Designing a Mobile and Socially Networked Learning Assistant for a University-level Keyword Advertising Course

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Abstract

An Internet-based learning assistant leveraging the social attribute features of mobile technology is designed and implemented to incorporate updating course content of an upper-level college technology advertising course in real-time. The mobile application offers an online collaborative environment utilizing the inherent social and location-independent features of mobile technology to improve the teaching and learning environment. The application was implemented in a university-level keyword advertising course and integrated with several course-related web tools, including an enterprise-level social network. Aspects of the effectiveness of the application were evaluated using a series of five hypotheses. The results supported three hypotheses testing the relationship between gender and application use, the variations among tool choices, and the identification of frequently used tools. The two hypotheses not supported were the preference of the mobile application and the use of the social network software as standalone services, as most students desired that the social network service be integrated with an existing, university-level, content management system. Research

results indicate that the integration of a mobile application with an existing content management system would be beneficial for increased student engagement with course content, which the university has since implemented.

Keywords: mobile technology, learning assistant, collaborative environment, social network, hypothesis testing

Introduction

The materials for many courses are often fairly static. The instructor organizes the classroom notes, prepares the presentations, creates the activities, and arranges the assignments. Once the course is set, it remains fairly unchanged throughout the semester, which is disadvantageous from a teaching and learning perspective for both the teacher and the students, as the course's content cannot change based on the current student population's interests or abilities; however, we know that students engage searching as a learning medium (Jansen, Booth, & Smith, 2009). Combining this individual learning process with a collaborative sharing mode for course content might enhance the course experience for both current and future students.

The motivation underlying this research is the design of a mobile application that makes the course more dynamic and that provides students more control over the direction of the course content. The student control of the course direction implies an online social interaction where the students can share their feelings and experiences and exchange these notions irrespective of place and time. This will assist the students in learning the course materials, managing time, and organizing the course work they are doing. The online collaboration via sharing views in and out of the class will help form networked learning communities within a course. The idea behind the need for a socially networked learning assistant relates to the following questions that motivate our research:

(a) How can students access and contribute to a collection of content beyond what an instructor would typically cover in a semester?

(b) How can a course be designed so that any student of that course could go through the material whenever and wherever that student needs it?

(c) Can ad-hoc peer assistance be delivered when a student needs assistance in the course or asks a question?

(d) How can the students interact, share feelings and views, in and out of the class in order to augment the learning experience?

The research concept involves "moving off the desktop" to develop an effective course-based learning assistant application that leverages cellular technology, mobile platforms, and social media (i.e., access to peers, and creation and exchange of ideas within peer networks). Just as a human teaching assistant can facilitate student learning, a learning assistant application is a technology that facilitate student learning. The app portion implies a mobile component. Being course-based refers to the applications being targeted to specific course content; although, the framework for the app can be transferable to other courses.

The use of a social media platform as a component of the app enables the participants to communicate irrespective of their geographical positions and time. This is deemed to be important to social connectivity, online learning, and formation of a networked learning community. The "moving off the desktop" concept involves whether (a) students can access the course materials through smartphones, tablets, etc., irrespective of place and time; (b) students can post queries, information, or views that can be shared by the other members of a course; (c) the instructor or students can upload files that contain extra information relevant to the course in response to changes in course topics or to student inquiries; (d) the mobile application interface can support different services that are relevant to the course; and (e) the mobile application contributes to the online learning experience by shared experiences via social interaction using the social network component.

The issues that the concept and mobile application emphasize are: (a) allowing for real time updating of course content based on the particular course population; (b) permitting students carrying the online course environment in their pockets to provide anytime and anywhere access; and (c) exploiting the

social attribute features of mobile technology for the enhancement of learning and for moving learning outside the classroom.

Using these concepts as guidelines, the researchers developed the mobile application using HTML5 and JavaScript. The application was implemented in a resident undergraduate course where students learned keyword advertising and worked on a real-world project in multidisciplinary teams. As the course was specialized, the students needed to be introduced to tools that online advertisers use in the keyword advertising businesses; therefore, the mobile application integrated the necessary online tools such as: Google AdWords, Alexa, SpyFu, etc., to ensure that students leveraged these services for learning and could choose the one(s) most relevant to their specific task. The researchers also incorporated an enterprise social network application (i.e., Yammer) with a dedicated Yammer group formed for this course. Using Yammer, the students could share information by uploading/downloading related artifacts, liking posted artifacts, publishing questions, and providing feedback to other students. The use of this social networking application created a cooperative e-learning framework to support collaboration among a society of peers and the use of social interaction to support and enhance member learning.

As it is important to determine the impact of technology use in the classroom (c.f., Smith, Ruocco, & Jansen, 1999), the research questions formulated in this paper examine whether there is any difference in students' preferences of the mobile application and its components during the progression of course. The research questions relate to (a) the effectiveness of the application in the classroom, (b) the preference of tool usage by the students via the application, and (c) the student preference for the social networking service integrated with the application.

The authors investigate these questions and their associated hypotheses by means of a survey that contains both ordinal scale and essay type questions. The results support three of the hypotheses (acceptance, gender, tools), but the results do not support preference of use of the application and the social networking software. The sharing of information and experiences via social media among students while engaging the course work was explored from an online learning perspective. The authors also comment on the student-centered pedagogy used by the instructor as a contributor to learning experience.

Related Work

Educational classroom technology is shifting from a desktop-based context to a cellular technology framework. Numerous studies point towards the direction of usage of handheld devices in education, as mobile computing devices are increasingly used by both universities and college students. Traxler (2008) observes that the nature of higher education has changed considerably with the introduction of notebook computers, wireless phones, and handheld devices. Kiger, Herro, and Prunty (2012) observe that a group of third grade school students using iPods outperformed a group of students using usual techniques in a mathematics multiplication test. Leveraging Internet-technology, Burns (2013) notes that though students do not believe they learn more in online classes, they want to take more online classes because of the convenience.

Mobile-Based Learning

Prior work has claimed that though there is high potential for handheld devices, e-learning, and wireless networks in the educational setting, mobile-based learning is still in an embryonic stage (Motiwalla, 2007). It is also asserted that self-regulation and learner's perception of ease of use and usefulness of new technology is affected by different personality variables (Tabak & Nguyen, 2013). One of the advantages of mobile-based learning is the combined personalized education with anytime and anywhere learning, which the desktop computer cannot exploit (Steinfield, 2004). Smartphones and wireless devices overcome this restriction by enabling the learners to access the courseware in remote places (e.g. airports, train stations, etc.) where a hard-wired network connection is difficult to find. Peters (2002) denotes this place-independence characteristic of wireless devices as an "anywhere" level of access. According to Karadeniz (2009), the relationship between the handheld device and the owner depends on the attributes of mobile technology, such as: always one-to-one, always on, always there, always aware of location, and always personalized. These attributes constitute an informal learning framework and place mobile-based learning at odds with established monitoring and evaluation procedures of formal learning (Ally, 2009).

Mobile--based learning also facilitates collaboration via real time interaction (Kukulska-Hulme & Shield, 2008). Elias (2011) mentions that the provision to build a learning community with collaborative support is one of the recommended design principles of mobile-based learning. Järvelä, Näykki, Laru, and Luokkanen (2007) identify pedagogical ideas based on concepts of collaborative learning. Looi, Seow, Zhang, So, Chen, and Wong (2010) stress portability, mobility, and versatility as the key characteristics of mobile technology for the pedagogical shift from the didactic teacher-centered to student-oriented learning; thus, mobile technology provides immense potential for collaborative learning. Ferdig (2007) highlights using social network software in education is important for monitoring attitudes and examining the mental frameworks of the students, especially those unwilling to interact with the faculty or with the peers. The social software provides collaborative and cooperative learning in the sense of posting questions, publishing artifacts, or providing feedback. It is easy to use and is proved best for reflective thinking (Carlson et al., 2012). In this research, the authors stress the "anytime"/"anywhere" characteristics along with the provision of collaborative framework for mobile-based learning by incorporating the social network software into the application.

