INTERACTIVITY EFFECTS ON THE USEFULNESS, EASE OF USE, AND ENJOYMENT OF UNIVERSITY MOBILE WEB

A paper submitted to the 2011 International Communication Association Annual Conference

Abstract

The value proposition of mobile technology in the educational setting is expected to grow as forecasts speak to mobile Internet users exceeding desktop Internet users in 2014. A key concern for administrators will be how to implement a university mobile website that attracts students to use it. To answer this question, a scenario-based study of 288 U.S. college students was conducted involving two wireframes varying in interactivity. A PLS-based data analysis offers support for the positive effects of mobile interactivity on the perceived usefulness, ease of use and enjoyment of the university's mobile website, which in turn positively influenced their intention to use it. The measurement model offered high explanatory power (i.e. 47% of the variance in the behavioral intention to use the university's mobile website was explained by its three antecedents). Implications for both theory and practice are also discussed.

Keywords: Interactivity, Usefulness, Ease of Use, Enjoyment, Mobile Web, Technology Acceptance Model.

Introduction

Moving to mobile media in higher education

Today, students tend to be nomadic learners in part due to their increasing use of mobile technologies. The former stationary nature of desktop computing restricted the "anytime-anyplace" potential of e-learning to those situations in which a learner was in front of his or her desk (Steinfield, 2003). However, according to Klopfer, Squire, Holland and Jenkins (2002), the handheld computers can produce social interactivity, context sensibility and individuality, in addition to portability and connectivity, which support educational interaction in anytime-anyplace. In an educational context, mobile Internet access can promote situated learning, allowing enhanced educational experiences because of the potential to draw on a student's environment and activities (Naismith, 2004). Also, mobile technologies are versatile and interactive, allowing users to share information as well as media (e.g., images, audio, and video) from the world around them without a time delay or the need for additional technology or expertise. In other words, mobile technology improves collaboration and sharing via instant real-time interactivity (Ebner & Schiefner, 2008). In higher education, mobile devices can provide course materials to students as well as timely notifications regarding changes in due dates or class events (Corlette, Sharples, Chan & Bull, 2004). It seems clear that the value of mobile technology in a university context can grow exponentially, as more students and more instructors use mobile content and services. In addition, ECAR (EDUCAUSE Center for Applied Research)'s study found that more than half (51.2 percent) of over 7,000 primarily US undergraduate students owned an internet-capable mobile device and a further 11.8 percent planned to purchase one in the next year (Smith, Salaway &

Caruso, 2009). More recently, according to "Internet Trends" (Morgan Stanley, 2010), Internet enabled devices are quickly adopting and it is expected that mobile Internet users will exceed desktop Internet users in 2014. A key concern for administrators will be how to implement a university mobile website that attracts students to use it.

Interactivity studies in Commerce setting

In the commerce setting, how a company interacts with customers is a key element in determining its success. Moreover, the significance of interactivity is growing as e-commerce or even m-commerce make it possible for customers to experience interaction with salespersons even when the two cannot physically interact (Bae et al., 2006). Limited empirical studies have examined the importance of such interactivity in the context of the Web. According to Johnson et al. (2006), perceived interactivity positively affects customer attitudes toward websites. In addition, interactivity was found to be related to the behavioral intention to return to a website (Jiang & Benbasat, 2007). In the popular Technology Acceptance Model (Davis, 1989), emphasis had been placed on the constructs of perceived usefulness and perceived ease of use. Teo and colleagues (2003) tested a model in which perceived interactivity was shown to affect the cognitive constructs of "effectiveness and efficiency." Hence, it is reasonable to expect that perceived interactivity would affect other related cognitive constructs. Also, affective elements such as enjoyment have recently received attention as important predictors of attitude (Kim et al., 2007; Sun & Zhang, 2006; Tractinsky, 2004). Therefore, when either or both components are in place, i.e., cognitive or affective elements, users will be more likely to visit a site (Cyr, 2006).

Lack of similar research in the context of academia

Most past studies on behavioral intention to visit the site were conducted in the context of e-commerce (Cyr et al., 2003; Cyr et al., 2009) or m- commerce (Yang, 2008). Furthermore, past studies investigated only perceived interactivity effects on cognitive components (Teo et al., 2003), cognitive and affective components without perceived interactivity (Cyr, 2006), or only perceived interactivity with satisfaction as a behavioral intention to use related factor (Chou, 2003; Chou, 2009; Yang, 2008). Although Cyr (2009) investigated cognitive and affective components with perceived interactivity, the levels of perceived interactivity were not significantly different; therefore, it was not clear which features contributed to increased or decreased levels of website interactivity.

Statement of purpose

The study examined the perceived mobile interactivity toward behavioral intention to use the university mobile website, examining specifically the effects of cognitive and affective perceptions regarding the university mobile web context. Aside from proposing a model for describing the behavioral intention to use the mobile website, the study investigated two mobile web scenarios, which varied in terms of their interactivity features; this was done in the anticipation that universities will thereby be afforded an understanding of the efficacy of certain feature design elements, among other insight. Therefore, this research aimed for producing implications to both theory and practice.

Theoretical foundations and research model

Technology Acceptance Model (TAM), which suggests that perceived usefulness (PU) and perceived ease of use (PEOU) of IT are major determinants of its usage, provides the theoretical framework for this research. However, depending on the specific

technological context, additional explanatory variables should be included in the study. For example, mobile phones may be fun and useful at the same time. In other words, users may expect to obtain information and enjoyment anytime, anywhere. Along with this view, the traditional TAM has been extended here to include a "Perceived Enjoyment (PE)" construct. In the past, information system researchers have agreed that PE has been validated for predicting the adoption of various information technologies (Childers et al., 2001; Cyr et al., 2007; Cyr & Head, 2008; Moon & Kim, 2001).

In addition to the TAM and PE, perceived interactivity was considered given its potential benefits, such as engagement, performance quality (Schaffer & Hannafin, 1986; Szuprowicz, 1996), and time efficiency (Cross & Smith, 1996). In addition to these potential benefits of perceived interactivity, Teo and colleagues (2003) found a positive relationship between interactivity and PU and PEOU. Moreover, Cyr and colleagues (2009) found a positive relationship between PE and perceived interactivity.

