Making it personal: Understanding the online learning experience to enable design of an inclusive, integrated e-learning solution for students

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Despite the availability of online learning applications and management systems used to deliver, house and organize e-learning content, students learning online continue to struggle with barriers that create an unnecessary disconnect between themselves and their peers, professors, the learning material and their parents (where applicable). Barriers personally experienced through participation in a synchronous online university-level graduate class, and documented barriers experienced by other students in similar distance learning environments, served as the primary narrative and driving incentive for this study. In addition to an extensive literature review, an in-depth study of a distance learning environment was conducted using an adaptation of Smart Design's 6 Real People approach which included 5 persona's, based on 5 real participants; a high school special needs class, a Masters of Inclusive Design Class, the Director of Education for Special Needs, A University Professor of Distance Learning, and a Visually Impaired User (Blind Participant). The users' experiences were documented through means of ethnographic observations, direct observations, and detailed interviews. Findings from these revealed many barriers and disruptions, including psychological, emotional, social, gender-related, environmental and cultural issues that were detrimental to class involvement and student success. These findings were then synthesized and applied to create a prototype, called inClass, developed to address these barriers and provide a model for a more cohesive, unified and accessible e-learning solution. Although this paper does not refer directly to design patterns, and does not claim to follow a pattern-based methodology it demonstrates some effective user-centred design techniques which pattern scouts and authors should consider as powerful tools for mining, elaborating and validating patterns.

Tags

Inclusive design, e-learning, personalization, design narrative, distance learning, information architecture

1. Introduction and Related Works

Participation in online learning across a variety of distance learning environments is growing rapidly due to increased affordability of enabling technologies and access to high-quality content. Yet in the midst of this growth many online learners cite feelings of isolation and poor communication (Dzakiria, 2008; Economides, 2008).

It seemed almost counterintuitive to continue reviewing literature about technical subject matter related to e-learning when our proposed design solution (and the motivation behind it) is user-centered; conceived from our own experiences and observations as distance learners in the Master of Design in Inclusive Design program at OCAD University. This meant moving away from reviewing literature that was technical in nature toward literature that is more focused on understanding what the distance learning experience is all about through the lens of students and instructors.

The first paper reviewed in this context was by Roussou (2004) entitled "Learning by doing and learning through play." This paper highlighted interactivity as essential to learning citing Seymour Papert's constructivist learning approach and the idea that the learner (or instructor for that matter) learns best when they are given the opportunity to set their own direction of learning. From a distance learning application interface viewpoint this could translate into providing the user with the ability to tailor their distance learning interface to their individual needs and preferences. In a 1987 paper by Malone and Lepper, challenge, curiosity, control, fantasy, competition, cooperation and recognition are also cited as essential to learning but more so as intrinsic motivations. These motivations could also be leveraged to improve upon current designs of distance learning web applications.

In much of the literature reviewed it was not just intrinsic motivations that were found to play a key role in determining the quality of a distance learning experience. One study by Dzakiria (2008) studied the voices of distance learners in Malaysia seeking to explore and offer a qualitative understanding of distance learner's perceptions of their educational experiences in distance learning. The findings broke down into two major areas – student-instructor interaction and technology used. As concerns student-instructor interaction the greatest problem experienced by students was a feeling of isolation. Many students expressed not knowing how to communicate or ask for help from their instructors, feedback from instructors was not timely and when feedback was provided learners were unsure of the instructors meaning. In the case of technology used most learners wished it was simpler to use stating in one instance, that "technology used in this course looks complicated." Overall, the findings from this study determined that for a quality distance learning experience essential elements include: a) an environment that is safe, flexible and facilitates learner support, b) a more personalized experience and c) being made aware of what it means to be a distance learner vs. in-class learner.

A second paper entitled "Serving Non-Traditional Students in E-Learning Environments" by Miller and Liu (2003) also does well at uncovering perceptions of students' and instructors' e-learning experiences. As in the Dzakiria paper, they too find that faculty mentoring, speedy responses to student inquiries and personalized responses to students rank as the most important aspects of enhancing non-traditional student learning. Unlike the Dzakiria study however this study also profiled aspects most important to instructor distance learning experiences. They found that most instructors tended to use group projects and open discussion as methods of choice.

Another study by Tham and Werner (2002) wraps the student, instructor and technological aspects of e-learning into one concluding that online learning success is found at the intersection of all three. As concerns the instructors they highlight that online educators wear many hats (technological, pedagogical and social) as noted by Bonk (2000). Of these, the social hat is even more important in distance learning because, as was observed by Dzakiria (2008), students typically feel isolated as if they are in the dark. Technological communication tools should be used to alleviate this by helping to establish a friendly, cohesive and inviting learning environment. In terms of the student this is the first paper that makes mention of learning styles and the importance of understanding the learning styles of students to avoid things such as mismatch of a diverse cohort in group work which can result in poor performance and hinder learning. This study does not go into detail about how the learning styles may be evaluated.

