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Design and Implementation Challenges to an Interactive Social Media Based Learning Environment

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Abstract

An Interactive Social Media Based Learning Environment is a software system that provides a classroom environment that leverages social media technologies to enhance the learning experience. A study was done to evaluate the success of this particular interactive social media based learning environment. A survey was given to students in three classes who used the system in order to identify areas where the system design succeeded and areas where it failed. Load testing was done to determine how usage of the system would impact usability and estimate potential congestion issues. These implementation issues were then reviewed to determine what areas need improvement. The survey results indicated that the designs of the chat and awards systems were the areas of greatest concern. Given the potential benefits of game-oriented learning, the failure of the award system is of particular note. The immediate feedback of quiz results and the ability to ask questions anonymously were the greatest successes. The note taking feature was a qualified success. Load testing's most apparent result was that large chat volume rendered chat impractical due to the limited rate at which humans can read and process text. Resolution of the chat issues will require both social adjustments to how such a system is used and technical alterations to limit the incoming rate of chat. The awards system requires a complete rework, both to make the awards more interesting and more appealing and to ensure that the correct behaviors are being motivated. The question system can be enhanced by providing more generic functionality, giving users a way to simply indicate that they have lost track of the lecture instead of forcing them to ask specific questions.

Keywords: Qizbox, online learning, social media, interactive social media based learning environment, pedagogy, collaborative learning, interactive learning

Introduction

The advent of social media has dramatically altered the way many people interact with their peers, the public, and the world at large. Twitter gives users instantly updated windows into the lives of those they follow. Sites like Fitocracy have attempted to make activities that are as tiring as exercising into game-oriented and socially-driven events. The challenge for educators is to adapt to these technologies correctly: taking advantages of their strengths and avoiding their weaknesses.

This paper describes the final developments of an interactive social media based learning environment and the

challenges it faces as it transitions through the beta-test environment to become a completed production system. The web-based tool embraces the social media environment and is designed to encourage student interaction and foster a new, socially-driven, learning experience. The tool allows students to view and navigate lecture slide shows, participate in quizzes, take notes, ask questions, participate in a classroom chat room, and receive awards for their activities.

The challenges that confront the development and deployment of the tool are both technical and interpersonal. One of the technical challenges is the load posed on the underlying infrastructure by serving lecturer-created content to the students. Another challenge is the load posed on the underlying infrastructure by student generated information, such as chat, that needs to be served to all other users. On an interpersonal level, additional features and options pose the risk of distracting students from the primary goal of learning.

Social media has come to dominate the interpersonal networking landscape. It has revolutionized the way people interact, the way they communicate, and even the way they think (Weisgerber & Butler, 2010). The rise of social software provides new avenues and new opportunities for increased participation and collaboration and an opportunity to change the way people learn (Parker & Chao, 2008; Prensky 2011). The participatory web, including social networking sites such as Facebook and content-sharing sites such as YouTube and Flickr, allows individuals to establish or maintain connections with others, establish their social networks, and share information in the form of wikis, blogs, tweets, podcasts, video, RSS feeds, and more (McCarthy, 2010). Facebook currently claims over 800 million active users sharing more than 30 billion pieces of content each month in the form of web links, news stories, blog posts, notes, photo albums, etc. (Facebook Statistics, 2011). Twitter, a social networking and micro-blogging service, is averaging 140 million tweets per day, up from 50 million the previous year, and gets 460,000 new accounts every day (Twitter Statistics, 2011). People are flocking to the Internet in order to upload pictures, share videos, tell stories, and simply interact with others (Weisgerber & Butler, 2010).

One aspect of social media that has gained tremendous attention and growth is gaming. These are not the traditional video games of years past, but simple, socially-leveraged games that play to the strengths of social media. These games are often simplistic and repetitive, but they engage the users to a tremendous degree. They amply demonstrate the ability to “hook” a user with simple game-play and a reward mechanism that has no intrinsic value. The quest for awards and rewards drives usage of these applications, though some argue there is a strong element of social obligation (Liszkiewicz, 2010). In a 2010 PopCap Games research paper, 35% of respondents said they played for the opportunity to win prizes, and “Incentives/Prizes/Rewards” was the second most common suggestion for how developers could enhance game-play experiences (Information Solutions Group, 2010).

This paradigm has been brought outside of simple gaming activities to utilize award-driven motivation in other arenas. The website Fitocracy attempts to make a game of exercise. awarding points that allow users to “level up” by exercising more and providing “quests” and “achievements” that encourage users to attempt new exercises, continue existing regimes, and, of course, interact with other users on the website (Wang, 2010). In five months, this website, which is still in an invite-only beta stage, has gone from 10,000 users to over 100,000 users (Fitocracy, 2011). The idea of using gaming conventions and styles to interest people in a traditionally less desirable activity is clearly effective. The ability to demonstrate accomplishments to peers and acquaintances is a driving factor in many gaming experiences (Cragg, Taylor, & Toombs, 2007).

These changes in the way users interact and are motivated have become so wide-spread and inculcated into our culture that attempting to stop their influence at the classroom door is futile. Moreover, it is a mistake to try to minimize the shifting paradigms they bring to education; they

should be embraced. They have the potential to enhance and energize the learning process and add new collaborative dimensions to the classroom (Parker & Chao, 2007).