This study will adapt Yang's (2008) study to investigate the effects of perceived interactivity in a university mobile web setting. Yang (2008) conducted a qualitative study to determine what kinds of features contribute to perceptions of interactivity in the mobile web setting and identified five constructs that characterize mobile interactivity: (1) two-way communication, (2) active control, (3) synchronicity, (4) richness of content, and (5) connectedness. These in turn are expected to result in improved user beliefs toward the mobile web (in terms of PU, PEOU, and PE), and subsequently to influence a behavioral intention to visit the mobile website. The associated relationships will be defined in the next section, which will be followed by a presentation of the proposed research model.

Hypothesis development

Perceived Interactivity

Rice (1984) defined interactivity as the capability of a communication system to permit an exchange of roles between sender and receiver and in turn allows the communicator to have more control over the content, structure, and pace of the communication. In addition, Lu and Shurm (2002) defined interactivity as the degree to which communication parties can act on each other, the communication media, and the message and the degree to which such influences are synchronized. Likewise, numerous definitions of interactivity exist; however, their general concept involves interactivity that allows a sense of connection and successfully provides information to users, which is perceived as responsive. Interactivity has been mentioned in many information system studies and has been regarded as a key value to successful communication, marketing, advertising, commerce, and course management system (Chou et al., 2010; Cyr et al., 2009; Lee, 2005; Liu & Shrum, 2002; Marcias, 2003; Teo et al., 2003). The dimensions of interactivity are numerous. According to Yang (2008), the concept of interactivity has often been represented through two distinct approaches, the “feature-oriented” and the “perception-oriented.” The “feature oriented” approach lists functional features to investigate the number or the degree of the interactivity (See Table 1). In other words, the number of features a certain site has determines whether the site is interactive or not. In addition, type of features a certain site includes determines its level of interactivity. For example, in the “feature oriented” approach, the research assessed the effects of interactivity on the appeal of the site to find the dimensions and features of interactivity (Chou, 2003; Chou et al., 2010; Ghose & Dou, 1998; Haubl & Trifts, 2000; Heeter, 1989;

Zeng & Li, 2006). Moreover, Teo and his colleagues (2003) manipulated interactivity level by locating certain features and analyzing their effect on user satisfaction, effectiveness, and efficiency.

On the other hand, the "perception oriented" approach concerns users' perception of interactivity, that is, individual evaluation of interactivity, rather than actual interactive features (See Table 2). Therefore, perceived interactivity of the site determines interactivity (Chen & Yen, 2004; Cyr et al., 2009; Dholakia et al., 2000; Gao et al., 2010; Ha & James, 1998; Johnson et al., 2006; Lee, 2005; Liu, 2003; McMillan & Hwang, 2002; Wu, 2000).

With regard to both these approaches, Yang's (2008) research is of particular relevance. Yang (2008) conducted a qualitative study to determine the kinds of features that contribute to forming perceived mobile interactivity in the m-commerce setting (feature oriented interactivity) and identified five constructs of mobile perception oriented interactivity: (1) two-way communication, (2) active control, (3) synchronicity, (4) richness of content, and (5) connectedness. She conducted interviews to explore, which of these features enhances interactivity (See, Table 3) and why they are important. Yang (2008) termed these five constructs based on various definitions in the literature and interviewees' explanations. Cyr (2009) also located certain features to manipulate interactivity level and to investigate their effect on three constructs, user control, connectedness, and responsiveness, which represent perception oriented interactivity. However, the manipulated websites were not significantly different. On the other hand, according to Yang (2008)'s study, the level of five constructs turned out to be significantly different, depending on the degree of interactivity, i.e., the higher perceived

interactivity, the higher the level of five constructs. Therefore, this study will adapt the interactivity features and the five constructs of perceived interactivity from Yang (2008)'s study.

Active control (Gao et al., 2010; Hoffman & Novak, 1996; Steuer, 1992; Williams et al., 1988; Yang, 2008) and two-way communication (Bretz & Schmidbauer, 1983; Gao et al., 2010; Yang, 2008) have been regarded as the core components of interactivity. First of all, active control, commonly referred to as user control, refers to the capability to have control over all the activities happening in mobile websites, such as choosing contents, timing, and sequence of a communication. Furthermore, active control is associated with ease of information use and reduced efforts to complete the task (Cyr et al., 2009; Gao et al., 2010; Yang, 2008). However, for mobile communication, perception of user control can be understood differently. For example, to reach efficient achievement, the advanced technology can push automatically updated information to individuals. Someone could perceive it as active control but others could be annoyed with it because mobile devices are often regarded as a personal gadget (Gao et al., 2010; Yang, 2008). Therefore, individuals may experience "active control" when they feel empowered with control over the communication without feeling disturbance. Two-way communication follows the concept of reciprocity, which is bi-directional information flow (Gao et al., 2010, Johnson et al., 2006; Teo et al., 2003; Yang, 2008). Individuals, senders and receivers, can exchange roles and in turn, they can engage in mutual communication, not monologue. Especially, mobile communication is expected to provide two-way communication; therefore, individuals are expected to give and receive feedback more with their mobile devices than with their PCs (Gao et al., 2010).

Synchronicity refers to the speed of delivering and processing the message and the extent to which a message exchange occurs in real time (Burgoon et al., 2002). When two parties communicate, fast response time contributes to the continuity of communication. Moreover, when the temporal delay between action and reply decreases, interactivity increases (Kirsh, 1997). Likewise, many studies emphasized the speed of response or synchronicity to be a facet of interactivity (Dholakia et al., 2000; Gao et al., 2010; Ha & James, 1998; Johnson, 2006; Liu, 2003; McMillan & Hwang, 2002). Speed is important to the mobile communication because the mobile communication provides instant response; therefore, there is an increasing need for fast speed (Gao et al., 2010).

While synchronicity concentrates on diminishing the time lag between sending and receiving messages, the connectedness represented the ubiquitous access to the mobile Internet, which allows people to connect to outside whenever and wherever they want to (Yang, 2008). The access also includes links to related information, channels, and alerts to timely events or newsletters. These possible connections could extend the likelihood of interactions (Gao et al., 2010). In addition, Anckar and his colleagues' research (2003) found out consumers in Finland wanted to adopt mobile commerce because of mobile internet's flexible access. In accordance with it, Lee (2005) included "Connectedness" as an additional constructs defining mobile interactivity.

