incorporating the usage of social media in an elearning course are multifold including its impact on communication, success and grades, complexity of learning, collaboration, and motivation (Zhuhadar, Yang & Lytras, 2013). Strategies to increase efficiency in the area of eLearning content, design, and media include scaffolding, web tools to foster collaboration, a repository or listing of additional resources for student access, and the provision of just in time feedback (Petchtone, Puangtong, Chaijaroen, Sumalee, 2012). In the area of content, the modality principle, when applied to multimedia learning, suggests that considering and incorporating different modes of input such as video lectures and content artifacts that include both spoken and written text presented simultaneously, helps to support learning and transfer, particularly in a self-paced learning environment (Dutra de Oliveira, Neto, Huang, & Melli, 2015). For the evaluation of an elearning environment, usability testing provides an excellent vehicle for efficient testing and subsequent revisions of web environments given that most of a site's usability issues will be experienced by the first three test participants during a round of usability testing (Krug, 2010). Intuitive and universal design principles, in combination with a "backwards design" approach, can aid in the creation of an effective and user-friendly e learning course that incorporates all of these factors (Bean, 2014).

The purpose of this usability study was to assess the user perception, efficiency, and ease of use of an e-learning course that integrates the use of the UH Google Apps for Education suite and UH connected Google+ social media "consumer app," with the Laulima LMS, for (IS-101 course) students at a community college on Hawaii Island.

Literature Review

Cloud computing functionalities are becoming increasingly complex and now include the capacity to support application development used to integrate cloud services through "linked data." In education, applications to support the integration of learning management systems and web app suites such as Google Apps, have been created to integrate these separate cloud services for a more effective user experience (for both student and administration) as well as to increase learning. These applications allow for the ability to integrate services while taking advantage of the superior affordances of each platform by picking and choosing the tools used in each (Gutiérrez-Carreón et al., 2015). Could this be possible without programming? Could an effective elearning design net similar affordances that an integration of services through application would? That is what this design sets out to do.

Vygotsky's sociocultural theory states that social interaction is key to cognitive development as increased skill acquisition and learning takes place through instructor guidance as well as peer interaction and modeling (Clabaugh, 2010). This social interaction in a predominantly online academic setting can be facilitated through the use of social media platforms. Recent findings appear to indicate that the impact of social multimedia systems on learners positively impacts communication between students and their peers, student and instructor, achievement and grades,

the coverage of course content, studying effectiveness, depth of learning, focus on important learning objectives, collaboration, and motivation in studying (Zhuhadar, Yang, & Lytras, 2013). In a predominantly online course, a social media platform can help to facilitate a robust asynchronous online community. Through the use of social media, students are able to become explorers, designers, and publishers of content, and this encourages them to provide both peer support and self reflection (Casey & Evans, 2011).

Key elements that aid in the creation of an effective elearning environment designed to decrease academic procrastination and increase student success (particularly applicable in a college success course) include a mechanism for students to keep on schedule with work and assignment submissions such as sequencing of content and scheduling aids (You, 2015). Additionally, web-based learning models that include **s**caffolding and a community component are both effective and relevant for today's learner (Kwanjai, 2014). These elements also positively impact critical thinking skills for students in an online setting (Petchtone, et al., 2012).

For effective content, the modality principle indicates that instruction should present both text and voice content together to decrease mental effort and the amount of time needed to complete and internalize a lesson. Furthermore, the importance for instructional designers to create multimedia design that fosters deeper learning as well as takes into account access across devices and platforms, along with accessibility aspects such as captioning and speech to text or text to talk capabilities, is paramount (Dutra de Oliveira, et al., 2015). Consideration of creativity and design of materials and content is also a top priority in the design of an effective elearning course (Wang, & Shen, 2012).

Considering the affordances of mobile devices and the high frequency of use by students, designing with mobile access in mind is paramount to creating a flexible and accessible elearning course. Students report that mobile devices allowed them to accomplish a task more quickly, are easy to operate and use, allow for flexible work style, facilitate self management of work, and allow for flexible access to the learning materials (Sevillano-García & Vázquez-Cano, 2015).