Effectively engaging students requires not only understanding their attitudes towards academic life, but also understanding their social life (McCarthy, 2010). Many of today's younger students can be thought of as "digital natives", a term coined by Prensky (2001) to describe individuals who have known nothing but a digital environment since birth, surrounded by and using cell phones, computers, videogames, digital music players, and all the "necessities" of the digital age. In many cases this digital culture has influenced student skills and preferences in a number of key areas related to education (McCarthy, 2010). These students prefer receiving information quickly and are adept at processing that information rapidly; they prefer multitasking and nonlinear access to information; they have a low tolerance for lectures and prefer active rather than passive learning, and they rely heavily on social media for social and professional interactions and accessing information (McCarthy, 2010).

Many students prefer that familiar technologies be used as part of their education, not only because they have mastered these tools and use them on a daily basis, but also because they recognize how useful these tools can be (Prensky, 2007). Weisgerber and Butler (2010, Editors' Introduction section, para.2) note:

> Although critics may see the constant connectedness offered by these new participatory technologies as a distraction hindering effective learning and resist the idea of incorporating such technologies into our classrooms, it is difficult to deny that blogs, micro-blogs, wikis, and social networks are quickly transforming, if not the classroom itself, then at least the learning environment our students operate in.

Social media can also help international students develop a sense of belonging in the academic community, specifically in building cross-cultural connections with local students (McCarthy, 2008). Although peers in the academic community often play a critical role in acclimating international students (Krause, McInnis, & Welle, 2003), language barriers and students' inhibitions can discourage such interaction, even on a basic level. Some forms of computer mediated communication, such as social media, can help international students overcome these barriers to interaction (Bargh, McKenna, & Fitzsimons, 2002).

A new pedagogical approach to learning needs to be formed to take full advantage of the opportunities social media provides. Learning as a game, driven by awards, trophies, and rewards, has the potential to transform the learning experience. This requires a different method of teaching: one that moves past a simple lecture and presentation method and which brings interesting and meaningful ways for students to advance themselves with immediate gains and rewards that are outside the normal grading system but that work in tandem with it.

This paper discusses the basics of the aforementioned learning system's implementation and gives detailed examples of how the system functions and is used before transitioning to a discussion of the results of a user survey about usage of the system. The paper then moves into a discussion of challenges to the system that are revealed through load testing. The paper concludes with a discussion of mitigation techniques and potential solutions to these obstacles, which will form a roadmap for future development.

The Interactive Learning Environment

A key goal of instructors is to engage their students. An unengaged student is unlikely to excel in a course but it can be difficult to hook every student, especially as course material and student interests diverge. An interactive learning environment provides mechanisms to address this problem. Sponsored by the university's Information Technology Services, the authors have worked

with others to develop a tool that attempts to leverage social media and game-focused learning to drive student involvement and interest.

System Implementation

The learning environment is implemented using the Zend framework, which is a model-view-controller framework implemented in PHP. Javascript, including the popular jQuery libraries, is used for many client-side processes. Communication between the server and the browser is accomplished with AJAX and long polling is used to pull updates from the server to the web browser. The server itself runs an instance of Apache, running on Redhat Linux Enterprise Server. A MySQL database provides data storage and retrieval for the system.

The learning environment was given the name "Qizbox", and a functional version of it can be found at http://qizbox.bgsu.edu. The release of the system, under license allowing other institutions to install and run their own Qizbox system, is planned for 2012.

Usage and Functionality

The use of the interactive learning environment begins with the instructor uploading a set of lecture slides and setting up an interactive lesson plan. A lesson plan encompasses the entire usage of the Qizbox system for a lecture and includes adding quiz questions and choosing which of Qizbox's interactive features to use. The ability to control which interactive features are present in the learning experience is critical to allowing an instructor to customize the experience, not only to the lecture material but to the nature of the students who will be participating in the lesson plan.

A student attends a course with a mobile device such as an iPad, tablet PC, or laptop. The instructor begins a lecture and then distributes the URL for the lecture to his students. This may be done by a simple expedient of displaying it on the screen in the classroom, by emailing it to remote students, or by any other distribution means. A student enters the URL into the portable device and is taken to the instance of the lecture.

The lecture is a touch-interface enabled web application. The student may view the lecture passively as a guest or log in with a Facebook account, Twitter account, or standard university login. All three logins may be tied to a single account, so the student has multiple ways to connect to his or her account. Logging in enables interactive features such as chat, questions, and quiz-taking. After logging in, the student's attendance is automatically noted by the application, providing a painless way for instructors to track attendance. On his/her screen, the student has a lecture slide pane and a tabbed pane with panels for interacting with other lecture participants, as seen in Figure 1. There is a panel for chat, asking questions, and taking notes on slides.

The lecture slide show may be locked in synchronization with the instructor's slide show or it may allow free navigation between the slides by the students. When the synchronization is locked, the students' slide shows will advance in concert as the instructor advances through the slide show.

Clicking on the Notes tab brings the note-taking panel to the forefront of the tabbed list, opposite the slide show. This provides a location for students to take notes on the slides as they see them, keeping their notes in a safe, easy-to-access location. Notes may be shared with other classmates or kept private at the student's discretion on a lecture by lecture basis. These notes may also be downloaded or emailed to give the student off-line access to the notes.