Lastly, richness of the content refers to entertaining documents provided including context-awareness services (Yang, 2008). Compared to PCs, mobile devices are used for entertaining and location-specific needs more. Proper services of such features will encourage individuals' involvement with the content.

Based on the articulated definition of the five constructs consisting of perceived m-interactivity, perceived m-interactivity has been conceptualized as a second-order construct. The latent reflective construct, m-interactivity, is a composite measure based on five manifest constructs, user control, two-way communication, synchronicity, connectedness and richness of contents.

H1: The higher the level of interactivity afforded in mobile websites, the greater the perceived level of a) two-way communication, b) active control, c) richness of content, d) synchronicity, and e) connectedness.

Perceived Usefulness and Perceived Ease of Use

Yang (2008) investigated the relationship between perceived interactivity and loyalty with satisfaction as a mediating factor. The results indicated that only two constructs of perceived interactivity (active control and two way communication) influenced satisfaction and, in turn, loyalty. In another study using different levels of interactivity, the latter was recently tested and, effects were shown on both effectiveness and efficiency (Cyr et al., 2009; Teo et al., 2003).

Technology Acceptance Model (TAM) suggests that perceived usefulness (PU) and perceived ease of use (PEOU) of IT are major determinants of a technology's usage. Davis (1989) defined PU as "the degree to which a person believes that using a particular system would enhance his or her job performance" and PEOU as "the degree to which a person believes that using a particular system would be free of effort." Users' beliefs also determine the attitude toward actual system use, which in turn determine the behavioral intentions (BI) to use the said technology. Finally, behavioral intentions to use a technology lead to its actual use. Within TAM, PEOU and PU constructs have been

considered important criteria in determining the acceptance and use of IT in the past decades (Keil et al., 1995; Malhotra & Galletta, 1999; Moon & Kim, 2001).

However, Davis (1989) argued that the technology acceptance research needed to address the effects of other variables on PU, PEOU, and user acceptance. Factors, which precede the acceptance of a new technology, vary with the technology characteristics, target users, and overall context (Moon & Kim, 2001). Likewise, mobile technology can be a good example of this, because it provides two-way communication in various contexts. In turn, such mobility comes with different interaction possibilities, depending on the particular environmental contexts (Dix et al., 2000). According to past studies on interactivity and user satisfaction, increased interactivity leads to increased performance quality (Shaffer & Hannafi, 1986) and time savings (Cross & Smith, 1996).

Thus, by building on past studies that suggested a relationship between interactivity and PU and PEOU, this study will test these relationships in the context of a university mobile website. It is plausible that the greater the perceived interactivity, e.g., users experience better control and access to a rich, two-way communication and contents, the more they will perceive it as useful and easy to use. Furthermore, if users believe the site is useful and easy to use, their intention to use the site is likely to increase. Therefore, the following hypotheses are proposed:

H2: Perceived interactivity will be directly related to the perceived usefulness of the mobile website.

H3: Perceived interactivity will be directly related to the perceived ease of use of the mobile website.

H4: Perceived usefulness of the mobile website will be directly related to the behavioral intention to use it.

H5: Perceived ease of use of the mobile website will be directly related to the behavioral intention to use it.

Perceived Enjoyment

According to Manovich (2006), interaction with computer and computer-based devices penetrates people's lives outside of work. The mobile phone does this particularly well with the plethora of animated icons, sounds, and personalized interfaces it affords, which makes the device (technology) even more attractive. Additionally, because of its multi-functionality and expandability, a mobile phone is being used for all kinds of non-work (i.e. leisurely) activities: entertainment (e.g., games, music, TV), information searching, and social life. As a result, new consumer purchase criteria, such as being friendly, pleasurable, aesthetically pleasing, and animated, have replaced efficiency and functionality (Manovich, 2006). With this viewpoint, the narrow focus on task-related usability has widened and has challenged designers and developers to introduce "emotional usability" (Kim & Moon, 1998). In such an emotional usability concept, enjoyment relates to the adoption of mobile services (Cyr et al., 2006; Jordan, 2000; Mahlke, 2007).

For example, in the research domain of online consumer behavior, Koufaris (2002) found that shopping enjoyment plays a critical role in predicting a consumer's intention to return to an online store. Moreover, Li et al. (2005) found that users, who perceive the use of IM (Instant Messaging) as enjoyable are more likely to continue using it. For IT product and services, users' perceived enjoyment seems to have a significant

effect on user's intention to use (Thong et al., 2006). In the context of online gaming, one important motive for playing these games is the pursuit of pleasure or enjoyment; players who experience enjoyment and the emotional response of pleasure are more likely to be motivated to play even more (Huang & Cappel, 2005; Kim et al. 2002; Wu & Liu, 2007). Such continuance of behaviors was also found by Cyr and colleagues (2007), who found a significant relationship between enjoyment and e-loyalty, i.e. the continued patronage of online stores.

Prior studies have not investigated the relationship between enjoyment and interactivity in a mobile context. Thus, this study adapts other, similar investigations in this manner. Cyr and colleagues (2009) investigated the relationship between interactivity and perceived enjoyment in the context of website. They found that enjoyment mediated the relationship between perceived interactivity and e-Loyalty. Moreover, Gonzales and colleagues (2009) conducted an experiment showing that perceived interactivity increases enjoyment in artistic spaces. Given the capability to control the sound, an interactive condition was able to generate sounds; however, a non-interactive condition allowed participants to only hear sounds that were previously recorded (intended to be more reflective than interactive). The results indicated a significant positive association between perceived interactivity and enjoyment. Their hypothesis was based on the assumption that interactivity enhances user experience and gives enjoyment. Similarly, the following hypotheses are suggested:

H6: Perceived Interactivity will be directly related to the perceived enjoyment of the mobile website.

H7: Perceived enjoyment of the mobile website will be directly related to the behavioral intention to use it.

Summarizing the aforementioned hypotheses, the proposed research model is presented in Figure 1.

Research Methodology

Participants

The context of this research is a university's mobile website; therefore, the sample was comprised of college students at a large Midwestern University. The sample was randomly recruited and only participants, who owned a mobile phone participated in the research, because mobile phone owners can be considered prospective mobile Internet users. Based on the data analysis method selected (i.e. Partial Least Squares or PLS), the minimum sample size should be the larger of (a) 10 times the number of items for the most complex construct; or (b) 10 times the largest number of independent variables impacting a dependent variable. In our model, the most complex construct contains 28 items. The first condition yields a minimum sample size required of 280, which was satisfied by the solicited sample of 288 responses.