To test an e-learning environment designed to present sequenced or scaffolded content, support mobile access, present multimodal learning content, and incorporate the use of social media, a usability test is crucial to gauge the effectiveness in the synthesis of the various components into one effective platform. Well-designed user interfaces that include all these factors have an important bearing on the reduction of cognitive load for learners (Gutiérrez-Carreón, et al., 2015). The importance of usability testing in conjunction with self-reported objective tests is necessary to fully gauge the usability of any eLearning course design, as perceived ease of usability has a direct bearing on more positive user attitudes. (Davids, Chitke, Grimmer-Somers, & Halperin, 2014). For an effective usability testing protocol, the Concurrent Think Aloud/Talk Aloud Method is an effective means to monitor and gauge participants thoughts and actions as they vocalize their experiences as they happen, and encounter any usability issues in the e-learning design (Bergstrom, 2013). Jakob Nielsen's *10 Usability heuristics for user interface design* (1995) are an effective means to inform the overall creation of a usable eLearning design with integrated services.

Project Design

By considering the standard tools used in UH online courses, the goal of this prototype design was to remix and combine these tools in a way that improves perceived ease of use of a Laulima elearning course. By embedding and integrating the use of the Google@UH platform, everything becomes accessible from one location with improved navigation among integrated tools used in the course. This integrated by design concept is illustrated in Figure 1.

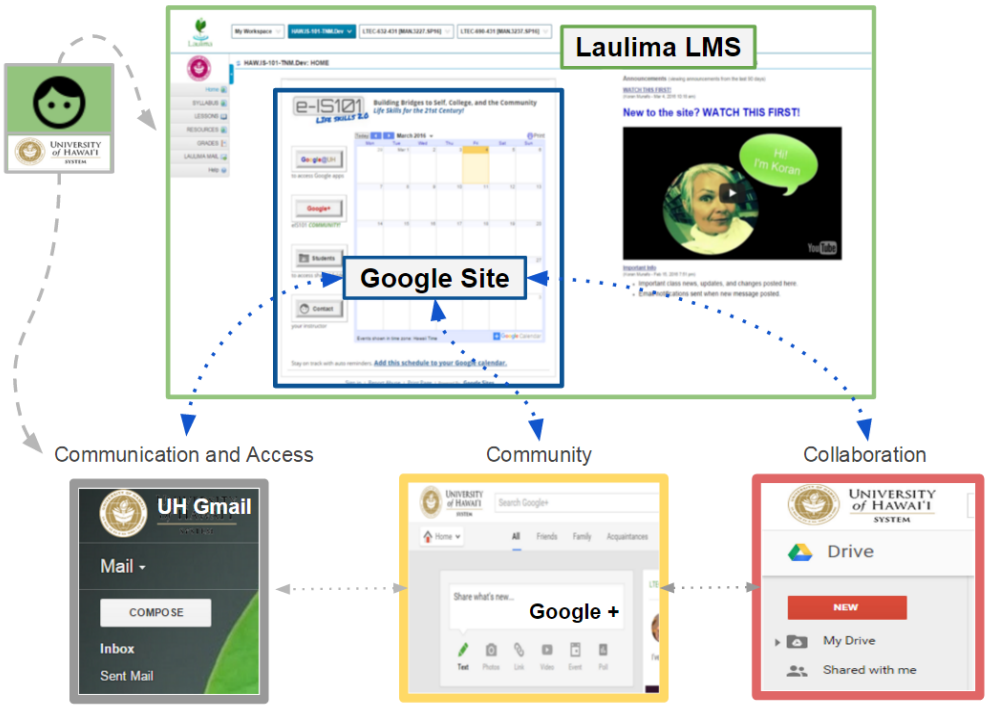

Figure 1. Integrated Design Concept

For the prototype design, I took a "modular approach" to the framework and constructed it in a way that Laulima acts as the elearning course "shell" that has been "customized" with the content topic hosted on the Google@UH cloud. This framework will also allow for easy replication should the design be used with different content. The embedded companion Google site has all native navigation and page titles disabled for seamless embedding into Laulima. As such, student navigation to Google services is directed through custom graphic navigation and a site map facilitates access for administrative purposes.

