

# Pilot Study to Develop Rich Internet Applications Using Adobe AIR for Educational Classroom Communication

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## Abstract

*CGT 411/450 is a senior capstone course in which students simulate the complexities of real-world corporations and business environments related to applied computer graphics. Part of this simulation includes the student and faculty functions of generating, tracking, and maintaining large amounts of mock data including stock information, press releases, corporate and individual finances. Typically, these functions have been achieved through a variety of mechanisms including web sites, RSS feeds, forums and conferencing applications. The current information dissemination mechanisms used in CGT 411/450 are perceived inefficient because of the lack of a centralized source of knowledge regarding the tracking of tasks related to the CGT 411/450 course simulation, in turn detracting from the true goal of the course, the scholarly research endeavor. The authors propose the creation of a rich internet application using the Adobe AIR technology that will consolidate the functions of the multiple simulation mechanisms into a single, unified application. This rich internet application, as a work in-progress, will be subjected to usability and assessment testing to ensure that an effective application is built that achieves the goals of the project.*

## 1.0 Introduction

Currently the Computer Graphics Technology (CGT) 411/450 course uses multiple channels to provide information to students regarding the three primary pillars of the course: the scholarly research endeavor, the product development and the corporation entities.

In recent years course information has transitioned to utilize internet technologies as a medium of providing information in a readily available format, such as web sites, RSS feeds, and data tracking applications. Information arriving to students from a variety of sources has created a perceived inefficiency among students regarding the ability to disseminate the knowledge being exchanged. This inefficiency detracts from the true goal of the course, as described by the professor, the scholarly research endeavor. However

the CGT Department has an overall goal to develop through the curriculum information managers that are capable to digest scattered information in order to make educated decisions.

This pilot study was pursued to produce a centralized source of knowledge as a tool to assimilate course information from existing channels. The proposed method to accomplish this task was to consolidate the information channels through the creation of a Rich Internet Application.

Among students in CGT 411/450 course, the assumption was made that students possess a level of knowledge pertaining to their interaction with a computer interface, dominantly a Microsoft Windows XP operating system.

*1.1 Index Terms* – rich internet applications, adobe integrated runtime, education multimedia, interactive multimedia, undergraduate research, data integration, dynamic content, web.

## **2.0 Background**

### *2.1 What are rich internet applications (RIAs)?*

The term “rich internet applications” has evolved over the years and has taken on many meanings. According to Tim O’Reilly (2005) Macromedia originally coined the term “to highlight the capabilities of Flash to deliver not just multimedia content but also GUI-style application experiences.” The goal for this study’s prototype application is to use the power of the internet to provide an interactive application integrated with data through the web to offer the user a uniquely branded experience conveniently on their desktop.

“It should be easy to use, engaging, and targeted to perform its task very well. To many this means a ‘desktop-application-like-experience’ delivered through the web,” states Rick Tretola in an article entitled “What is RIA?” (2008). The secret to a quality rich internet application is, simply put, to put the emphasis on the richness of the user’s experience with the application. The article goes on to state that “To the user the application should work without them thinking about the complexities of how.” This ties in to the goal to create an intuitive interface especially the main navigation for the application.

### *2.2 Multimedia in educational settings*

Deb, Bannur, and Bharti, authors of “Rich Internet Applications (RIA): Opportunities and Challenges for Enterprise,” describe the positive aspects of RIA’s versus web based communication channels. The authors write “Further, the inability to handle complex

multi-step business workflows was another hindrance. The synchronous nature of traditional Internet applications forced back-and-forth page-flips on users, resulting in a slow, confusing and frustrating user experience. Traditional Internet applications could neither visually represent large and complex data nor provide interactive manipulation by users. The latest transition in this ongoing evolution is RIA, which aims to combine the powerful and intuitive user experience of desktop applications with the reach of the internet.” To summarize, the article goes into detail of how the usability of web based communication channels are out-of-date compared to new and improved e-technologies of today, such as RIA’s. According to the article, RIA’s hold a promise to deliver responsiveness and interactivity, a rich user interface, a broad reach, and real time communication. With every advantage, there comes a disadvantage. The challenges of RIA’s include lack of standards, market volatility, security concerns, as well as accessibility. The goal for this study’s prototype application is to utilize the promises of RIA’s as well as improve upon the disadvantages for future endeavors.

“E-Learning Solutions: Unlock the power and potential of your own virtual schools” written by Adobe (2008c) states how educators can communicate efficiently and successfully with outsiders. E-Learning makes it possible to instantly share resources and expertise, reaching students, teachers, administrators, and parents when they need it. Advantage of E-Learning applications include tracking and gauging of student progression, the ability for students and teachers to learn at their own pace, quick connectivity to school community, and the ability to have more efficient training through online applications.

“Rich Internet Applications in Education” by Ferry, Kervin, and Rudd in 2006 was written in a journal about information and communication technologies. The article goes on to discuss capabilities of channeling information across the web. Advantages include easier access, updating capability, scheduling of tasks, and flexible learning environments. The authors go on to state more facts about the research this group had with the students under their studies on the online education simulations. This article relates to past implementations as well as future endeavors for the CGCentral Application.

Ryan Stewart (2007) wrote an article “Rich Internet Applications in Education” which was based on advancing user experience with Rich Internet Applications. He presented his topics at an Educase conference, a non-profit organization whose goal is to promote the intelligent use of information technology to advance higher education. He has helped create several applications including a Stock Market Game for Warton. Stewart states that “Games like this are engaging as well as informative and can help convey concepts as well as keeping students interested in the material.” This article relates to this study’s prototype application in the aspects of this application developed as a learning tool to supplement existing information channels. It also relates to a possible increase in student performance.