These 288 subjects were recruited by making announcements in various random classes across the university. The sample consisted of 172 males and 106 females, aged 17-53 with a mean of 20.37 years, and all owned a mobile phone. Regarding usage of mobile phone, participants used a mobile phone on average for 6 years, and 86% of them had accessed and used the Internet through a cell phone or mobile device including a PDA, smart phone, i-touch, etc. but excluding a laptop computer. Interestingly, their most

used mobile services were social [email and chatting services (69.5%), and Facebook/Community service (69.2%)] rather than timely and location related information [News/Weather/Sports (62.7%), and GPS/Map/Navigation service (51.9%)] and entertainment [Game/Ringtone/Music (61%)]. Banking/Finance services (24.7%) were the least used services by this group.

Procedure & Measures

The survey was created using SurveyGizmo (http://www.surveygizmo.com) and participants required approximately fifteen minutes to complete this web-based self reported survey. Participants were randomly assigned to either a high or a low interactive scenario and were instructed to respond to the survey assuming they are in the situation described in the scenario (See Appendix 1). To randomly assign the two scenarios, a "A/B split testing" function from SurveyGizmo was used, which enabled the presentation of each scenario to a predetermined percentage of respondents (i.e., 50% to high and 50% to low).

Survey measures were adopted from previous research and modified to fit the context of this research (See Table 4). A 7-point scale, ranging from 1 (strongly disagree) to 7 (strongly agree), was used to measure all statements in the questionnaire.

Development of high and low m-interactivity scenarios

Two scenarios related to a mobile website experience when searching for university related information were developed (See Appendix 1). The reason for using these scenarios is to avoid potential biases from respondents' past experiences of university mobile websites. For this reason, a university name and specific university information were not provided in these scenarios. The scenarios included only

information regarding the features of the university mobile website along with situational narratives.

Interactivity was manipulated by creating one scenario that contained design features that were associated with a lower degree of interactivity, while the other contained features that increased the level of interactivity (See Table 5). The features corresponding to each interactivity level were adapted from the Yang (2008)'s qualitative study (See Table 3) and were modified to fit into the university website context.

To make better understanding of the scenarios, wireframes for both the high and low interactivity scenarios were developed and placed alongside them (See Appendix 1). The wireframe was modified from other university mobile web interfaces (specifically, MIT and Duke's mobile web), and irrelevant information for this study (e.g., logo, specific university information and images, university title, etc) was removed.

A pilot test was performed to test the manipulation of interactivity across the two scenarios (high vs. low). The sample for the pilot test consisted of 39 undergraduate and graduate students. Participants were randomly assigned to either the high or low interactivity scenarios, and responded to the questionnaire. Results of a t-test showed that the high and low scenarios were significantly different in terms of the perceived interactivity of the university mobile website and scenario used in this study (See Table 6).

Results

Reliability and validity of measurements

All perceived interactivity (two-way communication, active control, richness of contents, synchronicity and connectedness), perceived usefulness, ease of use, enjoyment

and behavioral intention constructs were examined for reliability, as shown in Table 4. Internal consistency is evaluated by Cronbach's alpha value and the composite reliability of each construct, and all scales exceeded the recommended rule of thumb of .80. Convergent validity and discriminant validity for each construct were demonstrated. Convergent validity (see Table 7) was assessed through the average variance extracted (AVE) to ensure constructs differed from each other, and all constructs exceeded the recommended rule of thumb of .50 (Fornell and Larcker, 1981). Discriminant validity (See Table 8) was reviewed by the PLS CFA method, and the measurement items loaded more on the latent variables than their loadings on other variables, which satisfy the requirement for discriminant validity (Gefen and Straub, 2005).

Given the above statistical test results, it is confirmed that the scales and constructs demonstrate sufficient reliability and validity.

Analysis

The structural model shown in Figure 2 was analyzed using the Partial Least Square (PLS) method through the SmartPLS package. PLS features advantages over other methodologies. The PLS is not only used to identify relationship between constructs, but also relationships between items and their corresponding constructs (Chin & Gopal, 1995). Also, the variance-based PLS supports confirmatory and exploratory research, and it is robust to deviations from a multivariate distribution (Gefen et al., 2000). These features are important, because it allows for the specification of both the structural and measurement models.

Overall, the model demonstrated high explanatory power. The R-square of the behavioral intention construct was .46, or 46% of the variance in user intention to use the

university mobile website was explained by the model. The R-square values for the rest of the endogenous variables exceeded the 10% benchmark recommended by Falk and Miller (Falk & Miller, 1992). The variance explained is large enough to accept perceived interactivity (PI), perceived usefulness (PU), perceived ease of use (PEOU) and perceived enjoyment (PE) as significant antecedents of users' behavioral intention to use a university mobile website (BI). Also, all path coefficients of hypothesized relationships are significant. Table 9 presents the validation of these hypotheses in more detail.

Reviewing the above results, the following conclusions may be drawn. First, on the topic of perceived interactivity, the higher the level of interactivity afforded by the mobile website, 1) the greater the perceived level of "two-way communication (TWO)" [H1: $\beta = .61$, $p < .001$]; 2) "active control (AC)" [H1: $\beta = .61$, $p < .001$]; 3) "richness of contents (RICH)" [H1: $\beta = .71$, $p < .001$]; 4) "synchronicity (SYN)" [H1: $\beta = .82$, $p < .001$]; and 5) "connectedness (CON)" [H1: $\beta = .71$, $p < .001$].

Second, it was theorized that incremental levels of interactivity would be positively associated with the perceived usefulness (PU), perceived ease of use (PEOU) and perceived enjoyment (PE) of the university mobile website. There was strong statistical support for all three hypotheses, i.e., H2 ($\beta = .38$, $p < .001$), H3 ($\beta = .65$, $p < .001$), and H6 ($\beta = .59$, $p < .001$).