Mobile-Based Learning Technology and Its Effectiveness

Prior research has developed different e-learning or mobile-based learning software relevant to educational technology. Cochrane and Bateman (2010) experimented with the integration of smartphones for teaching students attending tertiary education in real-time. Ritter, Anderson, Koedinger, and Corbett (2007) developed a software system known as CognitiveTutor, an intelligent tutoring system in mathematics. Chu, Hwang, Tasi, and Tsen (2010) built a location-aware mobile-based learning system to provide personalized guidance to the students for a natural science course.

Though educational technology researchers are developing relevant software for mobile-based learning systems, the assessment of software effectiveness by the learners is also necessary. Concerning research measurement, the effectiveness of the cognitive tutoring system (Ritter et al., 2007) was measured via a survey conducted over five schools. The results showed that the artificial tutor outperformed the traditional system of teaching. Corlett, Sharples, Bull, and Chan (2005) conducted a survey to evaluate mobile-based learning systems among university students. The analysis identified that wireless connectivity and real time interaction appeared to be essential units of system usefulness. The helpfulness and the exploration features of the location-aware mobile-based learning system (Chu et al., 2010) have also been noted as positive attributes for system effectiveness. Cheng (2012) commented that information quality, service quality, system quality, and instructor quality are the key factors for preference of learning technologies in terms of perceived usefulness, ease of use, and enjoyment.

Parsons and Ryu (2006) highlight quality of service as the most significant aspect of mobile-based learning in terms of reliability and wireless network speed. Massy (2002) found that experiencing few technical problems is the most important characteristic of learning software. Stockwell (2010) identified that the provisions for experimentation and decision making are crucial to measure the effectiveness of mobile systems. Economides (2008) promoted the choice of content format provided to users' current context as one of the important quality requirements of mobile-based learning. So, the software effectiveness depends on a set of functionality attributes, as different scholars have identified different aspects to measure the effectiveness of mobile technology; however, it is hard to meet all aspects of effectiveness by a single individual learning system.

Many of the prior systems were developed to promote mobile technology with collaboration among the learners in an e-learning environment that involved either a set of dedicated devices or complex middleware that incurred high costs associated with high design and implementation complexity.

In this research, the design and implementation complexity of the mobile application is much lower as it relies on HTTP protocols. The application was developed in HTML5 and JavaScript so as to be a platform and a device independently operated on general handheld devices and computers that a typical student uses in everyday life. The authors leveraged existing social software (Ferdig, 2007) with limited additional development costs for students' active participation.

The authors believe that the assessment of effective mobile-based learning software depends on the users' context-based requirements. In this research, the researchers assess the application effectiveness in terms of (1) the students' acceptance of the application to learn the course material (i.e., context-

based), (2) the effect of gender on the app's acceptance (i.e., personalization), (3) the learners' preferences of the application components (i.e., context based requirements for different personality variables), and (4) the use of social network software for collaborative learning.

Research Objective

As the authors are leveraging the social attributes of mobile technology to complement the learning of course content, the theoretical foundation of this work is based on social constructive theory of learning with technology (A. Brown, 1996), transactional distance theory (Moore, 2007), and conversation theory (Pask, 1975). The social constructive theory emphasizes that successful learning is a constructive process where the goal is to seek a solution to a problem and, while doing that, the actor in the learning environment adds new experiences to his/her existing knowledge base. Transactional distance theory refers to the theory of cognitive space between instructors and learners in an educational setting, especially in distance education (Moore, 2007). Conversation theory holds that interaction is central to learning, and it posits that learning can be successful if there are two-way interactions between both the faculty and learner and/or amongst the learners.

These three theories, social constructive theory, transactional distance theory and conversation theory, are compatible with mobile technology (Motiwalla, 2007) with its ubiquitous communication capabilities. With the use of educational technology, it is believed that these three theories become important columns of social learning, where the learning community reflects the meaning of participants.

Pedagogical Framework

As prior work has shown (Park, Cha, Lim, & Jung, 2014), a social network can be useful in an academic environment for undergraduate students, as they often show reluctance to meet the instructor personally. A social networking technology integrated with mobile devices extends itself as a pedagogical framework for "reluctant" (along with other) students to interact with the instructor and, just as importantly, to interact with peers without the anxiety of speaking to the professor or in front of a group.

Collaboration often highlights learning by means of interaction with more knowledgeable peers, along with creating shared experiences and a means of social interaction (Madgea, Meekb, Wellensc, & Hooley, 2009). More knowledgeable peers are the social partners (e.g., instructors, tutors, etc.) who help less knowledgeable learners (e.g., students) acquire competencies by guiding and monitoring less knowledgeable learners' understanding of the course. Social interaction using social networks via computing devices becomes a predominant medium of learning from a socio-cultural perspective (Wenger, 2000). The learners yield, consume, and exchange the array of learning artifacts, share information across time and place by the multi modal communication with peers, teachers, and experts provided by the social network environments, which evidence indicates enhances creativity (Perry-Smith, 2014). Recent pedagogical frameworks highlight the importance of these conversations in teaching and learning (Laurillard, 2007; M. Sharples, Taylor, & Vavoula, 2007), especially with group newcomers (Morrison, 2002). The social networking service (i.e. Yammer in this research) provides the shared spaces for conversation where the instructor and the peers provide the personalized, tailored feedback, experiences, and interactions.

The proposed framework and efforts to design a mobile application in this research support the aforementioned theoretical concepts and also the notions for e-learning depicted by prior research (c.f., Bowman, 1998; Gleason, 1995; Karayan & Crowe, 1997), such as an interactive forum, provision for feedback about the teaching style and class materials, and building a learning community for the class.

Research Question 1

The first question related to the research objectives is defined based on the evaluation of the effectiveness of the system. Research question one is:

Research Question 1: Is the introduction of the mobile application in the classroom effective?

Context of Research Question 1

To measure the effectiveness of the educational software, the researchers needed to rely on student responses. Like other researchers (Corlett et al., 2005; Mike Sharples, Corlett, & Westmancott, 2002), a

survey was conducted among the students in the course about the acceptance of the designed mobile app. The research hypothesis that refers to this research question is stated as:

Hypothesis 01: There is acceptance among the students regarding the use of a mobile application in the classroom teaching and learning scenario.

In this research, the acceptance of the mobile application among the students relies on the ease of use and the mobile connectivity of the system (Motiwalla, 2007). The priority on these two aspects based on the application design features is assigned by the authors. The *anytime-anywhere* characteristics of mobile connectivity helps the real-time interaction in terms of the exchange of an array of information. The survey to measure the effectiveness of the software is assigned to the students where both male and female students respond to the questionnaires.

The present study also investigates the effect of gender difference on the evaluation of software effectiveness, as it is seen that the use of technology influences young men and women differently (Heemskerk, ten Dam, Volman, & Admiraal, 2009). The authors are inspired by prior work (Papastergiou, 2009), where the effectiveness of computer games are measured by the game's motivational appeal to different genders. The gender-based preference identifies the difference in gender-specific perceptions about technology use. This finding could lead to better mobile application personalization based on demographic variables. In this study, the first research question also begets the second hypothesis based on the acceptance of the mobile application across genders.

Hypothesis 02: There is no significant difference between the male and female students concerning the adoption of the mobile app in teaching and learning scenario.

Research Question 2

The designed application is course-based and consists of web-based keyword advertising tools required for use in the course. The list of tools is: (a) Google AdWords, (b) SpyFu, (c) WordStreams, (d) Keyword Spy, (e) Compete, (f) Alexa, (g) Geoselector, and (h) Yammer. The students use the tools to learn during the course, but among the students, the choice of particular tools may vary. This leads to the second research question:

Research Question 2: Is there any difference in the preference of keyword tools usage by the students via the mobile application?

Context of Research Question 2

The course is a problem-based learning class where the students work in teams to design, implement, and evaluate keyword advertising campaigns using Google AdWords for small-to-medium size enterprises (SMEs). This course is not a simulation, as the advertising campaigns are real – the ads show up on the Google search engine, clicks cost money, and real customers are driven to business websites.