“Designing and Developing Web-Based Instruction” describes how a visual representation is more likely to catch our attention because our eyes are more easily drawn to an image than by a line of text. The visual aspect of information processing is so pervasive in our perception of the world that we use the word “see” in English to mean comprehension or knowledge. The graphs of weekly IPOs are implemented into the

CGCentral application is one of few implementations representing visual significance. (Wang, H; Gearhard, D p160)

An Adobe Case Study entitled “Monfort College of Business at the University of Northern Colorado” (2008d) discusses how an online offering helps students work more efficiently by referring to course content on the web at their convenience. As web developers, the team relies heavily on student survey information to keep courses standardized, relevant, and engaging. This article ties into prototype developed through this study because rather than gathering information from the web, CGT 411/450 students may acquire information funneled from current mechanisms to their desktop even quicker and more convenient than before.

### *2.3 Usability/human factors of RIAs*

Interactive computer applications geared to single-users are present in our daily lives. This paper addresses the development of an application that enables individual users interact with information to be able to collaborate on a multi-user project. (Xia, S. 2004) The core of the CGT 411/450 course is team collaboration. The prototype developed through this study intended to provide students with a supplemental tool, in addition to the current mechanisms used in the course, in the form of a multi-user collaborative application. Increasing the quality of the information exchanged among the student project groups, as well as from the professor to the students, are the primary goals of the prototype.

The methodology as described in an article by Dantin (2005) of Goal-Directed Design helps to establish personas of users through tasks performed. This process helps to identify tools to maximize design quality of user-interfaces with a minimal budget of small development projects. The research team for

this study sought to have the testing participants achieve goals through the tasks they were to complete. As Dantin describes, this method should help to detect the aspects of the application that needed to be refined to produce a quality application.

Frokjaer (2005) found that rather than having testing participants use the “think-aloud testing” technique which can cause inconsistencies in the administrator’s interpretation of the participants’ process, two separate sessions should be held. The first session would be an interaction session where the administrator observes the user trying the application. Then during the interpretation session, administrators and participants discuss the usability issues found with the application. This testing procedure was also recommended by Dr. James Mohler during an interview with the researchers. Mohler’s recommendation, based upon the study’s research question, was to record the completion time for each participant and their error rate for a quantitative analysis. The feedback received from the focus group, as an interpretation session, would serve the role of providing anecdotal comments that would not receive a qualitative analysis due to the time allotted for the study. From an article published in 2000 by Frokjaer, Hertzum, and Hornbaek results from a study conducted with 87 subjects to solve twenty information retrieval tasks revealed that the correlation between efficiency (measured by task completion time) and effectiveness (measured by quality of solution) was negligible. A correlation among usability components depends on the user’s experience and the use context. They concluded that effectiveness, efficiency, and satisfaction are independent aspects of usability, but all should be included in usability testing.

Burr and Bagger (1999) discovered new concepts to counteract past usability testing

myths and common procedures. The test facilitator should be moved from behind a one-way mirror with an intercom into the testing lab to reduce tension and nervousness of the testing participant. The Research and Development team needs to serve as facilitators and observers. Transform testing sessions with a single participant into workshops with multiple participants to have them engage in “co-discovery learning.” R&D facilitates a discussion between users and designers. Involve the participants in the design process since they can be a source of new ideas and express opinions on the application’s design.

#### *2.4 Technologies to develop desktop RIAs*

The researchers investigated multiple rich internet application technologies that could be used to create an application to solve the perceived problem. After developing an interest in Adobe AIR, they researched an assortment of competing technology platforms to determine if Adobe AIR was the most effective choice. The technologies platforms they analyzed included Microsoft Silverlight, Google Gears, Java FX, and Mozilla Prism.

The articles by Physorg.com, Lai, LaMonica, and Cubrilovic discuss what Microsoft Silverlight is and some of its features. Microsoft Silverlight allows developers to create web applications with the .NET framework. One of its primary features is the ability to deliver high quality video which has received interest by Brightcove and other companies that provide web based videos. Also Silverlight actually is a competitor of the Adobe Flash Player not Adobe AIR because it is strictly web based. The information from these articles showed that Microsoft Silverlight was not a competitor of Adobe AIR but rather a competitor of the Adobe Flash Player. The researchers were not interested in creating a

web application so Silverlight was not the answer. Furthermore articles by Wildermuth and RustyLime.com illustrate some of the setbacks of Silverlight. The content in these articles showed how Silverlight was not what the researchers were looking for to solve their problem.

The article by Gonzalez (2007) gave an overview of what Google Gears is and how it works. Google Gears is a browser plug-in developed by Google that allows users to create desktop applications out of pre-existing web applications. The plug-in basically gives the web application its own window separate from the browser. It also downloads resources such as assets and data to run the application on the user's computer so if the user's internet connection is lost the application will still run. Google Gears simply allows a user to extract an existing web page as a standalone application on their desktop. In addition articles by Dhanjani (2007) and Kappe (2007) put light on some security issues of Google Gears. Of the issues discussed the articles mainly illustrate how data downloaded on the computer could be jeopardized due to lack of security. This information further showed the Google Gears did not provide the amount of security needed.

The articles from Gilbertson (2007b), LaMonica (2007b), Stewart (2007b), and Linsen (2007) overview what Mozilla Prism is and how it will function. Mozilla Prism is a plug-in for Mozilla, which like Google Gears creates desktop applications out of existing web applications. It does this just like Google Gears by giving the web application its own window, but unlike Google Gears, Prism does not download resources on to the computer for offline functionality. Mozilla Prism has the same concept as Google Gears, and so again it was not what

the researchers wanted to use to make our product.

Hendrickson, Patrizio, and Ezell all discuss Java FX in their articles. Java FX is an addition to the Java Runtime created by Sun Microsystems that allows developers to create desktop applications using the new Java FX scripting language. The desktop applications will run smoothly due to the fact that the program is using the Java SE runtime installed on the user's computer.