Third, the often studied relationships between perceived usefulness and behavioural intention, and perceived ease of use and behavioural intention were adapted in the context of the mobile university web and received strong support, as hypothesized (H4: $\beta = 0.13$, $p < .05$; H5: $\beta = .23$, $p < .05$). Also, perceived enjoyment was positively

related with the behavioural intention to use the university's mobile website (H7: $\beta = .48$, $p < .001$).

In addition to the path model, a t-test was performed to check for differences between the high and low interactive treatments in terms of interactivity and the dependent constructs. As expected, all construct means were significantly different between the two conditions of the university's mobile website (See Table 10).

Discussion

This study proposed and obtained support for a new theoretical model that furthers our understanding of constructs and consequents of interactivity in the context of mobile web design and use. Specifically, perceived interactivity was examined for its impact on the perceived usefulness, ease of use, enjoyment, and in turn, intention to use a university's mobile website.

From a theoretical point of view, this work contributes to mobile web design research by providing an initial understanding of what components shape interactivity, and how important interactivity may be in a mobile web context. This study supported that two way communication, active control, synchronicity, richness of contents, and connectedness of a mobile website reflect the level of interactivity, which validates Yang (2008)'s operationalization of the construct, and was further validated in this higher education, academic setting. Also, perceived interactivity was shown to positively affect users' perceptions of a mobile website (e.g., PU, PEOU and PE), all of which in turn drive their intention to use it. This finding contributes to an expanded understanding of technology adoption beyond what was afforded by TAM, and to consider interactivity as

a critical antecedent to perceived usefulness and ease of use, but more importantly as a precursor to positive user experiences and adoption of mobile websites, potentially leading to behavioral intention to use the mobile website.

In addition, the study showed that the strongest predictor of behavioral intention to use a university mobile website was perceived enjoyment rather than perceived ease of use or usefulness. This supports past research in that a mobile device is a personal gadget that is used not only for utility, but also for leisure (Manovich, 2006). This is consistent with participants' mobile Internet usage, where the most used mobile service were email/chat service and Facebook/community service instead of information related or monetary services. According to McNamara and Kirakowski (2005), perceived enjoyment is based on user experience, such as "how the person felt about the experience, what it meant to them, whether it was important to them, and whether it sat comfortably with their other values and goals." Therefore, when the mobile technology affords a user-experience, which supports their values and expectations, it leads to enjoyment, and ultimately results in use of the service. Also, in terms of perceived enjoyment, perceived interactivity was found to be highly related with it, suggesting a highly interactive mobile website is likely to be more enjoyable than one with less interactivity.

Further, the study was completed through the use of two scenarios (high vs. low interactivity), which varied in terms of the embedded features and illustrated through mobile website wireframes. The manipulation was successful and when considering implications for practice, mobile web designers or web services directors (particularly in higher education) interested in attracting users benefit from the visual metaphors of the

features that afford greater interactivity and produce more enjoyable experiences among users.

As with all studies, there are limitations associated with this study that prompt future research in this area. First, the study's tasks were simulated through scenarios (even though web design elements were also shown as wireframes). Thus, any sense of urgency or other contextual responses that a user may experience in a real-world setting may not arise here. While this is a limitation in terms of the realism of the study, it is a means of controlling for additional variables that could not be otherwise measured during the experiment. Second, the scenarios were developed for only two extreme cases, high and low. If multiple scenarios were developed based on multiple levels of interactivity, more specificity can be acquired regarding which features are essential or could be excluded while maintaining a sufficient level of interactivity that would elicit a favourable user experience associated with the mobile website. Third, since the manipulated features were adapted from Yang (2008)'s study, additional concurrent investigations may be underway that incorporate new features further raising the potential level of interactivity associated with a mobile website. While most of the existing university mobile websites are still fairly static, new social or other services (e.g., campus radio, student life, wall papers and ringtones) may become increasingly integrated with a university's mobile web. Therefore, continuous monitoring for new features that may impact interactivity is suggested for practitioners.

In closing, this research explored the perceived interactivity in the context of a university mobile website, and offered support for the impact of interactivity on perceptions of usefulness, ease of use, and enjoyment, and in turn, user intentions to use a

university's mobile website, an outcome that is likely to grow in importance in the coming years.

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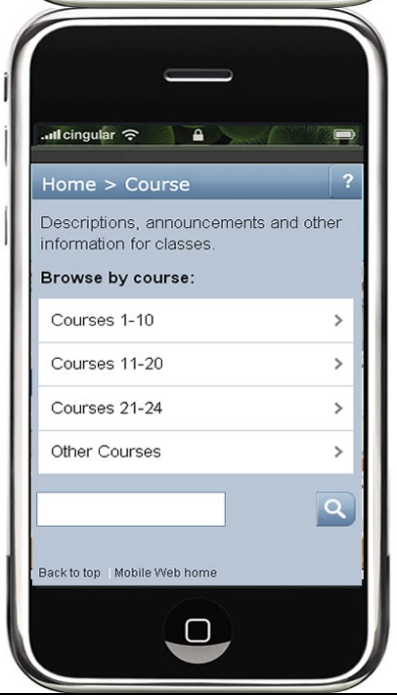
Appendix 1

High Interactive Scenario

Suppose you are a freshman and your first class starts today. You are meeting with your friend and taking the class together but your friend couldn't get the class information. You promised to your friend that you would help her and give class information. However, you didn't bring the notes with all information about your first class such as course number, location, syllabus, and so on.

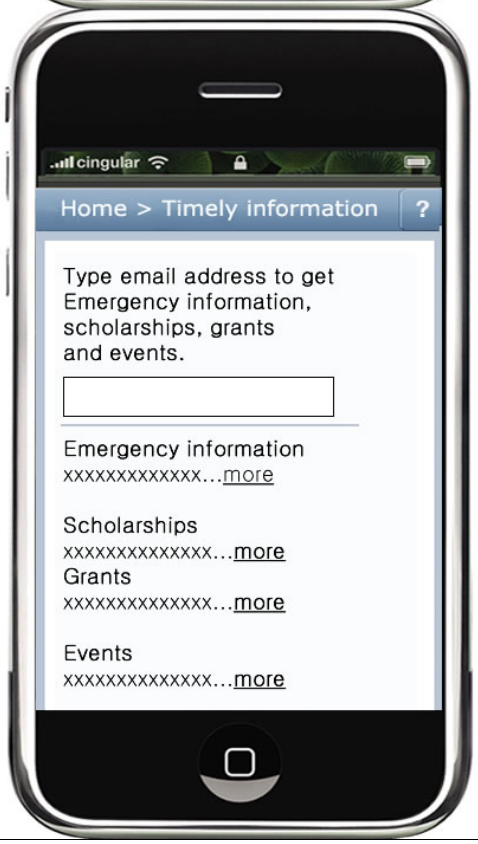
You suddenly remembered the university has the mobile website.