Backwards design principles informed the design approach, with the end goal of usability as paramount. Additionally, Menchaca's (2014) CASA model**,** a design framework for elearning courses that guides Content, Asynchronous (delivery methods), Synchronous (delivery methods), and Assessment, was considered. The design process included the rapid prototyping method where the design underwent a series of wireframe to prototype iterations before the final buildout. The creation of the usability testing protocol was a part of this iterative process as well

to ensure alignment to the research purpose.

Mobile design principles were considered for content inclusion and design as both the Laulima and Google platforms provide native adjustment for mobile view. Intuitive design principles **s**tate that the design allow for training while the user interacts with the design product, without the user being aware it is taking place (Spool, 2005). This guided the course design as well.

Design aesthetics were guided by the Universal Design Principles of contrast, repetition, alignment, and proximity (Williams, 2008). The design also includes strategically placed custom graphics, used native text and consistent matching typeface, and made effective use of white space and color. Elegantly simplified content graces the design as well. Navigation is presented with graphic buttons accompanied with minimal descriptive text to easily guide the user through the course site. These were created with Google Draw and Google's open source Material Icons to represent the Course Learning Outcomes, navigation, and the IS101 "logo" to "brand" the eLearning course. I created all other course content using Google Apps, Camtasia, and Audacity. Where possible, all images include alt text and headings/subheadings for accessibility purposes. Included videos are on YouTube which accommodates a broad range of operating systems and device types as accessibility is built directly into the youtube platform.

The design's framework to support learning takes advantage of the newly available option for Google@UH accounts to add the Google+ "consumer app" and includes the social media platform for several reasons. Among them, the creation and upkeep of a digital learning community, the ability to introduce the opportunity for practical application of digital literacy, and for the platform's superior web 2.0 affordances.

Scaffolding and sequencing allow for the progression of increasingly complex task completion as the user moves through the course content. Tech skill learning has been scaffolded and integrated at strategic locations in the sequence of instruction to aid students in increasing their level of ability and usage of web 2.0 technology. Asynchronous delivery of course content will be sequenced using the built in "lessons" tool in Laulima. The full course is designed to require students to meet for one face to face session at the beginning of the course for community building and to satisfy HawCC proctoring requirements.

Content includes multimedia learning objects to enhance the user experience. Course components and tools used in the prototype have been placed on the cloud system (Laulima vs. Google) on which they function most efficiently across devices and platforms.
The design also includes a built in support system for students to encourage effective use of the google cloud storage platform. To aid in the archiving of course content, the companion Google site "student page" has an embedded (instructor created) shared drive folder for the creation and storage of course artifacts. This aids students in building effective organizational methods they can carry forward with them through college and beyond, particularly important in a college success course. To aid in administration, organization, and sharing all artifacts are mapped (with live links) in varying formats including drive, sheets, docs, and the google site.

Methods

Research Questions

Research questions were crafted to guide the evaluation of the design in its effectiveness of combining UH services - Laulima and GAFE - into a simplified, user centered e-learning course accessible across devices and platforms. Questions focused on understanding the impact of the design on user perception, efficiency, and ease of use of the elearning course. Usability criteria in these three areas was guided by Jakob Nielsen's 10 Usability heuristics for user interface design (Nielsen, 1995).

Participants

A random sample of HawCC and University of Hawaii at Hilo (UHH) students totaled nine participants. The participant pool demographic makeup consisted of approximately half HawCC and half UHH students. In the pre survey, the majority of participants reported they had taken between 1-5 online courses in Laulima, and that they access course material with a mobile device. Participants also rated their overall tech ability and experience with Laulima and Google Apps. The participant self rated tech profile averages across the group showed the majority of participants falling in the mid range in all areas. Figure 2 provides a snapshot of the participant profile.