Five competing technologies for rich internet application were researched. The investigation revealed that only three of the five were actual competitors of Adobe AIR. Silverlight was more a competitor of the Adobe Flash Player. Since Microsoft Silverlight has no desktop capabilities the researchers eliminated it as a viable solution. Google Gears and Mozilla Prism both have the ability to enable the creation of a web application that a user could make into a desktop application. Since the researchers intended to create a desktop application, these two options did not exhibit the capabilities required. Finally Java FX proved to be a reasonable choice for the application. However, a limitation that hindered to use of this option was the researchers' lack of knowledge of the Java FX scripting language. Time was not available to dedicate towards learning a programming language.

### *2.5 Adobe Integrated Runtime (AIR) capabilities, values, and limitations*

Many different sources speak to the advantages of Adobe AIR. According to Anderson (2007) many advantages of AIR involve the technology's speed, cross-platform abilities, design possibilities, and ease of use. Location of processing is also a major advantage of Adobe AIR. In traditional web applications, most of the heavy processing is done on the server side of the equation, whereas

with AIR, data-intensive instructions can be carried out on the client side of things (Havenstein, 2008). Other advantages of AIR include the ability to create true desktop applications that go beyond the typical browser chrome, the ability for web developers to create client-server applications without learning extra languages, the ability to deploy a single file to run on all systems, and to be able to combine web applications with desktop storage (Snook, 2008; Krill, 2007; & Smith, 2007).

Other articles have showcased the disadvantages of Adobe AIR. Some of the main disadvantages include AIR's use of proprietary Adobe technology, limited extensibility, and low/no UI standards (Anderson, 2007). Also, according to O'Callahan, Adobe AIR isn't as secure as it could be since it doesn't sandbox applications and that users have to make a trust decision to use an AIR application, as well as the fact that though the ability to create custom application chomes is good for artistic vision, it may hinder users since people are used to back, forward, bookmarks, etc (2008b). James Gosling, the creator of the Java language has claimed that AIR can't handle advanced network protocols and complex API's as well as not being as secure as his own rich internet application solution, JavaFX (Rose, 2008). Another disadvantage of Adobe AIR is its lack of low-level native system integration (Rose, 2008).

But when the advantages and disadvantages are considered, it leads to the examination of the value of Adobe AIR overall. One of the main values of AIR it seems is the ability for web developers to take advantage of one technology to create something entirely new with the knowledge they already have, such as LaMonica points out by saying, "You can be a full Web developer and have access to the desktop which you didn't have access to before (2007)." Another realm of value that

AIR enters is the ability to release web applications from the constraints of the browser without much change in code for the desktop at all (Gilbertson, 2007; Smith, 2007)."

More value comes from AIR in that it can support both consumer and enterprise applications (Shipley, 2008; Krill 2007). O'Neil then furthers this line of thinking by expanding on the types of things that AIR can do by discussing how it can get data efficiently and present it to users in a "visually powerful" way (O'Neil, 2008). Lastly, the value of AIR is touted by Casario in a simple reference to an Italian newspaper featuring AIR to show that it really can hit the mainstream instead of just technology inclined people (Casario, 2008).

## 2.6 Color Theory

"Information Please Database: Blue" written by David Johnson discusses color theory and more importantly, the color theory of blue. Johnson states that mood set by blue is peaceful and tranquil which causes the body to produce calming chemicals. The color blue is often used in bedrooms because it is relaxing and often used in weight rooms/offices because it is proven to be a more productive color than others. Studies were done on the use of blue in different situations to prove productivity. In "The Blue Book", D. Russell concurs with David Johnson and also states how blue is associated with meditation and relaxation as well. The color blue was used on the prototype developed because the color promotes productivity and relaxation which could ultimately enhance student performance in CGT 411/450 when using the application.

Kendra Wagner, a specialist in color psychology, wrote "The Color Psychology of Blue" in 2008. An section in Wagner's book states that "blue is described as a favor-

rite color by many people and is the color most preferred by men. Blue calls to mind feelings of calmness or serenity. It is often described as peaceful, tranquil, secure, and orderly. The color blue can also lower the pulse rate and body temperature.” Another book by Wagner, “The Color Psychology of Orange”, defines the color orange. According to Wagner, the color orange can be defined as “A combination of yellow and red and is considered an energetic color. Orange calls to mind feelings of excitement, enthusiasm, and warmth. Orange is often used to draw attention, such as in traffic signs and advertising.” These findings are beneficial to the development of the CGCentral application and another reason why we chose the color blue as a main color for the interface and orange as a compliment. The more a desktop application, such as the prototype developed, stands out, the more likely the user will utilize the application. Along with an increase in productivity by the color blue, this could also lead to an increase in student performance for the long run.

### 3.0 Application

The rich internet application developed was a culmination of web technologies. These included ActionScript 3.0 using Adobe Flash CS 3, PHP, MySQL, and Adobe AIR. The application was named “CGCentral” to emphasize the goal of the application to serve as a central point of knowledge for students enrolled in the course.

#### 3.1 Backend Systems

The backend for the prototype consisted of a MySQL database. PHP was selected to serve as a liaison between the application and the database. Data was extracted from the database and formatted into name / value pairs using PHP. However the application, if needed, can easily retrieve data from a SQL-Server database using ASP or ASP.NET.

#### 3.2 Graphical User-Interface

Through the vector graphic capabilities of Adobe Flash CS 3 the end-user interface was created and programmed using ActionScript 3.0. The AIR platform allowed the development of the application to be packaged as an application targeted for an end-user’s desktop. CGCentral was divided into four sections to provide the end-user specific areas to receive information, the sections are: Account Overview, Lecture Schedule, Stocks, and News.

First a user must log-in to the CGCentral Application (Figure 1), since some portions of data they will receive and interact with will be specific to them. In future versions of CGCentral the username and password a student would use would be the same as the web site used to manage all transactions of the corporate and individual finance simulation aspect of the course.



FIGURE 1: Login screen, shown using the testing account username and password

The Account Overview section provides students with their individual financial status as well as their group’s status which are both components of the corporate and individual finances simulation aspect of the course.