You access the mobile website through your mobile phone in order to get the class information.
On the mobile website, you can use a "search engine" to search the course number.



When you click on the course number, you can see course related information such as the syllabus, the building number, and professors' contact information. In addition to the general course information, the site contains comments from students who took the class previous semester. Moreover, the site contains links to chat room, email lists of classmates, and social network sites. You may download the syllabus and you can send it to your friend using a share link. You just type her email address, and the class information is automatically attached.

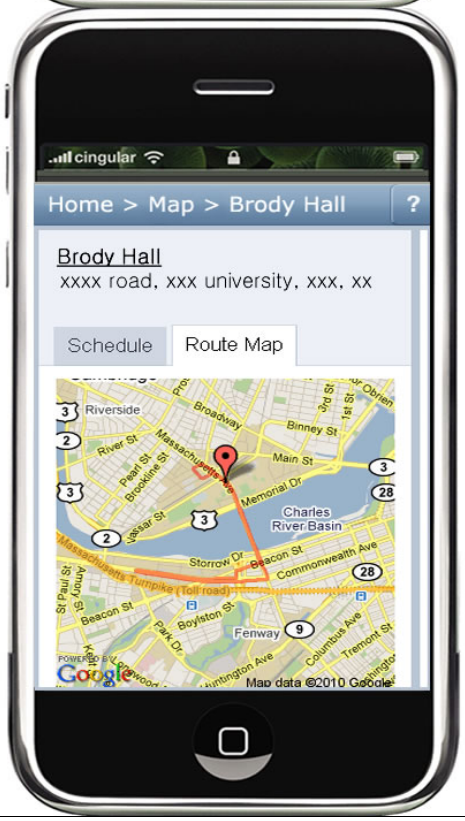
In addition, there is a notice board with the input box where you can type your mobile phone number and get timely school related information (e.g., scholarship, grants, and events) and emergency alerts through SMS.



The clock is ticking and you might be late. You decided to contact the professor. When you click the professors' email address or phone number, it automatically opens up the email window or calls the number directly.

To get to the building, you can click on the building address. The map to the building is available in pictures by 3G. It automatically recognizes your location and gives direction by showing pictures. In addition, the map has information on the closest bus stop and time schedule.

The entire process of surfing the university mobile website seems to be smooth with fast speed. The speed of loading pages and downloading information is faster than you would expect.

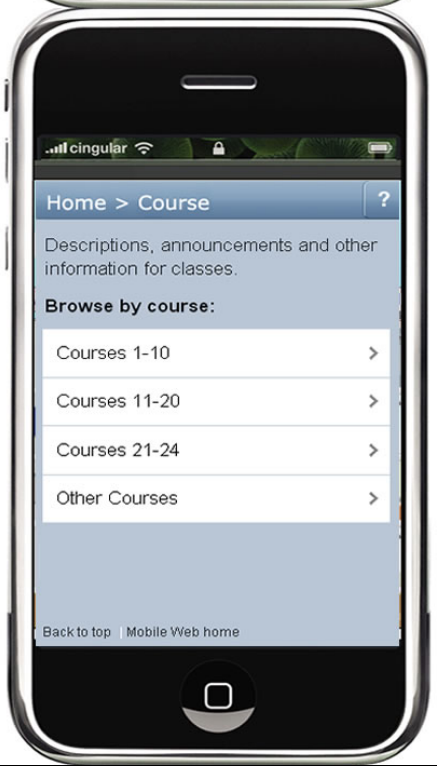


Low Interactive Scenario

Suppose you are a freshman and your first class starts today. You are meeting with your friend and taking the class together, but your friend couldn't get the class information. You promised to your friend that you would help her and give class information. However, you didn't bring the notes with all information about your first class such as course number, location, syllabus, and so on.

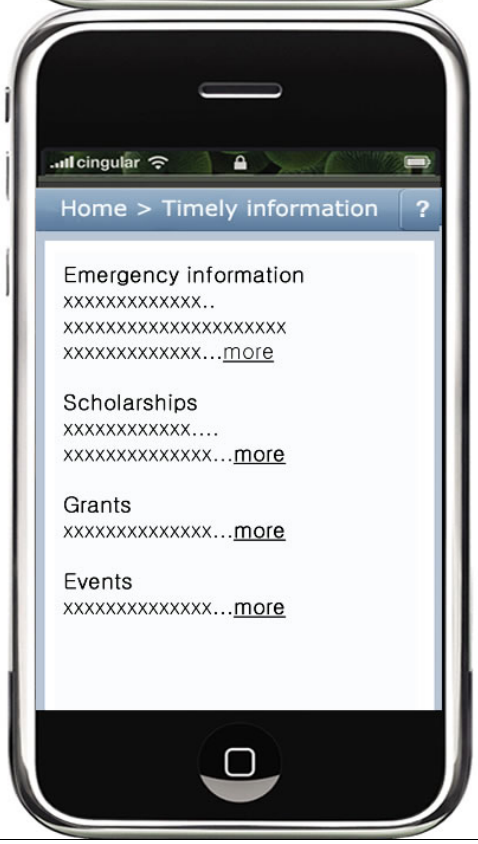
You suddenly remembered the university has the mobile website.

You access the mobile website through your mobile phone in order to get the class information. Since the mobile website doesn't provide a "search engine," you may have to navigate the site for a while to get to the course section.



When you click on the course number, you can see course related information, such as the syllabus, the building number, and professors' contact information. In addition to the general course information, you expect to see other classmates' information or any social network links, which can share class info or ideas. However, the site does not contain chat room, email lists of classmates, comments from students who took the class previous semester, or social network sites. You may be able to download the syllabus and let your friend know the class information. However, there is no link for sharing. So you have to open the new window and login to your own email account. You type all the information you want to share, or you can just close the window, memorize all information, and call your friend.