The previously cited Gunasekaran study (2002) does touch on how learning styles may be evaluated. It makes mention of Knowledge Pool, an e-learning and training company that introduced a preferred learning style evaluator. Called the Insights Discovery System Evaluator and Report it assesses personality, decision-making and communication styles. Paul Butler, CEO of Knowledge Pool is quoted as saying, "By suiting students personalities and providing the motivation inherent to their learning styles, we believe that students are more likely to utilize, retain and seek additional learning when these tools and methods are applied." Integrating a learning style evaluator tool into a web application for distance learning to create a learner profile that provides transparency to learner preferences before a course is started could significantly aid in improving the overall distance learning experience.

Adding another dimension to the topic of learning styles and profiles and the importance of evaluating and understanding learning styles in the e-learning environment is a paper by Economides (2008). Economides paper entitled "Culture-aware Collaborative Learning" cites that cultural differences of individual learners affects their collaboration and thus their learning and suggests that the collaborative e-learning environment be adapted to the learner's cultural profile. "Learners with diverse cultural background may have divergent modes of communicating, interacting, and working. They may

have different views of the world, different values, behaviors, and attitudes. They may also develop different feelings and thoughts during the collaborative learning activities. Therefore, the system should take into consideration cultural aspects of the learners in order to support every individual learner as well their efficient interaction and goal accomplishment."

Taken together, this review of related research about what makes a quality distance learning experience, and the value of directly studying the types of experiences distance learners have had in the past, provides valuable design patterns that can be leveraged to design a solution that can truly provide an improved distance learning experience.

The goal of our research is two-fold: 1) to identify opportunities for personalization of the digital learning experience through in vivo study of a distance learning environment and; 2) to understand how digital media might be leveraged in the design of a new e-learning solution that successfully preserves the individual needs of online learning participants.

2. Research Methods

2.1. Justification

Qualitative ethnographic research methods consisting of observations and interviews were chosen as most appropriate research methods for achieving our research goals. Observations provided for a general understanding of the learning dynamics associated with several different learning environments including corporate training, distance education and special education classrooms. Observations involved both "insider" and "outsider" observers to provide for inclusive perspectives; the "insider" experiencing shared user frustrations, and the "outsider" possessing necessary usability expertise. The knowledge gained from the observations then allowed us to dive deeper into researching the problem by way of a targeted interview to validate and confirm our findings.

Our ethnographic observation-interview methodology was modeled after similar methodologies used successfully in the design world. IDEO, a world-renowned design consultancy, subscribes to the human-centered design process and developed the Human Centered Design Toolkit or HCD for short. It breaks down the research process through the lenses of Desirability, Feasibility and Viability. The HCD process itself is to:

- HEAR (collect peoples stories and inspirations)
- CREATE (take what you hear and put into frameworks and prototypes)
- DELIVER (realize your solutions through implementation)

Much of the ethnographic study and observations are completed during the "HEAR" stage.

Smart Design, a consulting and innovation firm established in 1980 with the idea that design should be about people, not things, also utilize an ethnographic approach to their research. Dan Formosa, founder, states that,

> "Design should also consider the needs of a wide range of people, not a homogenized "average". People are diverse. Just as important, any one person can find his or her self in a diverse number of situations. In past projects our rejection of an average person or stereotype as a target, replaced with an understanding of diverse needs of many people, has led to a variety of innovations in product design. It has therefore been our point of view, for a long time, to reject the notion of "average" or "ideal" and consider the real world (Formosa, 2009)."

This view led to Smart Design's creation of their "six real people" approach, a method that focuses design efforts on a range of real people, typically outside the average user base and more at the extremes. The idea is simple. Identify six real people, each of whom the design team wishes to accommodate (or impress) with a new product – then design that product so that it does, in fact, impress all six (Formosa, 2009).

The very nature, and successful use, of ethnographic observations and interviews to gain insights into several aspects of the person-product interface including - psychological and emotional, social, gender-related, environmental and cultural issues - informed our decision to deploy them as our primary research methods.

2.2. Participants

The research process began by identifying and creating 5 personas. Although a fictitious description, these personas were developed based on observations of actual users of distance learning. They ranged from diverse students to instructors to corporate personnel. However, further in our process these

personas served as a basis for our decision to use the six real people approach described earlier with the exception that we focused on five representative real people instead of six to drive the development of our idea as depicted in Figure 1 below.

