Best Practices for MOOC Interface Design

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Introduction and Motivation

This report describes usability studies conducted on MOOC interfaces, the results of which were used to create a prototype MOOC interface. The prototype MOOC interface was also tested for usability, and the results of these tests informed the creation of a guide for best practices in the design of MOOC interfaces.

Massive open online courses, or MOOCs, have recently become a major focus for students and educators alike. This is not surprising, given that the three major companies offering MOOCs - Coursera, edX, and Udacity - are extremely young yet boast high enrollment numbers. All were founded less than two years ago, and combined enrollment in the first courses offered by these three companies exceeded 300,000 students; Coursera alone currently boasts over 7.3 million students and 638 courses (as of Apr. 2014) (Kamenetz; https://www.coursera.org/). Both students and educators are clearly interested in the possibilities of free online education. For students, MOOCs offer distance learning in a wide variety of subjects either for free or at a price significantly lower than the cost of college tuition. For educators, MOOCs offer the opportunity to impart knowledge to a large, diverse audience and incorporate "… new and different educational structures, organizations, and settings" in their courses (Waard 2011, p8).

Because MOOCs are so new, they "… are still evolving, each with its own format and underlying design priorities" (Waard 2011, p10). Improvements are constantly being made to MOOCs. Many of these improvements focus on instructional design and content organization; Grünewald, et al., developed principles for designing a MOOC, most of which fall into this category (Grünewald, Meinel, Totschnig, & Willems 2013). Schmidt also mentions changes to course material and course structure as the major improvements

made to Vanderbilt University's first MOOC (Schmidt & McCormick 2013). Mackness, on the other hand, discusses MOOC improvement from the perspective of technology selection - determining what technologies are best suited for a specific course (Mackness, Mak, & Williams, R. 2010). Changes made to Duke University's first MOOC also involved changes to the platform, such as allowing instructors more choice in the types of mathematical questions they used to assess students (Belanger & Thornton 2013).

Research on MOOC interface design and usability, however, is limited. Nevertheless, Waard suggests that "investigation into which design principles encourage dialogue, encourage retention, and lead to MOOC success would be beneficial" (Waard 2011, p10). The growing field of human-computer interaction has elucidated the importance of the user experience as it applies to new technologies, and there is no reason MOOCs should be exempt from proper usability evaluations. Dr. Jean-Eric Pelet, in his book compiling research findings in the area of e-learning, cites a body of research that states that "… the quality of educational software is significantly related to its interface quality", "the interface quality of educational software or websites, moreover, has a serious impact on the learning outcome of the student", and that a poor interface design "…impairs a student's overall motivation, as well as their learning performance, and has serious moral and ethical implications. In essence, interactivity between student and interface has been considered as the most important aspect in several studies on how to improve the quality of education through e-learning" (Pelet 2013, p2). Additionally, Grünewald, et al., in their principles for designing a MOOC, state the importance of "consistent and well presented learning materials", suggesting the importance of MOOC interface design (Grünewald, Meinel, Totschnig, & Willems 2013, p8).

This research, along with the growing popularity of MOOCs, justifies the evaluation of existing MOOCs from an interface design perspective. By focusing on a course common to Coursera, edX, and Udacity - an introductory computer science course - this project evaluated MOOC interfaces and MOOC usability. The results of this evaluation informed the creation of a prototype MOOC interface, which was also evaluated for design and usability. The findings from evaluations of the existing interfaces and the prototype were ultimately used to compile a list of best practices for MOOC interface design.

Users and Data Gathering

MOOC users can span a wide range of demographics and are typically only limited by connectivity (a broadband internet connection is required) and literacy (certain levels of reading comprehension and basic computer literacy are expected). However, data shows "MOOCs… tend to attract those who have already completed some traditional postsecondary education" (*Beyond the mooc hype: answers to the five biggest mooc questions* 2013). With this in mind, participants were recruited from the Georgia Institute of Technology (Georgia Tech) for studies to assess the design of the Coursera, edX, and Udacity interfaces. Five think-alouds and four interviews were conducted.

Think-alouds

To recruit think-aloud participants, an e-mail was sent to Georgia Tech undergraduate students majoring in computer science. The purpose of restricting the participant pool to only those students majoring in computer science was to ensure that

the content of the MOOCs didn't distract or confuse users as they navigated the courses, since the courses used in the think-alouds were introductory computer science courses.

The average age of the five think-aloud participants was 23 years. Four had completed some college, and one had completed a bachelor's degree. All five had some work experience, with 1.35 years as the average time worked. Four of the five job roles involved software development or information technology; the other participant had worked as an outreach program manager. Two of the participants had completed one MOOC each, both on the Udacity platform; one course covered introductory web development, and the other covered introductory computer science. Another participant was enrolled in a Physics I MOOC at the time of the study. Reasons for enrolling in the MOOCs included taking them "for fun" and using them in place of or in preparation for college courses. The remaining two participants had never enrolled in a MOOC. The background survey used to gather this data is contained in Appendix A. Participant responses are contained in Appendix B.

Think-alouds were conducted in the Clough Undergraduate Learning Center on the Georgia Tech campus. Participants were welcomed and introduced to the purpose and structure of the study, and their consent to participate was obtained. A brief demonstration of how to perform a think-aloud was then given using a website and benchmark task unrelated to online education.

Participants were seated in front of a laptop and directed to an introductory computer science course on a platform (Coursera, edX, or Udacity) randomly assigned prior to the study. The courses chosen were: "Learn to Program: The Fundamentals" from the University of Toronto (Coursera); "Introduction to Computer Science" from Harvard

College (edX); and "Introduction to Computer Science" from the University of Virginia (Udacity). These courses were chosen because they contained similar educational material. The advantage of studying three platforms instead of just one was the opportunity to gain more universal design insights; however, the disadvantage was that, due to time constraints, fewer participants could be observed using each platform. Two participants were assigned to each of the edX and Udacity platforms, and one participant was assigned to the Coursera platform.

Participants were then asked to perform three distinct benchmark tasks in the assigned course: determine the topic for Week/Unit 3 of the course; find and play the first lecture video in Week/Unit 2; and figure out where to go to find the answer to a question about course material. These tasks were chosen because they are likely often-performed and common across many MOOCs, and they would encourage interaction with multiple areas of the MOOC. Participants were instructed to verbalize their thoughts as much as possible while completing the tasks. A screen capture was taken, and participants were video and audio recorded. After participants had completed the three tasks, they were each interviewed about the perceived difficulty of the tasks and any changes they would make to the course site. The participants were then given a background survey (contained in Appendix A) to complete and thanked for participating in the study.

Quantitative data from the think-alouds was collected for each participant in the form of time on task (measured from the time the page loaded or the first mouse click - whichever was first - until the participant found the answer or said he or she was finished - whichever was first), total mouse clicks (which included every click the participant made, with each double-click counted as a single-click), and task-related mouse clicks

(which included only those mouse clicks thought to be relevant to the completion of the task, with each double-click again counted as a single-click). Whether or not each participant completed each task was also recorded. These evaluation criteria were chosen because of their relation to problems participants may have had navigating the course and confusion they may have experienced caused by the design of the interfaces. It was important to separate task-related mouse clicks from total mouse clicks because often a participant would click the mouse unnecessarily at various points during the think-aloud, and these clicks were not considered to contribute to the participant's effort to complete the task.

Additionally, audio recordings from each participant were transcribed and coded, and screen captures and videos were analyzed to qualitatively assess the participants' completion of the benchmark tasks and their responses to the follow-up interview questions. The think-aloud protocol, which includes interview questions, is contained in Appendix C.

<u>Interviews</u>

Interview participants were also recruited from Georgia Tech by e-mail. These participants included three students who had completed at least one MOOC and one professor who had taught a MOOC. It was necessary to recruit participants who had experience with MOOCs so they would be able to answer questions related to the design of the MOOC interfaces.

For the three student interview participants, the average age was 22 years. One had completed some college; the other two had bachelor's degrees. Two were majoring in computer science, one in electrical engineering, and all three had some work experience,

with the average time worked being a little over one year. Two had worked as software engineers; the other had worked as a general intern. All three participants had completed computer-science related MOOCs on Coursera, and one had also completed a programming course on Udacity; that same participant was also enrolled in a Coursera MOOC on genetics and evolution at the time of the interview. Reasons for enrolling in MOOCs included: general interest, as part of a Georgia Tech class (in a flipped classroom model), improving job prospects, and desire to practice programming and expand ability in that area. The fourth interview participant had taught a non-computer science course on Coursera.

Interviews were conducted in the Clough Undergraduate Learning Center on the Georgia Tech campus. Each participant was welcomed and introduced to the purpose and structure of the study, and his or her consent to participate was obtained. The three student participants were asked to comment on their reasons for enrolling in MOOCs, aspects of MOOCs they liked or disliked, features they felt were missing, and their goals upon completion of a MOOC. Two of these participants were interviewed simultaneously. The fourth interview participant was asked to comment on: the structure of her MOOC; what her students liked, disliked, and struggled with; perceived limitations of the Coursera platform; and the goal of a MOOC. All participants were audio recorded. After the interview, each participant was given a background survey (contained in Appendix A) to complete and thanked for participating in the interview.

Interview questions were chosen to help determine general, high-level aspects of MOOCs that are beneficial or prohibitive for students, from both a student and professor perspective. Audio recordings from each participant were transcribed and coded to

qualitatively assess each participant's responses. The student and professor interview protocols, which include interview questions, are contained in Appendices D and E, respectively.

Results of Data Gathering

All participants completed the first benchmark task (determining the topic for a specific week or unit) correctly. An average of 57 seconds was spent on this task across all participants (33 seconds for the Coursera participant, an average of 1 minute, 6 seconds for the edX participants, and an average of 1 minute, 1 second for the Udacity participants). It took participants an average of 6.4 total mouse clicks to complete this task (1 for the Coursera participant, an average of 8.5 for the edX participants, and an average of 7 for the Udacity participants), with an average 3.8 of those being task-related mouse clicks (1 for the Coursera participant, an average of 5 for the edX participants, and an average of 4 for the Udacity participants).

Four of the five participants completed the second benchmark task (finding and playing a specific lecture video in a specific week or unit) correctly. One of the Udacity participants navigated to the incorrect lecture video. An average of 36 seconds was spent on this task across all participants (17 seconds for the Coursera participant, an average of 49 seconds for the edX participants, and an average of 32 seconds for the Udacity participants). It took participants an average of 4.4 total mouse clicks to complete this task (2 for the Coursera participant, an average of 4 for the edX participants, and an average of 6 for the Udacity participants), with an average 3.2 of those being task-related

mouse clicks (2 for the Coursera participant, an average of 4 for the edX participants, and an average of 3 for the Udacity participants).

All participants completed the third benchmark task (determining where to go to obtain an answer to a question about course material) correctly. An average of 1 minute, 48 seconds was spent on this task across all participants (1 minute, 26 seconds for the Coursera participant, an average of 2 minutes, 53 seconds for the edX participants, and an average of 55 seconds for the Udacity participants). It took participants an average of 12.2 total mouse clicks to complete this task (2 for the Coursera participant, an average of 21 for the edX participants, and an average of 8.5 for the Udacity participants), with an average 4.6 of those being task-related mouse clicks (2 for the Coursera participant, an average of 8 for the edX participants, and an average of 2.5 for the Udacity participants). This data is contained in Appendices F and G.

Pertinent qualitative data from both the think-alouds and interviews, including quotes with timestamps and their correlated user needs, if applicable, is contained in the tables found in Appendices H-O. This data, along with the quantitative data, will be discussed in the following section.

Data Analysis and User Needs

Of the three platforms, both quantitative and qualitative data suggest that Coursera had the most transparent layout and easiest navigation. The Coursera think-aloud participant spent the least time on two of the three benchmark tasks and needed fewer mouse clicks to complete all three tasks compared to the averages for participants using edX and Udacity. Regarding the organization of the lecture videos, the Coursera

participant reported that, "It's organized very nicely." (See Figure 1.) However, a major qualification to these results is that there was only one think-aloud participant who used the Coursera platform. Additionally, the Coursera think-aloud participant was unsure that the forum was the place to go to obtain the answer to a question.
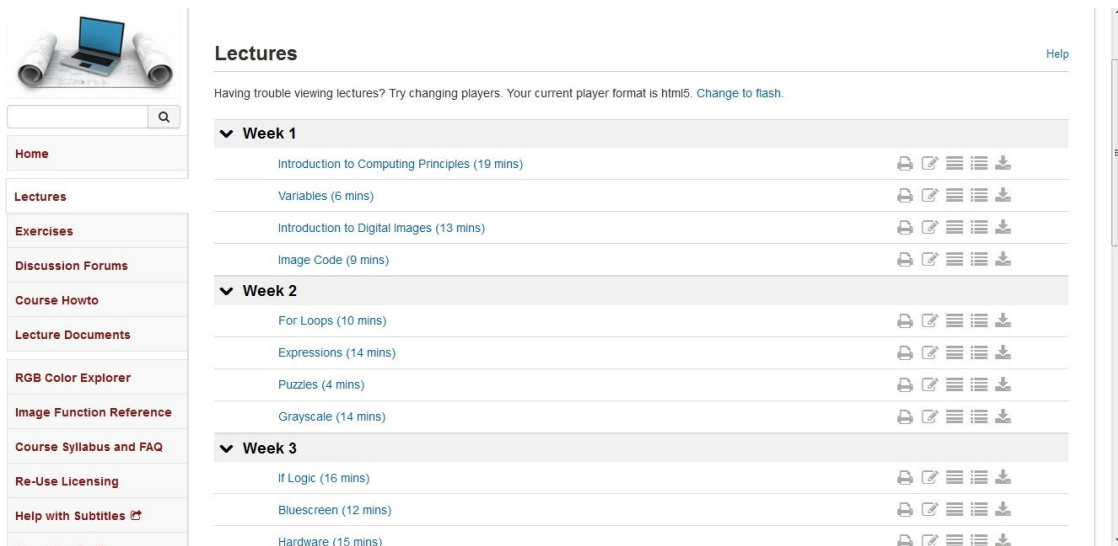
Figure 1. Coursera lecture video page

Think-aloud participants who used the edX platform reported that the placement of "important buttons" was good, and "Discussion" seemed to be an appropriate label for where you would go to obtain the answer to a question. (See Figure 2.) However, they expected a general syllabus or outline for the course to be more prominently displayed, and they found the labeling on some parts of the site confusing. In particular, the word "Courseware" was not viewed as a descriptive label for the location of the course materials.

Figure 2. edX navigation buttons

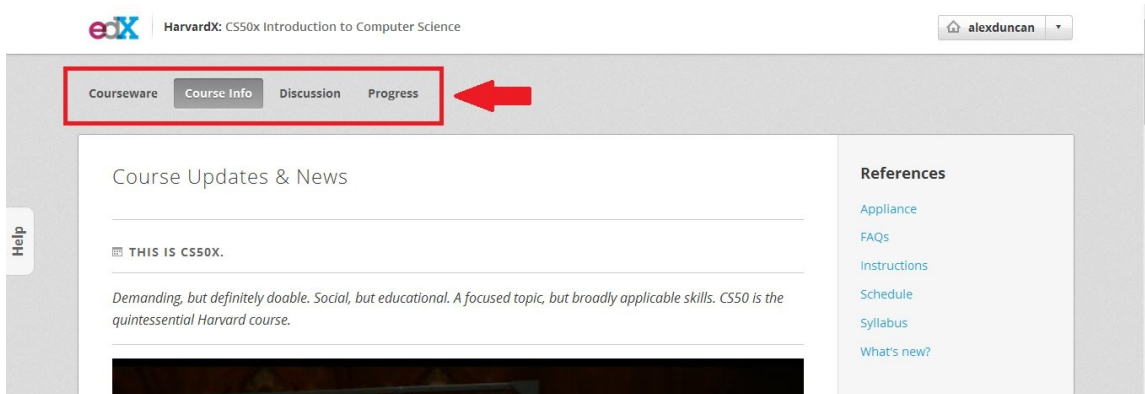Think-aloud participants who used the Udacity platform spent, on average, the least time of all participants to complete the third benchmark task and reported that, "They seemed pretty straightforward with the layout and the formatting of the page…" and that they, "… like the simplicity of the design." They also reported liking the "Ask a Question" button (which has since been changed to the "Start a discussion" button). (See Figure 3.) However, they also stated a desire for "… some kind of a course syllabus… an outline of what is expected in this course, what topics we cover, and what type of timeline is recommended." Additionally, they were confused about labeling within Udacity - particularly the difference between "lessons" and "units" - and they desired better indication of what page they were currently on.

Figure 3. Udacity "Start a discussion" button

One other notable finding from the think-alouds was that participants wanted to see a clear depiction of their personal progress in the course. The platforms studied either

didn't implement such a feature or implemented it in a way that was unclear to the participants (such as putting a check mark next to lecture videos that had been viewed).

Although nearly every task was completed by every participant, tasks often took an average of more than 30 seconds and 3 or more task-related mouse clicks to complete, suggesting that elements of the course were either embedded too deeply or were too difficult to find. These problems verify the course navigation, organization, and labeling issues that were implied by the qualitative data from the think-alouds. Interview participants reiterated many of these issues, particularly the need for easy-to-find course materials.

A complete, organized list of user needs related to MOOCs is contained in Appendix P. Below is a list of the most important (based on the number of times they were stated or implied by participants in the think-alouds and interviews) user needs, organized into categories: navigation, transparency, layout, overviews, professor options, and other considerations. The most important items in each category are located at the top of that category. Items that have asterisks beside them were not related to MOOC interface design and, though important considerations, are outside the scope of this project.

Navigation
- Easy-to-find course outline/syllabus/schedule
- Clear navigation to actual course materials
- Easy-to-find supporting materials (academic articles, etc.)
- Clarity in navigating to video lectures
- Link between presentation slides and the relevant place in the lecture video *

Transparency
- Clear, consistent, descriptive labeling of pages/sections
- Clear process for getting questions answered
- Clear display of lengths of lecture videos *

Layout
- Less scrolling required to be able to ask a question
- Fewer distractions

Overviews
- Clear depiction of personal progress in the course

Professor Options
- Ability to explain normed papers during guided peer review *

Other Considerations
- Ability to set the pace of the course and adjust speed of lecture videos *
- Clear video progress bar *
- Better and more feedback on assignments *
- Ability to pause video, leave course, and return to same spot in video *
- Embedded (as opposed to third-party) discussion forum *

Prototype Interface

      As an attempt to remedy some of the issues with current MOOC interfaces and better incorporate user needs, a prototype "Introduction to Computer Science" MOOC interface (nicknamed "Learnster") was created using Balsamiq. Wireframes were considered sufficient for the prototype because the focus of this project is on interface design of MOOCs rather than new or improved functionality. Elements of the Coursera, edX, and Udacity computer science courses were incorporated into the Learnster course to the extent possible. These elements include a syllabus, discussion forums, course materials (such as assignments, lecture videos, quizzes, surveys, references, and exams), and student grades. Each page of the Learnster site will be discussed individually in relation to the user needs outlined in the previous section.