The course contains lessons on how to develop Internet-based business advertising campaigns using keyword advertising for SMEs. The mobile application embeds the related web-based tools so that the students can use the tools in the learning process. For example, Google AdWords is a Pay-per-Click (PPC) product designed by Google that enables the advertisers to target their chosen audience more precisely using lists of keywords. Advertisers optimize the business results by use of provided analytic software. The SpyFu keyword research tool is a means of researching and learning about the competitor's ad campaign. The WordStream keyword software uses the Google AdWords to increase the quality of keyword traffic and the relevance of clicks. So, each tool has its own advantages and limitations that trigger the variance in tool preferences among the students. The preferences of particular tools signify the personalization based on the usefulness of the tool for that particular student's learning objective, which the authors choose as one of the determinants of application effectiveness. Based on the second research question, which relies on relative benefits and limitations of the tools, the following hypothesis is formulated:

Hypothesis 03: There is a significant difference in students' preferences of web based tools in the teaching and learning scenario.

The third hypothesis does not identify the particular web-based keyword tool that gains maximum preference. We are interested to simultaneously test the difference of choices among all pairs of tools

over the population of students. Based on this goal, the second research question generates the next hypothesis:

Hypothesis 04: There is significant difference in preference of at least one particular keyword tool over the others in the teaching and learning scenario.

Research Question 3

The authors incorporated a social network software to provide the affordance for collaborative learning (Ferdig, 2007), where the students and the instructor participated in online interaction with a cooperative learning goal. The usefulness of social networking software for collaborative learning is another aspect of the application's effectiveness that the authors desired to evaluate. This aim forms the third research question:

Research Question 3: Do the students leverage the social network software (Yammer) via the mobile application?

Context of Research Question 3

The mobile application contains a web-based discussion forum that is an enterprise social network, known as Yammer, that the students in the course use and access via their mobile devices. The social network provides the tool for community building based on the nature of the course or discussion. Students can exchange information, share knowledge with peers, provide feedback on teaching, or ask questions to the instructors via mobile devices using the shared space of the learning community created by the Yammer social network software. Based on the feedback and the questions posted by the students, the instructor can assess the degree of students' participation in the class and modify the structure of future courses.

While evaluating the third research question, one needs to consider the view of the population that contains both technology-friendly and technology-averse students. It has been noted that e-learners' competency has direct and positive significant influence on learning outcomes (Ho, Kuo, & Lin, 2010). The enterprising students are tech savvy and are interested in using new technology, while the technology-averse people prefer to stick to the traditional model. Based on the third research question, the fifth hypothesis is formulated:

Hypothesis 05: There is a significant difference in participants' preferences concerning the use of social network via the mobile app in teaching and learning scenario.

The authors have constructed the five hypotheses based on three research questions. The relevant statistical tests are performed to test those hypotheses, which are metrics for the application's effectiveness. The evaluation of its effectiveness could lead to the successful technical integration of mobile apps in the classroom.

Technological Framework

The mobile application is designed for a course titled The Google Online Marketing Challenge. The Google Online Marketing Challenge (Flaherty, Jansen, Hofacker, & Murphy, 2009)deals with keyword advertising, which refers to a process of online advertising based on specific phrases entered into search engines. In keyword advertising, the advertisers participate in auctions run by the search engine where the ad-agents bid for the key phrases that relate to the products or services they provide to online consumers. The key phrases are linked to ads displayed in the search engine result page (SERP). The ads exhibited on the SERP correspond to the queries submitted by the potential customers, who are the searchers of the web search engine. When the user's query matches the key phrase, a list of ads is displayed on specific locations relative to the organic search results of SERP based on the particular search engine. The position of the ad on the SERP is determined based on the bid price paid to the search engine and the ad's quality score. The ad quality score is determined based on relevance of ad, keyword, and landing page relationship with respect to the query submitted by the person viewing the ad. The advertisers pay the web search engine when the users click on their ads.

Keyword advertising is a very complex but essential process in today's online business environment (Jansen & Mullen, 2008). As companies become more inclined toward online business to broaden their scopes from local brick and mortar stores, keyword advertising is an indispensable instrument for

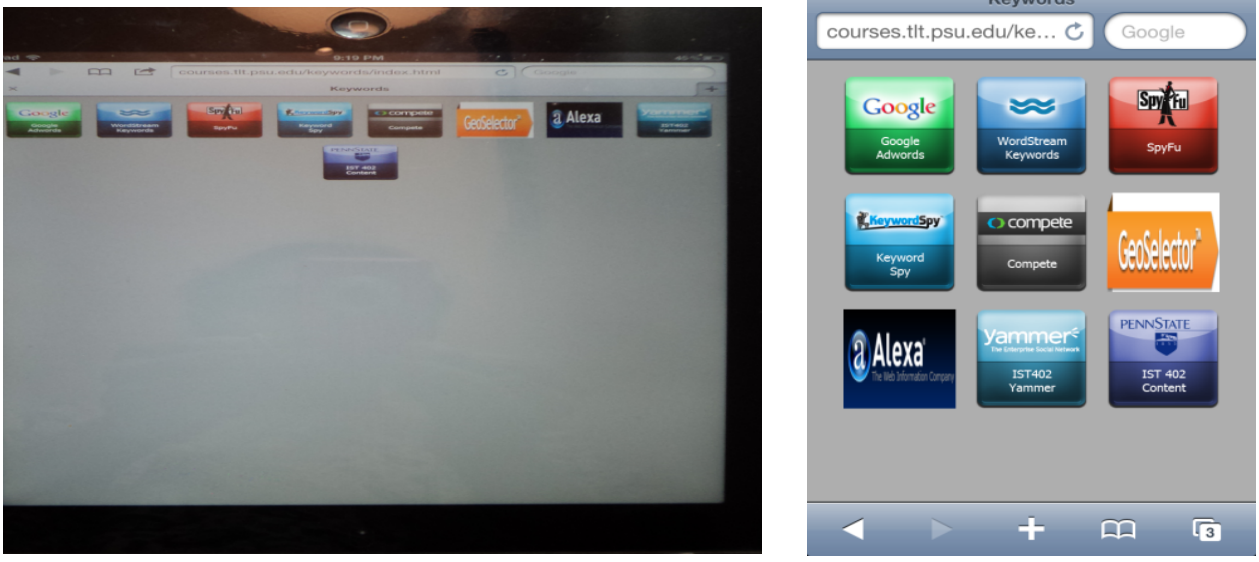
maintaining online business. As such, this was an ideal course to design a mobile application that affords use of different web-based tools associated with keyword advertising.

The mobile application was developed using HTML5 and JavaScript. These languages are the basis of many modern websites and web applications. An advantage of these languages is that they can be interpreted and executed by any modern web browser, including those on desktop, tablet, or mobile platforms. So, access to the application does not require students to possess any particular mobile platform.

The course is designed based on modules or lessons in forms of classroom presentation and PDF contents. Figure 1 shows the application interface where the users can access the link for the Yammer social network, thereby accessing the course- based learning community. A group was created on Yammer for the course where the students, teaching assistants, and the instructor are the members. Students could access the group by typing a log-in name and password in www.yammer.com/login. The group represents the learning community space where the students can exchange the information and array of content related to course learning.

The web application has one content component, the course material (IST 402), and nine tools:- (a) Google AdWords, (b) SpyFu, (c) WordStreams, (d) Keyword Spy, (e) Compete, (f) Alexa, (g) Geoselector, and (h) Yammer. Each component and tool has its own URL and is represented as an image icon of size 80x80 pixels in the interface of the app. The web tools that students learned in the class and their specific URLs are shown in Table 1.

In the keyword advertising course, the students are assigned to separate groups where each group acts as an ad-agent who participated in an auction run by a search engine and bids for the key phrases that relate to the products or services they provide to online consumers. The ad-agents search for key-phrases, manage their budget, monitor the online traffic, control the bidding strategies, and organize their campaign by means of web-based tools. Students explore the tool URLs shown in Table 1, access the preferred web tools via mobile devices, and learn by themselves how to use the tools to optimize the respective businesses that they are assigned to as real world course projects. The instructor stresses collaborative learning while handling the course-based real time business projects by sharing experiences, relevant articles, and knowledge via social network. In this collaborative learning, the instructor plays the role of “more knowledgeable peer” providing guidance and motivation to the students.



A) Application Interface on iPad B) Interface on Smartphone

Figure 1. The Course Application Interface as Displayed in iPad and Smartphone Respectively.

Figure 2 identifies some of the web tools accessed by students via the mobile application. The tool webpage gives the instructions to the students on application usage. We tracked user interactions to provide descriptive user behaviors (Jansen, 2009).

Table 1.