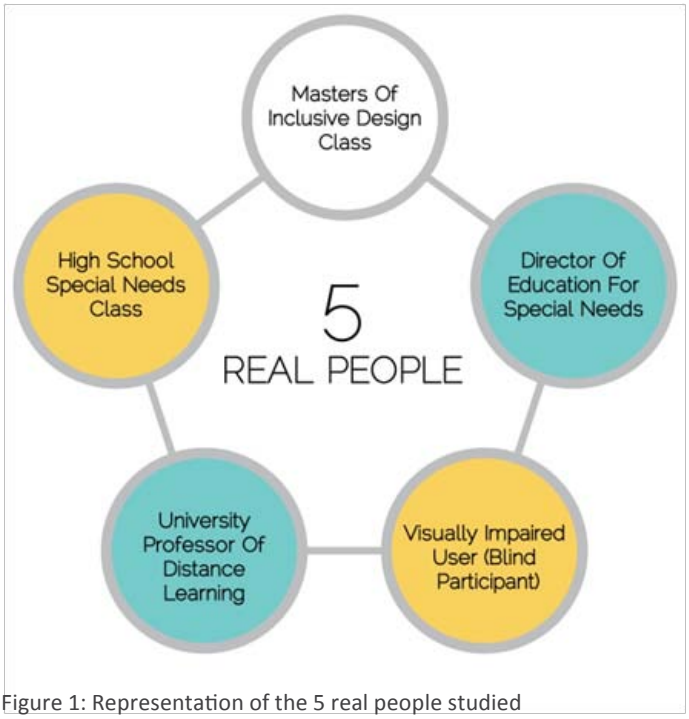

Figure 1: Representation of the 5 real people studied

Our first real participant was the entire Master of Inclusive Design class comprised of twenty-one graduate students (eight males and thirteen females). The students were ethnically diverse ranging from Asian, White, and African American to Aboriginal. The students meet twice a week (Thursday and Friday), four hours each week, for sixteen weeks. It was common to have nine students attend class virtually and twelve students attend either virtually or physically. The participants attending virtually consisted of students within Canada, the US, and the UAE.

The high school special needs class consisted of two teachers and fifteen special needs students ranging in age from 14-21 years of age. This class is housed within a regular high school building and is contained within its own classroom environment. Students range in ability from non-verbal to verbal, wheelchair bound to fully-abled, non-readers to 2nd/3rd grade level and includes students with Down's syndrome, Autism and Intellectual Disability (formerly Mental Retardation). Both classroom teachers were interviewed. Both are females. One teacher is in her late 30's while the other is in her early 60's.

The director of education for the special needs at the learning development center is involved in shaping the early years foundational curriculum and structure of educational formats. The center looks after kids that may not be able to attend schools for average students. The students at the center consists of down syndrome, aspergers, autism, motor skills and other physical and intellectual disabilities. The center also conducts educational psychology assessments, therapy assessments and multi-disciplinary assessments for children age 0 - 18 years. The interviewee provided insights as to how digital inclusion and digital design could assist in education for special needs children and some of the areas where it could fill a gap in the industry.

The blind participant in this study is an accessibility expert in the financial industry. His day-to-day work includes providing stakeholders project advice on accessibility-related issues and certifying projects that meet compliance to the Company's accessibility guidelines, and among other tasks. The blind participant is also a part-time researcher of accessible information and communications technologies in postsecondary education. Given his credentials, it was important that we kept the interview casual and open-ended so his responses do not influence our research objective, or create design fixation.

The university professor participating in this study teaches at a reputable college in Toronto, Ontario, in the field of health care. Her classes include diverse groups of students; multi culturally and geographically. Classes are conducted through online learning tools as well as the option to be present in a classroom setting. Students are given schedules with links to online class meetings prior to the beginning of the semester. Tools used in each class include basic features; such as video conferencing, text chat, audio conversations, and screen sharing.

2.3. Procedure

Research of our five real people was conducted either in the form of ethnographic observations, interviews or a combination of both depending on the situation. The research team, consisting of four members with diverse skills and backgrounds, conducted the interviews and observations over a total of twelve weeks.

When conducting observations the team observed learners in their normal classroom environment from the start to the end of class. For observation of the Master's class, two different classes were studied on two different days and times. In the first class remote conferencing equipment was set up including the required videoconferencing software. The software we tested included Adobe Connect, Skype, Google Hangout and GoToMeeting (Figure 2). In the second class we

had an administrator organize the virtual meeting logistics. Common to both classes was the use of a laptop, speaker, microphone and recording device. Both classes also used the learning management system, ATutor. Student and teacher comments and feedback were captured using pen and paper and feedback was documented in Google Docs. The participants were unaware that we were observing and documenting their behavior and comments. For observation of the high school special needs class one class was observed in one sitting from start to end of class. During this time learners were observed participating during one lesson. Observations of learners were written down and then later documented for further study in a Microsoft Word document.

Figure 2: Visual representation of Skype chat transcript and associated learning experience issues identified during synchronous Master's class session.

Interviews were structured to be informal and/or casual conversations with interviewees. Four series of interviews were conducted; one each with the director of education, the university professor, the blind participant and the teachers of the high school special needs class. Three of the four interviews were conducted face-to-face allowing both verbal and non-verbal responses to be captured. Responses were captured using a pen and paper and compiled as results after the interview using Google Docs. Our fourth interview, with the blind participant, was conducted through instant messaging. To see and hear the questions our blind participant used the JAWs screen reader and a standard mouse and keyboard. The interviewer captured notes using a word processing software as well as reviewing the chat log, and summarized the responses in Google Docs after the interview. All interviews lasted one hour or less.

The twelve weeks during which research was conducted were divided into three time periods herein referred to as Phase 1, Phase 2 and Phase 3. Phase 1 consisted of studying the Master's class. This part of the research was conducted over six synchronous online class sessions spanning eight of the twelve weeks. Three researchers collected data remotely via Skype chat transcripts which were later analyzed while one researcher collected data via traditional in-class, face-to-face classroom observation of student interaction. There were no set criteria for data collection. Both positive and negative feedback was collected including comments from students and instructors, verbally or virtually (through chat), during the two hour lecture. At completion of each class session data was compiled using a collaborative software, Google Docs, and analyzed for similarities, differences, gaps and opportunities.