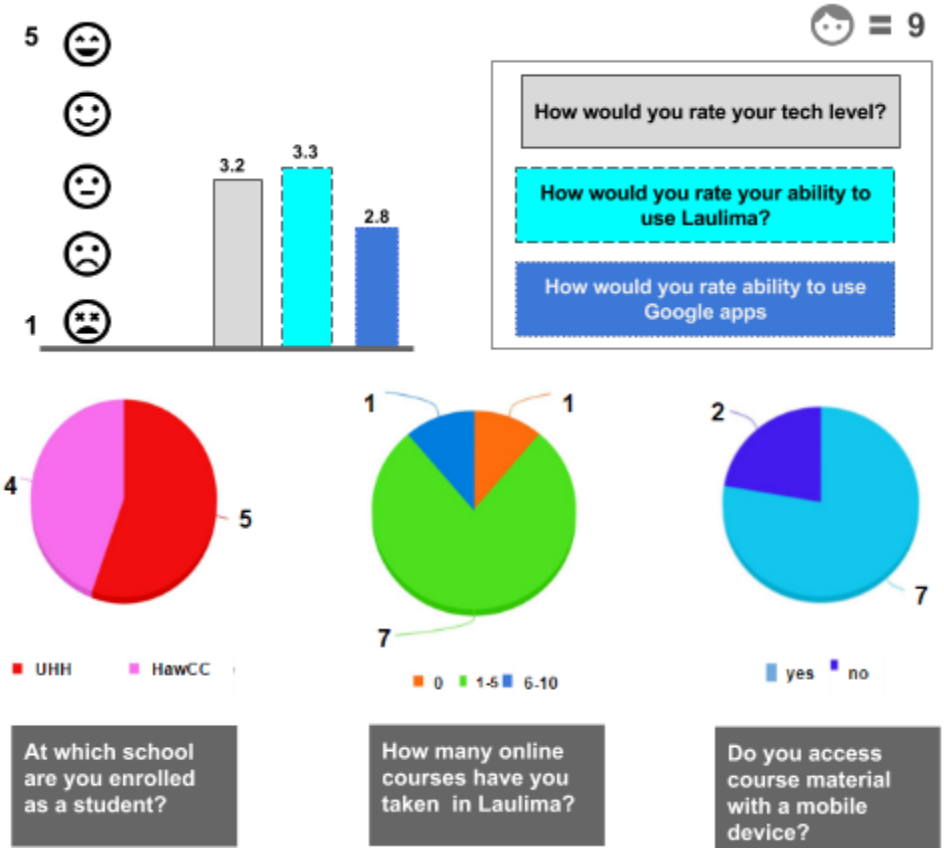

Figure 2. Participant Demographics

Procedures

Usability testing was conducted in-person in closed session computer and study labs at the UH Hilo campus and included testing on a variety of devices (including mobile) and platforms**.** Guided by Krug's (2010) findings that most of a site's usability issues will be uncovered within the first three test participants during a round of usability testing, three separate rounds of usability testing took place with four, two, and three participants in each round. Prototype revisions were made based on findings in-between the first and second rounds.

Participants were recruited in-person "on the spot" as it initially proved difficult to get students to schedule testing ahead of time. Once participants were recruited and led to the testing site, they completed a consent and presurvey (google form) which collected demographic data and included 5-point Likert scale questions for users to self rate tech use and experience with Laulima and Google@UH. Because *perceived* ease of usability has a direct bearing on more positive user attitudes, a combination of self-reported subjective test data and objective data collected during the usability protocol is necessary to fully gauge the usability of a web-based design (Davids, et. al., 2014). Users were then added to the Laulima course site and given the choice of devices on which to complete the study. The process continued with the usability study protocol , which employed the Concurrent Think Aloud and Concurrent Probing methods while participants interacted with the course site (Bergstrom, 2013). The protocol was modified from Steve Krug's example in *Rocket Surgery Made Easy: The Do-It-Yourself Guide to Finding and Fixing Usability Problems* (2009), and guided participants through scripted scenarios designed to mimic activities an elearner would do in the course such as accessing content and resources, submitting an assignment, and completing an assessment. After completing the protocol tasks, a post survey (google form) was administered to gauge overall user perception, efficiency, and ease of use. I then conducted a brief interview and asked participants to name one positive feature and one negative feature (if any) about the course site. Participants received a $10 gift card for participating.

Qualitative data gathered from the usability testing Concurrent Think Aloud and Concurrent Probing processes, in conjunction with participants' mouse movements on screencast recordings, was analyzed using an affinity diagramming process, a visual aid used to identify and tally the most frequently occurring usability issues in the areas of user perception, efficiency, and ease of use. Nielsen's *Severity Ratings for Usability Problems* guided the creation of the rating scale used to classify usability issue occurrences in those areas during testing (Nielsen, 1995). The scale developed and used for this study classifies usability issues as follows: *minor error* - experienced by one user during a round of testing, *serious error* - experienced by two users during a round of testing, and *critical error* - experienced by all users during a round of testing. Quantitative data including participant demographics, self tech ability ratings, and scaled user perception ratings were automatically collected via google surveys and averaged for the group and/or each round.