      The home page for the Learnster course is shown in Figure 4. It contains the course syllabus. Users need an easy-to-find course syllabus or outline, which is why it was decided that the syllabus should be the first thing students see when they log in to the

course. However, there is no formal "home" page because students may have different perceptions of what the course "home" is.
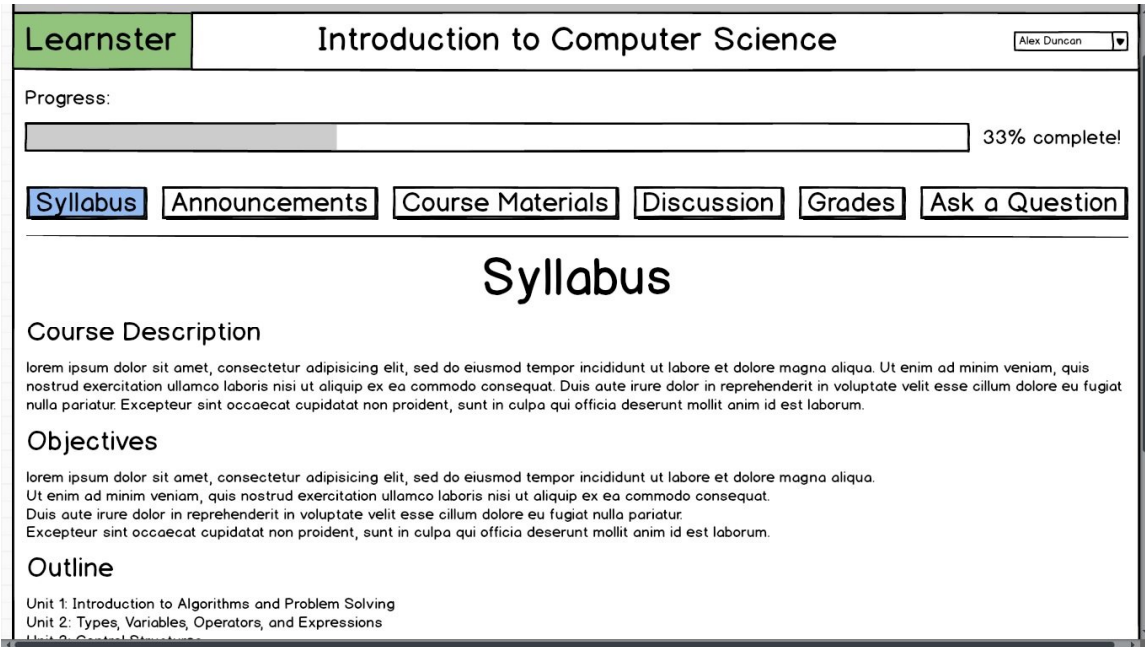

Figure 4. Syllabus page

From the Syllabus page, students can easily navigate to any of the other course pages with a single mouse click using the buttons at the top of the page. These buttons are large and always visible to allow for clear, consistent navigation; they are located at the top of the page so that they are visible to students who only have to look in one place to navigate the site, helping to keep them from "getting lost". Study participants also liked navigation buttons located near the top of the screen (refer to Figure 2), and they wanted limited distractions on the course pages. Additionally, page titles match the button labels, and buttons change from white to blue if the student is on that specific page; this helps students recognize what page they are on and associate that page with a name and a button to access it.

The Announcements page is shown in Figure 5. This page is straightforward and has no interactive functionality. It provides a means of one-way communication from the

course instructor or teaching assistant to the students, with the most recent

announcements at the top so students see the most up-to-date information first.
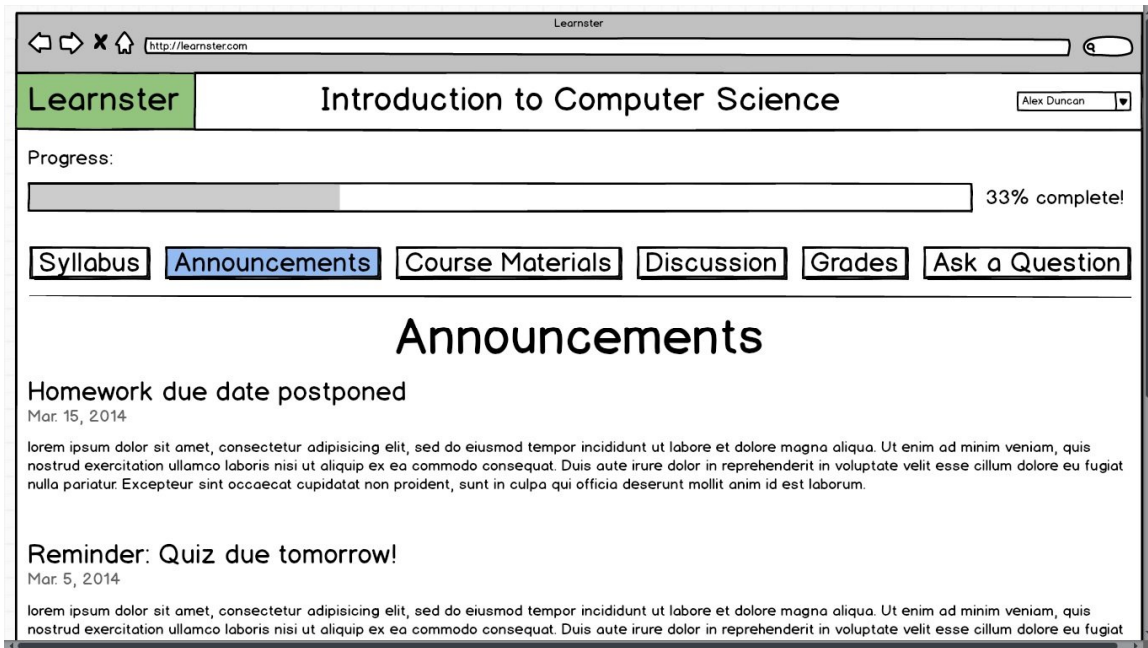
Figure 5. Announcements page

The Course Materials page is shown in Figure 6. This is where students can find

lecture videos, homework assignments, quizzes, tests, surveys, references, and any other

related materials instructors want to provide. The label for this page was chosen to

increase the transparency of the site - "course materials" suggests that this page is where

students will find what they need to learn and complete the course.
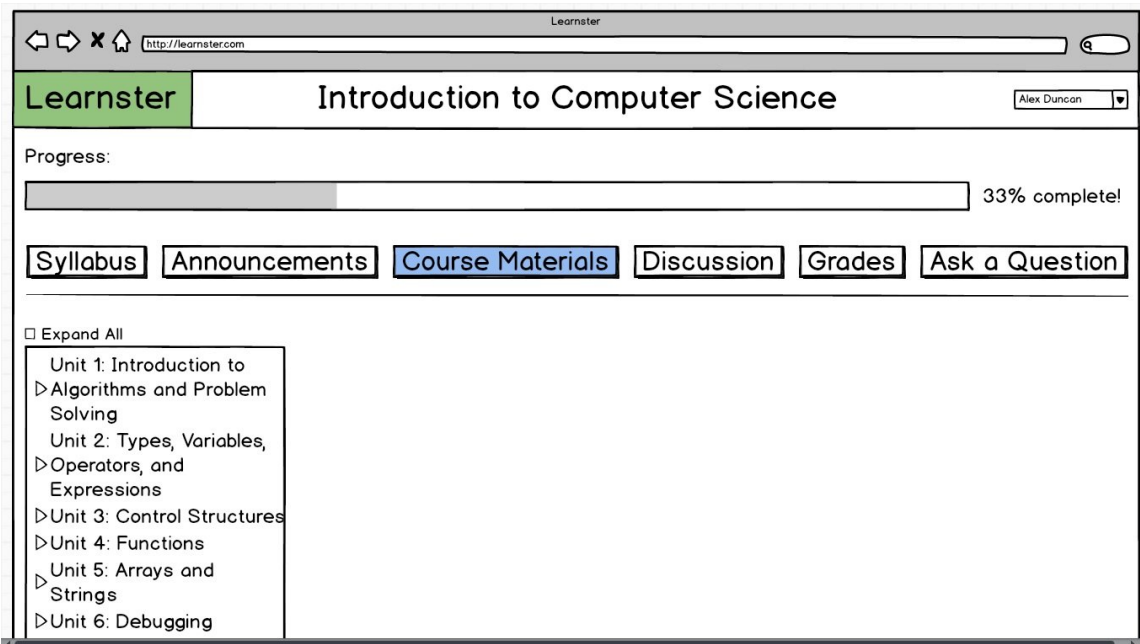
Figure 6. Course Materials page

When students navigate to the Course Materials page, they are presented with a unit menu on the left side of the screen displaying all the units in the course. The word "unit" rather than "week" was chosen to represent the different sections of the course materials because the word "week" typically implies a synchronous course that has a specified beginning and ending date; units, on the other hand, can be used in either a synchronous or asynchronous course, making the Learnster interface more generic.

The design decision to organize the course materials by unit (or subject matter) rather than by the types of materials (grouping lecture videos together, separate from homework assignments, and so on) was made due to the fact that study participants reported a preference for the organization of materials on the edX platform, which uses this same organization scheme, because it allows them to view or hide specific units. Additionally, it is likely that this organization scheme will help students mentally relate the materials in each unit to each other; if materials were grouped by type of material,

students may have a harder time understanding what is contained within each unit in the course.

Each unit within the unit menu can be expanded to reveal the course materials contained in that unit. (See Figure 7.) An "Expand All" option allows the student to quickly view all course materials in all units. When a student clicks on a unit, the title of the page changes to reflect what unit the student is in, and information about that unit is displayed. This reinforces to students "where they are" currently within the course, confirms they are on the correct page, and reinforces the link between options in the unit menu and what information is displayed.
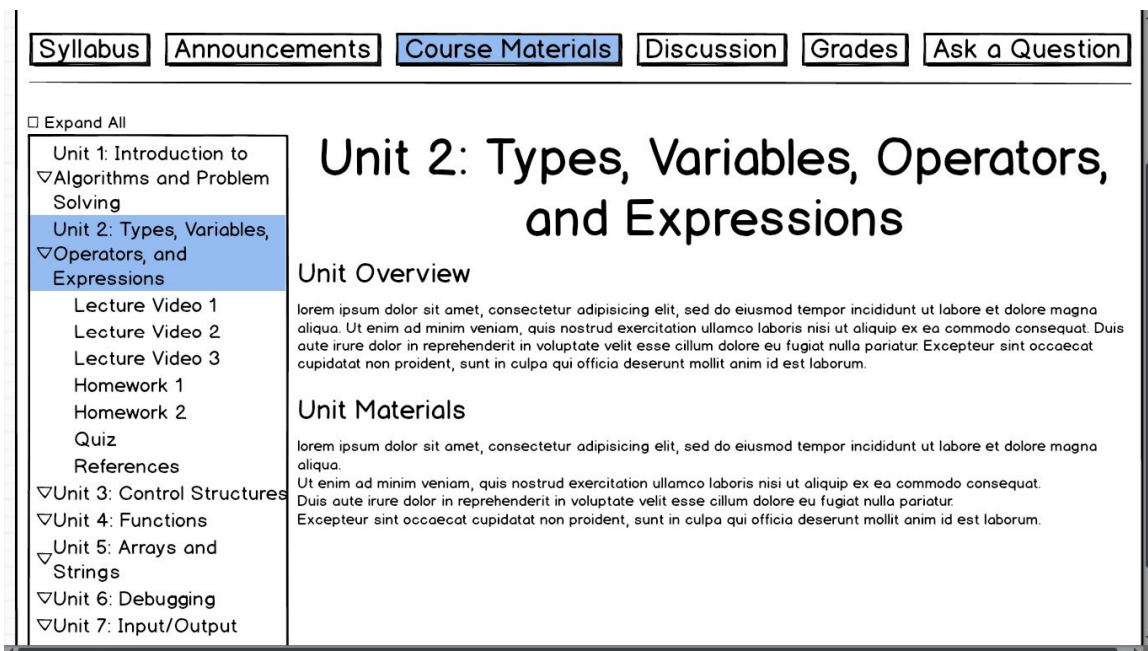
Figure 7. Course Materials page, Unit 2

Once a unit is expanded, materials contained within that unit are listed underneath it. Clicking on one of the materials displays it on the page to the right of the unit menu. The page retains the unit name as its title; the subtitle on the page changes to reflect what material the student is accessing. For example, clicking on Lecture Video 1 within Unit 2 leads to a page titled "Unit 2: Types, Variables, Operators, and Expressions", with the

subtitle "Lecture Video 1". (See Figure 8.) This page layout reflects the hierarchy of the

unit menu and again reassures students that they are on the correct page. Although a

course may have many materials, the number of ways the student can interact with the

unit menu to access them is severely restricted. In this case, restricting the student's

interactions is a good thing - having fewer options reduces the chance of the student

making a mistake or becoming confused about the organization of the course materials.

Labeling of materials and their ordering within each unit is also kept consistent, further

strengthening the organization of the materials.
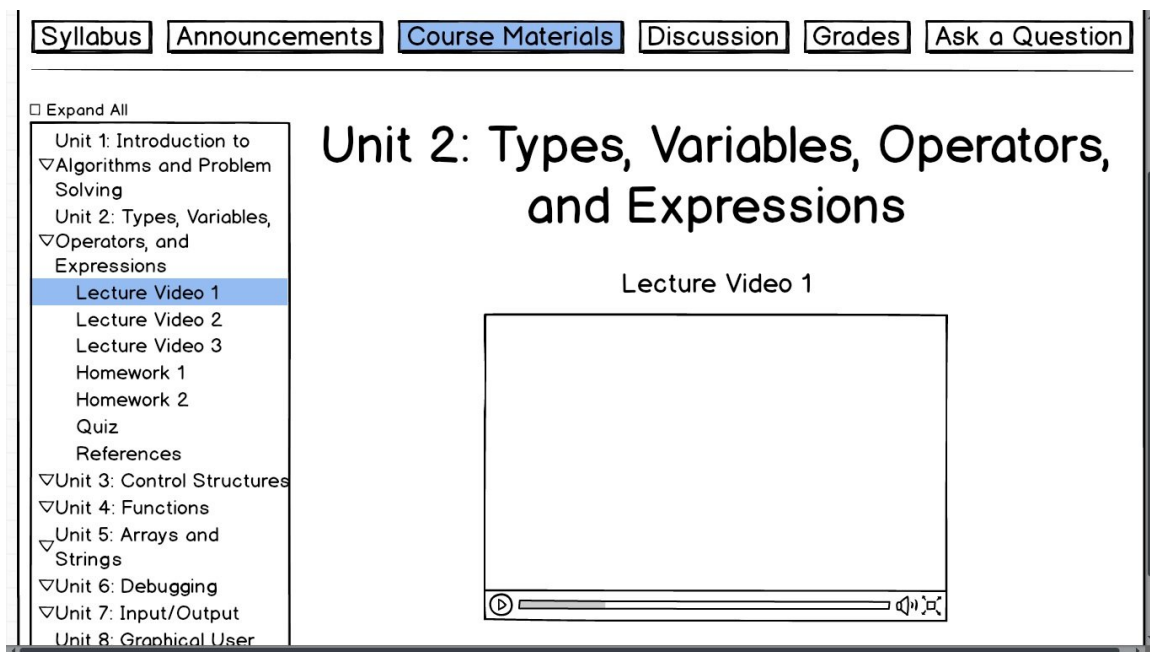
Figure 8. Course Materials page, Unit 2, Lecture Video 1

The Discussion page is where the student can communicate with other students,

teaching assistants, or instructors. (See Figure 9.) This page is so labeled because

participants in the user studies seemed to instinctively know the function of a discussion

page.
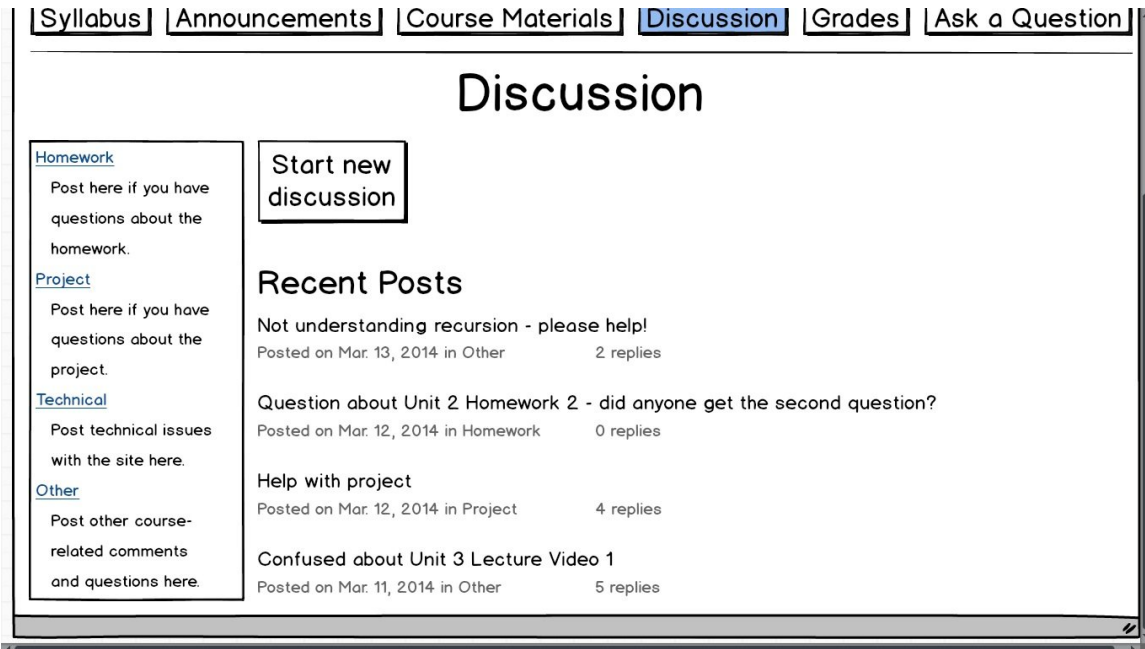
Figure 9. Discussion page

Again, options presented to students are somewhat limited. When students first navigate to the Discussion page, they are presented with a topic menu on the left side of the screen. Similar to the unit menu on the Course Materials page, the topic menu allows students to navigate to different areas within the Discussion page. Students are also presented with a button allowing them to start a new discussion and, underneath that button, the most recent discussion activity. Clicking on one of the topics in the topic menu displays discussions pertaining to that topic, with the most recent at the top. Detailed design of a discussion page, along with options to view individual posts and reply to posts, is outside the scope of this project, but this page is meant to be a place where the student can communicate with others about the course and get questions answered, so those options were included.

Clicking on the "Start new discussion" button displays a simple form students can fill out to post a new discussion. (See Figure 10.) Because being able to easily get help or ask a question is important for students, checkboxes are included allowing them to

indicate the post contains a question and/or is urgent. After creating a post title and post body, students can choose what topic the post falls under; submitting it will then place it under the appropriate topic, accessible through the topic menu. Choosing the topic of the post is the last action students perform when posting a new discussion because they can read back over the body of the post to decide the topic to which it is most related; so, the action flow from writing a post to determining the topic of the post seems more logical than determining the topic before the post is written.

Figure 10. New Post

A Grades page is included because study participants desired one place where they could view all their grades in the course, which not all of the current platforms have. (See Figure 11.) Again, design of the table containing the grades is outside the scope of this project, but assignments are organized by unit, the same way they are in the unit menu on the Course Materials page. Each assignment listed links back to the assignment on the Course Materials page, and any feedback given on graded assignments is also contained in the table.

Figure 11. Grades page

The "Ask a Question" button directs the student back to the New Post form on the Discussion page, with the "Question" checkbox checked so that the student's post will be marked as a question. The Udacity platform also incorporated such a button, and study participants liked this feature because it gave them a clear option for getting questions answered, accessible from anywhere on the course site. The "Ask a Question" button creates some built-in redundancy, since it links back to the Discussion page. However, study participants wanted the option to ask a question quickly and easily, and this button provides that option.

To accommodate the user need for a clear depiction of personal progress in the course, a progress bar is included above the page navigation buttons; like the buttons, it is also visible no matter what page the student is viewing. (See Figure 12.) The progress bar is located above the page navigation buttons in order to keep the buttons closer to the content to which they lead. It is meant to allow students to quickly visualize how much of

the course they have completed and will also hopefully serve as motivation to persist in the course.
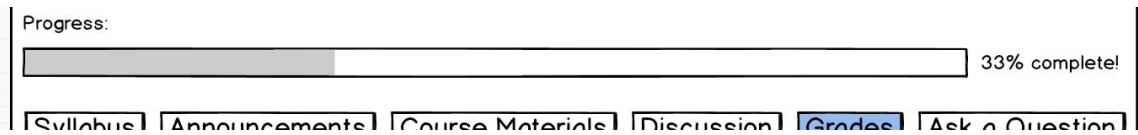
Figure 12. Progress bar

Evaluation of Prototype

Eight think-alouds were conducted to evaluate the Learnster interface. Participants were recruited from the undergraduate and graduate population of Georgia Tech. Again, it was ensured that all participants had some computer science knowledge so that the content of the MOOC wouldn't distract or confuse them.

The average age of the participants was 25 years. One had completed some college, four had completed a bachelor's degree, and three had completed a master's degree. All but one (who was a computational media major) were human-computer interaction majors. All eight had some work experience, with 3.9 years as the average time worked. The job roles mostly involved user experience design, software development, and research, although one participant had worked mostly as a massage therapist. Five of the eight participants had started a MOOC (four of them had completed one); four of those five had used the Coursera platform, and one had used Craftsy. Reasons for taking the MOOCs included furthering one's education, preparing for graduate school, and taking courses that would either not be offered in college or not be desirable to take in college. Two participants were enrolled in MOOCs at the time the think-alouds were conducted - one on the Craftsy platform and one on the Coursera platform. Reasons for enrolling in those MOOCs were to tailor a shirt and get an

introduction to statistics, respectively. The background survey used to gather this data is contained in Appendix A. Participant responses are contained in Appendix Q.