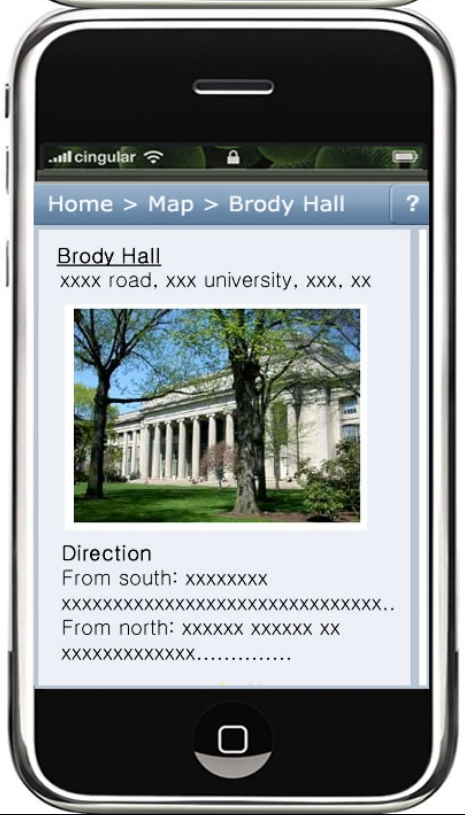
In addition, the site does not contain a notice board with timely school related information (e.g., scholarship, grants, and events) and emergency alerts. You would like to get that timely information but there is no way of getting it except by visiting the website.



The clock is ticking and you might be late. You decided to contact the professor. The professors' email address and phone number are not linked. You might need to memorize the phone number or email address. Moreover, you have to close the window to call or send the email.

To get to the building, you clicked the building address, but it shows the directions only in text format without any pictures. The directions might be difficult to you because you are not familiar with the campus. You might want to find the near bus stop but you have no idea how to get that information.

The entire process of surfing the university mobile website seems to be difficult with slow speed. The speed of loading pages and downloading information is slower than you would expect.



Appendix 2

Tables

Table 1

Feature Oriented Interactivity Constructs

Feature oriented\Multi-dimensional constructs	
Constructs	Author
Complexity of available choice (selectivity), The effort that any user of a media system must exert to access information, Responsiveness (conversationality), Information use monitoring, Ease of adding information, Interpersonal communication facilitation (asynchronous & synchronous)	Heeter, 1989
Customer support (order status tracking, form inquiry, feedback, comment), Marketing research (site survey, new product proposal, Personal choice helper (keyword search, dealer locator), Advertising/promotion/publicity (e-coupon, online orders, prizes, multimedia shows), Entertainment (e-postcard, games)	Ghose & Dou, 1998
Reciprocity in the exchange of information, availability of information on demand, response contingency, customization of content, real-time feedback	Haubl & Trifts, 2000
Interpersonal interactivity (email address, email link, discussion forums), Content interactivity (hypertext in story, headline, links to other websites, search engine)	Zeng & Li, 2006
Choice, Non-sequential access of choice, Responsiveness to learner, Monitoring information use, Personal-choice helper, Adaptability, Playfulness, Facilitation of interpersonal communication, Ease of adding information.	Chou, 2003; Chou et al., 2010
Feature oriented\Interactivity level	
Low: Product information Medium: Product information, FAQ, Feedback form, Search engine High: Product information, FAQ, Feedback form, Search engine, online quest-book, online forum, online chat	Teo et al., 2003
Quality of information visualization - Static condition - Basic bar chart version	Cyr et al., 2009

- Metaphor version
- Dynamic version
- Accurate version

Table 2

Perception Oriented Interactivity Constructs

Perception oriented interactivity	
Constructs	Author
Playfulness, choice, connectedness, information collection, reciprocal communication	Ha & James, 1998
User control, responsiveness, real time interactions, connectedness, personalization/customization, playfulness	Dholakia et al., 2000
Perceived user control, perceived responsiveness, perceived personalization	Wu, 2000
Real time conversation, no delay, engaging	McMillan & Hwang, 2002
Active control, two-way communication, synchronicity	Liu, 2003
Playfulness, choice, connectedness, information collection, reciprocal communication	Chen & Yen, 2004
User control, responsiveness, personalization, connectedness/ Mobile specific: Ubiquitous connectivity, contextual offer	Lee, 2005
Reciprocity, responsiveness, nonverbal, speed of response	Johnson et al., 2006
User control, Connectedness, Responsiveness	Cyr et al., 2009
User control, two-way communication, connectedness, synchronicity, interpersonal, playfulness	Gao et al., 2010

Table 3

Interactivity features (Yang, 2008)

Mobile interactivity features	Why important?
Send content to other users	For urgent communication

	Being in contact all the time
User reviews	For getting reliable information and real experience
Chat with other users	For interacting with human
Chat with service provider	To get help 24 hour To get real-time communication in urgent situation
Location-specific content	To get real time information To get merits which are different from the Internet To get information at the right moment and right place Convenient on the move
Customized promotion	Beneficial for both providers and users Useful when the Internet access is difficult To feel cared
Search engine	Efficiency
Multimedia (3G)	To interact with contents
Speed of responding	To get info quickly

Table 4

Measurement Items and Sources

Constructs	**Measure Items** ***(7-point multi-item scales from Strongly disagree to Strongly agree)***	**Sources**
M-Interactivity	Active control (AC)	
	• While I was on the mobile website, I always seemed to be aware of where I was. • While I was on the mobile website, I always seemed to be able to go where I thought I was going. • While I was on the mobile website, I always seemed to know where I was going. • It was easy to find my way through the mobile website.	Wu, 1999; McMillan & Hwang, 2002; Liu, 2003

• I felt that I had a lot of control over my surfing experience of the mobile website. • I felt that my actions decided the kind of experiences I got in the mobile website.	
Two-way communication (TWO)	
• The mobile website enabled two-way communication. • The mobile website seemed to be effective in gathering visitors' feedback. • The mobile website enabled conversation. • The mobile website seemed to facilitate two-way communication between the visitors and the site. • The mobile website was interpersonal. • The mobile website made me feel it wanted to listen to its visitors. • The mobile website gave visitors the opportunity to respond.	Wu, 1999; McMillan & Hwang, 2002; Liu, 2003
Synchronicity (SYN)	
• The mobile website seemed to operate at high speed. • The mobile website seemed to load fast • The mobile website processed my input very quickly. • Getting information from the mobile website was very fast. • I felt I was getting instantaneous information.	Wu, 1999; McMillan & Hwang, 2002; Liu, 2003
Richness of Contents (RICH)	
• The mobile website provided a variety of format of content. • The mobile website seemed to provide a variety of content. • The mobile website seemed to keep my attention. • Information in the mobile website helped to arouse users' curiosity and to entertain them. • This mobile website offered timely packets of information (e.g. scholarship information, and emergency alerts) to me.	McMillan & Hwang, 2002; Lee, 2005