Results

Round 1

The first round of testing consisted of four participants, two students from Hawaii Community College, and two from UHH. In the area of user perception, it was evident there was a need to simplify the design by removing text on the homepage and making it into more of a landing/launchpad of included services (*serious error*). The need for a higher degree of clarity of the included google services in the course site was evident as well, as participants were not immediately 100% familiar with those presented (*serious error*). Additionally, participants perceived the navigation sidebar in Laulima to be "too long" (*serious error*). As it relates to efficiency, participants were able to complete the majority of tasks presented in the protocol in a timely manner. However, a critical error was encountered 100% of the time when participants attempted to navigate to the course Google+ community page, as the private community settings required users to accept an invitation before allowing access. As it relates to ease of use, among all users, the most frequently encountered usability issues involved navigation (*critical error*) within the Lessons section of Laulima as navigation moves in a linear fashion and button placement is neither ideal nor intuitive. Conversely, navigation within the areas housed on the google platform did not appear to present any challenges despite (and perhaps because) not matching the navigational layout of Laulima. Some included tools and resources used in the course site did present a *serious error* in the area of ease of use as they were not ideally located. Despite these errors, all embedded pages and artifacts displayed well across devices and platforms including assignments using Google Docs, and multimedia instruction using Google Slides.

Solutions applied to the prototype to address these Round 1 usability issues were numerous. To address usability errors in the area of user perception, the homepage was simplified by reducing text. Important textual information that could not be entirely removed from the course site was relocated to the syllabus. Graphic navigation buttons to included Google services (including the Google+ community page) were redesigned with Google Universal Icons and were accompanied with minimal descriptive text to help orient the user to their purpose. Laulima services were reduced or hidden to create a more streamlined navigation bar in Laulima. The link to the Google+ community page was changed to the Google+ main page so a live page would display for users during the protocol. To address navigation errors, navigation "hint" buttons in the Lessons section of Laulima were inserted. Additionally, a narrated and animated "walkthrough" video describing navigation and other functions was created and inserted onto the reorganized homepage layout as "concise narrated animation [fosters] meaningful learning without creating cognitive overload" (Mayer & Moreno, 2003). To increase ease of use of the course site, the included tools and resources were reorganized and some were placed in multiple locations for ease of access in relation to a specific activity. For example, one student said he "never checks his email" unless it is an auto send from Laulima with the course info in the title. For that reason, I changed the announcements platform from an embedded Google site announcements page to the Laulima announcements tool to ensure a higher level of student reading. I did however, hide the tab from the navigation bar in Laulima and instead selected the maximum amount of announcements to show in the announcement pane which displays directly on the homepage in

Laulima. I also featured the course google calendar front and center on the homepage as opposed to housing it on a separate page. Figure 3 illustrates the simplified design of the homepage after revisions were made based on usability errors.