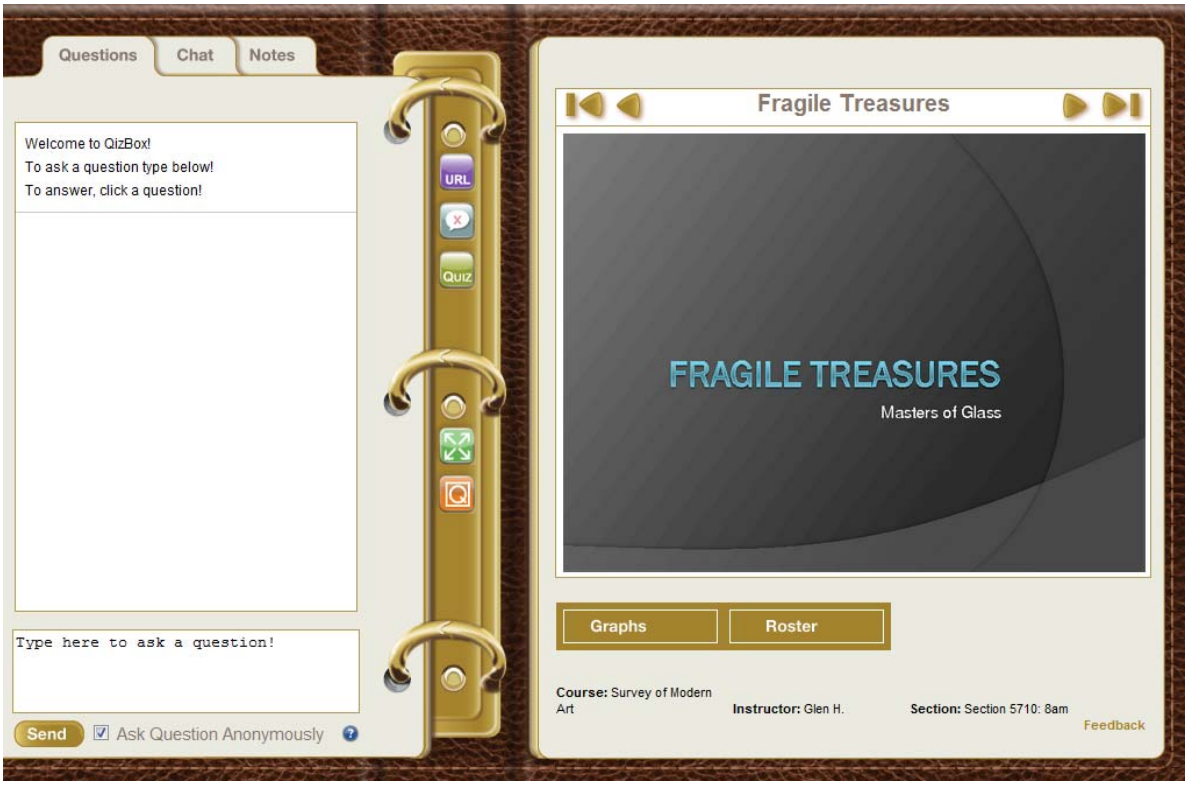

Figure 1: Lecture Display

There are times when a student has a comment he or she wishes to share. Often shyness or social-anxiety will limit the participation of students. Every instructor has asked a question of a class in an effort to elicit student feedback only to be met with a sea of silent and blank faces, some of whom know the answer but choose to remain silent. The social learning environment includes a chat feature to correct this short-coming of traditional classrooms. Social media is a comfortable environment for shy students to engage with others (Baker & McNulty, 2010). By clicking on the Chat tab, a pane for intra-class discussion is revealed alongside the lecture, replacing the notes tab. Here a student may type in his/her comments and share them with the rest of the class. The comments will be identified as coming from the student. Student chat allows students to "crowd-source", engaging in subject-related dialog to enhance their learning experience (Prensky, 2011). The negation of social distance provided by an online experience makes it easier for shy or uncertain students to engage positively with their peers. The increased engagement, even when it takes place before or after class, will enhance the student's learning experience (Schweinle, Reisetter, & Stokes, 2007).

As the lecture progresses, a student may miss something or may be unclear on a certain point. The learning environment addresses this problem in a social-media-centric way. It allows the student to ask the question not just of the instructor but of his fellow classmates. This crowd-sourcing allows the student to catch up or gain clarification without disrupting the entire class or limiting his answer pool to those classmates directly adjacent to him, and it allows him to do so in a minimally-disruptive way. Simple questions can be asked in chat and answered there as well, but sometimes a student has a more detailed or exacting question. The learning environment provides a specific pane for such questions. By clicking on the Question tab the student is able to open the question pane alongside the slide show.

The question system has a ranking system, allowing students to increase or decrease the placement of questions on the question pane. This allows for important questions to be quickly identi-

fied and common issues for the class are rapidly sorted out. Likewise, unimportant questions will rapidly sink down the list. Answers to a question are threaded below the question itself, providing a quick and organized view of each question and avoiding the risk of questions and answers being separated over the course of the lecture. Questions may be asked anonymously, which encourages students who are having difficulty but who are shy or otherwise reticent to actively engage (Barnes, 1999).

In order to leverage game-based learning, the learning environment includes the ability to grant awards, display the awards, and track awards. The awards system provides an incentive program for the students, much as awards, titles, and other prizes motivate users in other aspects of social media. Students may be given awards at any time, providing immediate feedback and gratification, by simply bringing up the roster, selecting the student or students to be given an award, and then selecting the award to be given. This further reinforces their desire to excel in class. Positive social feedback is an excellent tool for encouraging students.

For additional feedback instructors have always relied on quizzes. The social learning environment increases the immediacy of this feedback immensely. At any point during the lecture the instructor may ask prepared questions of the students, who will respond via the social learning environment. This generates a pop-up dialog box with the question and answer choices for the student. After the students have answered the question, the professor can get a real-time display of the results, which can be shared with the class, providing immediate feedback to the students to facilitate their learning.