FIGURE 2: A student's individual and group account details.

In the Lecture Schedule section, students have the option to scroll through the schedule for CGT 411 / 450 or to use the application search's feature. Details for each lecture meeting are found together for both the CGT 411 content focus and CGT 450 content focus as shown in Figure 3. The lecture schedule search (Figure 4) allows students to quickly find details they desire.

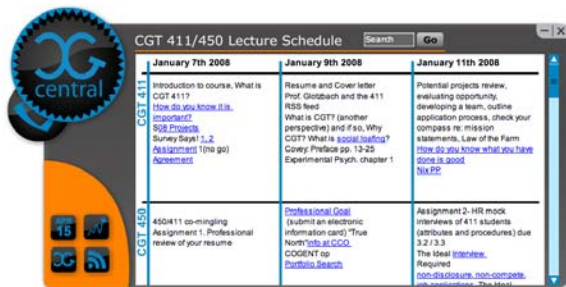


FIGURE 3: Lecture Schedule for CGT 411 / 450

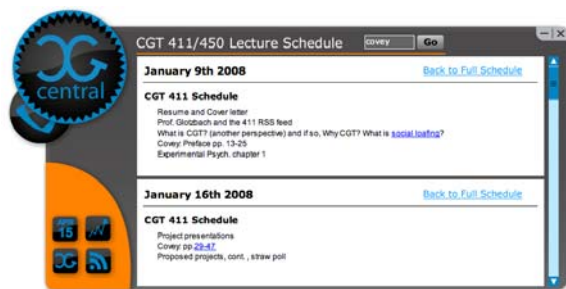


FIGURE 4: Search results for "covey"

Stock data as part of the corporate simulation of the course can be discovered through the features introduced in the Stock Information section. The "My Stocks" area provides

students with a list of the stocks they individually have in their portfolio as well as the current price for each of those stocks. Upon clicking on a stock listing, the student can view a line graph of the stock price history. In Figure 5, once the line graph is displayed, the student can mouse over each week's stock price to have the exact price amount popup. The stock prices and change in prices for the groups in the course can be found scrolling across the bottom.



FIGURE 5: A student's individual stock portfolio, including a graphical representation of the stock history and a stock ticker.

To distribute course announcements the professor has selected RSS feeds as the medium to channel information to students. In the News section, CGCentral retrieves the data from the course's RSS feeds as shown in Figure 6.



FIGURE 6: News section with "Press Releases" as the RSS feed selected to read.



FIGURE 7: News section with “Stock News” as the RSS feed selected to read.

## 4.0 Procedure

The procedure of this study consisted of performing a usability and subjective user satisfaction test of the existing set of information dissemination mechanisms used in the CGT 411/450 courses and the CGCentral application. Subjects were tested via two mechanisms: a general online session or a live session. Participants whom took part in the online session could not take part in the live session. Both the general online and the live session consisted of a four part task-based analysis for each of the information mechanisms. Data collected focused on three areas: time/speed to complete tasks, error rate (successful completion), and subjective user satisfaction.

### 4.1 Population

The population of this study was those currently enrolled in CGT 411/450 for the spring 2008 semester. These students are all seniors in the CGT major and they are made up of male and female students. Researchers were unable to locate an expert population, users who were familiar with both mechanisms, because the CGCentral information mechanism was created for this study.

### 4.2 Sample Size and Selected Participants

The live assessment consisted of a sample size of twenty students who performed the four part analysis for each mechanism.

Participants for the live assessment were a random sample selected from the entire population. Participants were recruited via a general e-mail distributed to all students enrolled in CGT 411/450. Students were also recruited with flyers. Participants were informed that the study will remain confidential and anonymous and that all surveys, forms, and documents will be destroyed after data compilation is complete.

### 4.3 Instrumentation

There were four instruments used during this research study. Those instruments were the survey, the four part task analysis that was performed for each of the two information mechanisms, the post-test questionnaire, and the focus group. Only participants of the live session took part in the focus group.

**4.3.1 Pre-Study Survey.** Before beginning the task-based analysis each participant filled out the pre-study survey that recorded general user information such as computer and internet use as well as a prior experience with RIAs.

**4.3.2 Tasks.** Researchers created four unique tasks to evaluate the usability of both information mechanisms. This set of four tasks was completed for each of the two mechanisms by every subject. The tasks were designed to test different parts of the information mechanisms. After each task the participants were asked a couple task related questions that were ranked on a 4 point Likert scale. Below each of the tasks are described in detail.

In the Setup task (task one), participants went through the procedure of setting up each of the information mechanisms. For the

current CGT 411/450 information mechanism participants opened the course lecture web site and the course's simulated on-line banking web site in their own internet window. Then the participants were asked to log-in where necessary. The Setup task for the CGCentral application had participants download, install, and login to the application. This task was designed to measure the ability of the user to access both of the mechanisms.

The Schedule task (task two) had participants locate a specific item on the course schedule. Once the participants found the item they had to report which of the two schedules (411 or 450) the item was found on and on what day it was located. The Schedule task was designed to test the course schedule in both of the mechanisms.

The Stock task (task three) tested the corporate and individual finance simulation aspect of the two mechanisms by having the participants locate the change in stock price for a particular group over the past week. On completion the participants then reported the value of the stock price change.

The News/RSS task (task four) charged the participants with the mission of locating information that could be found in the course RSS feeds. On completion of the task participants reported the information they found in the form of a date or number of shares available for a group.

*4.4.3 Post-test Questionnaire.* All participants filled out the post-test questionnaire on completion of the task-based analyses. This questionnaire gathered each participant's opinions on design, information layout, and preference to use the mechanism for each of the two information mechanisms. Each item in the post-test questionnaire was ranked by the participants on a 4 point Likert scale.

*4.4.4 Focus Group.* During the focus group sessions researchers kept notes as well as tape recorded the session. The information received from the focus group was for anecdotal comments and was not qualitatively analyzed.