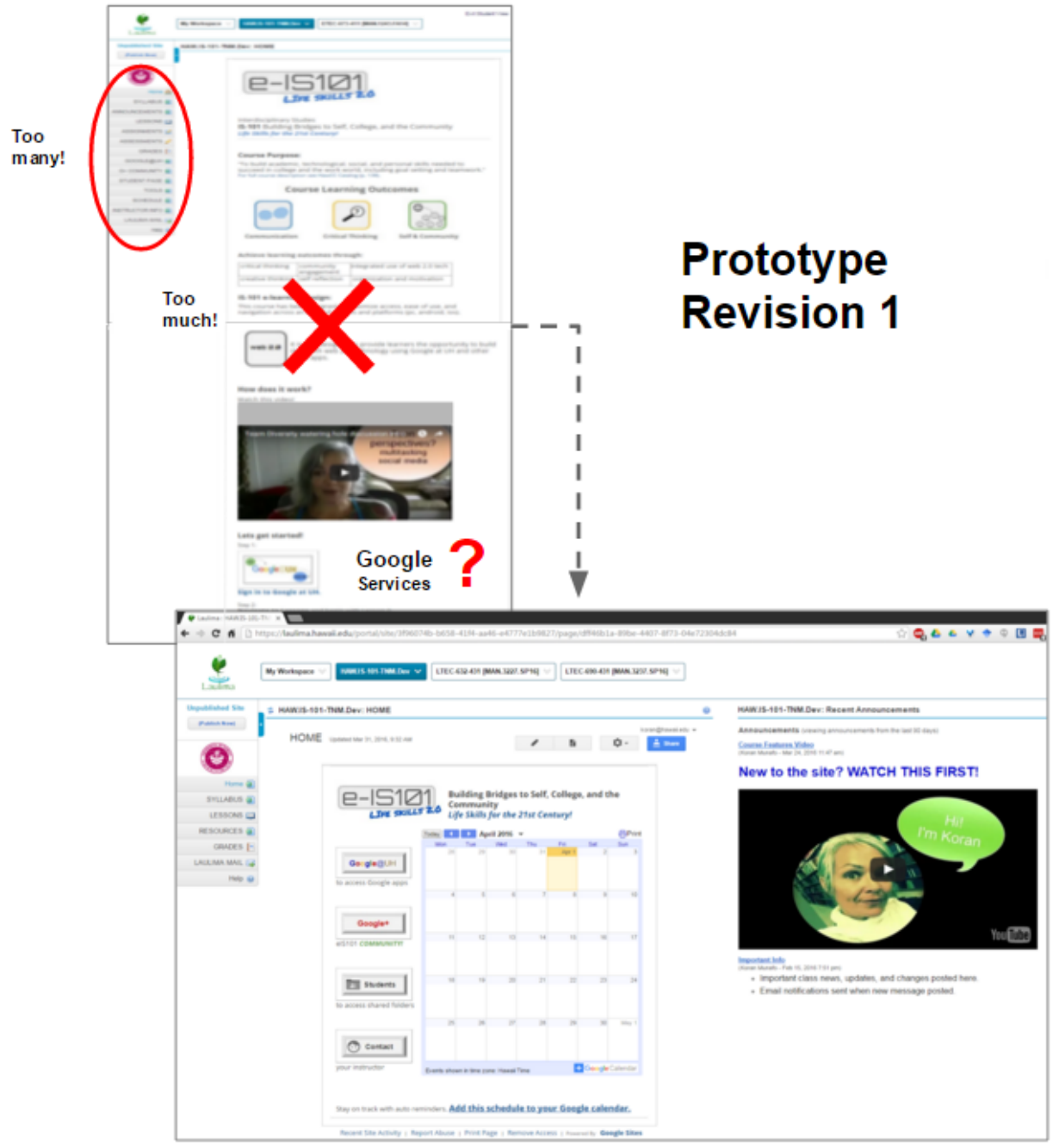

Figure 3. Simplified Design of the Homepage after Revisions

Round 2

The second round of usability testing consisted of two participants, one from HawCC, and one from UH Hilo. While the revised prototype did result in a reduced amount and severity of usability issues, some did remain. In the area of user perception, both participants experienced difficulty identifying included Google services (*serious error)* although that may have been related to their Google Apps familiarity, not the prototype design. As it relates to efficiency**,** much the same as round 1, participants were able to complete the majority of tasks presented in the protocol in a timely manner. However, again in round 2, a *critical error* was encountered 100% of the time when participants attempted to navigate to the (newly linked) Google+ page (showed page error), despite the effort to link to the main Google+ services. As it relates to ease of use, navigation still presented *serious* usability issues. The navigation "hint" buttons created to aid navigation within the lessons sections actually made navigation more confusing as they were mistaken for functional buttons as opposed to directions on how to navigate the actual buttons in Laulima (*critical error*). The animated video walkthrough did offer some help as users seemed to "remember" what the video had showed them about navigation within the Lessons section although, only after they had first made several attempts to navigate unsuccessfully (most likely due to the confusing "hint" buttons).

Several solutions were applied to address these Round 2 usability issues. To address usability errors in the area of user perception, the course features video was edited again for clarity. In the area of efficiency, graphic links and descriptive text for the Google+ class community page were changed again to the private page with plans to invite and add students before testing. As it relates to ease of use, navigation hints created in the Lessons section in prototype 1 were redesigned for a higher degree of clarity.