Think-alouds were conducted in the Clough Undergraduate Learning Center and the Technology Square Research Building on the Georgia Tech campus. For consistency, which would allow comparisons of results, the protocol was identical to that used for the data gathering think-alouds, except all participants used the exact same Learnster interface, and some follow-up questions were added. Participants were specifically asked about navigating the course, the site layout, labeling on the site, and the progress bar. These questions were added to get feedback on those aspects of the interface design determined to be most important based on user needs. This think-aloud protocol with the added follow-up questions can be found in Appendix R.

Evaluation Results

All participants completed the first benchmark task (determining the topic for a specific week or unit) correctly. An average of 21 seconds was spent on this task across all participants. It took participants an average of 0.75 total mouse clicks to complete this task, with an average 0.25 of those being task-related mouse clicks.

All participants completed the second benchmark task (finding and playing a specific lecture video in a specific week or unit) correctly. An average of 43 seconds was spent on this task across all participants. It took participants an average of 4.63 total mouse clicks to complete this task, with an average 4.25 of those being task-related mouse clicks.

All participants completed the third benchmark task (determining where to go to obtain an answer to a question about course material) correctly. An average of 1 minute, 28 seconds was spent on this task across all participants. It took participants an average of 6.89 total mouse clicks to complete this task, with an average 3.63 of those being task-related mouse clicks. This data is contained in Appendix S. Pertinent qualitative data gathered from notes taken during and after the think-alouds, along with tags applied to the data, is contained in Appendices T-Z. This data, along with the quantitative data, will be discussed in the following section.

Evaluation Data Analysis

Study participants using the Learnster interface were able to find a unit topic an average of 36 seconds faster, and used an average of 5.7 fewer total mouse clicks (an average of 3.6 fewer task-related mouse clicks), than those using current MOOC interfaces. This supports Learnster participant statements about this task being easy and the Syllabus page seeming "direct", or clear and simple.

It took Learnster participants 7 seconds longer to locate and play a lecture video than participants using current MOOC interfaces, and they used an average of 0.2 total mouse clicks (an average of 1 task-related mouse click) more to complete this task. Relative to the other two benchmark tasks, these increases in average completion time and average number of total and task-related mouse clicks are quite small, suggesting that the ease of locating and playing a lecture video is similar across Learnster and current MOOC interfaces.

Learnster participants were able to determine where to go to ask a question an average of 20 seconds faster, and used an average of 5.3 fewer total mouse clicks (an average of 1 less task-related mouse click), than those using current MOOC interfaces. This data is consistent with participant statements that the "Discussion" and "Ask a Question" buttons were intuitive options if they had a question for which they needed an answer.

In general, participants also seemed to like the design and layout of the buttons on the page menu, and they liked that it was constantly visible regardless of what page of the site they were viewing. Some participants also found the unit menu on the Course Materials page well-structured and the general labeling on menus descriptive. Additionally, multiple participants reported liking the idea of the progress bar and its placement and visibility.

However, participant responses during the think-alouds and follow-up interviews revealed some areas for improvement within the prototype. These areas were determined by coding and categorizing participant responses and then grouping these responses as pertaining to one of three categories: menus, the "ask a question" process, and progress indication. The "important" and "somewhat important" (based on how frequently they came up during the user studies, with issues that came up at least six times being considered "important" and those that came up at least three times being considered "somewhat important") issues participants voiced and/or encountered in each category will be discussed below. A small number of issues were related to the general design and layout of the site, but because these were mentioned infrequently, they will not be discussed. However, they are listed in the table in Appendix X. Many other issues related

to additional features or functionality participants wanted included in Learnster that were outside the scope of this project but are still considered important findings; these features will be discussed in a later section, and they can also be found in the table in Appendix Y. The table in Appendix Z contains participant comments and actions that were considered neutral or not directly linked to any particular system requirement or change.

Menus

The user studies revealed that some participants did not consider the label "Course Materials" very descriptive - one participant thought the "Course Materials" button would simply lead to reference material, and another did not know that page would contain the course lessons. One participant also mentioned preferring the label "Forum" rather than "Discussion", although most participants did not mention being confused by the label of this button. Additionally, on the unit menu, participants felt that some of the unit titles were too long, suggesting that the menu appeared cluttered or overwhelming.

Participants also felt the "Discussion" and "Ask a Question" buttons should be next to each other, since they both lead to the Discussion page. A suggestion was also made to further reorder the page menu items to: Syllabus, Course Materials, Grades, Discussion, Ask a Question, based on the order in which a student might access these pages. Additionally, one participant mentioned wanting a separate page containing the lecture videos because he didn't associate them with course materials. However, as discussed previously, the decision to organize materials by unit instead of by type of material was a conscious design decision meant to help students mentally group the course materials.

Based on this feedback, a reevaluation of the names, labels, and ordering of menu items on the site will be conducted.

"Ask a Question" Process

Many participants seemed confused about the process of asking a question using the "New Post" feature on the Discussion page (regardless of whether they navigated there using the "Discussion" button or the "Ask a Question" button). Confusion largely resulted from the participants being unsure of whether a question would be directed to the TA/professor or whether it would be made public to all students through the discussions. One participant also reported that it was unclear how a response would be received after she asked a question. Related to this confusion was the fact that many participants saw either ambiguity or redundancy between the "Discussion" and "Ask a Question" buttons.

One somewhat important issue related to asking a question was that participants were unsure where the "Ask a Question" button directed them, particularly because when this button was clicked, the "Discussion" button became highlighted. Some participants expected to see a pop-up rather than to be directed to the Discussion page. Additionally, some participants thought that, instead of being placed on the page menu, the "Ask a Question" button should be placed on the discussion page or eliminated altogether.

Due to these findings, reconsideration will be given to the placement, highlighting, and overall necessity of the "Ask a Question" button, and to the labeling of both this and the "Discussion" buttons. Additionally, a method of making the process of asking a question more explicit will be suggested.

<u>Progress Indication</u>

Participants suggested multiple modifications to the progress bar to make it more useful, such as color-coding it and allowing students to mouse over it to gain more information about their progress. For the most part, participants who made these suggestions desired the ability to see their progress through each unit in the course. It is also worth noting that participants generally assumed the progress bar to be course material-based (that is, representing completion of course materials); only one participant assumed the progress bar to be time-based (that is, representing how many weeks had passed since the beginning of the course).

Although some participants liked the placement and visibility of the progress bar, others reported wanting to make it less visible (either by decreasing its size or hiding it altogether and only displaying it when progress changes) and not wanting it to be the first thing they see when logging in to the course. Participants also reported wanting to see, in addition to the progress bar, more detailed progress depicted in the unit menu on the Course Materials page, such as when individual assignments have been completed or individual lecture videos have been viewed.

To better indicate progress to students, this feedback will be translated into modifications to the progress bar and the unit menu.

Changes to Prototype

Changes were made to the prototype based on analysis of the data gathered from the evaluation; these changes, organized by the same categories used to organize participant responses, are discussed below.

<u>Menus</u>

The "Course Materials" button in the page menu was renamed to simply "Course" to prevent students from mistakenly assuming clicking that button would bring up a list of supplementary materials, as opposed to the core course materials. Reducing the number of words on the page menu will reduce the clutter, giving the menu a cleaner look, and the new label will hopefully give students a better idea of where the course "lives" on the Learnster site.

The "Ask a Question" button was removed due to many participants saying the "Discussion" button made it redundant (since it led to the Discussion page), confusing, and not transparent (in terms of where it directed students). The "Discussion" button was renamed to "Ask/Discuss" to let students know that clicking that button would allow them to either ask a question or discuss course material with their classmates. More changes to the "ask a question" process will be discussed later.

The buttons on the page menu have also been reordered to reflect the order in which students are likely to access them. The modified page menu is shown in Figure 13.

| Syllabus | Course | Grades | Announcements | Ask/Discuss |

Figure 13. New page menu

Unit titles on the unit menu were shortened to reduce the clutter on this menu. Additionally, instead of the "Course" button leading to a page with nothing but the unit menu, some brief explanatory text has been added to the Course page instructing students how to navigate the unit menu and what it contains. The updated Course page is shown in Figure 14.
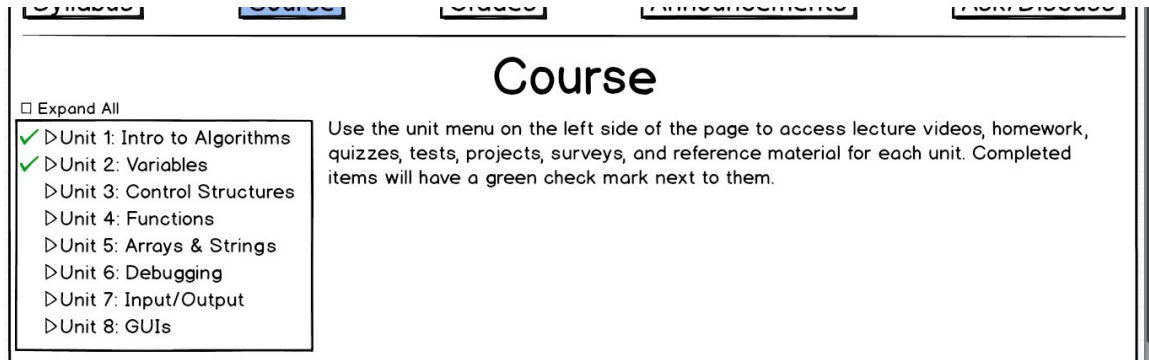
Figure 14. New Course page

Finally, the topic descriptions in the topic menu on the Ask/Discuss page were modified to remove the word "post", because this is a vague word. The new description now informs students of the actions they can perform by clicking on a specific topic. The updated topic menu is shown in Figure 15.

Figure 15. New topic menu

In addition to removing the "Ask a Question" button and renaming the "Discussion" button to "Ask/Discuss", several other changes were made to the prototype in the hopes of facilitating the process students go through to ask a question.

Because online discussion pages and forums (on MOOC and non-MOOC sites) take many different forms, different students will have different preconceptions of how the Ask/Discuss page functions; this was verified by the evaluation of the prototype. Therefore, brief explanatory text was added to the Ask/Discuss page explaining how to use the topic menu, how to start a new discussion, ask a question, or respond to another student's discussion, and what to expect in terms of replies to a discussion you start or question you ask. This change will hopefully mitigate any uncertainty students might have about how to get a question answered.

As stated previously, the word "post" is vague and should be removed from the Ask/Discuss page. So, the label of the "New Post" button was changed to "New Discussion" to more accurately describe the method of communication used on Learnster and to keep terminology consistent. The updated Ask/Discuss page is shown in Figure 16.
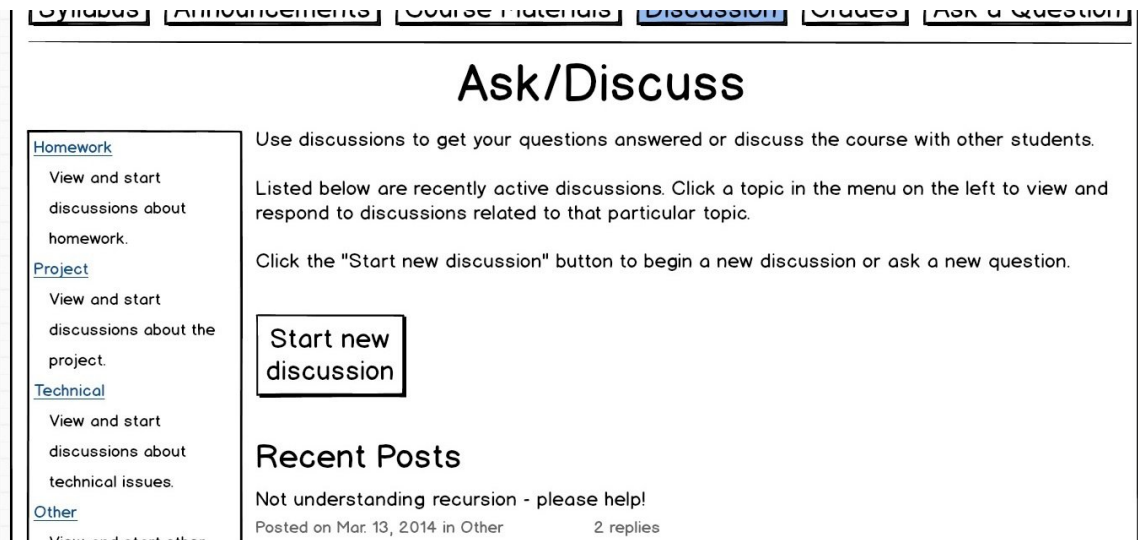
Figure 16. New Ask/Discuss page

Brief explanatory text was added to the New Discussion page informing students where their new discussions will appear once started, who will be able to view the discussion, who can reply to it, and how the student will be notified of a reply (the specifics of implementing these options have not been researched, so the details of the explanatory text may or may not reflect the best method of implementing these features). Additionally, because some students stated feeling uncomfortable making a post public an option to post anonymously was added so that students will still have the benefit of receiving replies to a question from classmates, without the potential social discomfort caused by informing thousands of classmates of their confusion about course material. Finally, to maintain consistency of terminology and make the result of clicking the "Submit" button more transparent, the button was renamed to "Start discussion!". The updated New Discussion page is shown in Figures 17-18.
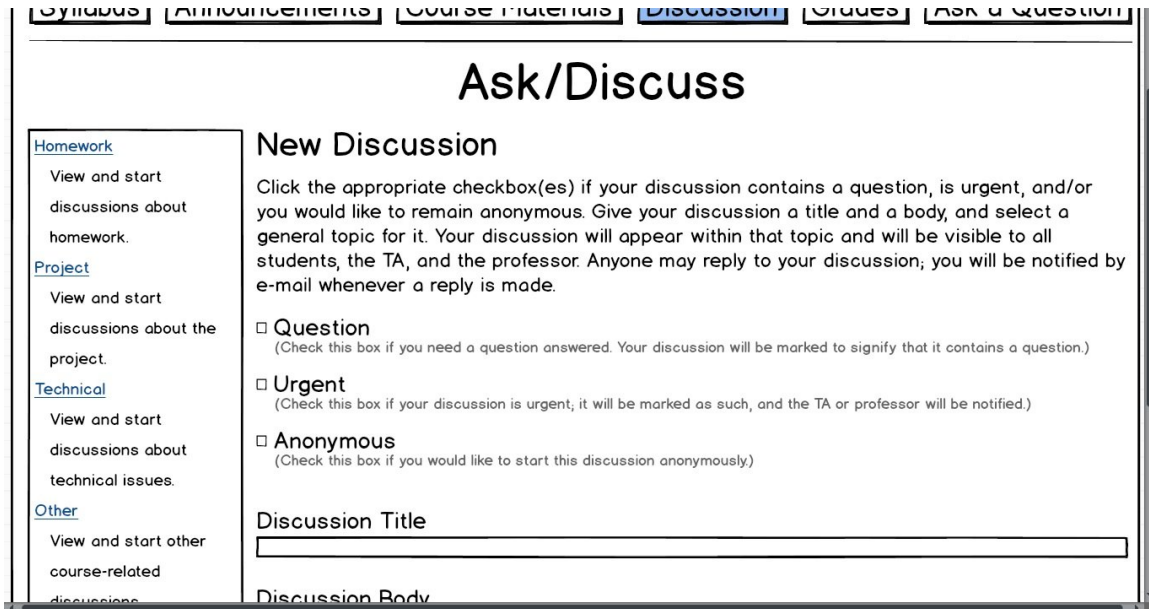
Figure 17. New "New Discussion" page
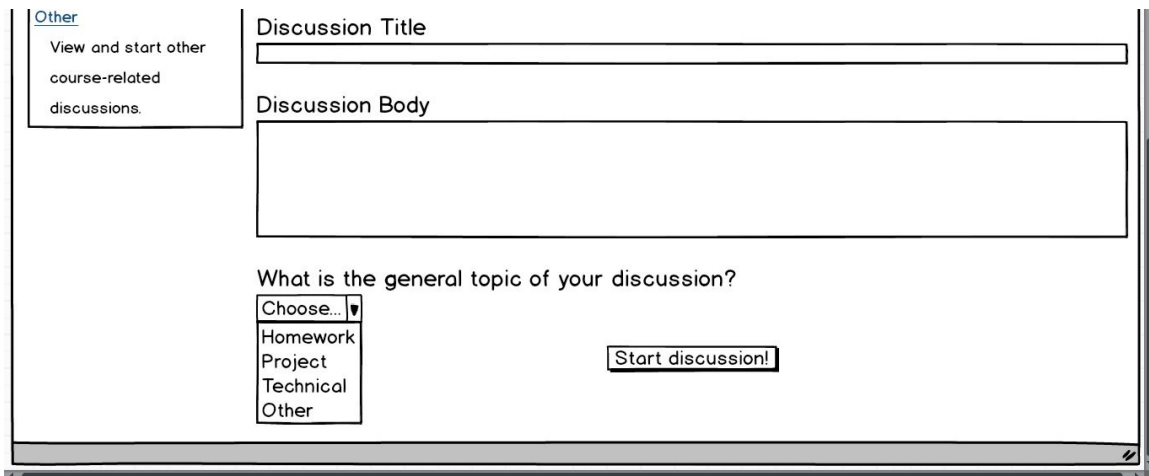
Figure 18. New "New Discussion" page

Progress Indication

Since many participants reported wanting the progress bar to show progress through each unit, it was broken up into 8 segments, denoting the 8 units in the Learnster course. The size of each segment varies in proportion to the amount of material (lecture videos, homeworks, quizzes, etc.) students are required to complete in each unit.

Participants seemed to find the percentage confusing or not descriptive; in addition, the progress bar is meant to be a visual representation of a student's progress

through the course - an image he or she can quickly glance at to obtain approximate, rather than exact, information. Therefore, it does not make sense to have an exact percentage next to the progress bar, and this percentage was removed. The progress bar was also resized to make it smaller and less intrusive. It may be helpful to allow students to complete remove the progress bar in a "settings" panel in the course, but this functionality is outside the scope of this project. The updated progress bar is shown in Figure 19.

Figure 19. New progress bar
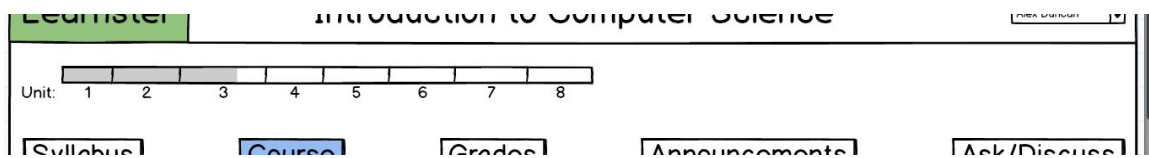
More detailed information about the student's progress is indicated in the unit menu on the Course page - green check marks are placed next to each of the course materials the student has completed. Additionally, a green check mark is placed next to a unit if the student has completed all the course materials contained within that unit. The updated unit menu is shown in Figure 20.
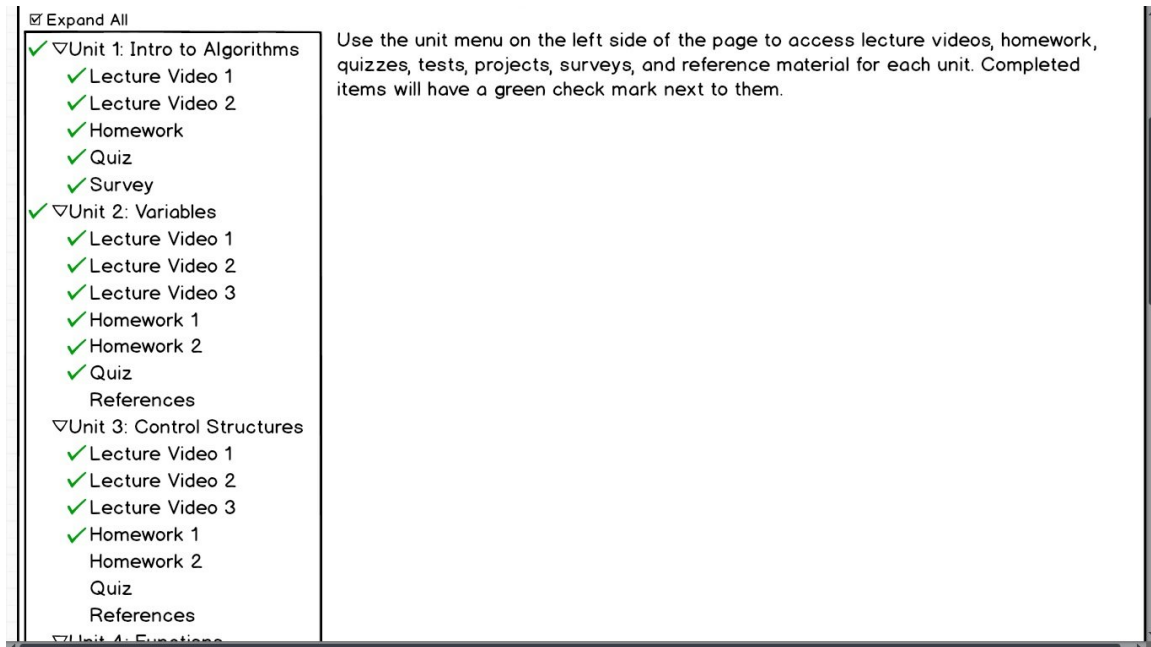
Figure 20. New unit menu

Screenshots of all pages of the updated Learnster prototype are contained in Appendices AA-AN.