#### *4.5 Implementation*

*4.5.1 Online Assessment.* After agreeing to serve as a participant and signing the consent form and assessment survey, students were given a hyperlink to the online assessment. The online assessment consisted of a task-based test where students were asked to complete a series of identical tasks using both the new RIA and the existing set of information dissemination mechanisms used in the CGT 411/450 course.

Participants began the online assessment with a short virtual introduction to the RIA to minimize learning effects and related confounding variables, half of the participants were asked to complete the tasks first using the new RIA while the other half began with the existing 411/450 mechanisms. After using one set of technology, each participant proceeded to complete the same set of tasks with the alternative set of technology. All tasks were time-stamped upon completion to record accurate lengths of task completion.

*4.5.2 Live Assessment.* The live assessment participants were asked to sign the consent form and complete the assessment survey. Prior to the assessment, subjects were given a brief verbal introduction to the assessment procedures and purpose of the study. In addition to having the test administrator record the actions of the subject, each session was video-recorded.

After the introduction, administrators read the task instructions to the subject. During each task the observers documented several

observations such as the time to complete each task and method of task completion. Administrators also noted any problems and errors in the subject’s process of completing the task.

Upon completion of the task-based usability assessment, subjects participating in the live assessment participated in the focus group to discuss the test and the particulars of both mechanisms.

#### 4.6 Data Analysis.

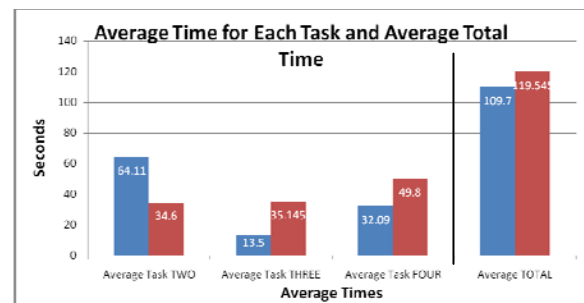
The analysis focused on completion time, error rate, and subject user satisfaction for both the CGCentral application and the current CGT 411/450 information resources with a population sample size of twenty (n = 20). The task based tests originally had four tasks. However due to a challenge with task one related to the “one-click download/install badge,” the ten participants in the first round of the study were not asked to perform this task. As a result data from task one was not analyzed.

The completion time and error rate were affected by external variables such as participants prior experience with our application. Some complications arose during testing, mainly computer wireless internet connection signal, server reliability, and program bugs in the application itself during the first round of the study.

**4.6.1 Completion Time.** The researchers compiled the average time for each mechanism and then ran a pair wise t-test with the null hypothesis that the average times for both programs are equal. Graph 1 and Table 1 show the average times across the tasks. The t-test returned a p-value of .15 which is well above the .05 standard. Since the p-value is above the .05 standard the null hypothesis holds true and the differences between the average times is not significant

enough to prove that one program has lower or higher completion times.

Due to a very high standard deviation when performing the t-test, a Wilcoxon Signed-Rank test was used to check the t-test results. The standard deviation was affected by outliers in the data and since the Wilcoxon Signed-Rank test is an alternative to the t-test that does not depend on the normality of the data. The results from the Wilcoxon Signed-Rank test confirmed that the results from the original t-test were correct.



GRAPH 1.

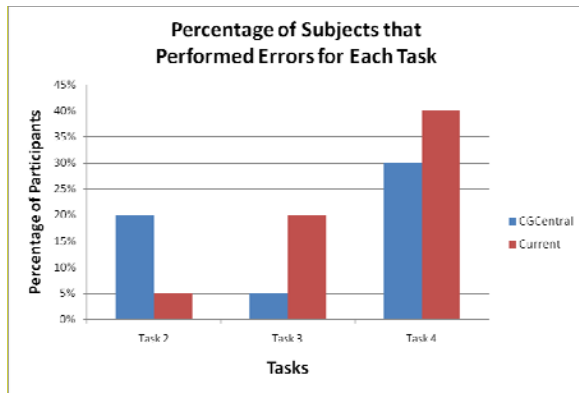
CGCentral	Task 2 (Schedule)	Task 3 (Stock)	Task 4 (News)	Avg Total Time
Average Time	64.11	13.5	32.09	109.7
Standard Deviation	42.63	10.76	25.46	50.19
Stat. Significance	+/- 9.53	+/- 2.41	+/- 5.69	+/- 11.22

Current	Task 2 (Schedule)	Task 3 (Stock)	Task 4 (News)	Avg Total Time
Average Time	34.6	35.145	49.8	119.545
Standard Deviation	15.54	24.99	26.90	43.53
Stat. Significance	+/- 3.48	+/- 5.59	+/- 6.02	+/- 9.73

TABLE 1.

**4.6.2 Error Rate.** An error rate was measured as a “yes there was an error” or

“no there were no errors” depending on if the participant completed the task with the desired process, failed to complete the task, or found the wrong information. Graph 2 shows the percentage of participants that performed an error for each of the tasks. The CGCentral application had a higher number of participants perform an error on task two but had less on tasks three and four than on the current information resources.



GRAPH 2.

**4.6.3 Subject User Satisfaction.** . The data collected from the post-test questionnaire can be seen in Table 2. Table 2 shows a compiled average rating for all twenty participants for both mechanisms. From the four-point Likert scale that was used a score of one was “very easy,” two was “easy,” three was “hard” and four was “very hard”. The CGCentral application received an average rating of 1.28 from the participants while the current CGT 411/450 resources received an average of 2.62. A t-test was then ran to test the null hypothesis that the average scores for both mechanisms were equal. The t-test returned a p-value that was less than .0001, and since this value is much lower than the .05 standard the null hypothesis was rejected. Later calculations showed that the CGCentral application did receive a better average rating from the participants.