Phase 2 involved direct observation of the high school special needs class in their class learning environment. This took place over a one week period. The class was observed for a period of sixty minutes. Only the teachers were made aware of our intent to observe the class ahead of time. There was no interaction between observer and students during the class session. The students were observed as they participated in their class session and notes of observations were made accordingly.

Phase 3 involved conducting interviews with each of our real people directly over a period of two weeks with the exception of the Master's class.. Each interview subject was briefed about our intent, asked if they would be willing to participate and then signed a consent form. Two open-ended interview questions were also prepared ahead of time to serve as seed questions for eliciting additional interview feedback about each subject's distance learning experiences. Each person was asked the same two seed questions. Question 1 asked "Do you see a gap in the day to day learning and/or training that happens here where you believe that technology can help close that gap?" Question 2 asked, "If you had access to a digital application that allowed you to connect better with your learners (and their stakeholders)

what are your thoughts on that?" Responses to these questions were captured as well as additional discussion points.

3. Results

3.1. Observations and Interviews

The sections that follow summarize both observation and interview outcomes from each of the five real people.

3.1.1 Master of Inclusive Design Class

The insights yielded from data collected from Skype log transcripts and direct participant observation of this class (Figure 3) pointed to five major gaps in the learner experience. The first gap was that of set-up struggles and inefficiencies. Specifically,

Figure 3: Students of the Masters of Inclusive Design program, participating in a distance learning environment.

Messy work flow related to content logistics during class time was noted as another significant gap. Recurring issues included poor transparency to links, usernames and passwords which caused frustration and inefficient use of class time required of peers to share these with one another. Furthermore, in order to send emails or communicate with peers during the class learners would have to step outside of the native meeting app to send emails or use back channel chat. When using chat, it was also noted that many students had difficulty following conversation streams as there were several different topics of conversation running at the same time.

The third gap identified was participant barrier. Both virtual and physical learners expressed on several occasions feeling as if an invisible barrier existed between participants making for an impersonal learning experience. Much of these feelings were associated with participant inability to see body language and affective expressions.

Fourth was lack of responsiveness from the actual collaborative classroom meeting software application being used. For example, microphones left unmuted by users captured unwanted and distracting sounds such as someone typing on a keyboard, a dog barking in the background or the sound of a PA system at the train station. The inability of the software to respond to such unwanted distractions creates interuptions for all learners and in some cases completely breaks the flow of the lesson.

The final major gap was found to be an overwhelming need for optional non-verbal methods of communication. Not surprisingly, since non-verbal communication makes up two-thirds of all communication (Gobron, S), participants expressed the need for options such as video and captioning.

3.1.2 High School Special Needs Class

Observations of this class occurred during a physical education lesson that involved students interacting with Microsoft XBox Kinect with Motion sensor and a game called Motion Explosion. The first ten to fifteen minutes were taken to set up the game for play. A considerable amount of effort went into achieving buy-in from students on what game to play, figuring out how to physically choose what game to play and how to setup customization options illustrating the importance of making interface options and choices for participation more obvious, easier to use and easier to understand.

Once the game was chosen (a dodgeball style game) and set up accordingly the students began to play. At the outset it was clear that many participating students had a difficult time understanding what to do with many requiring help in the form of verbal and physical cues from the teacher. The game itself did nothing, nor were there any options for providing cues and examples to the players on why they needed to do again illustrating the importance of a simple, easy to use interface.

During game play it was also noted that many of the participants were looking for reaffirmation of a job well done. The game did not provide any since most of the participants, many of whom have severe physical and intellectual disabilities, were performing at a level lower than the system deemed acceptable. This was a significant takeaway in that it points to the need for applications that allow users, or their teachers, to set user

performance goals in line with the physical and intellectual capabilities of the user so that appropriate feedback and reaffirmation can be given (rather than not at all).

During game play it was also noted that, particularly for wheelchair-bound users with significantly reduced mobility, sensors were not able to recognize their movements and kept timing out. In fact, one of the teachers commented that "Microsoft said it had problems recognizing people in a wheelchair." This brought to light the need for applications to do a better job sensing inputs from users and to provide the option for users to adapt the interface to accommodate for decreased motor skills.

Finally, it was also noted that participants could not tell who they were when their scores for "Player 1" or "Player 2" came up or whether they did well or not. There was no easily recognizable visual of themselves. In a related instance black students were using white avatars. There was no way to customize the avatars to allow for personalization to suit personal player preferences. Clearly digital applications, especially those used for learning, need to do a better job at representing user likeness not only to improve learner self-recognition but also to increase learner engagement and cultural relevance.

3.1.3 Director of Education for Special Needs

To understand from the perspective of education administration we had interviewed the education director at a centre that looks after diagnosis, therapy and education. The participant referred to personalization in the interface as a means to control colours. This is due to children with special needs often being sensitive to certain colours such as bright tones. She also highlighted that it should not be the instructor's or parent's task to identify the color scheme. As a user, the application should be expected to know what is right for a specific user. This could mean a set of color themes available for selection but the selection must be carefully selected.

The participant also brought to our attention that working parents are less fluid in communicating with the instructors, trainers and therapists. It would be great if digital inclusion could solve this problem and make parents more proactive in sharing and communicating with their children's instructors. A forum or tracker based communication approach could add a lot of value. Another feedback was to make parents be able to digitally participate in assisting children complete their tasks and assignments. Instructors always wished they could have instant feedback from the parents on their children's development and behavioural patterns at home. It is vital for the child's development that parents are able to track progress of their child's exercise and be able to communicate directly with their teachers, which is especially important.