Additional Recommendations

The following additional recommended changes to the Learnster interface resulted from user studies but are outside the scope of this project and were therefore not implemented. They have been organized into three categories: navigation, information, and features.

<u>Navigation</u>

Participants desired being able to ask a question about specific course material and link it to that material. For example, if students were watching a lecture video in Unit 4 and had a question about something mentioned in the video, they would be able to pause the video and ask a question from that page, tying the question to that specific lecture video, and possibly even to a specific point in that lecture video. Or, if students

were reading the description of a homework assignment and didn't understand part of it, they would be able to highlight the confusing text and ask a question related to the highlighted portion of text. These linked questions would likely appear as new discussions.

Study participants also wanted an increase in the number of links between pages and materials. Many of them expected to be able to click a unit displayed on the Syllabus page to navigate to that unit on the Course page, so implementing these links may be useful. Additionally, participants desired the ability to navigate from one course material to the next or previous material. For example, if a student had finished watching Lecture Video 2 in Unit 2, that page would contain links to the material preceding that video (Lecture Video 1) and the material following it (Lecture Video 3).

Information

Multiple participants reported wanting a calendar on the Learnster site to help them visualize important dates (such as homework due dates). They also wanted homework due dates to be displayed prominently with the description of that specific homework on the Course page.

According to user studies, the Grades page should display or allow easy access to: the student's submission for an assignment; feedback from the professor, TA, or peer reviewers (participants preferred feedback in the form of inline comments in their submissions rather than PDFs); the status (submitted, returned, etc.) of each assignment; important dates (when each assignment was submitted and returned, etc.); and the student's overall course grade. Study participants generally expected any of this

information not contained on the Grades page to be accessible by clicking on a specific assignment.

Participants during the data gathering user studies also mentioned displaying the length of each lecture video to help them better plan their time.

<u>Features</u>

Requests for added functionality varied by participant, but one of the more common requests was for notifications - participants wanted to be notified if anything in the course had changed (a new announcement had been posted, grades had been released, etc.). One participant suggested using a notification system similar to that used by sites like Facebook - a list of all activity in the course that remains hidden until clicked by the student, but that displays an eye-catching indicator of what and how many changes have taken place since the student last logged in to the course.

Many participants wanted to interact with the dropdown menu in the top right corner of the Learnster site that had the student's name. When asked what they expected to find in the dropdown menu, participants often cited the following items: student profile, messages, other courses, settings, and sign-in/sign-out.

Summary of Best Practices for MOOC Interface Design

A guide of best practices for MOOC interface design was created based on analysis of data from the user studies. The guide includes best practices that were incorporated in the prototype in addition to those that were outside the scope of the project, and it is organized into six categories: navigation, labeling, getting help, performance indication, layout and information display, and additional features.

Navigation

- Provide clear navigation to important elements of the course:
  - Syllabus
  - Main course materials (lecture videos, assignments, etc.)
  - Supporting materials (academic articles, etc.)
- Provide transparent, uncluttered, well-ordered navigation menus
  - Keep menu options labels and locations constant
  - Minimize or eliminate redundancy among menu options (menu options that lead to the same location, perform similar functions, etc.)
  - Order menu items to reflect student interaction
    - Order items on the course page menu by which ones students interact with most
    - Order items on the unit menu by unit number
- Link related elements of the course to each other
  - Link each unit in the syllabus to the course materials for that unit
  - Link course materials together to allow students to "step" through them
  - Link presentation slides to the corresponding place in the lecture video
- Reinforce the student's current location within the course
  - Highlight current page in navigation menu
  - Title each course page

Labeling

- Provide clear, consistent, descriptive labels for course pages
  - Rely on conventions students will understand (e.g., "Discuss")
  - Avoid misleading labels (e.g., "Course Materials")
- Label each button based on the action it performs or the page to which it navigates
- Condense button and menu labels as much as possible

Getting Help

- Provide a clear process for getting questions answered
  - Consider how students will ask questions, who will be able to view and respond to questions, and how students will receive replies
  - Provide a written explanation of the process if necessary
- Allow students to ask questions directly from course material, linked to the course material

Performance Indication
- Provide a visual depiction of the student's progress in the course
  - Make it clear how "progress" is being defined (progress through course material, number of weeks since beginning the course, etc.)
  - Tie the visualization to the course structure and course materials (e.g., divide a progress bar into segments representing the units of the course)
  - Make the visualization visible but unobtrusive
    - Allow students to hide the visualization
- Provide more detailed progress indication elsewhere in the course
  - Indicate which course materials the student has completed
- Provide quick, comprehensive access to assessment information in one place; for each assessment, allow the student to view:
  - His or her submission
  - Submission status (submitted, returned, etc.)
  - Important dates related to the assessment (date submitted, date returned, etc.)
  - Grade
  - Feedback from the professor, TA, or peer reviewers
    - Inline comments are preferable to separate feedback documents
- Clearly display student's overall course grade

Layout and Information Display
- Minimize distractions on each course page
- Display due date in each assessment description
- Display lengths of lecture videos
- Display a clear progress bar for the video the student is currently watching

Additional Features
- Provide course notifications (when new announcements are posted, when grades are released, etc.)
  - Investigate current notification systems (such as Facebook's system) for conventions
- Provide a calendar containing important dates in the course (e.g., assessment due dates)
- Allow professors to explain normed papers during guided peer review
- Allow the student to adjust the speed of videos
- Allow the student to pause a video, leave the course site, and return to same spot in the video
- Embed the discussion page within the course site rather than using a third-party
- Provide a user menu that includes the following options:
  - Student profile
  - Messages
  - Other courses
  - Settings
  - Sign-in/sign-out

As MOOCs continue to gain popularity and new MOOC platforms emerge, design of these interfaces will become increasingly important. The way in which a student interacts with MOOC interfaces affects his or her learning experience - well-designed MOOCs will facilitate learning and play an important role in the changing educational landscape. The best practices shown above apply to introductory computer science MOOCs; however, many other MOOCs, particularly in STEM areas, likely incorporate many of the same elements as the courses studied in this project. Therefore these best practices may represent a step towards a more comprehensive, universal guide to the design of MOOC interfaces.

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Appendix A - Background Survey

Master's Project Background Survey

1. **How old are you?**

   ....

2. **What is the highest level of education you have completed?**
   Mark only one oval.

   ◯ Some college

   ◯ Bachelor's degree

   ◯ Master's degree

   ◯ PhD

3. **What is your current major?**

   ....

4. **Do you have any work experience?**
   Mark only one oval.

   ◯ Yes

   ◯ No

5. **If yes, how many years of work experience do you have?**

   ....

6. **If you have work experience, what was your job title?**

   ....

7. **Have you completed a MOOC or MOOCs before?**
   Mark only one oval.

   ◯ Yes

   ◯ No

8. **If yes, what course(s)?**

   ....

9. **On what platforms?**
   Ex: Coursera, Udacity, edX

   ....

10. **Why did you take the MOOC(s)?**

_____

_____

_____

_____

_____

11. **Are you currently enrolled in a MOOC or MOOCs?**
    Mark only one oval.

    ◯ Yes

    ◯ No

12. **If yes, what course(s)?**

_____

13. **On what platforms?**
    Ex: Coursera, Udacity, edX

_____

14. **Why did you take the MOOC(s)?**

_____

_____

_____

_____

_____

Appendix B - Think-Aloud Round 1 Background Survey Responses

Participant	Age	Highest level of education completed	Major	Work experience	Years of work experience	Job title
1	21	Some college	CS	Yes	2	IT intern and student assistant
2	19	Some college	CM	Yes	0.5	Outreach Program Manager
3	27	Bachelor's degree	CS	Yes	2	Unsure… I work in IT at a small company. Officially "Chief Creative Officer in charge of special projects" but my boss just changed it to that on a lark.
5	24	Some college	CS	Yes	0.25	Software Developer
6	22	Some college	CS	Yes	2	Student Software Developer
AVERAGE	22.6				1.35	

Participant	Completed a MOOC?	MOOCs completed	Platform	Why did you take the MOOC(s)?
1	Yes	Web development intro	Udacity	Just for fun… to learn about web development in a course-like environment
2	No			
3	Yes	CS 101	Udacity	I wanted to get the fundamentals of Computer Science. (Now I am in a CS program at Tech.)
5	No			
6	No			

Participant	Currently enrolled in MOOC?	What course?	Platform	Why did you take the MOOC(s)?
1	No			
2	No			
3	No			
5	No			
6	Yes	Physics I	Coursera	In place of normal physics class here at Tech.

Appendix C - Think-Aloud Round 1 Protocol

1. Think-aloud will be conducted in a breakout room in the Clough Undergraduate Learning Center.
2. Subject will be seated at a computer.
3. The research study will be explained to the subject: "In this study, you will be asked to perform some basic tasks within an online course. While performing these tasks, you will be asked to verbalize your thought process as much as possible. You will be video and audio recorded. The purpose of this study is to identify 'pain points' in the course interface, not to assess you on your ability to navigate the course. You will then be asked a few follow-up questions and given a background survey to complete. You will not be compensated for participation. Your participation is voluntary, and you may leave at any time. Do you agree to participate in this study?"
4. Consent form will be provided to subject.
5. After subject consents to participation, the think-aloud will begin.
6. Subject will be asked to perform tasks within the course:
    a. Determine what the topic is for Week 3 (Unit 3 on Udacity) (navigate back to home page afterwards)
    b. Find and play the first video lecture in Week 2 (Unit 2 on Udacity) (navigate back to home page afterwards)
    c. Suppose you have a question about the course material that you want to ask. Figure out where on the site you would go to obtain the answer. (navigate back to home page afterwards)
7. Subject's verbalized thoughts will be audio recorded, and researcher will record observations.
8. Subject will be asked to answer a few follow-up questions:
    a. What task or tasks seemed easy? Why?
    b. What task or tasks seemed difficult? Why?
    c. Are there any changes you would make to the course site?
    d. Do you have any final comments?
9. Subject will be asked to complete a background survey.
10. Once subject has completed the background survey, he or she will be thanked for participating in the study and will be escorted out of the testing room.

Appendix D - Student Interview Protocol

Italics/italics = action items or reminders (not said to the participant)
Bold = said to participant

Protocol Materials
Computer
Power Supply
Paper
Pen
Consent
Questionnaires (If Necessary)
Greet Participant
·   *Ask participants if they would like to use the restroom before starting the experiment.*

Informed consent & questionnaires
·   *Administer informed consent.*
·   *Collect informed consent & check for completeness.*
·   *Collect any questionnaires not previously completed.*

Set up for interview
·   *Ask participants to be seated in a chair in the participant testing room.*
·   *Prepare computer for note taking.*

General introduction
Thank you for participating in this study. Before we get started I would like you to please turn off your cell phone, so we do not have any interruptions. Thank you.

Good afternoon. My name is Alex Duncan, and I am a Graduate Student at Georgia Tech. Today you will be answering a series of questions relevant to research I am conducting regarding MOOCs. There are no right or wrong answers. I am interested in your thoughts and opinions.

Topic and goal
This research is part of my capstone project for the Master's in Human Computer Interaction Program. My goal is to better understand what college-aged MOOC users think about MOOC interfaces. Your information will help me to conduct research on this topic and, ultimately, to develop a MOOC interface that is more useful and easier to use.

Are there any questions before we begin? *Answer participant questions*

I am going to begin the study now.

1. Why are you all enrolled in a MOOC? What are you hoping to get/achieve?
2. What things do you like about the particular MOOC you're in, with respect to the design?
3. What things do you dislike?
4. Are there any features not included in the MOOC that you would like included?
5. Are there any actions you feel take an unnecessarily long time?
6. What things have we not covered that you'd like to discuss?

Conversation Starters (corresponding to Interview Question numbers):
1. Some people enroll simply out of curiosity, some people enroll to gain job specific experience, some are in physical classes that require enrollment; does anyone fall into those categories? Are you hoping to gain new knowledge, or simply review something you've already learned?
2. With regard to:
   a. Assessments
   b. Communication with instructor/TA
   c. Communication with peers
   d. Ability to navigate through the course
   e. Anything else we haven't covered
3. (See 2)
4. Is there a way the items mentioned in (3) could be improved? Are there things present in a physical classroom that you wish were present in MOOCs?
5. With regard to:
   a. Content loading
   b. Obtaining answers to your questions
   c. Finding specific subject-matter information
   d. Receiving grades/feedback

Appendix E - Professor Interview Protocol

Italics/italics = action items or reminders (not said to the participant)
Bold = said to participant

Protocol Materials
Computer
Power Supply
Paper
Voice Recorder
Pen
Consent
Greet Participant
·   *Ask participants if they would like to use the restroom before starting the experiment.*

Informed consent & questionnaires
·   *Administer informed consent.*
·   *Collect informed consent & check for completeness.*

Set up for interview
·   *Prepare computer for note taking.*

General introduction
Good afternoon, and thank you for participating in this study. My name is Alex Duncan, and I am a Graduate Student at Georgia Tech. Today you will be answering a series of questions relevant to research I am conducting regarding MOOCs. There are no right or wrong answers. I am interested in your thoughts and opinions.

Topic and goal
This research is part of my capstone project for the Master's in Human Computer Interaction Program. My goal is to better understand the benefits and limitations of MOOC interfaces. Your information will help me to conduct research on this topic and, ultimately, to develop a MOOC interface that is more useful and easier to use.

I'd like to ask your permission to audio record our interview. Is that okay?

Are there any questions before we begin? *Answer participant questions*

I am going to begin the study now.

General Interview Questions:
- What MOOC did you teach, on what platform, how long did it last?

1. Please describe the components of your course.
2. What do students like about (your) MOOCs (not in terms of content, but in terms of course structure/design/functionality)?
3. What have students struggled with?
4. What are some limitations of the platform(s) you have used:
5. What features do you wish were available to students that aren't currently available?
6. What is the main goal of a MOOC?
7. Do you have any final comments?

Conversation Starters (corresponding to the Interview Question numbers):
6. Assessments, lectures, etc.
7. With regard to:
   a. Assessments
   b. Communication with instructor/TA
   c. Communication with peers
   d. Ability to navigate through the course
   e. Anything else we haven't covered
8. (See 1)
9. With regard to:
   a. Conveying information to students?
   b. Assessing students?
   c. Providing feedback/help to students?
10. Is there a way the items mentioned in (2) or (3) could be improved? Are there things present in a physical classroom that you wish were present in MOOCs?
11. For example, the main goal might be:
    a. Use in a flipped classroom
    b. To replace physical classrooms
    c. Give students review material

Appendix F - Think-Aloud Round 1 Quantitative Data

Task	Participant	Platform	Completed? (yes-1, no-0)	Task start	Task stop	Time on task	Total mouse clicks	Task-related mouse clicks
1	1	Coursera	1	0:29	1:02	0:33	1	1
	2	Udacity	1	0:31	1:15	0:44	6	3
	3	edX	1	0:16	0:46	0:30	3	3
	5	Udacity	1	0:42	2:01	1:19	8	5
	6	edX	1	0:37	2:19	1:42	14	7
Avg.			100%			0:57	6.40	3.80
2	1	Coursera	1	1:33	1:50	0:17	2	2
	2	Udacity	0	2:03	2:34	0:31	5	4
	3	edX	1	1:20	2:15	0:55	4	4
	5	Udacity	1	2:49	3:22	0:33	7	2
	6	edX	1	3:22	4:06	0:44	4	4
Avg.			80%			0:36	4.40	3.20
3	1	Coursera	1	2:44	4:10	1:26	2	2
	2	Udacity	1	3:28	3:53	0:25	4	3
	3	edX	1	2:44	7:58	5:14	33	14
	5	Udacity	1	4:05	5:30	1:25	13	2
	6	edX	1	6:00	6:32	0:32	9	2
Avg.			100%			1:48	12.20	4.60

Appendix G - Think-Aloud Round 1 Quantitative Data (Averages By Platform)

Task	Platform	Averages by platform		
		Time on task	Total mouse clicks	Task-related mouse clicks
1	Coursera	0:33	1	1
	Udacity	1:01	7	4
	edX	1:06	8.5	5
2	Coursera	0:17	2	2
	Udacity	0:32	6	3
	edX	0:49	4	4
3	Coursera	1:26	2	2
	Udacity	0:55	8.5	2.5
	edX	2:53	21	8

Appendix H - Think-Aloud Round 1 Participant #1 Qualitative Data

Task	Timestamp	Notes/Quotes	User Needs
1	00:41	Scrolls all the way down the page, trying to figure out where to go	Easy-to-find course outline/syllabus
	00:48	"I'm gonna check… I guess 'Syllabus'…"	Easy-to-find course outline/syllabus
2	01:37	"I see a section or button for video lectures"	
	01:45	"It's organized very nicely"	
3	03:02	"I guess I would check out Discussion Forums first"	Clarity of process for getting questions answered
		Scrolls somewhat randomly through forum threads for about 40 seconds	
	03:47	Finds the search bar	
	04:10	"I guess I would just look at the forums"	
Follow-up		Second task was the easiest because the "Video Lecture" section was clearly labeled and organized very well, by week - easy and straightforward	(Look at the organization of lecture videos on this platform)
		"Last task was a little confusing - don't know if the question was confusing or not. I assumed to go to forums because I figured that's where you would get an answer, but it wasn't super straight-forward if I'd find my answer here."	Clarity of process for getting questions answered
		"An FAQ section would help, but I don't know if that's something that would be useful. But for something like course material, or like the basics of how to use it."	Clarity of navigation through course (or explanation of it)
		"What do they mean by 'Surveys'?... If they're post-course surveys, they should specify… but maybe another course would have multiple surveys… Everything else looks pretty straightforward." (talking about Surveys page)	"Surveys" label is confusing

Appendix I - Think-Aloud Round 1 Participant #2 Qualitative Data

Task	Timestamp	Notes/Quotes	User Needs
1	00:45	Clicks on drop-down	(Look at placement and organization of
		Used drop-down to get to Unit 3 and figure out what topic of	
2	02:00	"From before, I found this scrollbar up here that says	Clarity in navigating to video lectures (this
	02:15	"I'll click on the first one that says 'Lesson 2' from the top	
3	03:36	"I can switch lessons with the scroll bar; that might not be it.	Less scrolling to ask a question
	03:48	"On the bottom, it actually says 'Discussions', and it says	Clarity of process for getting questions
Follow-up		All of the tasks seemed easy. "They seemed pretty	
		There were no tasks that seemed difficult. "At first, I thought the 'asking a question' one might be difficult to find, but I scrolled down the page, and it was right there! Pretty easy."	(Look at this platform for how to direct students to asking questions)
	06:30	She said she would definitely want to give the professor the	
	07:00	"Before Lesson 1, it would be great to see some kind of a	Easy-to-find course
	08:05	"It would be good to have a mini quiz every section or so to	
	08:30	"What is this?" (referring to the video navigation bar at the	Clear video progress bar
	08:43	Surprised that clicking on the different points on the video navigation keeps you within the same video. "That might be confusing. Intuitively… I haven't really used any website that you navigate it this way to get to the next video. There's usually a little arrow on the side or something... also, if it's not really obvious, having the arrow... you might not really click to that one, either. This [video navigation bar] could be confusing.	Clear video progress bar

Appendix J - Think-Aloud Round 1 Participant #3 Qualitative Data

Task	Timestamp	Notes/Quotes	User Needs
1	00:16	"My eye went first to 'Courseware' in the top left corner." He reads	(Look at this platform for placement
	00:28	Clicks on Syllabus	
	00:36	Scrolls down, finds Week 3, clicks on it	
2	01:22	"I already know the Syllabus, but I don't necessarily want to go there."	
	01:30	Looking under "References" heading.	
	01:40	Clicks on "Syllabus"	Navigation from Syllabus to actual
	02:00	Clicks on "Week 2"	
	02:08	Clicks on "Lecture"	
3	02:44	"I already thinking I'm looking for 'Help' or something… there's 'Discussion', that's pretty good, in the top left there. I'm going to check over here [top right corner drop-down] next to my user name. There are frequently 'Help's there. I found 'Help' there, as well, but I'm going to go click on 'Discussion'."	Looks for the word "Help", but decides on "Discussion"
	03:08	"I like Reddit because I'm a member." Scrolls down "Discussion" page.	
	03:33	"Those [things on 'Discussion' page] look like options."	
	03:35	Clicks on "Help" under user name drop-down menu.	
	03:54	"Now I'm thinking about doing Control+F for 'discussion' or something,	
	04:21	Searches for "help" using Control+F. Through this, he discovers something called "Help Center".	
	04:42	Frustrated that when he searches for "Help Center" using Control+F, it doesn't actually go to anything except something that talks about the Help Center.	
	04:49	"What's a 'Help Center'?"	
	04:59	Searches for "Help Center" on "Discussion" page. It's not there. Hesitates…	
	05:28	Searches for "edx.org help center" on Google	
	05:53	Going through Google results	
	06:15	Clicks on a result, finds link to Help Center on that page. Clicks on the link.	
	06:43	"Now I'm deciding whether or not this is what I want at all."	
	06:51	Clicks on "Browse discussions"	
	07:10	Searching to see if Help Center gets split up by classes	
	07:17	"I'm going to determine now that I've found a great source of general help for the website and go back to the first tab I had open, which had 'Discussion' and referenced Reddit and Facebook and Twitter and Meetup. Since I like Reddit, I'm going to select Reddit. I found the link and am opening it in a new window. It doesn't look right - the pictures and stuff... this all seems familiar, and so now I'm thinking, 'What was my question again that I was trying to answer?' Since I don't know, I guess I'm done.	