Post-Survey Questionnaire Average Score for Each Question		
Questions	CG Central	Current
1. The section titles are clear and easy to understand.	1.35	2.25
2. Colors, typefaces, and layouts are consistent throughout the application.	1.15	1.85
3. It was easy to travel between sections.	1.1	2.2
4. It was easy to determine which section you were in at all times.	1.35	2.95
5. The information in each section was readable and easy to understand.	1.4	2.55
6. I had no trouble figuring out which section certain information was under.	1.5	3.1
7. The layout of information was easy to interpret and understand.	1.35	2.6
8. The menu(s) is/are simple and intuitive.	1.25	2.15
9. The schedule layout(s) was/were easy to understand.	1.4	2.7
10. I could easily determine if an item was on the 411 or the 450 schedule	1.25	3.1
11. I would use this application again.	1.1	3.45

TABLE 2.

<b>Post-Survey Questionnaire Overall Averages, Standard Deviation, and Statistical Significance</b>	
<b>CGCentral Application</b>	
Average Score	1.28
Standard Dev	0.22
Statistical Significance	+/- 0.049
<b>Current CGT 411/450 Re-sources</b>	
Average Score	2.62
Standard Dev	0.50
Statistical Significance	+/- 0.11

TABLE 3.

## 5.0 Findings

A combination from the data analyzed and the anecdotal comments received from the focus group, the participants preferred the CGCentral application over the current information mechanisms available in the course.

Some participants during round one had difficulty with task two when interacting with the CGCentral application, specifically the scroll bars for the schedule module. The difficulty caused by the application led to an increase in completion time as well as a high error rate for task two. The problematic facet was corrected for round two of testing, which resulted in improved interactions.

The focus group allowed the researchers to record the thoughts of participants and collect constructive criticism. From round one participants stated the CGCentral application was “professional and clean,” “like the non standard square box,” “better than 411/450 [web] site,” “liked the 411/450 schedule next to each other,” “search was helpful,” and “a hamster can do this.” One participant highlighted from round one that information was hidden with miniature scroll bars for the schedule module and news module, so a revision was made for

round two to have the content areas dynamically adjust to the correct height of the content. Another mentioned the scroll bar needed arrows at the top and bottom, which resulted in another modification for round two. Others commented on the gray color of the scroll bar, so the scroll bar was changed to blue to match the color scheme of the application. The overall consensus was that the participants preferred the CGCentral application over the current mechanisms offered.

Round two’s focus group confirmed that even after the modifications made to the CGCentral application, it was still considered better than the current mechanisms offered. Feedback from this round resulted in changing three of the four icons on the navigation buttons. The schedule module icon was changed from a static calendar date (in a month name and day number format) to a dynamic calendar date pulling from the users operating system date setting. The news module icon was transformed from a lowercase “i” to the RSS symbol to showcase the news announcements pulling from RSS feeds. The accounts overview icon was altered from a dollar sign “\$” to the COGENT symbol (a backwards uppercase “C” and an uppercase “G”). COGENT stands for “Computer Graphics Enterprises,” and is the factious currency used in the corporate and individual finance simulation of the course.

Additional feedback from the focus group highlighted additional features and functionality that participants saw as potentially beneficial. These feature additions to the application could include: maximize capability, a group listing, course details, landing module with today’s details, enhanced search capabilities, messaging capabilities, file transfer capabilities and an optional calendar view of the lecture

schedule. To expand this application and its implementation further it needs to be integrated to the live data for the CGT 411 and 450 lecture schedule as well as the live data from the COGENT Management System. The application could be made available to all CGT students as well as CGT Alumni. A recommendation for future usability testing would be to only test the CGCentral application and not a comparison test.

## 6.0 Conclusion

The intent of this study was to determine if a dedicated standalone rich internet applications such as CGCentral was more usable

than traditional browser-based tools for students in CGT 411 and 450 to disseminate information. To draw a conclusion from the results of the three areas of usability addressed in this study, the CGCentral application was not faster for users to successfully and efficiently complete their tasks, however the users' subjective satisfaction was significantly higher. The completion times and error rates for the CGCentral application were only mildly lower in most cases. Alternatively the participants of the observed study and focus group expressed an interest in using the application.

## 7.0 References

- Adobe Systems (2008). Adobe AIR: Get Started. Retrieved March 28, 2008 from <http://www.adobe.com/products/air/getstarted/>
- Adobe Systems (2008). Adobe Labs: Adobe Integrated Runtime. Retrieved February 10, 2008 from <http://labs.adobe.com/downloads/air.html?promoid=ZMIZ>
- Adobe Systems (2008). E-Learning Solutions: Unlock the power and potential of your own virtual schools. Retrieved Date January 30, 2008, from <http://www.adobe.com/education/solutions/k12/elearning/>
- Adobe Systems (2008). Adobe Case Study: Monfort College of Business at the University of Northern Colorado. Retrieved January 30, 2008, from [http://www.adobe.com/cfusion/showcase/index.cfm?event=casestudydetail&casestudyid=380505&loc=en\\_us](http://www.adobe.com/cfusion/showcase/index.cfm?event=casestudydetail&casestudyid=380505&loc=en_us)
- Adobe Systems (2007). Adobe White Paper: Adobe AIR Security. Retrieved February 12, 2008 from [http://download.macromedia.com/pub/labs/air/air\\_security.pdf](http://download.macromedia.com/pub/labs/air/air_security.pdf)
- Anderson, T. (2007). Adobe AIR: 10 reasons to love it, 10 reasons to hate it. Retrieved January 30, 2008, from <http://www.itwriting.com/blog/?p=310>.
- Bortz, A. & Boneh, D. (2007). Exposing private information by timing web applications. International World Wide Web Conference: Proceedings of the 16<sup>th</sup> international conference on the World Wide Web. Retrieved January 30, 2008 from <http://portal.acm.org/citation.cfm?id=1242656&coll=Portal&dl=ACM&CFID=52432639&CFTOKEN=46083364>
- Bozzon, A., Comai, S., & Fraternali, P. (2006). Conceptual modeling and code generation for rich internet applications. ACM International Conference Proceedings Series, Vol. 263. Retrieved January 30, 2008, from <http://portal.acm.org/citation.cfm?id=1145649&coll=Portal&dl=ACM&CFID=52432639&CFTOKEN=46083364>