Web tools embedded in mobile application and the specific URLs

Web Tools	URL
Google AdWords	http://www.google.com/adwords
WordStream	http://www.wordstream.com/keywords
SpyFu	http://www.spyfu.com/
KeywordSpy	http://www.keywordspy.com/
Compete	http://www.compete.com/us/
Alexa	http://www.alexa.com/
GeoSelector	http://www.geoselector.com/default2.aspx/
Yammer	https://www.yammer.com/psu.edu/groups/ist402googleonlinemarketingchallenge

A) Accessing SpyFu Web Tool

B) Using GeoSelector Web Tool to Select Business Area

Figure 2. Using Web Tools via Smartphones During Coursework

The HTML5 code generates the interface of the application along with the links of the components, which is accessed from http://courses.tlt.psu.edu/keywords/index.html. The URL displays the interface for the application generated by the HTML5 code on the hand-held devices, such as an iPad and smartphone (Figure 1A and Figure 1B).

Methodology

The majority of the students in the course were seniors with a variety of majors. Some of the students had limited experience using Internet-based technology in their curriculums. The students in the class were exposed to a variety of web tools designed to handle the real-time keyword advertising campaign projects, such as the Geoselector tool to identify the locality of their business (Figure 2B).

Using the various tools, students learned how to optimize for the search of potential consumers, suggest positive and negative keywords to increase the traffic of searchers on their business websites, and track the number of clicks along with the transactions. While doing so, the students could consult the instructor over Yammer, both in and out of the class, over different issues of keyword selection, quality of traffic, framing the query etc.

Based on prior research (Hunt, Sparkman Jr, & Wilcox, 1982; Temple, 1999) a questionnaire-based survey was introduced to assess student perception of application effectiveness. The survey questionnaire consists of multiple choice questions and text-based questions. The survey was available to the students during the end of their project work. Students provided their responses for both multiple choice and text-based queries online using the university's content management system (CMS). The answers were collated in a spreadsheet as text from the CMS. The testing of hypotheses was done by accessing the spreadsheet containing the responses of students who participated in the survey. The answers of multiple choice questions had five options set in a five-point Likert scale (Table 2).

Table 2.

Likert scale for the degree of use of app

Degree of Use	**Scale Points**
Used the most	5
Used a lot	4
Used some	3
Didn't use much	2
Didn't use	1

The questions containing text-based responses were related to the students' brief comments on the use of the mobile application and the Yammer enterprise social network. The answers received were categorized into binary classes: **Like** and **Don't like**. To evaluate the hypotheses, the authors carried out a series of statistical, including one sample t-test, chi-square test, and the Marasquilo procedure on the Likert scale and binary scale data.

One sample t-test was performed t evaluate hypothesis 01 and hypothesis 05, as the observed data is in binary scale and the answers provided by the students for the mobile application and the social network are considered as independent random variables with values of either 0 or 1. For hypothesis 01, the dependent variable is the acceptance of the mobile app from a usage point of view while that for hypothesis 05 is students' preference of Yammer in terms of its usage in the mobile app. A t-test was performed based on comparing the sample proportions that are considered as sample means. For hypothesis 02 and hypothesis 03, a chi-square test was carried out to test significance, as the response data for evaluation of hypothesis 02 and hypothesis 03 can be designed into 2x2 and 7x2 contingency tables respectively (Pursall & Rolff, 2011). While doing the chi-square test, the precondition is that the observed cell count should be at least 5. If the precondition is violated, an exact Fisher's test was carried out to test the significance. The Fishers test is employed when sample sizes are small in the analysis of contingency tables (Fisher, 1922). The independent and dependent variables for hypothesis 02 are students' gender and preference of mobile app in binary response respectively. For hypothesis 03 the variables are students' Likert scale response (independent) and preference of web tools (dependent). Hypothesis 04 is based on the post hoc test of the result derived from evaluation of hypothesis 03 with the same independent and dependent variables. Marascuilo's procedure is the post hoc test when the

chi-square test is performed for more than two groups (i.e., a group for each of the of web tools) (Levine, Stephan, & Szabat, 2013).

Results

The hypotheses are tested based on the answers of the students. There were twenty-three students who participated in the survey.

Evaluation of Hypothesis 01

The first hypothesis deals with the acceptance of the mobile application. The choice of answers was categorized into two classes: **Like** and **Don't Like**. Students who "like" the use of application are considered the ones those accept the app. It was found that thirteen of the students accepted the app, while the remaining ten didn't like the use of the application that much. The authors conducted a one sample t-test with a 95% confidence interval. The result shows the sample proportion of acceptance is 0.565217 but $t_{test} = 0.62 < t_{0.05,22} = 1.717$ and *p-value* = 0.272 > 0.05. It infers that, though the mean of acceptance > 0.5, more samples are needed to show the clear majority over preference; therefore, Hypothesis 01 is not supported.

Evaluation of Hypothesis 02

To test the second hypothesis regarding relationship between gender and preference of the application, the authors divided the students into male and female categories (Table 3). The second hypothesis evaluates the independence between gender and students' preferences concerning the use of web application using the non-parametric Fisher's exact test. Parametric test cannot be performed, as expected frequencies of two cells are below five (Table 3).

Table 3.

Gender vs. preference of app-usage

	Accept	Don't Accept
Male	5	3
Female	8	7

While doing Fisher's exact test, the obtained *p-value* = 0.510 > 0.05. The result identifies that no relationship exists between gender and application preference, so hypothesis 02 is fully supported; there is no difference on application acceptance based on gender.

Evaluation of Hypothesis 03

This hypothesis tests whether there was a preference for different tools. The optimization of business search results depended on the advertiser's requirements. Some advertisers may have needed extensive researching and learning about the competitor's ad campaign, while others may have preferred tools that facilitate the increase of relevance of clicks. Others may have needed suggestions for positive and negative keywords to optimize their business goals. Keeping the tools' relative advantages and limitations in consideration, the authors divided the response regarding the preference of each tool usage into five groups (Table 2).

The researchers have grouped the "Used the Most", "Used a Lot", and "Used Some" responses of the test data (Table 2) as the preferred usage where "Didn't Use Much" and "Didn't Use" responses are non-preferred ones. The Chi-Square test was carried out over the data with responses for preferred and non-preferred categories of the web tools. The result shows that $\chi^2_{test} = 38.24 > \chi^2_{0.05,\ 6} = 12.59$ at 95% confidence. So, there is significant difference between the tool preferences. This supports hypothesis 03. Students preferred certain tools more than others.

Evaluation of Hypothesis 04

The researchers further explored the specific keyword tools that have different levels of usage preferences among the students. To accomplish this, hypothesis 04 was tested using the Marascuilo

procedure (Marascuilo, 1966). The test shows that pairwise differences between Google AdWords Web and most of the remaining tools are significant, except with Google AdWords Editor and Alexa. The significant pairs are selected when the difference of a pair of means exceeds the critical value (Table 4). μ_k is the mean of k^{th} keyword tool, r_{ij} is computed as $r_{ij} = \sqrt{\chi^2}_{1-\alpha,k-1} \sqrt{\frac{\mu_i(1-\mu_i)}{n_i} + \frac{\mu_j(1-\mu_j)}{n_j}}$, $i \neq j$ (Marascuilo, 1966). n_k is the sample size for population k.

Table 4.