Task	Timestamp	Notes/Quotes	User Needs
Follow-up	08:27	"The first one was a little bit tricky, and I think that was just because it was my first time looking at the website. It wasn't really tricky, but I felt like it was tricky."	
	08:37	"The second one seemed really easy. I recall thinking as I was completing the second task, 'Wow, my eye went pretty much exactly to where it needed to to complete that task. That was nice."	(Look at navigation to lecture videos on this platform)
	08:56	"The third one was fine. I think I tend a little bit to be thorough - even though I found an acceptable answer, I didn't like having something referenced [Help Center] and not knowing what that was. It was annoying… The first place I saw 'Help Center' in the frequently asked questions, it would have been cool if that was a link, because then I wouldn't have had to do that search at all. But if not that, then at least somewhere on that page - it bothered me that it wasn't on that page."	
	09:48	"I guess really, they were all easy, because I found the help resource very quickly, but I just wasn't sure that was the help resource that I wanted. It was *a* help resource, so I guess if I knew in advance that the website was organized perfectly, once you find *a* solution, it's probably next to all the solutions - all the help resources would be on that page. But since I didn't know that, I wanted to find out what the Help Center was."	
	10:35	"The tasks were very easy, but being introduced to something like the Help Center and not having any explanation as to what it was and having to search around for that - that was frustrating. But I didn't really need to do that to complete the task. I suppose if I was using this on my own, I would do the same thing."	
	11:17	"I use Reddit, but there are lots of sub-Reddits. I know they exist, and I use them occasionally, but I definitely don't look for sub-Reddits for things that I'm interested in; that's just not something I do. I should, and I'll try, but I just don't ever do that. So my first thought about anything would be, 'Oh, I wonder if this is already on Reddit.' Maybe it has something to do with the fact that I read, and I don't really post much on Reddit. Maybe if I did, I would have more interest in sub-Reddits."	
	12:26	"I wanted this course to have its own discussion forum. I don't think that's actually in my best interest; I think it's better if it's on Reddit. The feeling I have about help forums on websites is that they are usually useless. I've found them to be useless. But Reddit is a website I've found to be very useful, so I would think it would be better if it was on Reddit, but for some reason, I wanted to find one actually on the site. I can't explain that; it sounds like a contradiction."	Discussion forum on platform, not third-party
	13:11	"There was lots of different options for help, so if you have all the help separated in like 8 places, that doesn't seem right - I think it should be in one place. Maybe that's really what I was looking for, is to have a single source of discussion and help, rather than multiple."	Single source of discussion/help
	14:06	"I also would have interacted with it differently if I were on my own computer… The computer I have here is a tablet, it's got a stylus - that's pretty different. I like the mouse better for interacting with the computer. But shortcuts like opening tabs and stuff, I use a different keyboard layout, as well... just like the cost of shortcuts and my typical navigation things changes on a new computer.	

Task	Timestamp	Notes/Quotes	User Needs
Follow-up	15:50	"I guess what I'm kind of looking for right here [Course Info page] is like what's currently going on in the course. Since I haven't actually used this, I'm not really sure what sort of format I should expect in these courses - if they're 'learn at your own pace', I guess there's no like announcements or anything necessarily. But still, what's currently going on, what stage am I at, I guess? Progress is up here [top of page], that doesn't feel like what I was looking for... Some sort of a progress bar would have been cool, or like recent announcements. What point am I at right now? Something that tells me that on that first page would be cool."	Easy-to-find course outline/syllabus; clear depiction of his personal progress in the course
	18:00	"The other thing I'm thinking is, I clicked on this course… on 'Course Info', and I kind of expect like a general… syllabus, or like an outline, or objectives, or topics or something… describing what this course is. I was looking in this first line right after 'This is CS50' to see what it was, because I don't even know. And I didn't see it there. Then I saw up here [very top of page, next to 'edX'] that CS50X is 'Introduction to Computer Science'... That was the first time I realized that. I don't know if it was on the previous page or not.	Easy-to-find course outline/syllabus; clear depiction of his personal progress in the course
	19:04	"Is there a way to get to my dashboard from that previous page [page you get to when you enter course]? So it does say 'Introduction to Computer Science in huge letters there [on dashboard]. I didn't read that before."	
	19:25	"Now I'm wondering if there's a way to get to the dashboard from this page [page you get to when you enter course]… I kind of would have expected it to be up here in the top right [where user name is], I guess. But it could be anywhere.	
	19:52	"So I did find, when I was looking down to see what this course was about [on first page], I saw things like 'schedule' and stuff. I don't really care about any of this stuff, but 'Syllabus' was interesting." Clicks on "Syllabus".	
	20:16	"I still haven't found what I'm looking for at all - just a general idea of what this course is. I could go through the syllabus and these lectures and stuff…" He reads through a bunch of the topics on the syllabus. "It doesn't tell me what this course is, it's just stuff that's going on. I guess what I'm looking for is like, 'By completing this course, you will be able to write small programs, you'll be able to compile this, that, or the other thing, you will understand...' Just one sentence that explain what this course does. Like a summary... 'Introduction to Computer Science' is not really descriptive. Maybe, 'You're going to learn about this thing, that thing'... three points or something."	Broad overview of the course as soon as you log in; objectives, what you'll learn
	21:39	"There's 'Formats' over here [right side of page], and I'm thinking, 'Formats of what?' My first guess, since I saw iTunes here, is that formats are these videos? 'Harvard College' could be formats of this whole class. Does this whole class have different websites? And then I'm thinking, 'Am I in the right one? Should I be in one of these other ones?' None of these are familiar to me - I've never used them, but I know of them."	"Formats" is poorly labeled
	22:17	Clicks on "compare options". "'compare options' - that's interesting."	
	25:29	"Now I guess what I'm thinking is, 'Where's the actual course?' But I don't think it's started yet, right?	Clear picture of where the course "is"
	25:48	Clicks on "Courseware". "So I click on 'Courseware'. I've been to this page before, but I guess it's possible that that could be a bit more unique or clear. It probably doesn't matter, because once you click on it the first time…"	

Task	Timestamp	Notes/Quotes	User Needs
Follow-up	26:54	"There are a lot of links down here [Week 0, "lecture continued" page]. I'd rather have little graphics or something, like drop-down menus for clicking on 'Transcripts' and then seeing all the different languages or something. I don't like scrolling through it. I guess more of the problem, than not liking scrolling through it, is that I'd like to get like a quick idea of what's down there and available, and... I don't really know how to group all this - it's like information *for* the course, I guess? You could go through it one by one and read them all, but I'd rather just say, 'Oh yeah, that's where I download things for this lecture.'"	Download links that are grouped and hidden
	27:47	"What about if I wanted to get stuff for this week?"	Clear navigation to materials for each unit/lesson/week
	28:13	"Now I'm thinking, how are these things graded? I guess it would be cool if there was a… somewhere to see my grades. Maybe if I did the assignment it would appear…"	Clear navigation to grades
	29:58	"I like this one [website] a lot. Most of the time, what I wanted was right there… I would not expect a new site to be completely intuitive right away."	
	30:55	"I wonder how many people don't take a course because they're like, 'Oh, well, I couldn't find what I wanted, so probably the entire course is going to be me not being able to find what I want.' Maybe it's a ton of people."	

Appendix K - Think-Aloud Round 1 Participant #5 Qualitative Data

Task	Timestamp	Notes/Quotes	User Needs
1		Scrolls up and down first page, at first. Hesitant about where to go.	Clear navigation to each lesson/unit
	00:49	"Is units… like… lesson? Are they different, 'lesson' and 'unit'?" Clicks on drop-down at the top, scrolls down page.	Clear labeling of "lesson" and "unit"
	01:15	"So, there is something called 'Notes for Unit 1' [under 'Instructor Notes']… I'm going to 'Next' [button] to see if that is the unit." Clicks "Next" button, then clicks drop-down again and clicks "Lesson 3: How to manage data".	
	01:52	"Lesson 3 is Unit 3"	
2		Instantly clicks drop-down, then clicks on "Lesson 2: How to Repeat"	
	03:09	"So, this is like the first video, I guess." Seems unsure. "I guess that would be the first video."	Clear how many videos in each unit/lesson, and their order
3		Instantly goes to top right and finds "Forum".	(Look at this course for labeling and placement of "Forum")
	04:12	"So, I'm asking the question from other people, or from the specific instructor, or…?" Clicks on "Forum". "I either have to discuss the issues that I have on a forum because people can really respond, so I'll go here [clicks 'Ask a Question' button] and just ask a question."	
	04:37	"This ['Forum' button] is a real descriptive icon."	(Look at this course for "Forum" button)
	05:32	"If there are other resources for asking questions, maybe if it's in regard to the same unit I'm watching, I can go there ['Ask a Question' gray button on video page]." Clicks on "Ask a Question" button.	(Look at this course for "Ask a Question" button)
	06:04	"Either I would go to the Forum or to this 'Ask a Question' [gray button on video page] here."	
Follow-up	06:44	"All of them [tasks] were easy… The environment wasn't very confusing, so finding things was simple. The only thing that wasn't simple was that 'lesson' and 'unit' thing - it wasn't labeled consistently, the terminology that you use." I ask if he thinks lessons and units are the same thing, or if they're different. "Intuitively, it makes sense that 'lesson' is like a part of a 'unit', but considering the task that you told me... it would mean the same thing. If that is the case, then just use one of them, probably."	Consistent labeling of "lesson" and "unit"
	08:17	"It was difficult that 'unit' and 'lesson' confusion, so making that consistent…"	Consistent labeling of "lesson" and "unit"
	09:55	I ask him if there are any changes he would make to the course website. He starts looking at the "line of squares" that serves as the video navigation. I ask him what his sense is of what the line of squares means. "I guess they're like different lessons, I guess? In the same unit. 'Instructor Note' is... there are no notes here. One of the things is that it doesn't tell you exactly where you're at when you click on these [video navigation squares], so I'm not sure if I'm... still at Lesson 2 or not... There should be something like 'current state' or whatever that tells you which lesson, which unit you're at. Something that tells you a little bit more about the navigation of the videos here. This one [square] I'm playing, it's gonna be orange... It means that I haven't finished it, which is okay, but it would have been easier to have some sort of color thing here that says which one is which. And some of them have circles in them, which I'm not sure what that is. And some of them don't."	Clear video progress bar; course progress bar so you know where you are in the course

Task	Timestamp	Notes/Quotes	User Needs
Follow-up	13:10	I ask if he has any final comments about the website. "It's pretty good. I like the simplicity of the design. It's not confusing, but… they could have put more hints of the current web page that you're at."	(Look at this course for simplicity of design); course progress indication

Appendix L - Think-Aloud Round 1 Participant #6 Qualitative Data

Task	Timestamp	Notes/Quotes	User Needs
1	00:40	"It looks like I landed on a general course information page. Based on the top bar, I think 'Progress' is probably going to give me… nope, maybe not - nothing's here. I'm going to go back to 'Course Info' and maybe look for a syllabus or some kind of schedule. It looks like Weeks 0 through 4 are ready, so they're here somewhere, I just have to find them. It doesn't seem like any- oh, here's a 'Schedule' link in references." Clicks on "Schedule" link.	Easy-to-find course outline/syllabus/schedule
	01:21	"I'm looking for the 3rd week, which I assume to be 'month', maybe? If this is supposed to be broken down by weeks, it doesn't do a very good job of it."	
	01:53	"Maybe there's more information in the problem [set]; probably not." Clicked on "Problem Set 2", then back to "Schedule", then back to home page.	
	02:11	Clicks on "Syllabus" under "References".	
2	03:25	Gets to home page and hesitates, scrolls a bit.	Clear navigation to lecture videos
	03:30	"I'm just gonna scan the front page again. I see there is a link: 'watch first and second lecture'." Clicks on "second lecture". "Looks like here all the lectures are." Clicks "Week 2", then "Lecture". "I would have expected that link to take me to the Week 2 lecture, I guess."	
	04:16	"I can't say that that was a pretty logical place to look, but… I don't know how you normally would have gotten there, assuming there wasn't a link in the information [home page]. Because in that first page, it's just like a blurb that the professor writes, right?"	
	04:47	"I'm not sure what this [home page] is. I guess this is like an update page. So, if he hadn't put a link to it [second lecture video], I'm not really sure…"	
	05:04	I ask him what he would have tried next if there was no link. "I don't know what 'Courserware' is, but… that's it. Lucky guess. 'Courserware' is a pretty terrible word for that. But it's gotta be important, being in the top left, the very first button."	Clear labeling of course materials; "Courseware" is not descriptive
3	06:07	"I'm gonna start with 'Discussion' because that sounds pretty reasonable for asking questions…" He reads through the first bit of the "Discussion" page. "So I'm guessing they want us to do all of our Q&A on a Reddit page, which I think is pretty terrible, but I guess it's *a* solution. So, if I wanted to ask a question here, I guess first of all, I'd have to create a user name."	Clear labeling of place to ask a question - "Discussion" seems to be intuitive
Follow-up	07:30	"Discounting the really poor naming of the course content button, finding a lecture would have been the easiest, because at its core, that's kind of what you're trying to do here - provide video lectures. So, I would have expected that to be the very first thing that they do, and it turned out that it was, but it was poorly labeled. I would have said finding the topic for Week 3 should have been easy - I would just expect the syllabus to be somewhere up front and center, because it's like an overview thing. I guess having the bar up here ['Courserware' bar] and then another one on the far right ['References' bar], and these [under 'References'] seem more like instructions, how do I use this site?, what's changed here, and	Clear labeling of course materials; "Courseware" is not descriptive; easy-to-find syllabus/schedule

Task	Timestamp	Notes/Quotes	User Needs
Follow-up	09:40	"Finding the topic when the syllabus was really what we were looking for was by far the most difficult. Finding a discussion or a place to ask questions - again, it's something I would expect from this software, being an online course platform, and it's up there in the top left with everything I want to see. I would have expected... 'Courseware', assuming that's materials. 'Course Info', 'Discussion', and 'Progress' - those are like the four parts of the class. I would have expected 'Syllabus' and 'Schedule' to be prominent on the course information page just because this is where you're looking for... you're going to look at this page pretty much the first	(Look at this course for placement of "Discussion"); easy-to-find syllabus/schedule
	10:59	I ask him if, after going into "Discussion", it was simple to know what to do. "Yes, it was very straightforward what to do. I can't say that I like the solution, but I guess that's not the point… I don't like that you have to go elsewhere [Reddit] and create another account. I'm not really a fan of it being on Reddit, I don't think Reddit is a good medium for question/answer... If you want to get an answer from a teacher or someone who... you know you can trust their answer, you know you're not	Discussion forum dedicated to platform (not 3rd party)
	12:30	I ask if there's anything else he would change about the course site. "Other than 'Courseware' being extremely poorly-labeled… Maybe that's a really common term, and I've never heard it before. I do like the layout of the week-by-week. You can pop it open, and you have lecture,	Good labeling of course materials ("Courseware" is not descriptive)
	13:17	"I do like that it's pretty simple, when it comes down to the entire web page, or the entire design. You really only have these four buttons [top left], and that's really all there is to it. It doesn't seem like you have the option to change any of your settings, but I guess that's not a thing. I do like the simplicity, because when it comes down to it, I don't want to spend my time dealing with an online course site - I just want to be getting to the materials that the professor is giving me. And if I were using this, I would probably just bookmark this page ['Courseware' page] and then just come	Simplicity; minimal buttons
	14:33	I ask him to elaborate on what he means when he says the layout is "simple". "I come to the page… The first page you land on is really busy, but from anywhere in the app, there's really only four things. And they're very clear, at the top of the screen, they're pretty prominent, it's the first thing my eyes went to, and that's really it for options. It seems like there's not really too much you can do with this web app, but that might be a good thing. At its core, I'm trying to get to my professor's course material, and having tons of features and a lot of stuff going on on the page isn't gonna	No distractions; limited options (so it's easier to find where to go)
	16:12	"I'm assuming these [links under 'Formats' heading] are video formats, or something along those lines, and if that's the case, then that's pretty poorly done. Actually, really poorly done. Oh, they're just links to… oh. These are just random resources, just in the 'Formats' section... It seems like he [professor] probably needs some more guidance in configuring these links on the side [under 'Formats']. Because I do think there needs to be a place where you can put reference links, or some kind of resources that are not related to your course material in this right column - I don't think that's maybe the best place, but I don't think it really warrants an extra section up here [top left, with four main options] just to list all the links, unless they	Clearly-labeled place to put reference links/additional course materials, likely in the top left with main course aspects

Appendix M - Interview Participants #1-2 Qualitative Data

Timestamp	Notes/Quotes	User Needs
00:11	1 - "I took… an inverted classroom MOOC. It was ECE 4555. It was basically a controls course on controlling mobile robots. And it went over basic topics about control systems and electrical engineering. There were about 20 of us in the class, but then there were 40,000 other people in the class with us that were on the MOOC but not in that class, in the actual inverted classroom situation. They were just taking that half of the class. Part of our grade was based on how we did in the MOOC, but it was basically kind of pass/fail..."	
01:03	2 - "I've taken a couple of courses. I took "Complexity Theory". Then I took "Data Science". I think I took one game theory course and one algorithms course… Mine [platform] was Coursera."	
01:30	1 - He says he also used Coursera for his course.	
01:45	2 - "In Coursera, every video had 2 to 3 single-question quizzes in between the video. Then, you had homeworks which were multi-choice homeworks, like filling in a number kind of homeworks. Then, in some of the classes, because they were CS classes, we had programming assignments, which I could very clearly tell were auto-graded on certain criteria. So, it wasn't something very creative or intense; it was very basic programming stuff. Other than that, it was just quizzes... the multi-choice quizzes.	
02:33	1 - "Ours [assessments] were very basic - just quizzes every week… And then as part of the class, we had to actually do programming assignments, but that wasn't related to the MOOC… We watched the video lectures, and then we used what we learned from the video lectures in the MOOC to do the programming assignments in class. But the other people in the MOOC just had to take the quizzes every week."	
03:24	2 - "The idea [reason for enrolling] was, partially, some of the things, I was interested in, and some of the things were what I needed to get an internship, and I wouldn't be able to register for them until maybe next year, so I might as well learn it now and... put that on my skillset, have some basic knowledge about it, and be able to talk about it to a recruiter. And the other stuff, I was interested in." Used them for building job skills/resume.	Reasons for enrolling: personal interest, building job skills
04:15	1 - "Spring of [2013]" - when he took the MOOC.	
04:20	2 - "My… class ended last week. It was like a 5-week class. I've been taking other courses over the past year."	