Round 3

The third round of usability testing included three participants, two HawCC students, and one UH Hilo student. Round 3 usability issues were considerably lessened and an increase in positive user perception was evident in participant spoken comments and those given in the post survey. Google apps functionality was excellent and presented an issue only experienced on the ipad when attempting to open the embedded assignment doc. A graphic with (instructor) picture and speech bubble saying "great job!" after the final task in the testing sequence was unanimously well received. One student suggested that it may "just be me" but having encouragement when a task is completed successfully, however minute it seems, is a boost to morale and satisfying to her as a student, especially in an online forum. There was however, a *minor error* in the area of user perception as the video explaining navigation was overlapping the Laulima embedded google site pane on the homepage, although this only occurred on the ipad. Users in this round were able to identify the graphic navigation link to Google+ services however, the *critical error* with navigating to the Google+ Community page remained, as the time constraints during testing did not allow for the extra step of inviting and accepting users to the G+ page. Navigation errors within Laulima also remained however, the video did help to clarify the navigation and the error was reduced from *critical* to *serious*. It is evident over the course of three rounds of testing that as usability errors decreased, user perception increased. Figure 4 clearly illustrates the reduction

of usability errors and the resulting increased user perception as the prototype progressed through the rounds of testing.

Usability Protocol Tested	Round 1	Round 2	Round 3
user perception	Serious Error		Minor Error
overall design	Serious Error	Minor Error	
language/concepts	Serious Error		
simplified/intuitive			
efficiency			
task completion	Critical Error	Critical Error	Critical Error
ease of use			
navigation	Critical Error	Critical Error	Serious Error
accessing resources/ multimedia content	Serious Error	Minor Error	Minor Error

post survey mean user ratings	5 point scale [1] highly disagree - [5] highly		
user perception			
The home page is clear and serves as an orientation to the course.	4.25	4.5	4.6
The organization of the course site is logical and easy to follow.	3.25	4	4.6
efficiency			
It was easy to complete the tasks given during the study.	4	5	5
ease of use			
The course site is easy to use.	4.5	4.5	4.6

Figure 4. Reduction of Usability Errors and Increased Overall Mean User Ratings

Increased positive user perception is also evidenced in participant comments recorded during the second and third rounds of testing shown in Figure 5.