- Burr, J., Bagger, K. (1999). Replacing usability testing with user dialogue. *Communications of the ACM*. Retrieved April 17, 2008, from <http://portal.acm.org/citation.cfm?id=301417&dl=GUIDE&coll=Portal&CFID=24516614&CFTOKEN=96042290>
- Casario, M. (2008). Adobe AIR article on the most popular Italian newspaper. Retrieved February 19, 2008, from <http://casario.blogs.com/mmworld/2008/01/adobe-air-artic.html>.
- Cooper Consulting (2007) Modeling: are you frustrated by trying to develop a product that serves thousands – or event millions – of different users? Retrieved February 12, 2008 from <http://www.cooper.com/about/process/modeling.html>
- Cubrilovic, N. (2007). *Silverlight: The Web Just Got Richer*. Retrieved January 29, 2008, from <http://www.techcrunch.com/2007/04/30/silverlight-the-web-just-got-richer/>
- Dantin, U. (2005). Application of personas in user interface design for educational software. *ACM International Conference Proceedings Series*, Vol. 106. Retrieved January 30, 2008, from <http://portal.acm.org/citation.cfm?id=1082455&coll=Portal&dl=ACM&CFID=52432639&CFTOKEN=46083364>
- Deb, B., Bannur, S. G., Bharti, S. (2008) *Rich Internet Applications (RIA): Opportunities and Challenges for Enterprise*. Retrieved February 28, 2008, from <http://inderscience.metapress.com/app/home/contribution.asp?referrer=parent&backto=issue,4,10;journal,8,24;linkingpublicationresults,1:110841,1>
- Dhanjani, N. (2007). *Google Gears: Initial Thoughts on Security*. Retrieved February 12, 2008, from [http://www.oreillynet.com/onlamp/blog/2007/06/google\\_gears\\_initial\\_thoughts.html](http://www.oreillynet.com/onlamp/blog/2007/06/google_gears_initial_thoughts.html)
- Ezell, J. (2007). *Java FX: Sun Wants a Piece*. Retrieved February 19, 2008, from <http://weblogs.asp.net/jezell/archive/2007/05/08/java-fx-sun-wants-a-piece.aspx>
- Frokjaer, E., Hertzum, M., Hornbaek, K. (2000). Measuring usability: are effectiveness, efficiency and satisfaction really correlated? *Conference on Human Factors in Computing Systems*. Retrieved on April 17, 2008, from <http://portal.acm.org/citation.cfm?id=332455&dl=GUIDE&coll=Portal&CFID=24516614&CFTOKEN=96042290>
- Frokjaer, E., Hornbaek, K. (2005). Cooperative usability testing: complementing usability tests with user-supported interpretation sessions. *Conference on Human Factors in Computing Systems*. Retrieved April 17, 2008, from <http://portal.acm.org/citation.cfm?id=1056808.1056922&coll=Portal&dl=GUIDE&CFID=24516614&CFTOKEN=96042290>
- Gilbertson, S. (2007). Jesse James Garrett Sees Adobe AIR as Another Boost For Web Apps. Retrieved February 13, 2008, from [http://blog.wired.com/monkeybites/2007/06/jesse\\_james\\_gar.html](http://blog.wired.com/monkeybites/2007/06/jesse_james_gar.html).
- Gilbertson, S. (2007). *Mozilla Prism: Refracting The Web Onto Your Desktop*. Retrieved February 4, 2008, from <http://blog.wired.com/monkeybites/2007/10/mozilla-prism-r.html>

- Gonzalez, N. (2007). *Google Gears Lets Developers Take Apps Offline*. Retrieved February 11, 2008, from <http://www.techcrunch.com/2007/05/30/google-gears-lets-developers-take-apps-offline/>
- Havenstein, H. (2008). Adobe AIR set to take flight at NASDAQ, charity: Runtime promises to let companies extend rich Internet applications to desktop. Retrieved January 30, 2008, from <http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9058878&pageNumber=1>.
- Hendrickson, M. (2007). *JavaFX*. Retrieved February 19, 2008, from [http://www.oreillynet.com/onjava/blog/2007/05/java\\_fx.html](http://www.oreillynet.com/onjava/blog/2007/05/java_fx.html)
- Johnson, David. (2001). Information Please Database: Blue. Retrieved April 9, 2008, from <http://www.infoplease.com/spot/colors1.html>
- Kappe, D. (2007). *Google Gears Security Thoughts*. Retrieved February 12, 2008, from [http://blogs.pathf.com/agileajax/2007/06/google\\_gears\\_se.html](http://blogs.pathf.com/agileajax/2007/06/google_gears_se.html)
- Kaiser, M. (February 13, 2008) [Email correspondence with Marco Kaiser, developer of Twirl].
- Krill, P. (2007). Adobe AIR fulfills hopes for cross-platform developers. AIR applications, which can run online or offline, may pull some market share from existing single-platform applications. Retrieved February 19, 2008, from [http://www.infoworld.com/article/07/06/18/adobe-air\\_1.html](http://www.infoworld.com/article/07/06/18/adobe-air_1.html).
- Lai, E. (2007). *Is Microsoft's Silverlight Likely To Shine?*. Retrieved February 5, 2008, from <http://www.computerworld.com/action/article.do?command=viewArticleBasic&articleId=9016683&pageNumber=1>
- LaMonica, M. (2007). *Microsoft's Silverlight aims to topple Flash*. Retrieved February 5, 2008, from <http://news.cnet.co.uk/software/0,39029694,49289135-1,00.htm>
- LaMonica, M. (2007). *Mozilla's Prism to bring Web apps to desktop*. Retrieved February 5, 2008, from [http://www.news.com/8301-10784\\_3-9805103-7.html](http://www.news.com/8301-10784_3-9805103-7.html)
- LaMonica, M (2007). Adobe's AIR: Niche or the future of desktop development? Retrieved February 13, 2008, from [http://www.news.com/8301-10784\\_3-9789007-7.html](http://www.news.com/8301-10784_3-9789007-7.html).
- Lenssen, P. (2007). *Mozilla Prism Aims to Bring Web Apps Closer to the Desktop*. Retrieved February 11, 2008, from <http://blogscoped.com/archive/2007-10-26-n61.html>
- Lewis, A. (2008) [Interview with Alan Lewis, Product Manager for eBay Desktop] Interview via conference call.
- Microsoft: Silverlight More Than Just A Flash*. (2007). Retrieved February 4, 2008, from <http://www.physorg.com/news95944421.html>
- Microsoft Silverlight. Security nightmare?* (2007). Retrieved January 29, 2008, from [http://www.rustylime.com/show\\_article.php?id=1040](http://www.rustylime.com/show_article.php?id=1040)
- Mohler, J. (2008) [Interview with Dr. James Mohler, Professor in Computer Graphics Technology, Purdue University] Interview via face-to-face conversation.
- O'Callahan, R. (2008). Recap Part 2: Foo/Baa Camp. Retrieved February 6, 2008, from [http://weblogs.mozillazine.org/roc/archives/2008/02/recap\\_part\\_2\\_fo.html](http://weblogs.mozillazine.org/roc/archives/2008/02/recap_part_2_fo.html).