The following scenario describes student interaction with the learning environment:

> Gregory Scott, a student in "Survey of Modern Art", arrives in class. The URL for today's lecture is on the class webpage, which Greg already has bookmarked. A single click and his iPad loads today's lecture.
>
> Greg logs in using his Facebook account, since he has long-since forgotten his university login and keeps forgetting to get his password reset. While Greg waits for the class to begin, he uses the chat feature to talk to his classmates. Discussion quickly veers from school to the latest episode of a popular TV series a number of students are following. Greg takes part in the discussion avidly, happy to discover a common interest with his classmates. Later, this common ground will provide the basis for Greg to approach some students about forming a study group.
>
> The instructor, Dr. Viridian, calls the class to order and begins the lecture. Today's lecture is on the glass blowing artists of the 20th century. As the lecture progresses, discussing the glass-blowing art of Dale Chihuly, the student takes notes by clicking on the Notes tab. The professor tells of his personal visit to Chihuly's Pilchuck Glass School, and Greg wants to note several interesting facts the instructor shares. Greg does not catch every relevant detail, but he is confident that when his classmates share their lecture notes later they will have a complete and detailed list of everything that they need to know.
>
> When a slide about the red glass chandelier at Gonzaga University comes up, Greg is able to record his own thoughts on the piece (he does not like it) in the notes for future reference, as well as a few facts from the lecture not on the slide. In this class, lecture notes are reviewed by the instructor as part of the student's participation grade, so Greg makes a point to pay attention and take good notes.
>
> Greg is struck by the curious shapes of some of the art pieces. They remind him of sea anemones. He types this into the chat window. Another student replies that he read that Chihuly did an entire series called "Seaforms," which may explain the impression. A third student comments that the "Seaforms" came before the piece the original student

commented on. The students are now actively engaged in their learning, which will increase their retention and motivation.

Greg gets slightly confused when the instructor mentions William Gudenrath. He is reluctant to raise his hand and interrupt the lecture, but his confusion is distracting him from the lecture. He clicks on the Question tab and types in, "Did Chihuly have any association with William Gudenrath, and why isn't William's work considered to be that of a master?"

A number of other students have been wondering the same thing, and the question rapidly rises to the top of the list. Several students provide partial answers to the question, creating a threaded discussion.

The instructor, seeing the importance and attention of the question, chooses to take time out to answer it, clarifying that Gudenrath is considered a master and providing additional detail. The instructor decides the question is extremely insightful and chooses to reward the student who asked it.

The instructor gives the student a silver star for asking an excellent and insightful question. The student, in turn, sees this reward. He has already earned the bronze star and is now motivated to complete the set. He shares his award on Facebook to brag to his friends, some of whom are in class with him.

As the instructor finishes the section on Chihuly, he clicks the quiz button and asks a question of the class. Greg has been paying attention and is able to state that the "Persian Series" was not inspired by 15th century Middle East glass. Two of the students in the class get it wrong, but not Greg.

When class is over for the day, Greg powers down his iPad and heads off to his next lecture. In the evening he will log back into the social learning environment to go over his notes.

The following scenario describes the instructor's viewpoint of the same interactions:

Dr. Viridian is planning to teach a class on the glass blowing masters of the 20th century. He is familiar with Microsoft PowerPoint, so he uses this familiar tool to put together a series of slides for his lecture, complete with graphics of note-worthy art pieces and bullet points of relevant facts and opinions. When his work is complete, he makes a few modifications to slide order and applies a template that he feels will make his slides more interesting. With his creation complete, he saves his work as a PDF file.

Dr. Viridian now opens his favorite web browser and logs into the learning environment. This brings him to his lecture dashboard (see Figure 2) where he selects the course to add the lecture to, then adds a new lecture. Dr. Viridian uploads his PDF file into the new lecture, chooses to enable or disable chat, questions, chat, and awards. He chooses to enable all of these features.

Next, Dr. Viridian adds the quiz questions he plans to ask his students over the course of the lecture. He enters several questions, including two on Chihuly's work. He starts up the lecture to type a welcome message for his students into the chat window and includes a discussion topic in the hope that some students will use the time before class to discuss the previous lecture. He also copies the URL of the lecture and pastes it into his course webpage so students will have a ready link for the lecture. With his lecture prepared, Dr. Viridian logs out and goes home for the night.

The next day Dr. Viridian logs into the learning environment and starts the lecture. He clicks the URL button in the lecture display to prominently display the lecture URL for

those students who have again forgotten to access the class webpage. With his classroom set up, he waits patiently for the class to begin.

Figure 2: Lecture Dashboard

Dr. Viridian is pleased to note that some discussion did take place about the proposed chat topic, but is disappointed that a chit-chat about TV series has derailed learning. At the scheduled time, he calls the class to order and begins his lecture. He expands the slide show to full screen as he begins so he can point out some of the finer details in some of the images in his lecture.

As he reaches a juncture where he shares a personal anecdote about his trip to Seattle, Dr. Viridian toggles back from full-screen slide show to the complete lecture display. This enables him to keep an eye on chat and any questions the students may have. As his lecture continues he elects to remain in the lecture display so he can keep an eye on the question window.

As he continues his lecture, Dr. Viridian notes that one question has climbed to the top of the list. It deals with Chihuly's association with Gudenrath, and a moment's reflection convinces Dr. Viridian that this topic is worth expanding on, even though it leads him away from his original lecture points.

After answering the Gudenrath question, Dr. Viridian realizes that, not only was the question extremely relevant, but that it prompted him to cover an area that strongly reinforced his core point. He makes a mental note to add that material to the lecture for the next semester. Such an insightful question should be rewarded, but Dr. Viridian is reluctant to

give out extra credit for asking questions. Instead, Dr. Viridian clicks on the Roster button, selects the student's name, and gives the student a silver star.