Timestamp	Notes/Quotes	User Needs
04:53	I ask them if there was anything they liked about doing courses online, or the Coursera platform. 1 - "3 or 4 years ago, I… used to use this thing called Kahn Academy… I used to watch his videos, I thought they were really entertaining and helpful when I would have issues in freshman, sophomore calculus... I... saw him, and he was the first person to really introduce... me to the idea of having short lectures as homework, and then have the coursework be... the implementation of what you learn. With that idea in mind, I really thought it was helpful to be able to go through the lecture over and over again or kind of like review material and really... have the material to yourself and just look over it, kind of like an interactive textbook a little bit, but having it explained a little better than a textbook, and then go somewhere else and be evaluated, like live evaluation, rather than the opposite... I really like the inverted classroom idea... For the MOOC specifically, I like when it's paired with some other kind of instruction because I feel like it gives you... some kind of way to e	
06:50	2 - "The two things I like about MOOCs are, number 1, I like that I could go at my own pace. Even after the class ended, I still had access to the lectures, and I could still turn in the assignments - that was if I wanted to go slow. But let's say I knew something, I don't have to sit through that part of the lecture... and say, 'I know this, I don't have to waste my time watching this video.' It was kind of the flexibility of, I can go as fast or slow as I want... When I used to watch Kahn Academy, the frustration I had was, I don't know what he's going to cover... I don't know if what I want to learn is in this video..."	Ability to set own pace, go as fast or slow as they want
08:04	Both of them agree that they liked being able to go at their own pace.	Ability to set own pace, go as fast or slow as they want
08:31	I ask them what things they disliked with regard to the course setup/design/structure. 2 - "Many times, I've seen professors using the microphone less than ideally… If it's not set up properly, I can barely hear you, or it's too loud."	
09:06	2 - "This was extremely rare… You know how they start writing on the slides? At times, it became pretty cluttered. If you go to a classroom here at Georgia Tech where they have slides, they have 2 screens - one is the slide, and one is a blank sheet of paper they start scribbling on."	
09:38	2 - "Also, one more thing I did not like - the programming assignments were not challenging enough, but again, that is probably more of a 'what's the audience you're trying to address?' kind of issue."	
10:08	1 - "My only dislike was the same thing - I felt like the assessments didn't evaluate my knowledge very well."	
10:32	I ask them if they remember ever not being able to find something on the course site. 1 - "I don't know specifically - it was awhile back - but I do remember being confused from time to time about… I remember the due dates for things were sometimes not very clear - it would say a due date, then you'd have an extra week to complete it... weird things like that. The same kind of stuff... that we have with T-Square here. It was frustrating because it seemed like, especially with the assignments and the quizzes, it was hard to understand what you *had* to do, what was suggested, and how to separate those two things... It was hard to navigate that. I specifically remember it being difficult."	Clear due dates; clear distinction between mandatory and optional assignments

Timestamp	Notes/Quotes	User Needs
11:18	2 - "I've been using Coursera for some time. Recently, I don't think I had difficulty finding stuff. They can definitely structure it better in terms of… but I think the structure depends upon class to class. At times, they have the assignment and the submission page separate, which can get annoying, but that's about it. But it's probably because I've taken so many classes on Coursera - I'm used to exactly where [stuff] is."	Assignment and submission pages should be consolidated?
12:32	I ask if there's anything in the MOOCs they've taken that they'd like to see included, like to see them do better, or something that's not there now that they'd like to see. 1 - "All the MOOCs I've been in, it's like someone sitting here, writing on a digital screen, and they write *on* the slides, or they write... and it gets cluttered, or they... have like a blank screen... it always seems really confusing because they keep erasing it and stuff, and I'm kind of more used to a physical board. I feel like someone standing in front of a board - I've always just liked the way that looks a lot better, and the way it feels when you can actually see the last 10 minutes of lecture on the board, rather than having this one little screen, they keep erasing stuff, and going back, going to the next page... I kind of wish they tried to make it... feel as realistic as possible without actually being in the classroom. So, make it feel like you're watching a lecture from the back of the room."	
13:41	2 - "You can probably have a track for everyone, but if you want to take on challenges, then you could probably have separate programming assignments. Let's say you feel *more* comfortable on this topic - you could have a standard programming assignment, and you could have a more 'challenge yourself' programming assignment... This is an alternative to that, as opposed to being something after... both of them are credit, you can do one or the other... You can test you're self based on how comfortable you feel with the material."	"Tracks" for people at different levels of knowledge in the course
14:38	2 - "The other thing that is, again, slightly programming-specific is that, let's say I was doing computer science, so I have to write… functions. Now, when I am writing… functions, I don't have my own… setup where I can test it or debug it. They obviously have some sort of setup... So, if I could have the setup, if it's other than a standard compilation program, if it's something else... if I could have that setup built into the website, then I could just compile or debug... if Coursera comes up with a formal platform for code-checking, and you can set up your own syntax rules..."	For CS courses: way of compiling and debugging built in
16:25	I ask if they had problems, did they use an online forum? Or online communication with TA/prof? 1 - "I didn't. The people who were teaching the class, I had interactions with a few times a week, so I would… just go talk to them."	(Didn't use forums much)
16:42	I ask if it was available to use in his course. 1 - "I talked to my professor, and he said he'd get thousands of responses all the time… but I… looked at it once because I was interested, but I didn't see any of it."	(Didn't use forums much)
17:01	1 - "I went to the forums, I never actively posted, I just saw other people who have already answered the questions that I was going to ask. More often than not, if I'm stuck on a problem, instead of going to the class, and the forum, I would just Google it out of habit."	(Didn't use forums much; use Google instead)

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Timestamp	Notes/Quotes	User Needs
18:10	I ask if there were any actions in the course that they felt took an unnecessarily long time to complete. 1 - "I already had some knowledge of the subject material going in… So, a lot of the lectures seemed inefficient because I knew the stuff… it was not helpful... My classmates and I would just press the 'speed-up' button... we'd have to run the lectures at like twice the speed... we didn't want to miss anything extra." I ask if he would have preferred that those lectures still be there, or would he like to have the option of removing them from the course? 1 - "I would prefer they were still there, but you [2nd person] were saying they had like preview slides, but I don't remember having..." 2 - "If we can go to the PDF, and we can see in the PDF what slide we wanted to go to... and somehow jump to that slide... that would be more efficient." 1 - "I don't think I had the option in mine... to look through the slides - you just had to watch the videos. I felt like I wasted a lot of time watching videos that were unnecessary."	Be able to speed up videos; be able to view presentation slides, and jump to a specific slide in the video
19:48	2 - "I would like the professor to go through the material faster… What we can minimize is chopping off stuff we already know… I would use it [speed-up button] until I realized I could just look at the PDF, and then I'd start clicking until I saw that slide on the video screen. So if I could directly jump to that slide... it would save me the trouble of having to go through the video and random places until I see the slide."	Be able to view presentation slides, and jump to a specific slide in the video
21:01	1 - Talks about a platform called Tegrity that used videos that had separating markers every time the professor changed slides. He says that would be really helpful.	Markers in the video whenever the professor changed slides
21:30	I ask how 2 feels about having quizzes embedded in the videos. 2 - "At times when I thought I understood something, and after that I took the quiz, then I saw the explanation, and then it corrected me at times. At other times, it really forced my understanding... I definitely like the idea of having quizzes embedded, because it reinforced what I had learned at the point where I really cared about it."	(Likes quizzes embedded in videos)
22:10	I ask how they felt about the amount of feedback they got in the online course. 1 - "I would definitely say it was insufficient… I understand they give little explanations on multiple-choice quizzes, but that's all you can do when you have 40,000 students - you can't give them individualized feedback. But it's always been preferable to have a real grader over an autograder, so coming from real classes, it felt like it was insufficient, but I think it's also they best they could do."	(Insufficient feedback given on assignments)
22:43	2 - "If they would have an explanation as to what's the mistake that you might have made, for each option… so when I'm confused… so you know when they make the options, they obviously have the mindset of a student can go wrong, a student can go wrong, a student can go wrong here. Then, they explain kind of that when you click on the correct think, and you look up the explanation, at least on Coursera, it shows you why that's the correct option. If it showed you why the other 3 were wrong, that would kind of help to give you feedback in a setting like this... But I would have liked more feedback."	(Insufficient feedback given on assignments)

Timestamp	Notes/Quotes	User Needs
23:40	1 - "In the one I was in, actually, they didn't do that… When you had a wrong answer, I don't know if they'd necessarily say, 'You obviously went wrong here.' Because I think you got two tries on every question. For the first try, they would give you a hint to try to help you get to the right answer, and then if you got it wrong again, they would give you a full explanation of why that's wrong... But they did have individualized explanations for each wrong answer. Or at least hints. And that was helpful, I liked that a lot."	
24:49	2 - "There's one thing I would like… he [person 1] was saying that the idea that not having the core things… so when I'm watching a video, I can fullscreen… but if my entire screen could be the teacher, the sheet that he's scribbling on, and maybe just the components of what I'm teaching covers the complete screen, as opposed to just the video... So this has two parts. First, we would have to incorporate the changes regarding the... video we were talking about - it's not just the slideshow... it's the slideshow, it's his [professor's?] inset, and then it's the place where he's writing on. If I could just have a no-distraction kind of zone when I'm watching the video... that's something... a guy like me has an attention span of 15 seconds... If I could have a distraction-free environment to just watch videos, take the quiz, take the test... I would like that option... What I'm saying is, instead of just the video going fullscreen, you could have these three or four different components, and they are organized on the screen, and they take up the complete screen. So it's like an i	Distraction-free fullscreen mode
27:11	1 - "To be honest, I'm not a big fan of online courses in general because I think it's… good to lightly cover material, but I think there's a level of understanding that I've never gotten from reading a textbook, that I've never gotten without some kind of interaction with a professor... somebody actually grading your homeworks... or going to office hours... I think that's not something you can entirely replace. And also, the MOOCs have always... I don't really understand what they are, because they're not really classes, but they're also not just online tutorials. Because there's online tutorials that you can just go on the website and go through yourself for a while and look at examples and have sample problems... and you also have classes and schools that are accredited where you get course credit, and the MOOC falls somewhere in between, I don't really understand what it is and what it's supposed to be, what kind of gap it's supposed to fill."	
28:29	I ask if he thinks it has a place to fill at all. 1 - "Yeah, I think it's good because… it's a really user-friendly way of doing online tutorials, or online help for learning how to do something specific. But it's almost like they're marketing it… as a... full class, or like a college class equivalent, and so that confuses me because I don't know if I feel like it's to the point that they market it, like... it might not be to that level. I don't think a 5-week class is mature enough... for someone to compare it with a full, 16-week class where you get an A, B, C, D, or F...	

Appendix N - Interview Participant #3 Qualitative Data

Timestamp	Notes/Quotes	User Needs
00:15	I ask her what MOOCs she took. "My first one was one during college, and then I took one kind of over winter break, and I'm doing one now… The one during junior year of college… would have been… something about learning programming techniques. It was a Udacity one. The one over winter break was the... machine learning course on Coursera. I think that's a pretty... well-known one on Coursera. And then right now, I'm taking "Genetics and Evolution" by Muhammad Nor on Coursera."	
01:05	I ask why she enrolled in the MOOCs - was it for personal interest? "Yeah… the current one is purely just interest - it was a way for me to learn about the subject without having to devote… time to something other than my PhD curriculum. Also, it kind of gives me a break. The "Machine Learning" during winter break was because it was interesting, but also, it gave me some background knowledge prior to coming here. I wanted to know something about machine learning before taking the courses I'm taking this semester. And then the one about general programming techniques and styles during college was just because I wanted to know more... I didn't do it all the way - I kind of took the chunks that I wanted to learn out of it, just as a way to kind of get better at programming... It was a way I could practice without... the full college load."	(Reasons for enrolling: personal interest; prep for PhD program)
02:17	Right now, she's studying intelligent systems. "My two areas… I specialize in are perception and machine learinng."	
02:52	I ask her what things she liked about MOOCs, and ways she thinks they're helpful for her. "In general, the thing I like about all of them is that for the most part, they're really modular. So, in the first case [first course], for example, I can take what I wanted to learn out of it without feeling like I was pressured... I could really just kind of skip through the parts that I wanted to do. The one I'm doing right now, I'm doing 'all the way', but... because it's modular, I can break it up into like, 'Oh, I need a break, I'll watch this lecture for 10 minutes.' So I really like that. And because it's online, there isn't the same social pressure, which might be bad, if... I wanted to continue it all the way, because I know social pressure is part of what makes someone stick with a program. But since I'm doing them mainly out of actual interest, that's proving sufficient for me to continue through. The ones I don't find interesting, I've just kind of stopped... For me... I can do it almost as more of a hobby, instead of feeling the stresses of it being an actual class, which is nice because I have a lot of interests, and	(Likes videos with questions embedded)
04:59	I ask her what the assessments are like in "Genetics and Evolution". "That one does involve mathematics to a degree. For example, one of the things that was done this past week was analyzing how often particular genes in a chromosome remain on the same chromosome in an organism's offspring. Their distance on the chromosome and recombination rates... So that used mathematics. In that one, it is a little different - the weekly problem sets are more like quizzes, but they're... kind of like a math quiz... some of it is content and concepts, but then some of it you would have to do mathematics to do. Then, of course, there's the in-video questions where he takes a break, and you have to guess... on a multiple-choice question. There are two exams in it, as well, but I haven't done the exams... It's my first one that has an exam... So I don't know yet if I'm going to do that or not... I'll probably just do it just to see how well I do."	

Timestamp	Notes/Quotes	User Needs
06:43	I ask about her previous courses - what would she do? As soon as she logged in to the course, what would she go to? "The Udacity one, I was doing partly because I was curious what Udacity courses were like. But for the most part… I got on the page, and I just went straight to my course... It's sort of set up so there's a video, and then next to the video, there's weeks, kind of like bars, and if you clicked on it, it would toggle down all the lectures for that week. I knew I wasn't going to have time to do all the lectures in the week, so I kind of looked at the titles, and... if they seemed like something I hadn't done before, I clicked on it, watched it... If I had trouble with it, sometimes I'd even come back, because I usually ended up doing it... if it was on the weekend or in the evening, and I didn't really have much homework, I might do it for like an hour, but other times, I didn't have much time, and it was like, 'I need to kill some time, I'll do this, a 10-, 15-minute thing.' So that one kind of kept you in one screen. You didn't really toggle much through the various pages. The machine learning one, I	
08:45	I ask why she did the quizzes before the problem sets. "You could do either. I think the quizzes were higher up than the problem set on the navigation bar, but if they were, they would have been right above it. I was doing the quizzes before the problem sets because the quizzes tested concepts, and the problem sets tested actually doing it, so I wanted to make sure I understood the concept before doing the problem set. You could do it either way. The reason the evolution one is different is because I'm actually doing it along the 'week' structure... Sometimes, if I don't understand a concept, instead of going away, thinking about it, and coming back, or googling it online... The main difference is there are people doing it, too. I haven't really made use of the discussion forums to converse myself, because I don't tend to, but it's nice to see people discuss other... If I've already done the stuff, sometimes I'll go to discussion forums and find other things that I'd look up if I'm interested."	(Didn't use discussion forums much)
10:13	I ask her which of the three courses seemed easiest in terms of accessing materials and navigating, or which one did you like the most? "I think I liked the… Coursera one. It's been a while since I did the Udacity. Out of the two, I don't know, because Coursera, at least between those 2, have pretty similar formats, but the reason I like them is because the thing I tried to describe to you, it had the video, and then showed this navigation bar next to it that was the same height as the video, with a toggle bar, and then all the lectures came down. The way that that looked - like, the lectures looked like every week was forever. You had to scroll through this entire week, and they might have only been 2-minute videos, but there were like 20 lectures. It was... easier to get fatigued on that, whereas with Coursera, both of those had maybe 8, 9 [videos], and even if those are 10 minutes, because you see them in this chunk, and you see how long the time limit is, and you know once you get in, you... can speed up the person's voice to like 1.75 [times the speed], it makes it less fatiguing... Bec	(Coursera easiest in terms of accessing materials); fewer lectures, with lengths displayed; ability to speed up videos; possibly separate assessments from lecture videos so each week doesn't seem so intimidating (but combined is fine)
12:28	"The other thing is, I don't remember if, in Udacity, you could speed up the person's voice - I really like that."	Ability to speed up video
12:50	I ask if Udacity felt more like a set track that you had to go through? "Kind of. I didn't use it that way. It was more like, because of how broken up the lectures were, it made each week feel a lot more cluttered… For example, say in the"Darwin and Evolution" class on Coursera, he might have one lecture devoted to recombination of genes. Say the Udacity course I took, they might have broken up the recombination of genes into 6 or 7 sub-topics, even though it might be the same length overall... and covers the same material, the fact that I'm looking at 7 lectures here and 1 lecture here makes it seem like, 'Oh, well I really only have time for one lecture.' Mentally, you're looking at this, and there are 40 lectures you need to watch, and this one, you have like 7 - it just makes it different in the perceived effort."	Don't include too much stuff in each week - makes it seem cluttered

Timestamp	Notes/Quotes	User Needs
14:04	"The other thing is, the Udacity one always had a question, so that probably did make it slightly longer." (Likely a question after each 2-minute video.)	
14:20	"I will mention, just in regard to the length of the videos, one thing I don't like about Coursera is that you can't pause in the middle of a video and come back to that spot, and it check-marks/shows that you've watched the video as soon as you open the video, so since they are longer videos, those are two things I'd like to have... Or at least for it to say how much time [in the video] you've watched."	Be able to pause video and come back to that exact spot; only mark the video as watched after *whole thing* has been watched
15:17	I ask her if there's anything she didn't like about these platforms or courses. "The one thing about discussion forums in Coursera is they're not immediately obvious to me when… it's the general forum problem where you can't always tell… it takes a long time to return back to the main thread. You know how sometimes people will reply to a comment... and someone replies to that person, and it gets smaller... it doesn't *super* get smaller too much, but those sub-threads get to really interesting, but totally different discussions, and sometimes it's hard to find the comments about like, the original topic, just because you have to scroll through a lot. I think the main thing for me has always been pausing the videos. Other than that, the Coursera one, I like quite a bit. The Udacity one... having the lecture bar not be so short, and in general feeling like you have more space on the screen would have been nicer. I also like that Coursera, you see the person's face when they're talking. I like the hands for when they are writing, but if they're just talking, sometimes it's helpful for me to unders	(Likes Coursera platform; wants more space on Udacity screen)
17:34	"It [Udacity course] was taught by Sebastian Thrun, but I think I saw his face maybe like 2 or 3 times - it was mainly the pen… I like where I get to see the professor… Part of communicating is gesturing and expressions…"	
18:54	I ask her if there's anything she would like included in the MOOCs she took that's not already there? "One thing… this is kind of done in Coursera already where they have the TAs, but it's kinda nice when they do the [Google] Hangouts, or like… a recitation would be kinda helpful, just because the professor, I don't expect to have time to respond to all the questions - the "Evolution" one is really good at that. It would be nice to have a little more discussion on topic... But actually... it's kind of already done."	
19:47	"For the evolution one, it would be nice if there were more review problem sets… but that's not really that exciting."	
19:58	"I think what would probably be more exciting would be being able to feel like… I feel like the discussion forums aren't really something I've done much with, but I would like to do more, because it seems like there's all these people with really cool background experiences talking. Maybe this would change if the discussion forums were a different style... Maybe if there was more of a scalability thing... make it easier to talk in a smaller group without having to venture outside the MOOC walls, that would be nice."	
21:25	"I've been pretty happy with my experiences, particularly the last 2."	
21:47	I ask if she would use TA recitation sessions if they existed. "I guess because the TAs are oftentimes on-hand to answer problems in the discussion forums, but they don't always get to everything. Sometimes we get misleading answers when the person who's responding first doesn't understand the... who thinks they understand the concept, but they actually have a misconception of what's going on... If they [TAs] were on the video, and we could submit questions, and they could respond, that would be kind of cool because it would add a little more interactivity."	
23:59	I ask if she was able to search through forums, if that functionality existed. "I have. I did that on "Machine Learning"… I usually found… what I was looking for, so that wasn't too bad, but I guess it was more like, if you're looking for further explanation on a certain concept..."	