The participant also brought to our attention that most learning applications are dull and boring. These systems are engineered and lack the spark of creativity in the user interface or fail to promote creativity in children. In most cases, the difference between using traditional methods and digital applications are only in the use of technology or hardware. There seems to be little thought and value placed on children's emotional or interest points in the digital environment. Although some iPad apps are emerging most are designed for individual use rather than a classroom environment. The digital inclusion should be blended with good inclusive design or inclusive creative graphics to encourage and motivate students to get involved.

3.1.4 Visually Impaired User (Blind Participant)

Our blind participant provided several responses about the current state of eLearning systems. He felt that current learning management systems were not completely accessible, particularly for visually impaired users, and provided three reasons. The first is that most learning management systems comes from many third-party sources, making it difficult to customize. The second is that shrink-wrapped learning management systems are often white-labeled, and as a result does not provide a one-size-fits-one solution. And third is that most learning management systems are designed for sighted users. For example, interactive learning exercises, such as dragging-and-dropping of elements on screen become irrelevant without an alternative learning method. Another example he provided was multimedia, such as video, which is difficult to use if course designers do not provide video captions or descriptions.

When asked in what ways do you think designers can improve eLearning systems for personalization, the participant responded that systems should have a familiar interface in which people already know of. For example, many people already know how to use Facebook. Having a learning system with similar features such as Facebook can decrease the learning curve and may increase the adoption rate. Another suggestion was to include the Universal Design of Learning principles as an integral part of the learning management system.

3.1.5 University Professor of Distance Learning

The University Professor participant commented on virtual communication, inclusion, and overall user experience, with regards to distance learning. The participant provided didactic feedback on experiences and communication within the class. She described a brief history of previous systems used for distance learning, and is content with the current software being used. Features that were found efficient include in-application recording, the option for video chat, and text chat. The participant continued to reveal that something is missing; the remote students do not participate as much in conversation, they miss out on non-verbal communication, and often not everyone is comfortable using webcam and audio. There are also accessibility issues with this system. For example, one class taught was located in the Bahamas. They did not have competent internet access, which made teaching classes strenuous. Some students do not have access to quality microphones and video which disrupts communication. Ideas to better overall learning include more efficient personalization options, language translation, technological support, and mandatory in-class sessions.

Collectively, the results of the above interviews and observations resulted in the identification of seven key design patterns, henceforth referred to as the seven core stages, that will improve the current e-learning experience: class awareness, attendance, class activity, peer interactions, assignments and tests, progress, and student-teacher interactions. In the next section we shall discuss how these findings led to the creation of our design artifact, the inClass concept.

3.2. Design Artifact

3.2.1 User Journey

Results about who we are designing for were compiled to aid in developing a user archetype of our five real users to help guide decisions throughout the development process. Creating this summary helped to understand the nature of the industry, understand user behaviors and to define objectives. Next, user-journeys were created (Figure 4) to illustrate how real people might interact with the potential platform. These journeys were communicated visually, with supporting text, sketches and photographs in the style of a flow-chart. The outcome allowed us to identify possible routes, and usable features that added value to the final design.

Figure 4: A user journey designed to aid in understanding of user experience, and behaviours.

3.2.2 User Experience Architecture

Based on the discoveries from the previous task we began sketching ideas that aligned with the user journeys to facilitate concept exploration, structure details and interface solutions (Figure 5).

Figure 5: Common themes discovered through user journies. Orange words are technical features, while blue words are emotional features.

Subsequently, we then executed information architecture. We started by creating a low-fidelity site-map to address the pages that need prototyping and designing (Figure 6). Next, we defined a more detailed user-flow which acted as an evolving artifact through the various project stages.

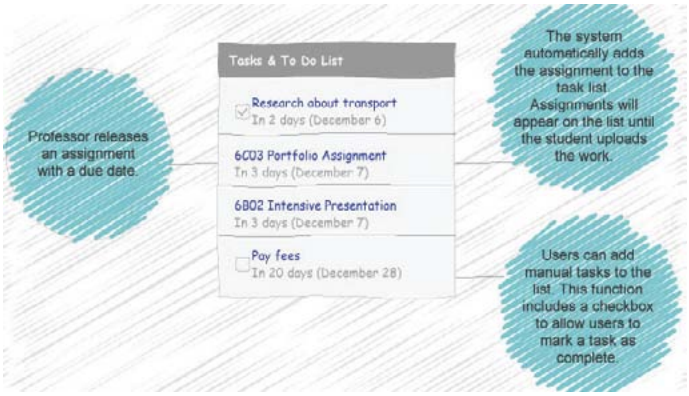

Figure 6: One of the low-fidelity site-map design concepts, focusing on dated to-do lists.

We then created wireframes to design the portal experience and specify the interactions (Figure 7). Wireframing allowed us to test the design concepts through prototyping and helped us define the technology and functional behaviors of the project.