Continuing the lecture, Dr. Viridian reaches the end of the slides on Chihuly and decides to see how much attention the class has been paying and whether they understood any of his core points. He clicks the quiz button and selects the first question he entered for Chihuly. He gives the students a few minutes to ponder the question, then clicks the grade button. Twenty-eight of his thirty students got the question right, so he decides to skip the second question and resume his lecture.

At the end of the class period, Dr. Viridian is almost done with his lecture. He informs the class that they will resume from the current slide at the beginning of the next class and then dismisses them. After the class, Dr. Viridian spends a few minutes reviewing questions students entered in the question log and skimming the contents of the chat log. This helps him understand what issues the students had with his lecture and gives him additional information for preparing his next lecture.

User Surveys

In order to better understand how users used the system, what features appealed to users, and to determine effectiveness of the system, a user survey was created to gather feedback from students who used the system.

An online survey was created and given to 82 students from three different classes. Twenty-four of the students were enrolled at Bowling Green State and the remainder were enrolled at Indiana University. Fifty-eight students had used the system one or more times in the past, and twenty-four did not indicate their previous usage patterns. In some instances a student did not answer a question on the survey. Specifically, 70 students responded to the question asking whether or not they reviewed the notes, 76 students responded to the question about whether the quiz results were helpful, and 63 students responded to the question asking if they posted awards on Facebook.

In addition to the surveys, a number of conversations were held with an instructor who uses the system regularly. These conversations primarily provided context and qualitative data that allowed the survey results to be better understood and served to reinforce the conclusions drawn from the surveys.

Things That Worked

In reviewing the user surveys it is worth noting successes as well as challenges. There are a number of features that worked well and that can give us guidance on how to proceed with future enhancement and new features.

The most successful feature, from a user-acceptance point of view, was the ability to ask anonymous questions. 100% of the users surveyed liked the ability to ask anonymous questions, which is a sign that the ability to overcome resistance to asking questions is needed in a social learning environment. This is also indicative of the social engagement such a system provides, allowing users to be both safely emotionally distant and actively engaged socially.

Fourteen percent of the respondents said they asked a question, which is fairly good engagement for students (Bauer & Snizek, 1989; Dillon, 1981; Pearson & West, 1991). More impressively, 25.6% said they answered a question, which shows the benefits of crowd sourcing. The fact that more students answered questions than asked them may indicate lingering resistance to appearing ignorant or attracting attention, but the ability to ask questions anonymously should mitigate this.

The larger answering percentage also indicates positive engagement from the students in answering the questions of their peers and in reacting to the content of the lecture.

What questions are answered by other students and who answers them may be a useful tool for teachers to evaluate the effectiveness of their lectures and judge student participation. The review of the questions can be done outside the classroom experience, allowing the instructor to review the lecture and improve teaching performance.

Immediate feedback on quiz questions was also valued by users. 93.4% of respondents found the immediate display of the quiz results useful. This is in line with expectations, since most students are concerned with grades and performance. Figure 3 displays the percentages for the survey respondents who used the features of the system.

Note taking was a qualified success. The results of the user surveys indicate that 62.2% of the students took notes on the slides. Typical note-taking tends to be higher than this (Suritsky & Hughes, 1991), but it becomes less prevalent in courses where PowerPoint lectures are already available to the students. Being able to take notes directly on the slides is beneficial and the ability to share notes ensures that more students will have access to notes taken in class, but there is room for improvement in this feature. The ability to have access to the slides is a proven benefit to students, regardless of note-taking (Chen & Tsui-Fang, 2008).