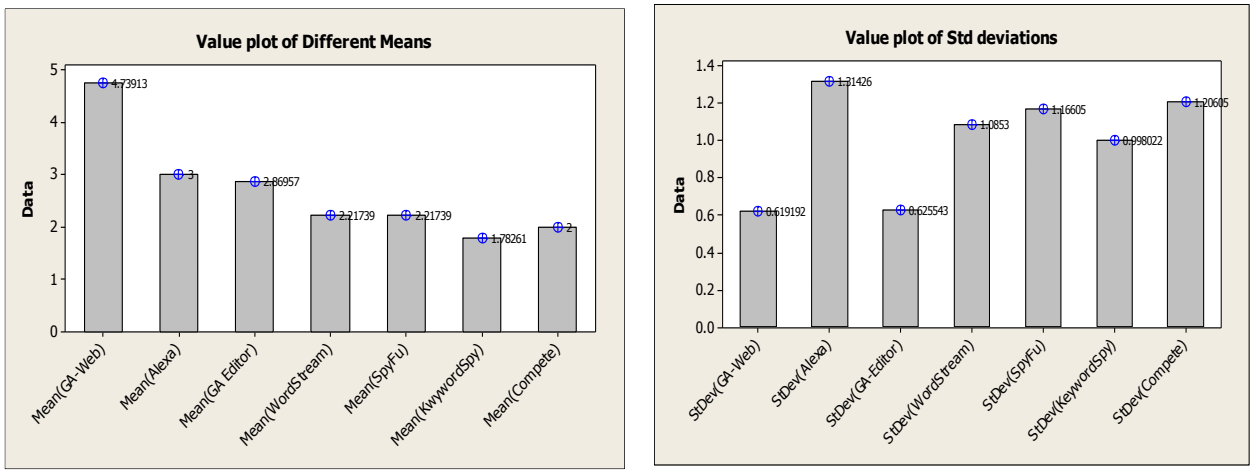
The test statistic and critical values for the tool pairs. Significant pairs are bolded.

Tool Pairs	**$\lvert\mu_i - \mu_j\rvert$**	**Critical value r_{ij}**
Google AdWords Web, Google AdWords Editor	0.261	0.325
Google AdWords Web, WordStream	**0.522**	0.370
Google AdWords Web, SpyFu	**0.565**	0.367
Google AdWords Web, KeywordSpy	**0.739**	0.325
Google AdWords Web, Compete	**0.696**	0.340
Google AdWords Web, Alexa	0.348	0.352
Google AdWords Editor, WordStream	0.261	0.492
Google AdWords Editor, SpyFu	0.304	0.490
Google AdWords Editor, KeywordSpy	**0.478**	0.459
Google AdWords Editor, Compete	0.435	0.471
Google AdWords Editor, Alexa	0.087	0.479
WordStream, SpyFu	0.043	0.521
WordStream, KeywordSpy	0.217	0.492
WordStream, Compete	0.174	0.503
WordStream, Alexa	0.174	0.511
SpyFu, KeywordSpy	0.174	0.490
SpyFu, Compete	0.130	0.500
SpyFu, Alexa	0.217	0.509
KeywordSpy, Compete	0.043	0.471
KeywordSpy, Alexa	0.391	0.479
Compete, Alexa	0.348	0.490

It could be concluded that Google AdWords tool is significantly more popular than most of the remaining tools, followed by Google AdWords and Alexa. It is because the mean of preference of Google AdWords (4.739) is highest, while the standard deviation is the lowest (0.6192), as observed in Figure 3A and Figure 3B. This supports hypothesis 04 that there is a preference among the students for at least one tool.

Evaluation of Hypothesis 05

Apart from these four hypotheses, the authors evaluated the preference of the Yammer social network software use within the mobile app. A survey was conducted in which seventeen students responded concerning Yammer usage. The survey questionnaire regarding the effectiveness of Yammer focused on the collaborative, group making features, and cooperative learning. The responses are divided into binary classes of reply: "1" stands for the acceptance and "0" for rejection. It was observed that out of 17 students, ten supported the use of Yammer, while the rest reported rejection. Based on the response data, a one sample two tailed t test was carried out. At 95% confidence the obtained t_{test} = 0.72 < $t_{0.025,16}$ = 2.120 and *p-value* = 0.242 > 0.05. The result does not conclude any clear majority or minority of student population that accept the social network. The result does not support hypothesis 05.



A) Preference Means of the Tools

B) Preference Standard Deviation of the Tool

Figure 3. The Mean and Standard Deviation of the Tool Preferences

Online Learning Experience

The issue that emerges from the comments posted in the social network about the use of mobile application and associated tools concerns the social nature of the learning experience, including pedagogical considerations and social interaction via social networking as augmentations of online learning, as detailed in social constructive theory of learning with technology (A. Brown, 1996), transactional distance theory (Moore, 2007), and conversation theory (Pask, 1975).

Pedagogical Considerations

The attention of the learners is encouraged toward student-centered pedagogy by the instructor in an indirect fashion. The social networking site builds the framework for the social constructive and conversation of learning pedagogy that is used by the instructor. Such student-centered pedagogical framework acts as the positive contributor of the learning experience. For example:

- Student A posted that she "is very happy to introduce Google AdWords in her project successfully, as the use of it was demonstrated very well in class". This comment indirectly contributes to the "good" teaching style of the instructor.
- Student B who was not present during the demonstration of Google AdWords stated in the social networking site that, "It is easy to use Google AdWords via mobile application in the project, as the information on how to use it is posted in Yammer." The instructor summarized the required instructions to run the specific tool when needed and uploaded them to the social networking site.
- Student C mentioned in Yammer that, "It will be helpful to post some materials on how to target the display network." It is important to note that student C did not speak to the instructor directly but posted it in Yammer, hereby using the implemented technology as an alternate communication device (Ferdig, 2007), which is an indication of the enabling effect of the technology.

The comments of the students in and out of the class contributes positively to the learning experience, emphasizes the need for the web tools, and maintains an indirect focus on positive and negative aspects of the teaching style via the student-centered pedagogy. The instructor uses this pedagogical framework to internalize the students' indirect comments about the teaching style, and to identify the needs of the students who avoid active participation in the class and the student requirements about learning. These capabilities will help the instructor modify future course content accordingly; for example, as shown in Figure 4, the instructor uploads the article on display network against the need of student C.

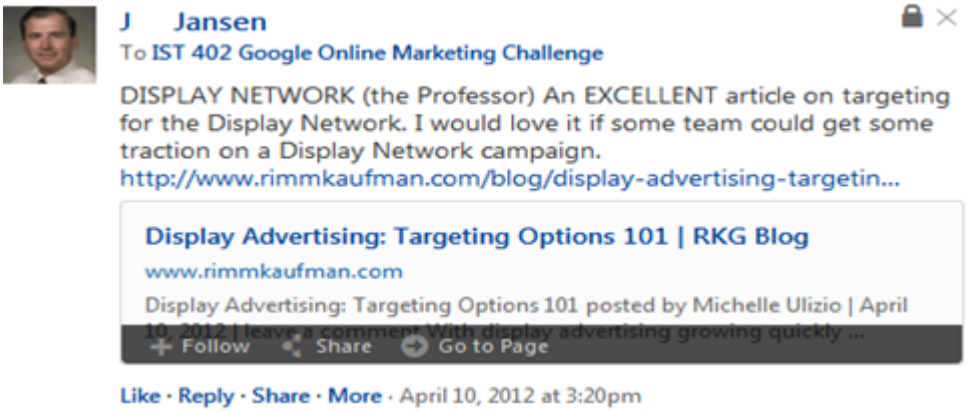


Figure 4. Uploaded content in Yammer by instructor for learning

The educational setting of our pedagogical framework is based on transactional distance theory (Moore, 2007). Transactional distance theory defines the concepts of distance learning. Transactional distance theory implies a knowledge separation between teachers and learners; however, in mobile learning environments, mobile devices extend beyond the traditional classroom settings to informal and non-institutional settings by means of social networks and online learning technologies, which work to decrease the knowledge distance between teachers and students.

Online Learning Mediated by Yammer

The messages posted to the Yammer social networking site concerning the course content and experiences in handling the real life project by the students generate group dynamics via social interaction pertaining to the course. Such group dynamics are positive contributors to the learning experience and formation of an online learning community. As the students work through the assigned readings or work-related artifacts posted in social networks, it appears that learner's strategies for managing time, information, and web tool usage centered on scanning other students' contribution and making judgments on comments seen to be optimal.