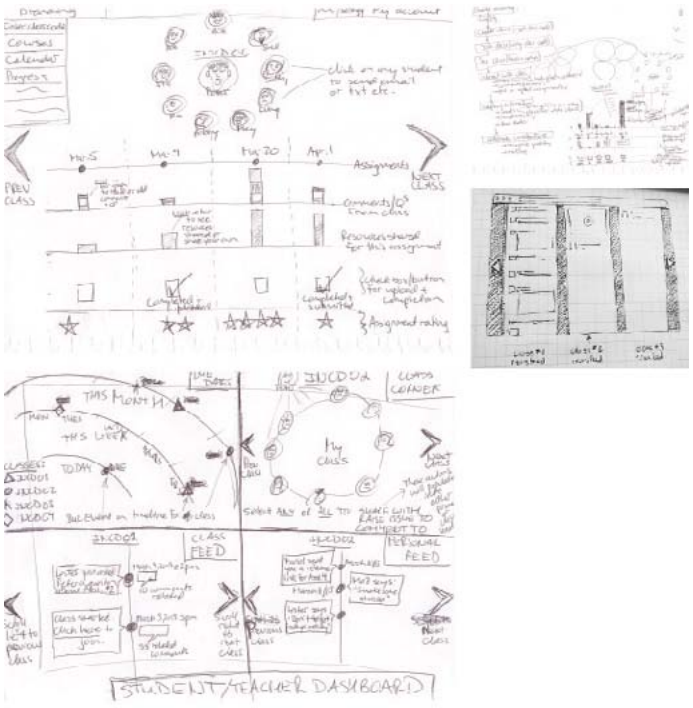

Figure 7: Wireframe sketches to specify features, and user interaction.

3.2.3 Touchpoint Map

Given the resource constraints encountered during this project creation of a touchpoint map as the culmination of our design artifact was decided upon as a reasonable compromise between development time and illustration of key functional features. A touchpoint map is a user experience design artifact that showcases potential system features, capabilities and functionalities, as well as user interaction. Subsequent design phases, such as creating wireframes, will allow designers to use the touchpoint map as a guide to design the interface and to refine system requirements. It also becomes the reference point for the designers to see whether they are hitting the benchmark in solving the real problems.

The sections below and respective figures therein describe each module of the touchpoint map. Figure 8 illustrates the touchpoint map in its entirety.

Figure 8: Illustrates the touchpoint map in its entirety.

3.2.3a Class Awareness

The Class Awareness module provides students an easy way to conduct course administration throughout the school experience. This module removes the complexity of managing courses allowing students to concentrate on what matters most: learning. The Class Awareness module has three main features namely, course notification, course registration (Figure 9), and course recommendation.

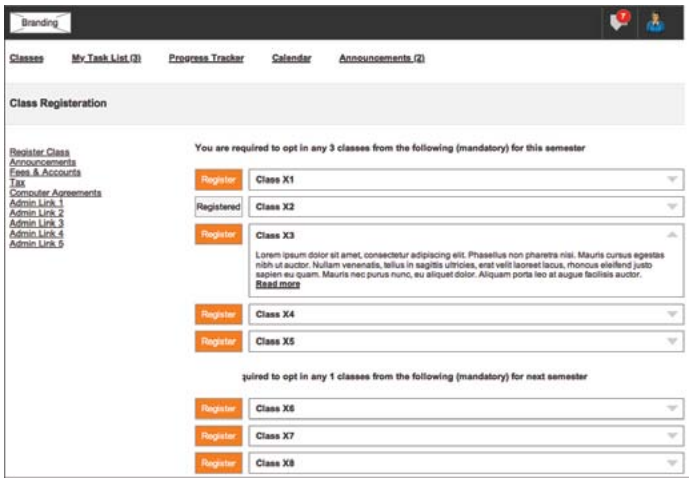

Figure 9: Wireframe sketches to specify functionality of the registration process.

The course notification feature reminds students of when the registration of the courses have begun. The system displays this reminder in the notification toolbar. The student can also set up email and text message alert reminders of registration dates.

The course registration feature lists applicable courses that students can take based on their student profile. This is done by showcasing the courses that the student is eligible to register for. The idea is to guide the user of what classes they need to join rather than making them search using class codes. Students

can then register for courses simply by selecting a course from the list and clicking the "Register" button next to the course description.

The course recommendation feature recommends courses (e.g., electives) students can take based on the student's interests, feedback and academic progress. This feature works together with the course registration and notification modules, as described below.

3.2.3b Attendance

The Attendance Module is a single sign-on feature that allows students to use their inClass username and password to access external software systems and all other university-related logins (Figure 10). The idea is to streamline the whole process into one single dashboard which becomes the gateway to all things about their education and admin related.