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Timestamp	Notes/Quotes	User Needs
24:54	"The recitation is something I would see as something where you could kind of get another opportunity for discussion, but a little more TA-oriented, just because you would know you were getting it from a knowledgeable source, just to address any potential misconceptions..."	
25:30	"If you made a format that let me pause the video and come back, that would be sufficient for me!"	Ability to pause video and come back to exact spot
27:50	I ask if she remembers if there was ever a time when she felt like she didn't quite know where to go to find something, or was there any action she had to perform in the course that took a long time? "I can give you a good example of this with one that I signed up for this semester, but I'm probably going to leave. I don't remember the exact name, it's an image processing course by a French university. Part of the problem is that it's harder to speed up the videos because the professor has a strong accent. Two problems with that one: 1) The lectures don't have their length listed. I didn't realize that was even an optional thing, but it makes it way harder to know when I can watch the videos, because I don't know if they're 5 minutes or 20 minutes. The other one [2)] is that they... start off with a high view, and then I think are supposed to get more specific as they go on. But they have a bunch of papers that are supposed to be supporting materials... that you can read about to get a more in-depth view on a	Ability to speed up video; lecture videos display lengths; easy-to-find supporting materials (academic articles, etc.)
30:18	"Machine Learning"… I'm going to mention because it's an example of a different thing that was good that could have been a really long time to turn in the programming assignments and get them assessed… but he included a script, and we could do it from the command line. If you didn't know command line, it could still be... actually, no, he told you how to do it, so if you were capable of following instructions, you would have been able to turn it in much more quickly than if you were using the user interface, which would have been probably not the worst, if you're used to using user interfaces, but the nice thing about him doing the script was that he took what could have been a lengthy task and made it much faster."	
31:08	"The biggest thing, I would say, is the supporting materials, particularly like either setting up your programming space or in particular for image processing, going and Google Scholar-ing all these papers without knowing which ones were the most important to look at."	Easy-to-find and organized supporting materials
32:13	"It [supporting materials] was something that was important to learning about the subject that was stuck in a tab like 'Additional Materials' that I learned about from looking at the discussion forums. And then when I did look at it, it was just like a list of papers to search... It would have been nice if they were at least ranked... That was something where it was just kind of frustrating. What might be nice is... because the "Darwin and Evolution" course has additional materials as well, and he kind of like tags them all, but they pop up at the bottom of the week. If there was some way to put 'Additional Materials', as a link, next to each lecture, so like it was additional materials relevant to that lecture, or additional materials relevant to the overall week, that would be really helpful, just because he has like 8 things, and they all correspond to each lecture, but... it would be nice to know which things correspond to what."	Supporting materials are listed in each week

Appendix O - Interview Participant #4 Qualitative Data

Timestamp	Notes/Quotes	User Needs
00:15	Taught first-year writing 2.0 - freshman composition course; taught writing, visual design, and oral communication; taught on Coursera platform (not her choice); lasted 8 weeks	
01:20	I ask about components of her course. "We did the fairly traditional lecture modules, 3 of those per week, and we were pretty unsatisfied with that. For me, that was very foreign and strange because I don't lecture as a professor usually. In my field, that's considered not very good teaching... For the last 20 years, that's been considered not a very good way to teach writing or communication-type courses."	
02:16	"We did want to have some version of discussion, which is why we used Google Hangout. We invited a very small number of students from the course… based on their activity on the forums… We had a Google Air Hangout once a week… We had a group of our team members sitting here at a table... and the students dialed in, and we had essentially a discussion session about what we'd been doing that week. Those, we were very happy with... we would like to have done a lot more of that."	(Happy with Google Hangouts, used for discussion sessions with students)
03:42	I ask if she had assessments in her course. "We had 2 levels of assessment… We had to do peer assessment - there was just no other way in a writing course to deal with these kinds of numbers. It can be overwhelming when you only have 25 students. In our field, the preferred number... is officially 21, is the number you should shoot for in a first-year writing course."	
04:28	"We wanted to use guided peer review, which we use in our regular classes… it's all about getting as much feedback as possible as a communicator… Replicating that on the platform was a little bit troublesome, in part because we did it two ways… In this case, students submitted drafts of their assignments, which were peer-reviewed. They were supposed to respond to the feedback they got, revise, and then have a final evaluation, which was also by peers. The problem with that was that the Coursera platform didn't allow us to guide the peer review in the ways that we wanted to. We developed elaborate rubrics for each assignment. With the norming - the training - for doing peer assessment, we would evaluate a dozen assignments... or we would create fake assignments, which is actually what we did for the first assignment - we had students here at Tech actually answer the assignment and write up a response, and we normed using those... The way that Coursera's platform is built, they're looking for matching numbers... We wanted the rating system to actually be on a 4-point, ideally it would be on a 5- or 7-point scale"	Ability to explain normed papers for guided peer review
06:46	"We wanted another pop-up box to come up and say, not necessarily 'We gave it [normed assignment] a 2', but 'Here are the reasons we marked it the way that we did. We were looking for this…' We wanted the explanation to be the focus, because that's what really good guided peer review does - it teaches people what matters, and it's not just about matching a number. We couldn't do that, so we did post all of our explanations and our rubric... but we couldn't count on them [students] to go look at it. And most of them didn't. And you could do the training 7 times, and even if you failed the 7th time, after the 7th time, you were pushed through. No matter what. And that's a huge problem. We were really unhappy about that." Apparently students were very unhappy about it, too.	Ability to explain normed papers for guided peer review; not pushing students through if they fail peer review training

Timestamp	Notes/Quotes	User Needs
07:48	"The other thing that made us unhappy is - and this is pretty standard in our regular classes - if you don't do peer review, you don't get credit for your own assignment. And we wanted the penalty to be 100%; Coursera had it built in at 20% maximum. We approached them and asked them to change that. Basically... they came back to me and said, 'It's hard-coded in at 20%.'"	Ability to set any penalty for not completing peer review
09:02	"From a teaching standpoint, that [preventing her from changing the penalty from 20% to 100%] takes away pedagogical control that is extremely important. It should be the instructor's decision how things are weighted and what counts and what doesn't count. If I say, 'You get a 0 if you don't do this,'... then I don't think somebody else should tell me that should only be 20%."	
09:32	She gives an overview of their evaluations. "It was always in 2 parts. The other thing that we didn't like about that is that we couldn't guarantee… there was no way for the students to contact each other, so they couldn't ask questions about, in the draft version, 'Why... I see that you're saying this, but I'm not sure I understand exactly what you mean by your feedback.' The platform said that, 'We anonymize everything,'... We said, 'It's great to be anonymous, but can't you take that a step further and still allow people to talk to each other, even if it's anonymous, because they might have a follow-up question.' They seemed surprised that we would want something like that. To us, it seemed like a perfectly expected kind of thing... Many of their programmers... probably have never taught anything... You really have to involve... instructional design support on both sides."	Ability for students to contact each other during peer review to clarify feedback
11:42	"The needs for a computer science class are very very different than the needs for any kind of humanities course, which is entirely qualitative in its evaluation. I think that it's much easier to build these kinds of systems when what you're building for is quantitative evaluation."	
12:18	I ask about feedback she got from students. "I think that they liked the idea of it [peer assessment]. It creates authority, which is why we do it in our regular classrooms."	(Peer assessment gives students feelings of authority)
13:20	"The students, I think, liked the idea of feeling like they had enough authority to give feedback to someone else. And then that makes them more confident about themselves."	(Peer assessment gives students feelings of authority)
13:36	"Confidence was actually our goal in the course. Our goals was to make people more confident communicators - that was a stated goal. Not to make them A+ writers, but to make them more confident communicators, wherever they started from."	
14:05	"They [students] didn't trust the system sometimes, because they knew people could fail the [peer review] training, and they certainly said that. There was a little bit of the, 'Well, you're the expert, I want *your* feedback,' which is an unrealistic expectation given the MOOC situation, because there's just no way that I'm going to be able to give people that much feedback. I think they would have preferred hearing directly from me... which is interesting in its own sense, because in traditional classrooms, I think students sometimes get frustrated by thinking that they're writing... [thinking] 'I only have to do what the faculty member wants, and that's my goal - figure out what the faculty member wants, give that to the faculty member, and then I get my A.'... In this sense, I like the fact that it [MOOC] decentralizes my role - I try to do that in my own classrooms."	

Timestamp	Notes/Quotes	User Needs
16:50	"The more that you ask students to do, the more you're going to have people not doing things, especially if it's not for credit and they're not paying for it. I think getting people interested and keeping them interested and making them trust that the system is valid without the traditional authority figure being the one who makes all the decisions... First-world students expect that kind of authoritative final word. We might see cultural differences if we were looking at populations who don't have a context for that at all... They [villagers in a remote part of the world] would probably actually respond to collective evaluation much better."	
18:46	"Right now, MOOCs are a question of accessibility."	
19:10	"Some of our students didn't have access to materials that we put… because they were on banned platforms like Youtube. People are paying for bandwidth, and they have to make decisions about what they're going to download or upload."	
19:52	I ask about feedback students gave about the course aside from peer assessment. "Students really like community, but I think the forums are interesting in that sense. We had students who formed all kinds of spontaneous communities based on needs, wants, likes, language. We actually had a Russian forum that developed. Students translate for each other."	(Students like community); forums
20:48	"We had a lot of people who are teachers who lurked in our course because they wanted to see what we were doing so they could use it in their own classes. They had a group… There were people who made study guides for the course - students made study guides for other students. It's amazing how they help one another and how that's something that I would love to replicate in my regular class because I don't see that kind of community. I think that kind of community comes from massive numbers - that's something you gain from the massive numbers."	
21:28	"They [students] loved the Hangouts, the students who participated in them, the students who watched them. Two complaints they had: sometimes the technology made it… the recording of the Google Air would be garbled at times. And the translation tool for Google Air is pretty amusing... Sometimes it would make these crazy assumptions... There were some really funny misinterpreted transcription problems."	(Students love Google Hangouts)
22:23	"We couldn't do live streaming through Coursera, so we had to find other ways to do it… A lot of people are using other evaluation platforms because they weren't happy with what Coursera or Udacity has. Evaluation I think is definitely one of their weak points. Dissemination is obviously their strong point, and getting an audience. For dissemination and marketing... they're really good for that... the evaluation obviously has to be something they fix - that's the part that's hard... As a teacher, I would have preferred that they do that first."	
24:28	"The 'pMOOCs' are problem-based learning MOOCs, and they are built on the idea that peer evaluation and collaboration are at the heart of what they do. It's already a better system. I've seen a couple of the courses they run on that." She says that NovoEd might have a platform that is better for the humanities.	

Timestamp	Notes/Quotes	User Needs
26:30	I ask if there's anything else (aside from guided peer review) that she has in her physical class that she wishes Coursera had, or that doesn't translate as well. "What I like about the potential of how MOOCs can help a teacher like me, a professor like me, is I like the idea that I might be able to use that in much the way that Mike Schatz has been doing in physics - as a way to flip... I already have a flipped classroom, but if I could flip it even more - if there are things that I can put on the MOOC to free up class time, free up the time I have one-on-one, where I'm in the room with the students, that give me time to do things with the students *only* I can do, then I'm all for those things... How do I use this platform to make the experience in the brick-and-mortar classroom better than it is? I think that there are, right now, limitations that are just too big for me to imagine how they're going to change."	(Sees biggest MOOC potential in flipped classrooms)
29:19	I ask where she sees MOOCs being most useful. "I think… there are two major uses that I imagine. One is hybridity - flipping classrooms… how does it augment what we already do? That flies in the face of the very political aim of disruption… 'disruption' means 'destroy', and this isn't a corporate problem... It's never good when we try to corporatize education because sound pedagogy as of yet hasn't usually gone very well with ideas about how to save a whole lot of money... Great teaching is an expensive thing to do. We know smaller classrooms create better outcomes."	(MOOCs are most useful in flipped classrooms)
30:50	"I don't think it's either or [MOOCs or physical classrooms]."	
31:15	"From a useful standpoint, I think it's about how do we strengthen what we already do in the ways that we do it?... If we're talking about just sharing knowledge in the world, we're having a very different conversation, and I think there it has huge potential. If it's about people getting just-in-time information, if it's people who aren't really looking to be certified in anything, they just want... more information about something, then I think it has huge potential. Outreach, I think is huge. I think another really interesting way that MOOCs might tell us something is, let's say there's some physics genius in Mongolia, and that physics genius happens to take Mike Schatz's physics class, and they realize there's somebody out there who's really doing amazing work... I think it could create opportunities for people to go to college who maybe would never go. From a recruiting standpoint, I think we might find some hidden diamonds in the rough, hidden geniuses out there in the world. Outreach to underserved communities. I think that we have to deal with... at least OOCs [as opposed to MO	(MOOCs are also useful for outreach to underserved communities and potential "hidden geniuses")
33:52	"We have 1.5 million people in the state of Georgia alone who attempted college and didn't finish - we need to deal with those people. We need to find ways to help them improve. We probably have about a million more who could go and never have." Also mentions veterans, people with disabilities, people who have psychological problems, the elderly.	

Timestamp	Notes/Quotes	User Needs
41:06	She asks herself the question of whether she'd ever do it (teach a MOOC) again. "My answer is yes, I would do it again, but I would not do it again under the same situation… I wouldn't use Coursera. That's [the peer assessment problems] a big part of it. I also wouldn't be that keen on using Udacity, which has even less evaluation mechanisms, in some ways. One thing I do like about Udacity is I like the fact that it's not term-dependent. One of the big differences between the two obviously is that Coursera runs a fixed term and then starts over again; Udacity has been traditionally open... The more that I learn about a platform like NovoEd, the more interested I would be in trying it again, but trying it again in a different way."	

Appendix P - User Needs Based on Think-Aloud Round 1 and Interviews

REQUIREMENT	TOTAL STATEMENTS BY USERS
Navigation	**20**
Easy-to-find course outline/syllabus/schedule	8
Clear navigation through course (or explanation of it)	1
Clarity in navigating to video lectures	2
Clear navigation to actual course materials	3
Clear navigation to grades	1
Jump from presentation slides to that place in a video	2
Easy-to-find supporting materials (academic articles, etc.); list in each week	3
Transparency	**20**
Clear process for getting questions answered	3
Clear, consistent, descriptive labeling of pages/sections (lesson vs. unit; "Courserware" is not descriptive)	9
Clear, descriptive labeling of place to go to get questions answered	1
Clear picture of where the course "is"	1
Clear number and order of videos in each unit/lesson	1
Clear due dates	1
Distinction between mandatory and optional assignments	1
Display lengths of lecture videos	2
Single source of discussion/help	1
Layout	**9**
Less scrolling to ask a question	2
Group and hide download links	1
Minimal buttons	1
No distractions (ex: distraction-free fullscreen mode)	2
Limited options	1
Consolidate assignment and submission pages	1
Reduce total number of items included in each week	1
Other Features	**23**
Clear video progress bar	3
Markers in the video where slide changes occur	1
Ability to set own pace/dictate speed/speed up lecture videos	7
"Tracks" for people at different levels of knowledge	1
For CS courses: built-in compiler and debugger	1
Better/more feedback on assignments	2
Pause video and come back to exact spot	2
Mark video as "watched" only after whole thing has been viewed	1
Ability for students to contact each other during peer review	1
Forums	1
Embedded (not 3rd-party) discussion forum	2
Fewer total lectures	1
Overviews	**5**
Clear depiction of personal progress in the course	4
Broad course overview displayed at login (objectives, what you'll learn, etc.)	1
Professor Options	**4**
Prof: ability to explain normed papers for guided peer review	2
Prof: don't push students through if they fail peer review training	1
Prof: ability to set penalty if a student doesn't complete peer review	1

Appendix Q - Think-Aloud Round 2 Background Survey Responses

Participant	Age	Highest level of education completed	Major	Work experience	Years of work experience	Job title
21	29	Bachelor's degree	HCI	Yes	12	Massage therapist mostly
22	25	Master's degree	HCI	Yes	2	Front-end designer
23	26	Master's degree	HCI	Yes	3	Software developer (2.5 years); UX designer (3 months)
24	24	Bachelor's degree	HCI	Yes	1	Interaction Designer
25	25	Master's degree	HCI	Yes	2.333333333	Software developer; product manager
26	22	Some college	CM	Yes	3	Undergraduate research assistant and program manager
27	24	Bachelor's degree	HCI	Yes	2.5	Research Analyst/UX designer
28	25	Bachelor's degree	HCI	Yes	5	Research Assistant
AVERAGE	25				3.854166667	

Participant	Completed a MOOC?	MOOCs completed	Platform	Why did you take the MOOC(s)?
21	Yes	Sewing	Craftsy	Furthering my education
22	Yes	Intro to music theory	Coursera	I dislike grades and would not have taken the course at grad school knowing people would be more experienced in a university setting
23	Yes	HCI course	Coursera	To get a background on HCI before I started my degree in HCI at Georgia Tech.
24	No	HCI	Coursera	Being in an architecture school in India, HCI was not something that would be "taught" as a regular course. And Stanford has a pretty respectable course (online) in HCI (this I heard from a friend). And because I could access it from anywhere I wanted.
25	Yes	HCI	Coursera	Get introduction to field; Try some project hands-on; Learn from a professor from a prestigious university
26	No			
27	No			
28	No			

Participant	Currently enrolled in MOOC?	What course?	Platform	Why did you take the MOOC(s)?
21	Yes	Tailoring a shirt	Craftsy	To make a shirt
22	No			
23	No			
24	No			
25	Yes	Introduction to Statistics	Coursera	Get an intro to stats.
26	No			
27	No			
28	No			

Appendix R - Think-Aloud Round 2 Protocol

1. Think-aloud will be conducted in a breakout room in the Clough Undergraduate Learning Center.
2. Subject will be seated at a computer.
3. The research study will be explained to the subject: "In this study, you will be asked to perform some basic tasks within an online course. While performing these tasks, you will be asked to verbalize your thought process as much as possible. You will be video and audio recorded. The purpose of this study is to identify 'pain points' in the course interface, not to assess you on your ability to navigate the course. You will then be asked a few follow-up questions and given a background survey to complete. You will not be compensated for participation. Your participation is voluntary, and you may leave at any time. Do you agree to participate in this study?"
4. Consent form will be provided to subject.
5. After subject consents to participation, the think-aloud will begin.
6. Subject will be asked to perform tasks within the course:
    a. Determine what the topic is for Week 3 (Unit 3 on Udacity) (navigate back to home page afterwards)
    b. Find and play the first video lecture in Week 2 (Unit 2 on Udacity) (navigate back to home page afterwards)
    c. Suppose you have a question about the course material that you want to ask. Figure out where on the site you would go to obtain the answer. (navigate back to home page afterwards)
7. Subject's verbalized thoughts will be audio recorded, and researcher will record observations.
8. Subject will be asked to answer a few follow-up questions:
    d. What task or tasks seemed easy? Why?
    e. What task or tasks seemed difficult? Why?
    f. How did you feel about navigating the course site? What is your impression of the course layout?
    g. What did you think of the labels of the buttons and materials?
    h. Did you notice the progress bar at all? What did you think of it?
    i. Are there any changes you would make to the course site?
    j. Do you have any final comments?
9. Subject will be asked to complete a background survey.
10. Once subject has completed the background survey, he or she will be thanked for participating in the study and will be escorted out of the testing room.