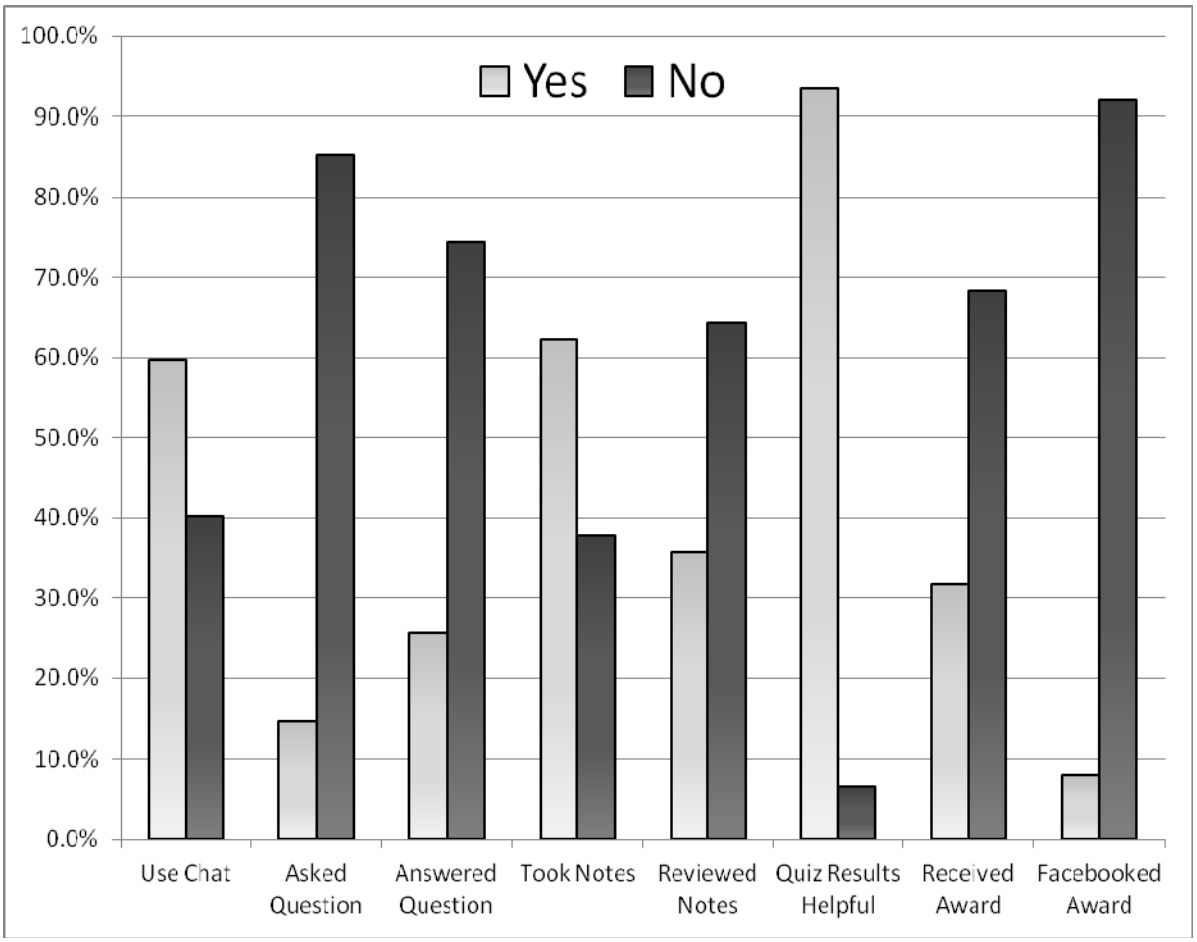

Figure 3: Student Feature Usage

Design Challenges in the Learning Environment

The challenges facing this system that were revealed by the surveys can be broadly categorized as design challenges. Design challenges are created by design decisions and cannot be overcome with clever implementation. They may be socially-based or pedagogical in nature. The design challenges we investigate are misuse of certain features and a lack of the desired engagement with other features. Design challenges were identified by doing user surveys to investigate the impact of the system on the student learning experience and to discern key issues that need to be resolved to better integrate the social media and gaming aspects into the learning environment.

The biggest design challenge revealed by user surveys was the chat system. Just as it is possible for chat to enhance the learning experience by encouraging dialog between students on the subject matter in conjunction with the lecture, it is also possible for students to run amok and veer wildly off subject.

Thirty-one percent of survey respondents noted the chat option as the least useful feature of the system. The largest complaint was that it actively detracted from the lectures. A brief review of some respondent comments makes the problem very clear:

> “People were just typing irrelevant comments.”
>
> “The chat was distracting, and was not relevant to the lecture.”
>
> “It somewhat looked like everyone was just using it as a tool for joking around.”
>
> “Chat people just talked about random things and not the class.”

The major flaw with chat, from a user perspective, is a lack of focus. Students are accustomed to using chat systems for trivial and impulsive communications, and this was reflected in the usage of the chat system. The social pressures and anxieties that prevent students from positively participating in a traditional lecture also form a bulwark against students participating negatively in a lecture. As those pressures and anxieties are reduced, all sorts of behaviors, both positive and negative, may be encouraged. It is important to note that some users were still positively impressed with chat and found the ability to discuss course material as it was presented a positive user experience.

The second design challenge revealed by user surveys was the awards system. Even more users, 63% of respondents (see Figure 4), found the award system to be the least useful feature of the system (note: some users listed multiple “least useful” features). This challenge only ranks second despite its greater user dissatisfaction because it did not serve as an active detriment to the learning process for any users. Many users were either confused by the purpose of awards or unmotivated by their acquisition. 29.3% stated that they found awards desirable, with the remainder either stating that they did not care for awards or that awards were not desirable. While a portion of this dissatisfaction might be laid at the feet of “sour grapes”, as only 31.7% received awards, the numbers themselves imply only coincidence, not causation. Only 53.8% of those who received an award stated that they found the awards desirable. There are a substantial number of students who received awards and simply did not care.