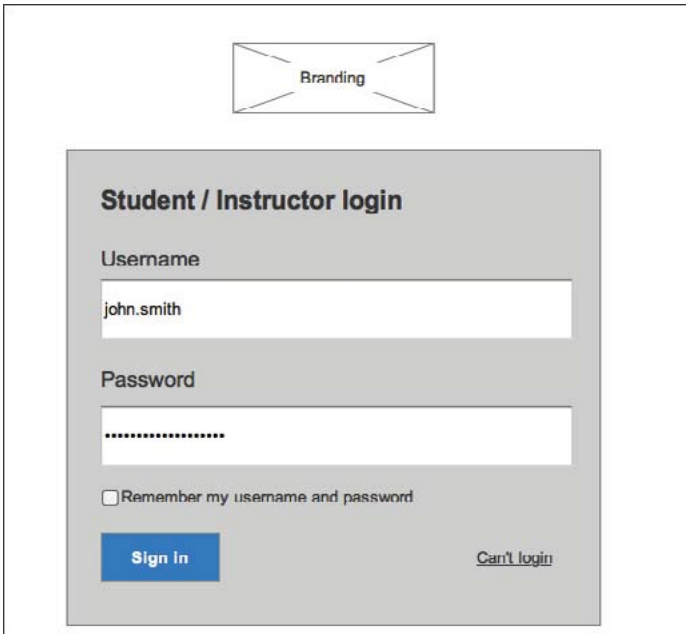

Figure 10: Wireframe design explains the functionality of the unified sign-in process.

This feature removes the need to remember multiple usernames, passwords, and system locations. Once the educator or system administrator adds the external system (e.g., GoToMeeting, Google Drive, ATutor etc.) to inClass through the Control Panel, students can then access the resource on their dashboard. As soon as the student selects the resource, the system will automatically redirect and sign in the user. Users also have the ability to easily switch between external applications by selecting another application on the application list, while maintaining a seamless transition between the two applications.

The Attendance Module also works with the Peer Interactions module, as described below. Briefly, the Peer Interactions Classmates Status Bar will display indicators (e.g., online, offline, etc.) informing the user who is available for a conversation or to collaborate.

3.2.3c Class Activity

The Class Activity module displays all course material, class and peer discussions, class announcements, and other school-related activities, on a timeline (Figure 11). This timeline works with the built in tagging engine. Once the educator or student submits content, the inClass System will automatically tag content by date, time and location. With tagged content, users can easily search and retrieve data through the timeline or using the search feature.

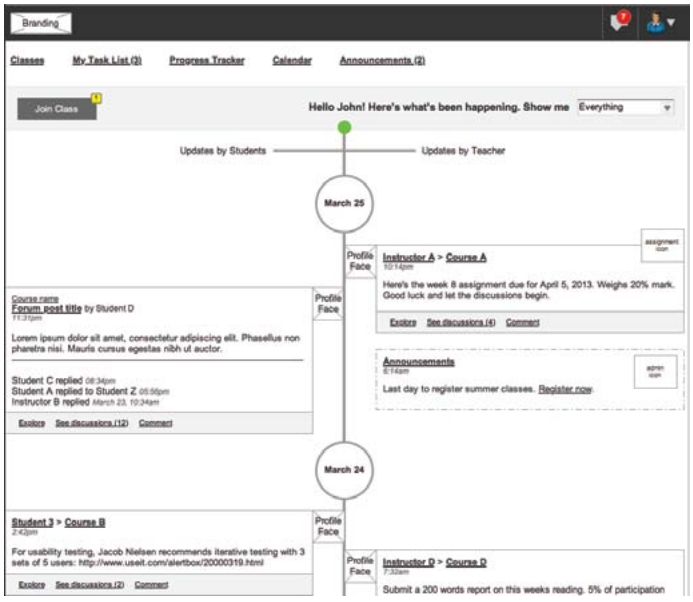

Figure 11: Wireframe sketches outlining features of the timeline integration.

The Class Activity module also integrates with mainstream document management systems, such as Google Drive, to allow students to use external systems and tools they are most familiar with and are comfortable using. This integration occurs once the educator or system administrator adds the document management system to inClass. After integration, students can then access inClass course materials, such as lectures, tests and assignments, from the document management system.

3.2.3d Peer Interactions

The Peer Interactions module provides students a simple way to take part in discussions and to collaborate. Students and teachers can start conversations in the inClass environment by first reviewing the Classmates Status Bar. This Status Bar shows user availability (e.g., online or offline) as well as the time difference of distance learners in other countries to ensure meetings are appropriate for both parties.

Students can interact with one another in three ways. The first method of interaction is through the forum (Figure 12). The forum provides a simple method to capture all discussions in a central and accessible location. The system automatically tags all forum content the student or teacher submits for easy search and retrieval. Also when a teacher posts an assignment, this will go into the class activity feed whereby students can start interacting directly from the landing page.

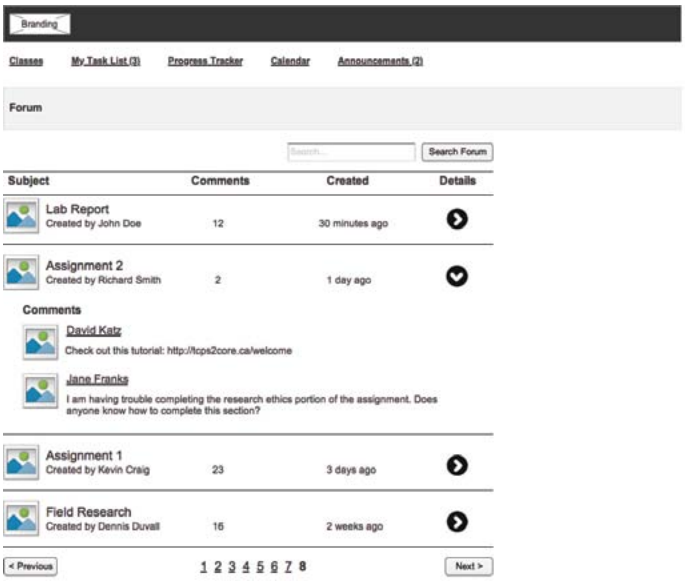

Figure 12: Wireframe sketches outlining features of the forum.