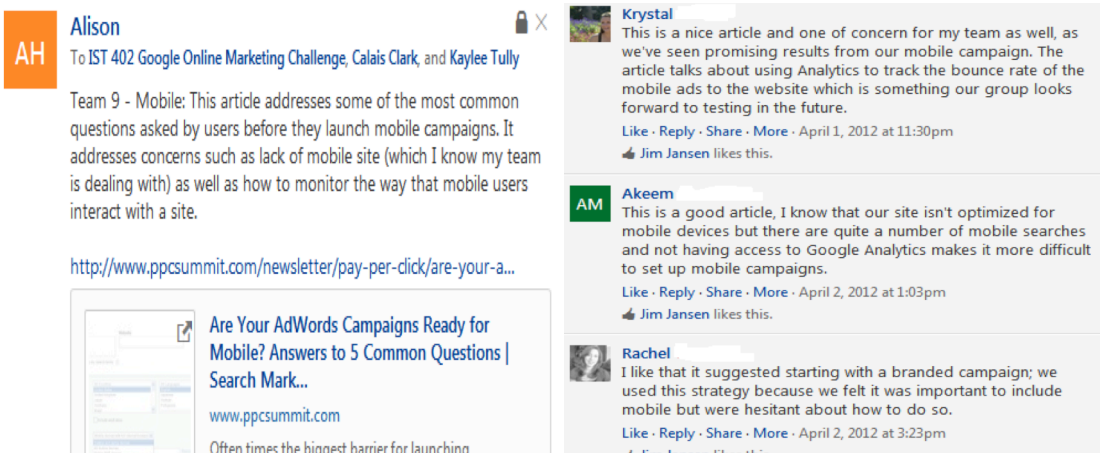
For example, a student posted an article on a mobile campaign in Yammer as observed in Figure 5A. The students who found this artifact important for their work participated in a discussion and shared their feelings and views about the impact of it on their own work, as shown in Figure 5B. Another learner using the branding campaign strategy suggested the article originally was posted by a different student. The students using this strategy unanimously identified the circumstances where they could use the information in the article. This social collaboration and conversation contributes to collaborative social learning through shared feelings. It is also identified that at least one of the students needed coaching to upgrade his advertising website for mobile campaigns accessing "Google Analytics".

It seems that the learners enjoyed and appreciated social learning (i.e., course related) via shared experiences by making real time social interaction (Kukulska-Hulme & Shield, 2008). The interactions further identified the learners who needed coaching on certain issues under certain circumstances.

These interaction dynamics helped form a community on the topic of "branding campaign on mobile phones" with the students sharing views and materials on the topic in Yammer.

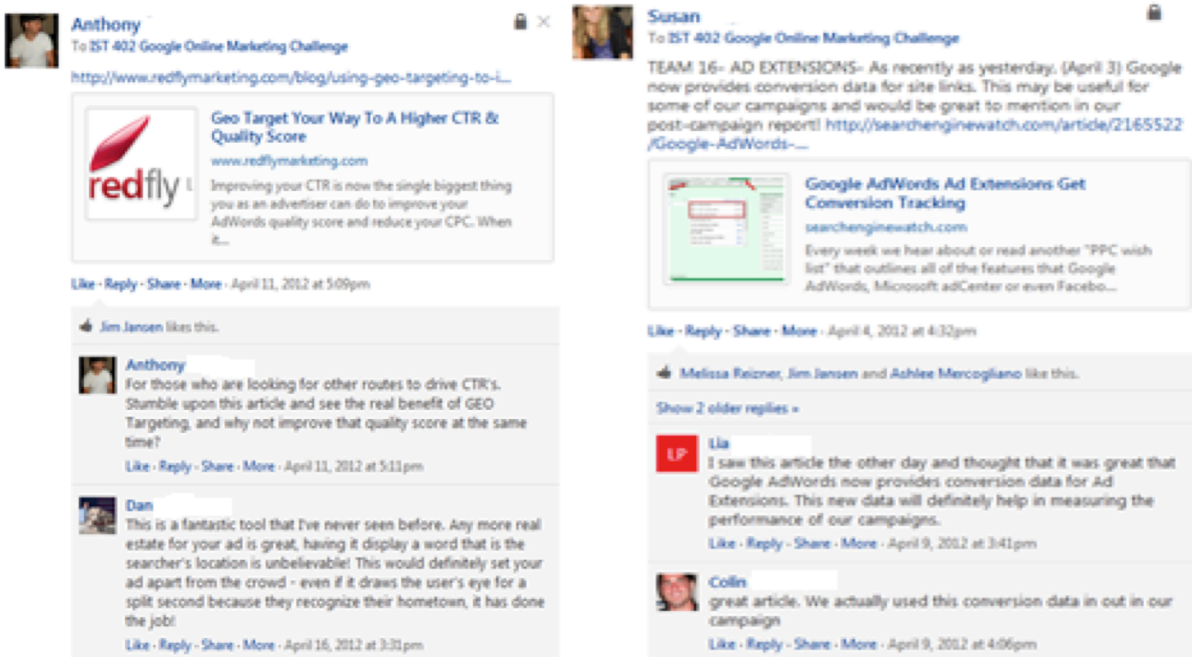
In Figure 6, learners supported one another in their collaborative learning, and they enhanced their learning experiences via social interactions, which was consistent with prior work (Elias, 2011). By

posting an article about geo-targeting in Figure 6a, a student eventually helped another learn to target the audience for publishing his/ her ad. In Figure 6b, sharing the article about Google AdWords ad extension helped other students to use it in their campaigns.



A) Article on Mobile Campaign B) Sharing Feelings and Views among Participants

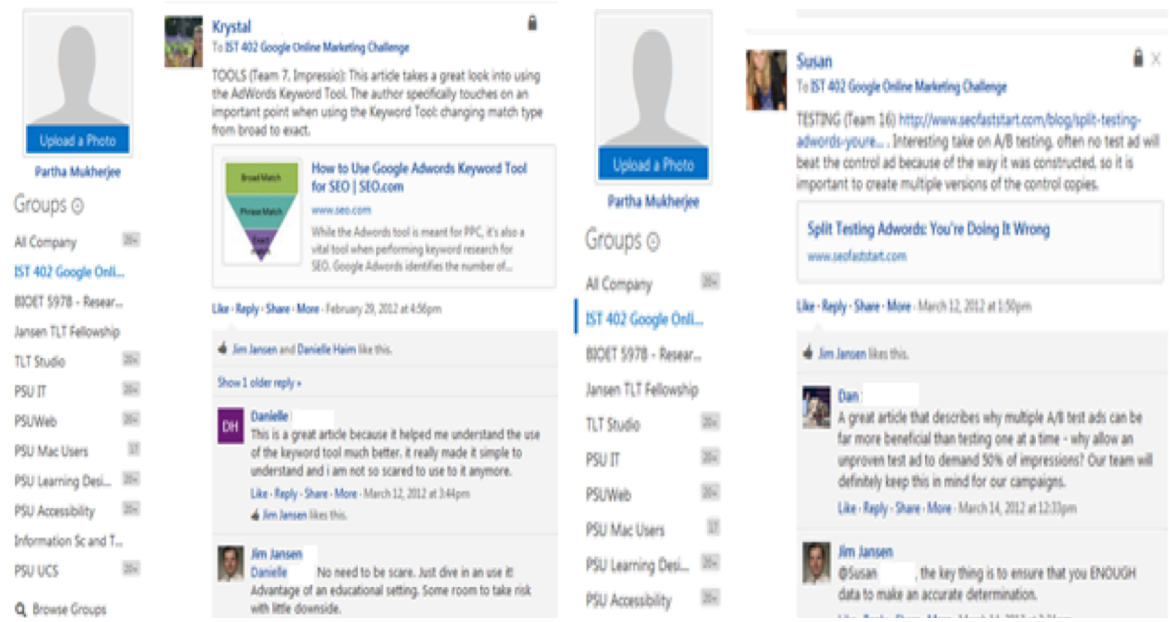
Figure 5. Sharing experiences via social interactions in Yammer