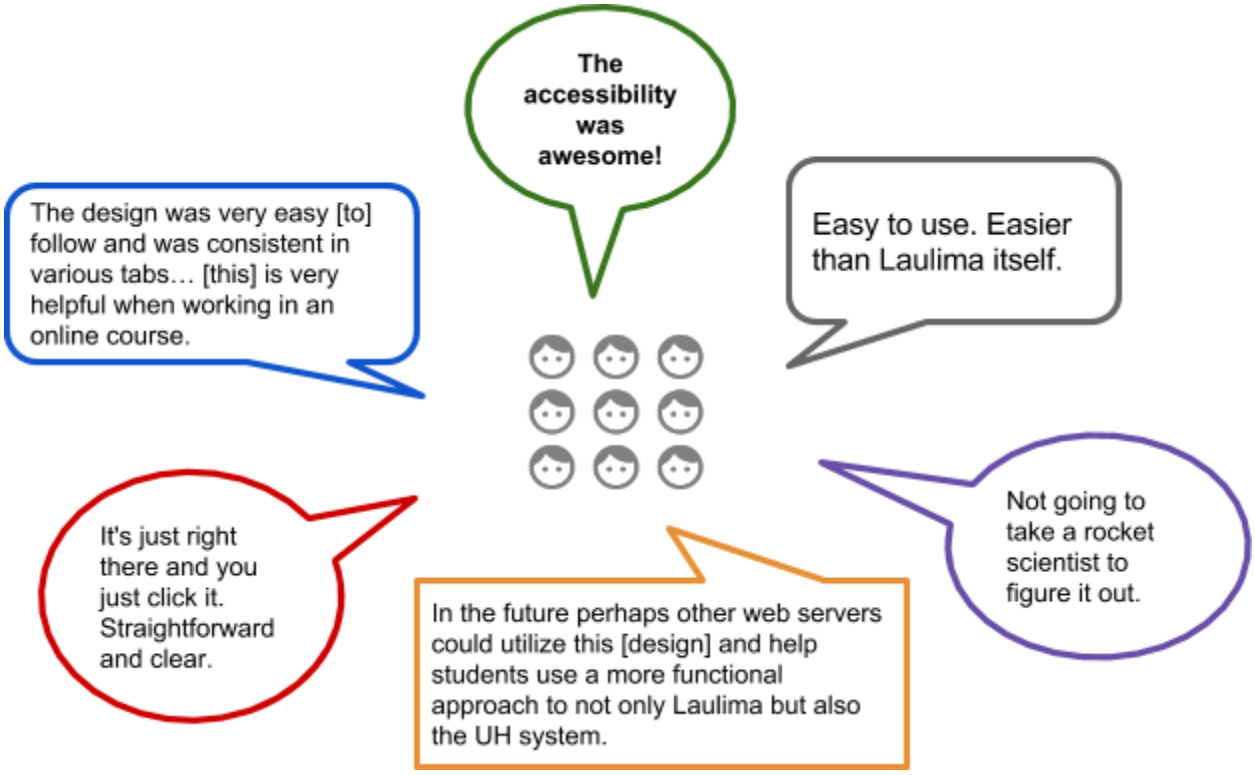

Figure 5. Participant Comments

Discussion

Although a 100% completion rate was not obtained for all tasks, despite limitations to the Laulima platform, the navigation hints and style of the design did aid students while they were navigating the course site. The design strived to minimize interaction with the tools in Laulima that are difficult to navigate and replaced those with the Google alternative with built-in superior affordances inherent in the Google platform. For example, forgoing the use of the forums tool for class discussion with its more difficult (text based) platform and instead opting for the private Google+ community page for asynchronous, interactive, multimedia discussions (Gutiérrez-Carreón, et al., 2015). This is also an ideal platform for the instructor to build class presence through video responses and discussion prompts when teaching the course.

This study found universally recognized features included the syllabus, announcements, and instructor contact page as well as graphic link to the google @UH signin during all rounds of usability testing. However, student comments during the study suggest that students are not being widely exposed to Google Apps during the course of their learning. At least half of the participants shared that they used google apps rarely or not at all and they had not encountered any requirements to do so in their courses. This coincides with the low participant average self

rating of ability to use Google Apps. Thus, a design with embedded Google App learning and usage opportunities is relevant to learners at UH, and particularly for those in a college success course with the purpose of preparing learners with 21st century skills for success in college and beyond.

While there was some difficulty navigating within the lessons area initially, I noticed a sense of accomplishment once the students had figured out how the learning sequence worked, which generally occurred by step 3 or 4 of the sequence. Overall, during a 30 minute usability testing session, students were able to learn the navigation and follow clues to move through the course site. This suggests that subsequent visits to the site and usage would be easier and usability and learnability was improved as a result of the integrated design. Participant feedback and usability study results suggest that users prefer simplified interfaces, with clearly defined step by step processes when action is required, as *perceived* ease of usability has a direct bearing on more positive user attitudes. (Davids, et. al., 2014).

In sum, the notable design features of this integrated by design elearning course prototype include: a simplified homepage with minimal text, graphic links created with universal icons, an animated course "features" video, and strategically placed links to tools and resources. Additionally, students will benefit from the built in tech skill learning, built in content archiving, and the integration of the social media platform. It is my hope that an increase in user perception, efficiency, and ease of use, of this integrated by design elearning course is further evident during launch this Summer 2016.

Conclusion

The overall goal for this project was to create a user friendly and engaging e-learning course design that incorporates Google@UH web 2.0 cloud technology with Laulima, while preparing students to succeed in college and beyond. The prototype utilizes existing UH system tools and combines them in an intuitive interface that maximizes ease of use and efficiency as well as fosters positive user perception of the course learning site. The usability study provided an effective means for testing the design, and confirmed users experienced increased positive user perception, efficiency, and ease of use of the integrated toolset across an array of devices and platforms. Ultimately, this process resulted in a living cloud based design prototype optimized for ease of use, sharing, updating, and collaboration. Further, it is my belief that the design has the potential to be used effectively as a model for similar applications across varying subject matter and may even positively impact user satisfaction and Google Apps proficiency among eLearners at UH.

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