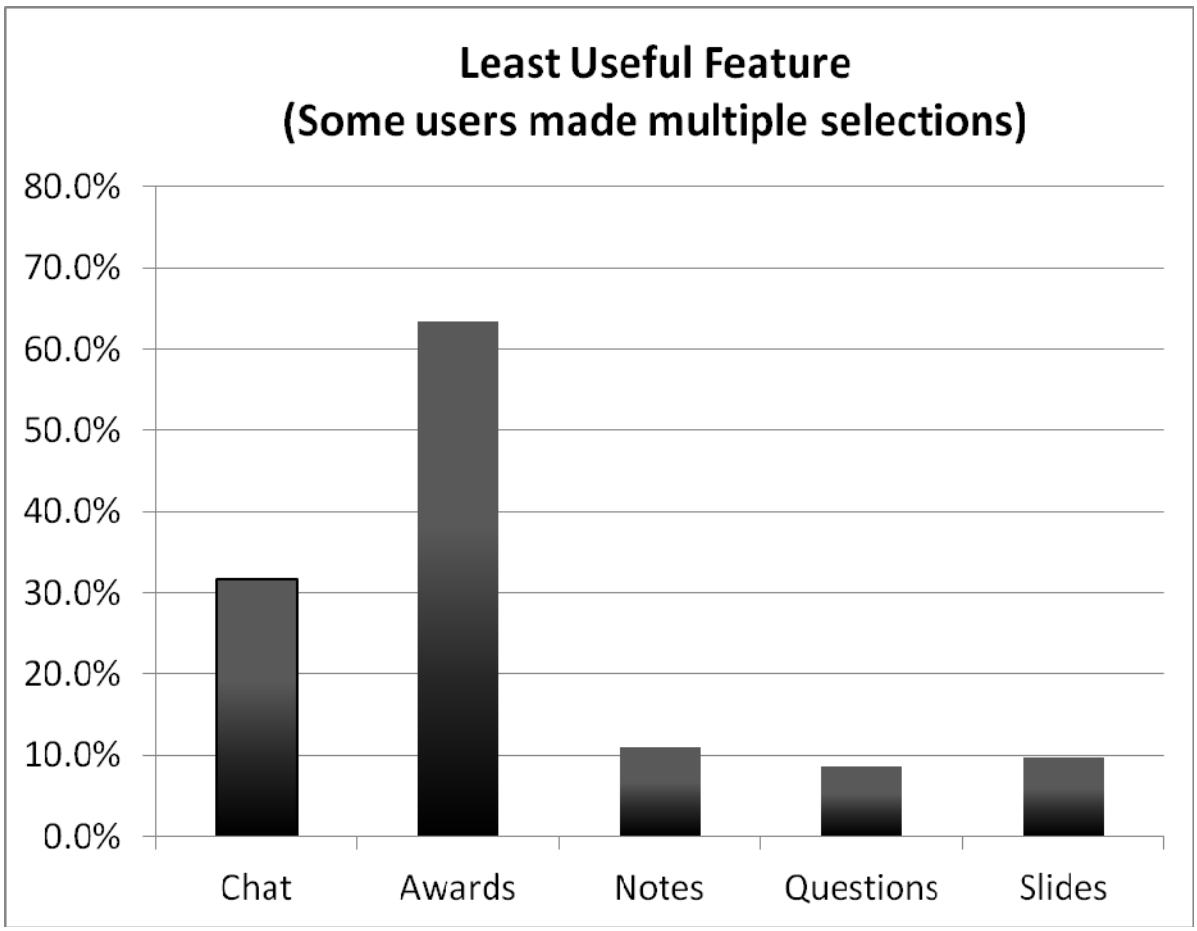

Figure 4: Least Useful Features

Awards were further marginalized when exposed to social media. Only 19.2% of those who earned awards, less than half of those who received an award and desired one, posted their award to Facebook. This means that, even when given an award they wanted, the extra social leverage of social media publication was not brought to bear on their learning experience.

The third design challenge that the user surveys brought to light was in the question system. The question engagement was good, though it seems there is room for improvement. For a feature so popular it received comparatively little actual usage. This may reflect thorough and efficient teaching by the instructors, or it may be a sign that design improvements can be made.

Load Testing

Load testing on the social media system was carried out using Hewlett-Packard's Loadrunner tools. User accounts were created for test users, and then scripts prepared to stress-test the system to determine actual performance characteristics. A set of twenty-five users was created and scripted with a heavy chat usage. Each chat user was given the chat volume of ten other users, to bring the simulated chat volume up to the size of a large, auditorium-style course. Software limitations imposed the limit of twenty-five users, which necessitated having each user do the work of ten additional users.

The chat usage was modeled on the concept of a contentious discussion with high volumes of not only typed text but also text that is copied from some third-party source, such as a website, and pasted into the chat window. This gives the worst-case scenario for chat loading.

It is worth mentioning that using twenty-five users does reduce the load on the system for chat overhead because only twenty-five connections to chat have to be maintained. However, the primary concern is for data handling and end-user performance, not for server connectivity. Therefore, it is fair to conclude that the test remains valid as a means of testing end-user performance.

Implementation Challenges

Implementation challenges are much more “nuts and bolts” than design challenges and may admit to a purely technological solution but will often require design changes to support implementation improvements. The primary implementation challenge we focus on is system load.

The chat system was the first feature tested. Automated users were logged into the system rapidly, as would happen at the beginning of a lecture. Chat was then instigated by all the users. The chat itself was pre-generated text of varying lengths.

The system handled the processing load well. A total chat volume of about 7 million characters was generated over the course of 50 minutes, much of it in the first half of that time period. Twenty-five automated users generated this load. To handle this volume, as well as the attendant lecture, a total throughput of more than 30 GB was handled by the system server. It handled almost 35 000 transactions.

There was no deviation in response speed during the tests, and the system was able to handle this extreme load without noticeable impact. The challenge that was discovered is the ability of human beings to keep up with a fast-moving conversation. As the conversation flew by the chat window it became impossible to keep up. This rendered the chat system unusable, not from a lack of efficiency but from too much efficiency. Any sudden or active discussion in a large class will generate enough volume of chat that a user will not be able to keep up with the discussion in the available chat window.

Another challenge that was discovered with chat was due to browser limitations. While browsers were able to handle this chat volume when it arrived in stages, any user who attempted to join the lecture after it had progressed for a significant time and thus had accumulated a very large chat history experienced browser crashes.

The second design challenge discovered by load testing is theoretical rather than a direct result of the load testing. As the social learning environment scales to serve more simultaneous classes and thus more simultaneous users, it may begin to congest the network. This will not be a problem on most wired networks unless there is an extremely large and concentrated class load, but on the wireless networks which are usually deployed in classrooms, which may already be loaded by other uses, the social environment may surpass the ability of the network to serve the users. A load test on an already congested residential wireless network resulted in the failure of that network under load, effectively denying access to the learning environment to all the users.

Mitigation and Resolution Strategies

The chat system may be the most difficult problem to resolve. The ability to monitor chat and supervise its use is not a viable solution. This would require the instructor to divert time from teaching to supervise the students or would require the employment of a teaching assistant, both of which are sub-optimal solutions.