The second method of interaction is by integrating a social network site with inClass, such as Facebook. Once integrated, students can then access and participate in forum posts and discussions through the social network site.

3.2.3e Assignments and Tests

The Assignments and Tests module provides students an easy and convenient way to see when tests and assignments are due (Figure 13). This scheduling tool works with the built-in to-do list. To illustrate, once the educator adds an assignment to inClass, the system will automatically populate the student's to-do list with the associated task and due date. along with a dedicated box for the student to submit their assignment. Only after the student has submitted the assignment through the system's submission module will the system remove the task off of the student's to-do list. To complement this module, students can also set up email and text message alert reminders of upcoming due dates.

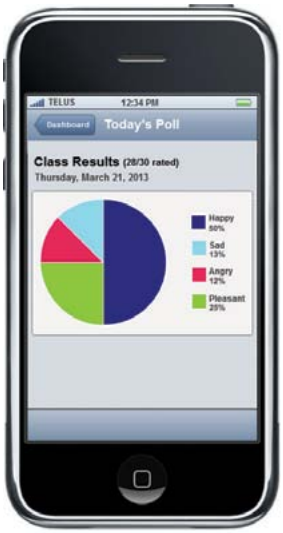

Figure 13: Wireframe design showing the Assignments & Test results on a mobile device.

Apart from automated tasks, students can add their own tasks to the list, sync it with Google Calendar or other calendars via APIs.

3.2.3f Progress

The Progress Module is a feedback tool that shows students' their progress for each class, such as marks and grades. The system displays this feedback with both text and graphics (i.e., charts) for easy comparison of feedback between courses and as an accessible alternative format (Figure 14). The main benefit of this module is to display all feedback in a central location, while also allowing access to this feedback through various entry points, such as the timeline. Another benefit is that educators can personalize this feedback (i.e., grading criteria) at both the class level and individual student level.

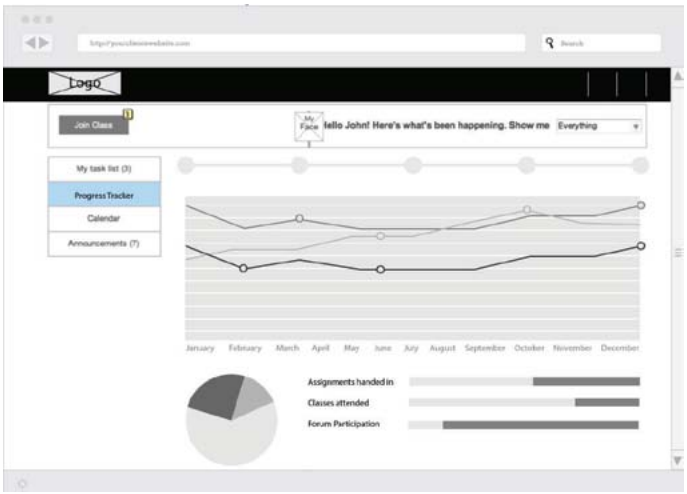

Figure 14: Wireframe sketches outlining functionality of the Progress Module feature.

3.2.3g Student and Teacher

The Student and Teacher module provides students and teachers an easy way to communicate with one another (Figure 15). This communication happens through the inClass mobile application, which complements the Web-based version of inClass. The decision to introduce a mobile version stems from our research results that show that most students have and like using a smartphone.

Figure 15: Wireframe sketches outlining functionality of the Progress Module feature on a mobile device

Our research has identified the following main benefits of this module. The first is that it provides an alternative form of communications for both the student and teacher during and after school hours. Providing an alternative form of communications can also benefit students that feel uncomfortable speaking in front of the class or need to speak to the teacher privately. Another benefit is that frequent communications allow the teacher to capture student feedback. Teachers can then use this feedback to build an understanding of what students currently like or dislike about the class to further customize the course material to better suit their needs and interests.

4. Conclusion

We have presented a design concept for a distance learning web application that, based on comprehensive user-centered research, delivers meaningful functionality that is inclusive of user needs and preferences. The barrier-based design narrative together with the multi-user, multi-environment research approach used to understand the current state of the distance learning experience from a diverse range of online learners and instructors provided a holistic and organic foundation for our identification of seven core e-learning stages: class awareness, attendance, class activity, peer interactions, assignments and tests, progress, and student-teacher interactions. Identification and subsequent transparency to these seven core stages provides for a rich use-case medium from which a truly personal and inclusive design concept prototype could be developed. Although presented as a touchpoint map rather than a fully functional clickable prototype it is our belief that this is just a matter of semantics in terms of providing a sound basis from which to realize a fully viable solution to improve the distance learning experience. Additionally, the user-centered design techniques used to inform the design of the prototype may provide pattern scouts and authors with powerful tools for mining, elaborating and validating design patterns. It is our opinion that given the research and proposed solution presented we have provided a substantial case for development of a solution containing the proposed feature set and for leveraging a learner/instructor-centric research methodology to develop similar distance learning solutions.

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