- O'Neil, M. (2008). View your Google Analytics Account using Adobe AIR. Retrieved February 19, 2008, from <http://www.makeuseof.com/tag/view-your-google-analytics-account-using-adobe-air/>
- Online versus traditional education.* (2008) Retrieved Date February 28, 2008, from <http://www.academon.com/lib/essay/online-versus-traditional-education.html>
- O'Reilly, T. (2005). What is Web 2.0. Retrieved February 6, 2008, from <http://tim.oreilly.com/news/2005/09/30/what-is-web-20.html>
- Patrizio, A. (2007). *Does JavaFX spell the end for AJAX?*. Retrieved February 19, 2008, from <http://www.internetnews.com/dev-news/article.php/3676226>
- Rose, J. (2008). Adobe AIR 1.0 – Native OS Integration Problem. Retrieved February 19, 2008, from <http://www.infoq.com/news/2008/01/adobe-air-native-os-integration>.
- Rose, J (2008). James Gosling on Adobe Flash/Flex/AIR. Retrieved February 13, 2008, from <http://www.infoq.com/news/2008/01/gosling-on-flash>.
- Russell, D. (1990). *The Blue Book*. Cincinnati: Quarto Publishing plc.
- Schwerdtfeger, R. (2006). Roadmap for Accessible Rich Internet Applications (WAI-ARIA Roadmap). W3C Working Draft. Retrieved February 6, 2008 from <http://www.w3.org/TR/2006/WD-aria-roadmap-20061220/>
- Shiple, C. (2008). Adobe's AIR Gives New Apps Wings. Retrieved February 19, 2008, from <http://www.demo.com/community/?q=node/17464>.
- Smith, I. (2007). Interview with Adobe AIR Evangelist Ryan Stewart. Retrieved February 19, 2008, from <http://www.downloadsquad.com/2007/07/09/interview-with-adobe-air-evangelist-ryan-stewart/>.
- Snook, J. (2008). Misconceptions about Air. InsideRIA – O'Reilly. Retrieved February 6, 2008 from <http://www.insideria.com/2008/02/every-fledgling-technology-has.html>
- Snook, J. (2008). Misconceptions about AIR. Retrieved February 6, 2008, from <http://www.insideria.com/2008/02/every-fledgling-technology-has.html>.
- Stewart, R. (2007). Rich Internet Applications in Education. Retrieved February 19, 2008, from <http://blogs.zdnet.com/Stewart/?p=601>
- Stewart, R. (2007). *Mozilla moves closer to the desktop with Prism*. Retrieved February 11, 2008, from <http://blogs.zdnet.com/Stewart/?p=604>
- Tretola, R. (2008). What is RIA? Retrieved February 6, 2008, from <http://www.insideria.com/2008/01/what-is-ria-1.html>
- Wagner, K. (2008). The Color Psychology of Blue. Retrieved April 9, 2008, from [http://psychology.about.com/od/sensationandperception/a/color\\_blue.htm](http://psychology.about.com/od/sensationandperception/a/color_blue.htm)
- Wagner, K. (2008). The Color Psychology of Orange. Retrieved April 9, 2008, from [http://psychology.about.com/od/sensationandperception/a/color\\_orange.htm](http://psychology.about.com/od/sensationandperception/a/color_orange.htm)
- Wang, H., Gearhart, D. *Designing and Developing Web-Based Instruction*. Pearson Education, Inc., New Jersey, 2006 retrieved on February 19, 2008

- Wildermuth, S. (2007). *10 Things You Should Know About Microsoft Silverlight*. Retrieved February 4, 2008, from [http://www.cio.com/article/128700/\\_Things\\_You\\_Should\\_Know\\_About\\_Microsoft\\_s\\_Silverlight\\_1](http://www.cio.com/article/128700/_Things_You_Should_Know_About_Microsoft_s_Silverlight_1)
- Xia, S., Sun, D., Sun, C., Chen, D., Shen, H. (2004) Leveraging single-user applications for multi-user collaboration: the co-word approach. Proceedings of the 2004 ACM conference on Computer supported cooperative work. Retrieved February 28, 2008 from <http://portal.acm.org/citation.cfm?id=1031607.1031635&coll=Portal&dl=GUIDE&CFID=18199101&CFTOKEN=88319743>