The best solution may be one that is inevitable as social media become more entrenched in the general learning environment: Just as students are taught at a young age not to get up and wander around the classroom and not to talk aloud during class, so too will students learn not to chat frivolously online during class. This behavior is not yet learned by students because it has not been taught. It may appear to be common sense, but it is a different use for the chat communication

medium than it has been used for in the past and it will take time for social and academic etiquette to catch up. It is entirely possible that students talking off-topic in class will cease to be a problem as students become acclimated to social media tools in the classroom.

In the interim there are technical solutions that can address the problems of chat to some degree. Throttling user participation is one way to keep students from overwhelming chat, either through good intentions or bad. If users are limited to a set number of messages in a time period, this will prevent one student from seizing control of the discussion and monopolizing learning and it will mitigate the issue of students talking at length about off-topic subjects. One or two off-topic comments are tolerable, just as the occasional student witticism is tolerable and may serve an important function by relaxing and energizing the class; it is the extended loss of focus that is an issue.

The same throttling can be used in sending chat to all users. The system can be designed to limit the amount of chat it sends to users, informing users that chat is now backlogged and preventing their individual sessions from submitting new comments until the backlog is cleared.

An alternative way to handle excessive chat volume is to freeze the chat window and have the incoming chat messages accumulate “below the fold” instead of being added to the chat window and scrolling previous content off the screen. This would allow the user to manually scroll down as needed rather than being helplessly overwhelmed by a continual avalanche of messages. A combination of these two approaches is probably ideal.

The failure of the award system is both the most disappointing and, upon reflection, the least puzzling. There are several avenues to improve the award system. As it currently stands, there are nine generic awards: bronze, silver, and gold trophies, stars, and medals. The instructors may provide any reason they wish for giving the award. This was done with the idea of maximum flexibility. The result, however, is awards that are uninteresting and visually unappealing. Graphics that look “cool” motivate users (Cragg et al., 2007). Specially designed, visually exciting awards will increase the motivation factor. Users are accustomed to a highly detailed graphical world, and the current awards do not align with these expectations. In short, the awards appear bland and uninteresting.

A second fix to the award system can be lifted directly from the “achievement” systems in many popular video games. Set achievements, numerous and varied, defined well in advance, will give the students specific goals and objectives. A generic “Bronze Star” is not as attractive or interesting, and thus not as motivating, as “Smart Cookie”, an award with sharp and whimsical graphics given for asking the best question of the day in class.

These achievements can be further enhanced by making them chain. Provide easily achieved awards to set users on the path of collecting achievements and awards and to provide positive reinforcement, and then tie in more important or difficult to get achievements that, taken as a whole, unlock a new achievement. This gaming approach can greatly enhance and focus the behavior of students towards specific desirable goals, such as participation.

One factor that must be taken into consideration is that users will often attempt to “game” the system. They will do the minimum amount of work required to earn the maximum amount of reward. Therefore it is of extreme importance that specific awards drive the correct behavior. An award for “most chatty” that is given for the most usage of the chat system might motivate a student to diligently engage with their classmates in chat. It might also motivate them to paste large chunks of semi-relevant text from Wikipedia into chat to pad their usage statistics so they can get the desired award.

Of additional concern is the lack of granularity in the award system. Minor activities that the instructor wishes to encourage, especially daily ones such as arriving to class on time, are ill-suited

to actual awards. Giving an award too often will cheapen its value. A solution to this is to give users "experience points" for such activities. This is another type of award and it can lead to rewards such as leveling up and earning a new title for leveling up without the risk of diluting the value of awards through overuse.

A future feature of this system will be this sort of reward system, using an automatic experience point system to award points each time a pre-defined desired activity is completed. These points will accumulate over time and at set point totals the user will achieve a new level, which will in turn grant the user a new title that she can claim in the learning environment.

Question participation is the most difficult challenge to overcome. Awards that are more desirable and that motivate good question behavior will help in this area. Another solution is to broaden the functionality of chat. Often a student's question is not specific issue, but a much more amorphous "I am lost" issue. The implementation of a toggling "I am lost" feature, with a small display on the instructor's screen that indicates how many students, if any, are currently indicating they are in that state, may allow instructors to redirect their lecture to encompass and resolve student confusion without the need for any particular student to ask a question. While this does not increase question asking, it enhances the underlying objective of ensuring maximum knowledge transfer to students.

The issue of sheer technical volume of data can be resolved in two ways. For chat specifically, not providing the entire chat history to new users will resolve the issue of joining lectures in progress with large chat histories. For overall usage issues, an attempt must be made to make the overall structure lighter, dealing with less overhead in the transmission of the environment state and the maintenance of the synchronization between the server and the running copy of the learning environment. A slight decrease in the frequency of that synchronization can also reap large rewards in traffic reduction. This is an area that merits considerable future research.

Conclusion

There are many challenges to bringing social media to the learning environment. Some of them are technical and some of them are conceptual and cultural. In this implementation of a social learning environment several challenges have been discovered. The ability to maintain focus in a socially-aware environment is perhaps the most difficult. There are technical tricks that can mitigate this but the ultimate answer will have to be cultural. The ability to bring game-oriented behavior to learning has considerable potential that is not being properly addressed. By adapting the existing approach, repackaging it to be more engaging and more detailed, we can tap into that potential. These challenges, although specific to this implementation, are general enough to inform the efforts of others when developing similar systems. Students need to be focused and motivated, and these are the difficulties and solutions found by our learning environment.

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