A) Learning Geo-targeting B) Learning Google AdWords Ad *extension*

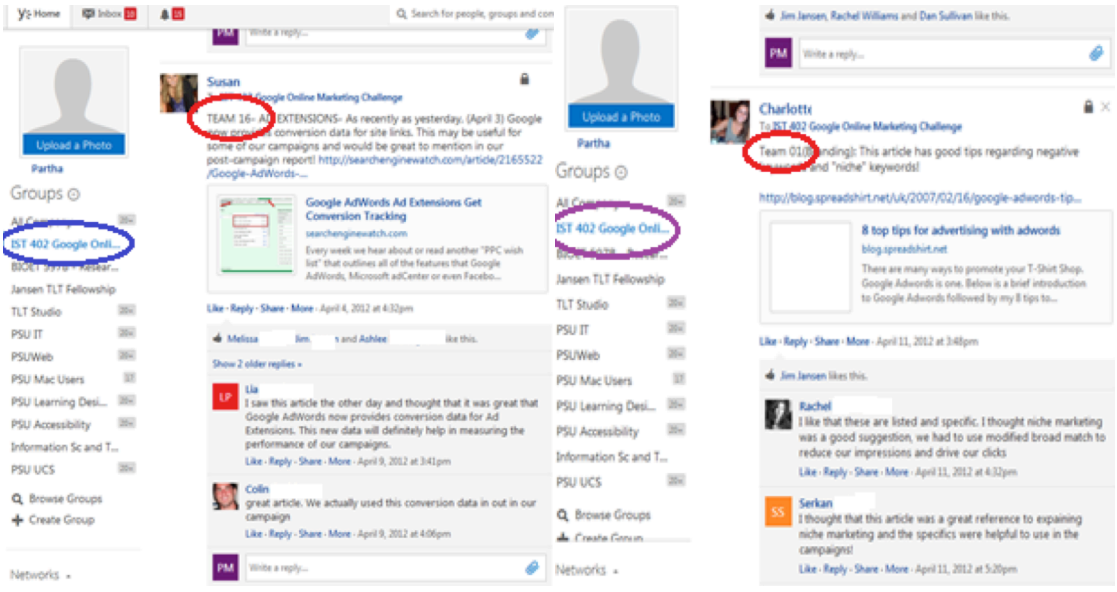
Figure 6. Collaborative learning via shared experience

Figures 7a and 7b display the scenarios where the instructor, as a more knowledgeable peer, provides motivation and technical guidance to the students (less knowledgeable peers) to handle the difficulties faced in their course-based projects.



A) Instructor providing motivation B) Instructor providing guidance

Figure7. Motivation and guidance from more knowledgeable peer



A) Team 16 community B) Team 01 community

Figure 8. Social communities with course based learning

In our research, we used Yammer as the social network with the group name “IST402 Google Online Marketing Challenge”; while there were multiple subgroups, each was considered a social learning community where the members of each group shared articles via yammer with their respective group members and beyond as shown in Figures 8a and 8b. In Figure 8a, Team 16 was the community learning

about Google AdWords ad extensions while Figure 8b shows the Team 01 community discussing tips for advertising with Google AdWords.

In collaborative learning scenario participants belong to one particular group and sit together to discuss about the project assigned to them. As a group, they present their views about the issues of the project, such as: workflow of their design, their targeted audiences, selection of the sponsor (i.e. outside entrepreneurs) and merchandise, preferred keyword advertising app, etc. While exchanging their views about different aspects of the project, they present their strength and weakness regarding technical knowledge, management of data, and maintaining the communication network particularly with their sponsor and the knowledgeable peers. While carrying out the project, if the participants of a group face difficulties in understanding the issues of the features, be it design, implementation or management, they usually reach out to the members of other groups via the social networking service (i.e. Yammer). The members from the others groups know the query makers by viewing their names and the profile images the askers use while creating their accounts in Yammer. Based on the query, the members from the second group try to give the relevant answers by means of comments, providing related links of websites, or giving information about pertinent artifacts. The respondents can be from multiple groups to the query and there can be discussion on the viability of the responses. The more knowledgeable peers (e.g., instructor or teaching assistants) may join the discussion and additionally serve the collaborative / social learning. A particular member or specific members from each group maintain the periodic interaction with their sponsors, sharing their business experiences and reporting the dynamics of sales. So, the entire course is structured in a very collaborative manner.

Discussion and Implications

In this research, the researchers emphasize the use of mobile technology in teaching and learning. The use of mobile technology changes the conventional static learning materials environment in education to a non-conventional, non-static one. With the notion of the "off the desktop" context, a course-based mobile application was created. The mobile application is accessed via a course URL from computers, tablets, or smartphones. JavaScripts and HTML5 are the underlying technologies use to create the mobile application with the utilization of the offline cache feature of HTML5 to access the application's webpage even if the student's device is not connected to the Internet. The application was introduced in a classroom with 45 students. It was observed that students accessed the application and the necessary tools using their handheld devices and with their desktops. The factors regarding the app effectiveness are related to 1) whether students prefer the usage of app, 2) What are the students' perception about the embedded social network, 3) what are the relative advantages and disadvantages of web tools, and 4) How students handle different web tools while handling the project. These factors were defined to the students before experimentation with the application effectiveness.

To measure the effectiveness of the application, a survey was conducted to address a set of five hypotheses. The first hypothesis asked whether the majority of the students preferred using the app. The test results of hypothesis 01 conclude that there is not enough evidence to infer acceptance by a majority of the students. This implies that the application does not entirely satisfy the general requirements of the students. Though the keyword tools can be opened in smartphones or in hand-held devices, the display of the required links embedded in the landing pages may not give clear views due to not being optimized for mobile devices. Also, content downloaded from the course content link may be difficult to read on smartphones compared to desktop/laptop screens. This points to the need for web services and websites, including education ones such as content management systems, that are designed for mobile devices.

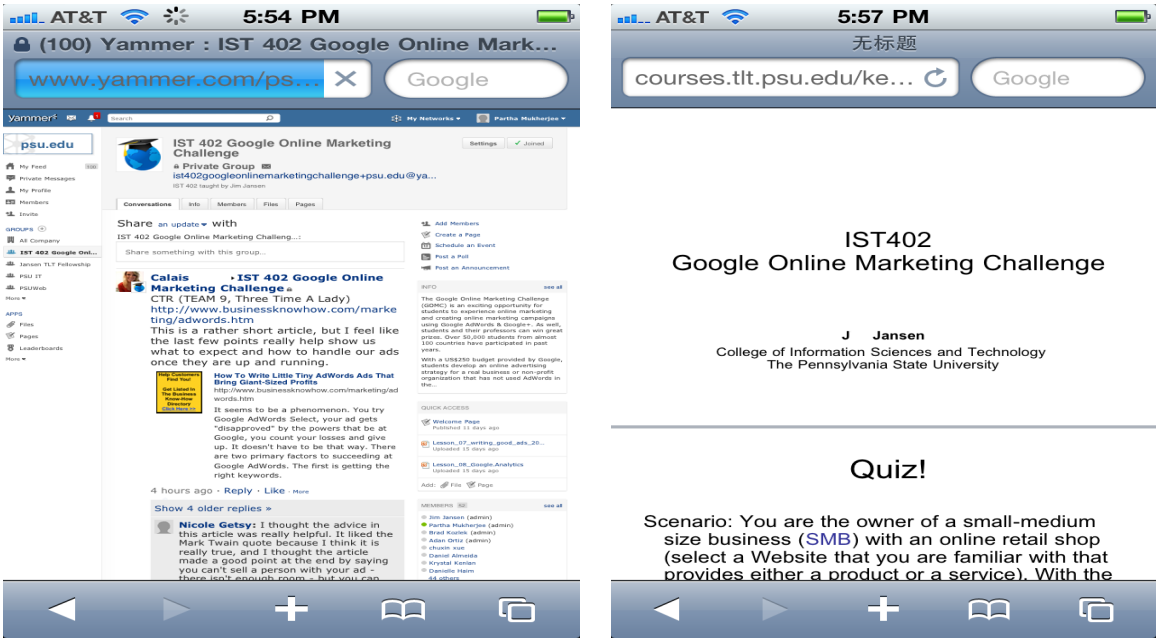
The second hypothesis dealt with the relationship between the gender and preference for the mobile app. Fisher's exact test corroborated the notion of independence between preference of application use and student gender. Results from the data analysis show that user interaction with the application does not differ significantly based on the gender of the students.

The third hypothesis measured the variation of users' choices for using the keyword tools associated with the application during the project. This hypothesis assumed that there were certain tools that were used more frequently than others. The result of the Chi Square test with multiple proportions supports the hypothesis. The implication of the variation of learners' choices among the tools supports the notion of cognitive variability (Ferdig, 2007) of users. Cognitive variability refers to the extent that the keyword tools

offer meaningful user interactions. So, different tools embedded in the application have different degrees of user interactions depending on the users' cognitive aspects.

The result of hypothesis 04 showed that students experienced more flexibility and ease of use for Google AdWords in terms of immediate visibility of business results and suggested a list of keywords to target potential customers relative to the other keyword tools. So, the notion of cognitive variability across the keyword tool's features supports the view of meaningful interaction offered by Google AdWords to enhance the learning process.