Appendix S - Think-Aloud Round 2 Quantitative Data

Task	Participant	Completed? (yes-1, no-0)	Task start	Task stop	Time on task	Total mouse clicks	Task-related mouse clicks
1	21	1	0:31	1:21	0:50	2	1
	22	1	1:01	1:10	0:09	0	0
	23	1	0:37	1:07	0:30	2	0
	24	1	0:23	0:53	0:30	2	1
	25	1	0:41	0:46	0:05	0	0
	26	1	0:42	0:48	0:06	0	0
	27	1	0:41	0:55	0:14	0	0
	28	1	0:23	0:48	0:25	0	0
Avg.		100%			0:21	0.75	0.25
2	21	1	1:52	2:27	0:35	6	4
	22	1	1:30	2:06	0:36	6	6
	23	1	1:28	2:20	0:52	4	4
	24	1	1:49	3:19	1:30	4	4
	25	1	1:09	1:32	0:23	4	4
	26	1	1:11	1:36	0:25	5	4
	27	1	1:37	2:00	0:23	4	4
	28	1	1:15	2:15	1:00	4	4
Avg.		100%			0:43	4.625	4.25
3	21	1	4:06	5:18	1:12	2	1
	22	1	2:39	3:44	1:05	11	7
	23	1	2:41	3:53	1:12	3	1
	24	1	3:47	5:05	1:18	2	1
	25	1	1:57	5:40	3:43	25	14
	26	1	2:23	3:28	1:05	3	3
	27	1	2:35	3:34	0:59	1	1
	28		2:40	3:57	1:17	8	1
Avg.		100%			1:28	6.875	3.625

Appendix T - Think-Aloud Round 2 Qualitative Data: Positive Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
Tasks 1 and 2 were easy	Ease of completing tasks
all tasks seemed easy	Ease of completing tasks
Task 1 was really easy	Ease of completing tasks
all tasks seemed easy	Ease of completing tasks
all tasks were straightforward	Ease of completing tasks
interface is "sexy"	General design/layout
#1 - found it in Syllabus	General design/layout
says Course Materials unit menu is well-structured and well-laid out	General design/layout
design is clear, not much noise	General design/layout
likes that there aren't TWO side navigations (there's only one, on Course Materials page)	General design/layout
#1 - quickly found on Syllabus page	General design/layout
Syllabus was very direct	General design/layout
layout is clear	General design/layout
#2 - easy to find video	General design/layout
likes lefthand unit menu	General design/layout
#1 - didn't need to click at all to find	General design/layout
"Ask a Question" was easy, but it wasn't intuitive	Other
likes big, easy-to-read buttons	Page menu design/layout
likes button system	Page menu design/layout
easiest task was navigating to/from pages because the page buttons are constant	Page menu design/layout
likes that page menu is static	Page menu design/layout
is used to T-Square, with all options on the left side, but either top or left is valid way of organizing page buttons	Page menu design/layout
#3 - clicked on "Ask a Question" instantly	Transparency/labeling
buttons are well-labeled	Transparency/labeling
likes labels of buttons	Transparency/labeling
#3 - instantly thought to click "Ask a Question"	Transparency/labeling
#2 - instantly went to Course Materials	Transparency/labeling
#3 - instantly clicked "Ask a Question" button	Transparency/labeling
#2 - went to Course Materials instantly because she knows it's not on the Syllabus	Transparency/labeling
things are labeled well	Transparency/labeling
nothing surprising about course materials	Transparency/labeling
#3 - didn't seem confused by labeling	Transparency/labeling

Appendix U - Think-Aloud Round 2 Qualitative Data: Menu Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
lefthand menu is good if you have a lot of headings (as opposed to top menu) - referring to page buttons; prefers lefthand menu, generally	Menu placement - top vs. lefthand side
suggested making topic menu across top of page instead of on lefthand side	Menu placement - top vs. lefthand side
unit menu - first 2 unit names are too long - wants title of unit all on one line	Naming/labeling
#2 - Unit 2 title should be indented to reduce confusion	Naming/labeling
#2 - "Course Materials" label was confusing - didn't know that was where lessons would be	Naming/labeling
"Course Materials" should be more obvious/descriptive - sounds like it just contains references	Naming/labeling
wants to rephrase some page menu options	Naming/labeling
prefers "Forum" to "Discussion"	Naming/labeling
unit menu can look overwhelming and cluttered	Other
#3 - didn't know what to expect when clicking "Homework" on Discussion page	Other
#3 - wants number after each topic in topic menu showing how many questions are in that topic	Other
thinks it's weird that "Discussion" and "Ask a Question" aren't next to each other	Page menu - rearrange/add buttons
wants "Course Materials" button to come right after "Syllabus" button; expects order to be: Syllabus, Course Materials, Grades, Discussion	Page menu - rearrange/add buttons
is used to having lecture videos broken out of other course materials - doesn't necessarily associate lecture videos with course materials; would want lecture videos on their own separate page	Page menu - rearrange/add buttons
#2 - wants arrow in unit menu next to "Unit 2", not in middle of unit title	Shift "expand" triangle up
#2 - wants expanding triangle to be next to the words "Unit 2" rather than in the middle of the title of the unit	Shift "expand" triangle up

Appendix V - Think-Aloud Round 2 Qualitative Data: "Ask a Question" Process Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
#3 - doesn't like that "Discussion" button is highlighted when "Ask a Question" button is clicked	Navigaton confusion
didn't like that "Ask a Question" button went to Discussion page - expected a pop-up, instead	Navigaton confusion
#3 - unsure about where "Ask a Question" directs the student	Navigaton confusion
#3 - confused by "Discussion" button being highlighted after clicking "Ask a Question" - "discussion" implies that it's like a chat	Navigaton confusion
wants to separate asking peers from asking TA/prof, although this might overwhelm TA/prof	Other
expected "Ask a Question" button to change when clicked	Other
if there was no "Ask a Question" button, would have used "Discussion"	Other
views "Discussion" more like talking with people	Other
#3 - doesn't know how reply is received - might look for mailbox under name in top right	Process confusion
#3 - doesn't want question to be made public; should be clear if it is	Process confusion
it was unclear what would happen to the question after clicking "Submit" button	Process confusion
unsure if "Ask a Question" button makes question public or sends it to TA/prof; seems similar to "Discussion" button	Process confusion
expects "Ask a Question" button to send question to TA/prof; wants it separate from "Discussion" button, where you can start a discussion with friends/other students	Process confusion
#3 - thinks "Ask a Question" is to TA/prof	Process confusion
#3 - thinks "Ask a Question" will e-mail TA/prof	Process confusion
possibly put "Ask a Question" button on the Discussion page	Relocate/eliminate "Ask a Question" button
thinks "Ask a Question" button should be eliminated	Relocate/eliminate "Ask a Question" button
thinks "Ask a Question" is redundant	Relocate/eliminate "Ask a Question" button
wants "Ask a Question" to be blatant on the page	Relocate/eliminate "Ask a Question" button
sees ambiguity between "Discussion" and "Ask a Question"	Transparency/labeling
"Ask a Question" was easy, but it wasn't intuitive	Transparency/labeling
confusion between "Discussion" and "Ask a Question"	Transparency/labeling
"Discussion" and "Ask a Question" are confusing	Transparency/labeling
#3 - doesn't know if "Discussion" or "Ask a Question" is what he wants	Transparency/labeling
Task 3 - unsure what "Ask a Question" would get him	Transparency/labeling
not sure if "Discussion" is supposed to be same as "Ask a Question"	Transparency/labeling

Appendix W - Think-Aloud Round 2 Qualitative Data: Progress Indication Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
unsure what progress bar percentage represents - percentage is ambiguous	Confusion about meaning of progress bar/percentage
progress bar - doesn't know what "complete" is	Confusion about meaning of progress bar/percentage
said you might not need such a large progress bar - maybe just have it in the title bar, and you can hover over it to see the percent you've completed; less desirable possibility is having "Progress" as another button	Hide/minimize visibility of progress bar
doesn't want progress bar to be first thing he sees, since it won't change very often	Hide/minimize visibility of progress bar
progress bar is too big, doesn't want to see it all the time - maybe it only pops up once something in progress changes	Hide/minimize visibility of progress bar
would be good to see if a unit is completed in unit menu	Indicate completion/progress in unit menu
wants to see which things are complete in each unit in unit menu	Indicate completion/progress in unit menu
wants check marks next to completed stuff on unit menu	Indicate completion/progress in unit menu
likes progress	Like/understand current progress bar
progress bar makes sense	Like/understand current progress bar
likes overall progress bar on top	Like/understand current progress bar
progress bar is motivating - likes that it's always visible	Like/understand current progress bar
progress bar is straightforward	Like/understand current progress bar
wants to be able to quickly see what's been done and what hasn't, and what has been done well	Other
progress bar is only useful if learning at your own pace	Other
thinks progress bar means progress for entire course rather than current unit	Other
assumes progress bar percentage describes number of assignments completed (or possibly number of units looked at, although that's not a useful indicator)	Progress bar assumed to be course material-based
progress bar - assumes 33% represents progress through course materials/units	Progress bar assumed to be course material-based
assumes 33% means percentage of lessons completed	Progress bar assumed to be course material-based
assumes progress bar is percentage of time needed to complete course	Progress bar assumed to be time-based
think about color coding units and applying colors to progress bar	Progress bar modifications
be able to move mouse over progress bar to see what units you've completed	Progress bar modifications
wants to see which units she's completed	Progress bar modifications
wants to split progress bar up by units	Progress bar modifications
thinks progress bar should tie into course materials	Progress bar modifications
progress bar is good for "at a glance", but would be good to be able to click the bar and get more details (such as grades) on progress	Progress bar modifications

Appendix X - Think-Aloud Round 2 Qualitative Data: Design and Layout Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
#2 - looked on Syllabus page, but couldn't figure out how to "start" things	Confusing design/layout
unsure what hyperlinks are for assignments that don't yet have grades	Confusing design/layout
only wants to see important announcements on Announcements page (not the "Welcome!" announcement)	Display of information/menus
wants unit menu available on every page	Display of information/menus

Appendix Y - Think-Aloud Round 2 Qualitative Data: Features and Functionality Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
wants calendar for visual representation of when things are due	Calendar/due dates
might want reminders of what's due, as an indicator of what to do next in the course	Calendar/due dates
expects to see deadlines where description of each homework is shown	Calendar/due dates
might want list of FAQs students have asked	FAQ
wants FAQ as first discussion topic in topic menu	FAQ
wants to see his grades on Announcements page	Grade display
wants to see grade on each homework page, too	Grade display
expects link in Grades page to link to student submission	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
Grades page - wants to know status of each assignments (submitted, awaiting feedback, returned, etc.)	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
wants certain colors for certain grades on Grades page	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
grades - clicking on homework - expects to see assignment description, personal submission, and feedback inline (NOT as PDF)	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
Grades page - wants to see deadlines and when each item was submitted	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
wants to see overall grade on Grades page	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
wants to see how well student needs to do on remaining assignments to get a certain grade in the course	Grades page - display or allow easy access to submission, feedback, grades, status, dates submitted/received, overall grade, etc.
#1 - wanted to be able to click on unit name in Syllabus	Linking (syllabus to unit pages; course material to subsequent course material)
#2 - wants to click Unit 2 under Syllabus to get to video lectures	Linking (syllabus to unit pages; course material to subsequent course material)
might want links on each course material that goes to the next material in the sequence to step you through materials (lecture video 1 links to lecture video 2, etc.)	Linking (syllabus to unit pages; course material to subsequent course material)
only wants announcements shown at sign-in, but it's good to have an archive; wants new ones to pop up when signing in	New activity notification (new grade, announcement, etc.)
wants notifications if something has changed since last login, like Facebook notifications (new grade, new announcement, etc.)	New activity notification (new grade, announcement, etc.)
wants Announcements RSS feed	Other
#3 - assumes starting a discussion while on "Project" topic would automatically put it under the "Project" topic	Other
on Course Materials page, might have expected text or picture	Other
wants to be able to search through entire course; have grades come up in search, too	Searchability
#3 - wants to be able to search through discussion posts	Searchability
name in top right - expects: sign out, messages, profile	Username dropdown options
user name: expects log in, log out, settings	Username dropdown options
name in top right - expects: profile, settings, sign out, other courses	Username dropdown options
dropdown in top right - assumes it's a control panel with: settings, profile, sign out	Username dropdown options
#3 - wanted question to be tied to course material	Ability to link question to course material
wants more context-sensitive stuff (ask question tied to course material)	Ability to link question to course material
on lecture video, wants button that says "Start discussion" that quickly directs you to start discussion on that topic	Ability to link question to course material
wants to be able to ask a question from Course Materials	Ability to link question to course material

Appendix Z - Think-Aloud Round 2 Qualitative Data: Neutral and Other Comments

COMMENT/NOTE	SYSTEM REQUIREMENT/CHANGE
Course materials are the most important part of course	Most important parts of course
pertinent buttons are Syllabus, Course Materials, and Grades	Most important parts of course
#1 - was looking for dates initially	Other
#1 - went to Course Materials after scrolling through Syllabus!	Other
#2 - instantly went to Course Materials page because of first task	Other
#3 - didn't instantly click "Ask A Question"	Other
#3 - tried going to course materials to ask question about that specific topic	Other
#3 - went to Discussion page - would post question there	Other
#1 - found on Syllabus page	Other
#3 - assumes she can post to forums	Other
#1 - found on Syllabus page	Other
#2 - process of elimination to figure out it would be on Course Materials page	Other
#2 - expanded all units to complete task	Other

Appendix AA - Learnster Header, Progress Bar, and Page Menu

Appendix AB - Learnster Syllabus Page

| Syllabus | Course | Grades | Announcements | Ask/Discuss |

Syllabus

Course Description

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Objectives

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Outline

Unit 1: Introduction to Algorithms and Problem Solving
Unit 2: Types, Variables, Operators, and Expressions
Unit 3: Control Structures
Unit 4: Functions
Unit 5: Arrays and Strings
Unit 6: Debugging
Unit 7: Input/Output
Unit 8: Graphical User Interfaces

Grading Policy

Homework: 15%

Appendix AC - Learnster Course Page

Course

☐ Expand All

✓ ▷ Unit 1: Intro to Algorithms
✓ ▷ Unit 2: Variables
　 ▷ Unit 3: Control Structures
　 ▷ Unit 4: Functions
　 ▷ Unit 5: Arrays & Strings
　 ▷ Unit 6: Debugging
　 ▷ Unit 7: Input/Output
　 ▷ Unit 8: GUIs

Use the unit menu on the left side of the page to access lecture videos, homework, quizzes, tests, projects, surveys, and reference material for each unit. Completed items will have a green check mark next to them.

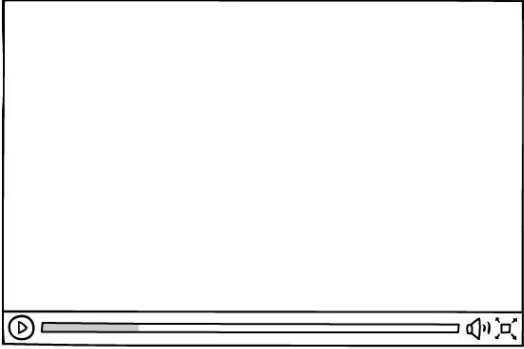**Appendix AD - Learnster Course Page: Unit 2**

| Syllabus | Course | Grades | Announcements | Ask/Discuss |

☐ Expand All

✓ ▽Unit 1: Intro to Algorithms
✓ ▽Unit 2: Variables
   ✓ Lecture Video 1
   ✓ Lecture Video 2
   ✓ Lecture Video 3
   ✓ Homework 1
   ✓ Homework 2
   ✓ Quiz
   ✓ References
  ▽Unit 3: Control Structures
  ▽Unit 4: Functions
  ▽Unit 5: Arrays & Strings
  ▽Unit 6: Debugging
  ▽Unit 7: Input/Output
  ▽Unit 8: GUIs

Unit 2: Variables

Unit Overview

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Unit Materials

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Appendix AE - Learnster Course Page: Unit 2, Lecture Video 1

Syllabus | Course | Grades | Announcements | Ask/Discuss

☐ Expand All

✓ ▽Unit 1: Intro to Algorithms
✓ ▽Unit 2: Variables
   ✓ Lecture Video 1
   ✓ Lecture Video 2
   ✓ Lecture Video 3
   ✓ Homework 1
   ✓ Homework 2
   ✓ Quiz
   ✓ References
▽Unit 3: Control Structures
▽Unit 4: Functions
▽Unit 5: Arrays & Strings
▽Unit 6: Debugging
▽Unit 7: Input/Output
▽Unit 8: GUIs

Unit 2: Variables

Lecture Video 1

Syllabus | Course | Grades | Announcements | Ask/Discuss

☐ Expand All

✓ ▽Unit 1: Intro to Algorithms
✓ ▽Unit 2: Variables
   ✓ Lecture Video 1
   ✓ Lecture Video 2
   ✓ Lecture Video 3
   ✓ Homework 1
   ✓ Homework 2
   ✓ Quiz
   ✓ References
  ▽Unit 3: Control Structures
  ▽Unit 4: Functions
  ▽Unit 5: Arrays & Strings
  ▽Unit 6: Debugging
  ▽Unit 7: Input/Output
  ▽Unit 8: GUIs

Unit 2: Variables

Homework 1

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Appendix AG - Learnster Course Page: Unit 2, Quiz

☐ Expand All

- ✓ ▽Unit 1: Intro to Algorithms
- ✓ ▽Unit 2: Variables
  - ✓ Lecture Video 1
  - ✓ Lecture Video 2
  - ✓ Lecture Video 3
  - ✓ Homework 1
  - ✓ Homework 2
  - ✓ Quiz
  - ✓ References
- ▽Unit 3: Control Structures
- ▽Unit 4: Functions
- ▽Unit 5: Arrays & Strings
- ▽Unit 6: Debugging
- ▽Unit 7: Input/Output
- ▽Unit 8: GUIs

Unit 2: Variables

Quiz

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Appendix AH - Learnster Course Page: Unit 2, References

| Syllabus | Course | Grades | Announcements | Ask/Discuss |

☐ Expand All

✓ ▽Unit 1: Intro to Algorithms
✓ ▽Unit 2: Variables
  ✓ Lecture Video 1
  ✓ Lecture Video 2
  ✓ Lecture Video 3
  ✓ Homework 1
  ✓ Homework 2
  ✓ Quiz
  ✓ References
▽Unit 3: Control Structures
▽Unit 4: Functions
▽Unit 5: Arrays & Strings
▽Unit 6: Debugging
▽Unit 7: Input/Output
▽Unit 8: GUIs

Unit 2: Variables

References

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Appendix AI - Learnster Course Page: Unit 1, Survey

| Syllabus | **Course** | Grades | Announcements | Ask/Discuss |

☐ Expand All

- ✓ ▽ Unit 1: Intro to Algorithms
  - ✓ Lecture Video 1
  - ✓ Lecture Video 2
  - ✓ Homework
  - ✓ Quiz
  - ✓ Survey
- ✓ ▽ Unit 2: Variables
- ▽ Unit 3: Control Structures
- ▽ Unit 4: Functions
- ▽ Unit 5: Arrays & Strings
- ▽ Unit 6: Debugging
- ▽ Unit 7: Input/Output
- ▽ Unit 8: GUIs

Unit 1: Intro to Algorithms

Survey

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Submit

Appendix AJ - Learnster Grades Page

| Syllabus | Course | Grades | Announcements | Ask/Discuss |

Grades

UNIT	ASSIGNMENT	GRADE	FEEDBACK
Unit 1			
	Homework	90	(PDF)
Unit 2			
	Homework 1	80	(PDF)
	Homework 2	100	(PDF)
Unit 3			
	Homework 1	75	(PDF)
	Homework 2	80	(PDF)
Unit 4			
	Homework 1		
	Homework 2		
Unit 5			
	Homework 1		
	Homework 2		
Unit 6			
	Homework		
Unit 7			
	Homework 1		
	Homework 2		

Appendix AK - Learnster Announcements Page

Syllabus   Course   Grades   Announcements   Ask/Discuss

Announcements

Homework due date postponed
Mar. 15, 2014

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Reminder: Quiz due tomorrow!
Mar. 5, 2014

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Explanation of homework rubric
Feb. 20, 2014

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Welcome!

Appendix AL - Learnster Ask/Discuss Page

Appendix AM - Learnster Ask/Discuss Page: Homework Topic

Syllabus   Course   Grades   Announcements   Ask/Discuss

Ask/Discuss

Homework
View and start
discussions about
homework.

Project
View and start
discussions about the
project.

Technical
View and start
discussions about
technical issues.

Other
View and start other
course-related
discussions.

Start new
discussion

Homework

Question about Unit 2 Homework 2 - did anyone get the second question?
Posted on Mar. 12, 2014   0 replies

Need help on current homework
Posted on Mar. 12, 2014   4 replies

When is the homework due?
Posted on Mar. 11, 2014   5 replies

Appendix AN - Learnster Ask/Discuss Page: New Discussion

Ask/Discuss

New Discussion

Click the appropriate checkbox(es) if your discussion contains a question, is urgent, and/or you would like to remain anonymous. Give your discussion a title and a body, and select a general topic for it. Your discussion will appear within that topic and will be visible to all students, the TA, and the professor. Anyone may reply to your discussion; you will be notified by e-mail whenever a reply is made.

☐ **Question**
(Check this box if you need a question answered. Your discussion will be marked to signify that it contains a question.)

☐ **Urgent**
(Check this box if your discussion is urgent; it will be marked as such, and the TA or professor will be notified.)

☐ **Anonymous**
(Check this box if you would like to start this discussion anonymously.)

Discussion Title

Discussion Body

What is the general topic of your discussion?

Choose... ▾
- Homework
- Project
- Technical
- Other

[Start discussion!]

Homework
View and start discussions about homework.

Project
View and start discussions about the project.

Technical
View and start discussions about technical issues.

Other
View and start other course-related discussions.