The result of hypothesis 05 did not infer difference in participants' perception or intention about using the social networking software. Yammer software is relatively new compared to other more popular social networking sites, so there is a novelty factor affecting its use. Research on student (Stoel & Lee, 2003) interactions with web-based learning showed that experience with technology had a positive impact on perceived ease of use. People familiar with the popular social networking sites felt reluctant to adopt relatively new software offering similar affordances. The environment of used social software provides the zone of proximal development (ZPD) (A. L. Brown & Ferrara, 1999). ZPD is the Vygotskian concept that acts as a scaffolding of gaining knowledge via a collaborative environment.

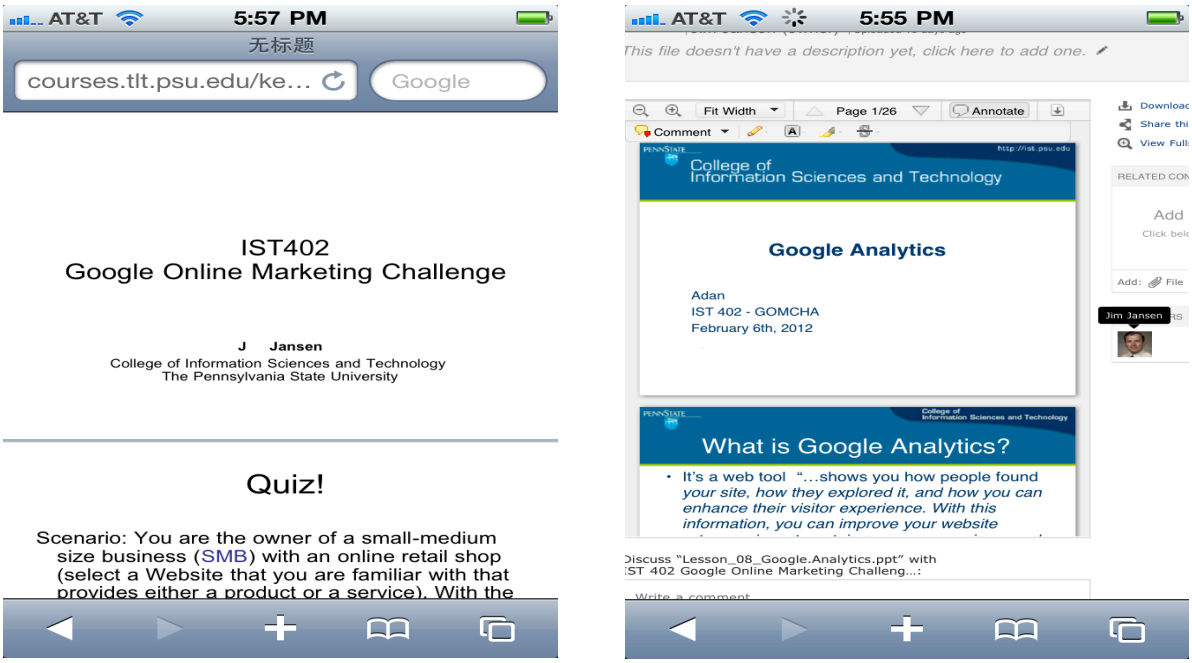


A) Interacting in Learning Community B) Artifacts Accessed by Mobile Device

Figure 9. Pedagogical framework enhanced by Yammer and smartphones

Figure 9A shows the community in the Yammer social network where the users can engage in leaning activities, while Figure 9B shows the artifacts that can be accessed or downloaded via smartphones. Thus, the students can build a learning community using the social network software by sharing interaction via mobile devices. Though there was no clear majority of preference concerning the use of Yammer among the students, it was observed that throughout the course, a large proportion of students used the Yammer collaborative space to learn how to use the other tools for optimizing the computational advertising campaign within a predefined budget.

Figure 10 shows a scenario of course redesign. Figure 10A shows the PDF version of the material the students are exposed at the beginning of the course, while the format of the material posted later by the instructor is changed (to a PowerPoint presentation) on better visualization based on the students feedback in Yammer.



A) The PDF Version of the Course B) Artifacts Changed to Different Format

Figure 10. Format of the course content change based on students' feedback

Moreover, from the comments posted in Yammer by the learners, a student-centered pedagogy was certainly generated. The instructor can use this pedagogical framework to identify students' needs and the relative positive and negative sides of the teaching style. This helps the instructor modify the skill level of instruction accordingly. Apart from that, it was observed that students used the social network to share course-related experiences via online interaction (see Figure 5) and thus contribute to online learning mediated by social networking and its technology. The group interaction dynamics will eventually form a learning community of participating learners as its members.

Limitations and Strength

As in all studies, there are limitations to this research. The first limitation is that the application is designed for one specialized course embedding with several course-specific tools; however, the mobile application framework could easily be used to target other courses and services.

The second limitation is related to the app's offline use. The authors leveraged the offline cache feature of HTML5 to permit access to the portion of the application content, even if the student's device is not connected to the Internet. This was great for accessing static content, such as slide decks; however, the web tools and the Yammer site could not be accessed, as they have their dedicated servers. This hinders the users in accessing those components when the network connection is down.

Finally, the number of participants in the survey is only 23. As a consequence, the analyses are carried out with a small sample. We agree that the key constraint of that study is that we are limited to detect large differences in design and measures. So, the statistical measures of the test have limited significance for hypothesis 01 and hypothesis 05 on identifying the preference of the application and Yammer respectively; however, in user-experience research, the small sample sizes typically between 5 and 30 users are very common where representativeness is more important than sample size (Sauro, 2010).

Concerning strengths of the research, the mobile application does not need a dedicated platform or operating system to be functional. The design and implementation complexity are much lower compared to other software built for mobile-based learning mentioned in prior research. This mobile application only

requires the most basic web server and is accessible from any device, including both mobile devices and desktops.

Secondly, the application helps students enhance their learning even when they are not in the classroom. By means of social networking software, instructors may upload study materials that students can access irrespective of time and place. So, a student can prepare without needing to physically attend the classroom lecture. The mobile application acts as a learning assistant that leverages the use of mobile technology.

Conclusion

In this research, three main objectives were addressed. The first one was real-time course content refreshing, moving from a static classroom environment, which is often devoid of real-time development for course content. The application developed in this research accommodates this space via its social networking attribute, where students' feedback of the course material can be posted. The instructor can then redesign the course content or remodel the teaching style based on the remarks published in the social network software.

Secondly, the mobile application assisted in addressing and procuring extra information that might remain uncovered in the semester. While teaching a course, an instructor designs his artifacts accordingly, but there are nearly variables that cannot be predicted beforehand (e.g., specific terminologies, queries in the class, skill sets of the students, etc.). The instructor can select and uploaded extra materials via the application to respond to such issues. These materials may not be discussed in the class because of time constraints, but those particular issues can be resolved once the students access the posted material online via a social conversation service. The designed application provides the course content link, links to the web tools, and the Yammer enterprise social network where the required materials can easily be uploaded and downloaded by the instructor and the students.

The third issue was collaborative learning. The authors developed a course-based mobile application that contains different web tools that help students learn the course material and a social network-based discussion forum where peers can share their views. Unlike routine classroom protocol, students make an online collaborative environment that utilizes the social attributes of the technology to enhance cooperative learning. The Yammer social network is used as the platform for students to share experiences and feelings regarding course-related issues. The shared feelings and views about a concept or article help the students identify own mistakes and select the optimal strategy from others' contribution into the online discussion. This helps the students to learn from peers, collaborated in a group, and hence form social learning community.

In future further exploitation of the mobile application, the HTML5 offline-cache feature will be concentrated so that students can access the course materials offline. This will greatly help students use the artifacts even if their devices are not connected to Internet. In addition, the authors will analyze the conversation between the members of Yammer to understand how cognition and power relate to the discourse; this will shed more light on course-based community building, adding to insights from our survey. Additionally, the authors will build a course-based knowledge repository of the students' interactions based on the sets of questions and answers related to the course. This knowledge base will enriched with more information from subsequent students, resulting in an ever-growing repository of material for use by students and faculty.

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