	• The mobile website provided me with location-specific packets of information (e.g. near bus stop). • The mobile website provided me with optimal information or service that was contextually relevant to me based upon where I was and what I was interested in.	
	Connectedness (CON)	
	• I could access the mobile website any time for the necessary information or service. • I could use the mobile website anywhere, any time at the point of need. • I could access the mobile website anywhere for the necessary information or service.	Lee, 2005
Perceived Enjoyment (PE)	• I found my visit to this mobile website enterta ining. • I found my visit to this mobile website pleasa nt. • I found my visit to this mobile website excitin g. • I found my visit to this mobile website is fun. • I found my visit to this mobile website enjoya ble.	Cyr et al., 2009; Nysveen et al, 2005; Yu et al, 2005; Heijden, 2001
Perceived Ease of Use (PEOU)	• I could easily search for information. • I was able to access the information I needed quickly. • It took little effort to find information I needed. • The mobile website allowed me to make a de cision quickly.	Teo et al., 2003; Cyr et al., 2009
Perceived Usefulness (PU)	• Using this mobile website improved my task quality. • Using this mobile website improved the perfo rmance of my tasks. • Using this mobile website supported the critic al part of my tasks. • Using this mobile website enabled me to acco mplish tasks more quickly.	Hsu & Lu, 2004

	• Using this mobile website increased my task productivity. • Using this mobile website enabled me to have more accurate information. • Using this mobile website enabled me to acce ss a lot of information. • Using this mobile website enabled me to acce ss the newest information. • Using this mobile website enabled me to acqu ire high quality Information.	
Behavioral intention to use the mobile website	• Given the chance, I intend to visit this univer sity mobile website. • I expect my use of this university mobile web site to continue in the future. • I have intention to use university services via this mobile website.	Suh & Han, 2003; Pavlou, 2003; Lee, 2005

Table 5

Manipulation of Interactivity in Mobile University Website

Interactivity features	High interactivity	Low interactivity
Send content to other students	I can send information to other students using a share link. I can type the email address, and the information is automatically attached.	I have to open the new window and login to my own email account. Moreover, I have to type all the information I want to share.
User reviews	Comments section from students who previously took the class last semester is available	No comments section
Chat with other students	Chatting room, email lists of classmates, and social network sites, which built the page for the class are available.	No links for chatting room, email lists of other students, and social network sites
Chat with service provider	I can click the link of the professors' email address or phone number, and it	The contact information has no links. I have to memorize the phone number, or email

	automatically connects to email window, or directly call the number.	address. Moreover, to call or send the mail, I have to open the new window.
Location-specific content	The map has information of closest bus stop, and time schedule.	No location specific content
Customized promotion	There is an input box, which I can put my mobile phone number and get the school related information (e.g., scholarship, grants, and events) and emergency alerts through SMS.	No timely school related information and emergency alerts through SMS.
Search engine	In order to get the class information, I can use the search engine.	No search engine
Multimedia (3G)	I can click the link of the building address, and it connects to the map. The map automatically recognizes my location and gives direction by showing pictures.	I can click the link of the building address, and it shows the direction in text format without any pictures.
Speed of responding	The speed of loading and downloading is faster than I expected.	The speed of loading and downloading is slower than I expected.

Table 6

Results of t-test in the manipulation check

	High (n= 21)		Low (n= 18)		Sig	
	Mean	SD	Mean	SD	t value	P value
Two-way communication	3.54	.78	2.01	.67	6.09	.000
Active control	4.15	.57	2.63	.69	7.42	.000
Richness of content	4.08	.61	2.46	.62	7.29	.000
Synchronicity	4.40	.57	2.24	.88	8.54	.000
Connectedness	4.40	.61	3.18	.90	4.38	.000

Table 7

Construct validity

	High (n= 21)		Low (n= 18)		Sig	
	Mean	SD	Mean	SD	t value	P value
Two-way communication	3.54	.78	2.01	.67	6.09	.000
Active control	4.15	.57	2.63	.69	7.42	.000
Richness of content	4.08	.61	2.46	.62	7.29	.000
Synchronicity	4.40	.57	2.24	.88	8.54	.000
Connectedness	4.40	.61	3.18	.90	4.38	.000

Table 8

CFA loadings matrix

	PI	PU	PEOU	PE	BI
AC1	**.70**	.56	.55	.52	.57
AC2	**.71**	.57	.57	.51	.54
AC3	**.68**	.54	.51	.48	.51
AC4	**.79**	.64	.67	.58	.61
AC5	**.76**	.61	.60	.60	.58
AC6	**.66**	.55	.54	.50	.47
TWO1	**.76**	.57	.60	.61	.55
TWO2	**.76**	.55	.61	.62	.55
TWO3	**.76**	.55	.61	.63	.55
TWO4	**.72**	.56	.60	.57	.52
TWO5	**.73**	.55	.59	.56	.53
TWO6	**.71**	.56	.58	.53	.53
TWO7	**.75**	.60	.61	.65	.57
SYN1	**.83**	.66	.75	.67	.62
SYN2	**.83**	.67	.78	.65	.62
SYN3	**.84**	.68	.79	.68	.64
SYN4	**.86**	.70	.82	.68	.67
SYN5	**.85**	.69	.76	.67	.66
RICH1	**.79**	.72	.68	.70	.68
RICH2	**.78**	.71	.67	.67	.68
RICH3	**.75**	.70	.64	.64	.66
RICH4	**.66**	.57	.54	.62	.56
RICH5	**.82**	.72	.71	.66	.65
RICH6	**.80**	.71	.70	.69	.63
RICH7	**.83**	.73	.79	.67	.65
CON1	**.74**	.73	.70	.59	.66
CON2	**.74**	.73	.69	.60	.66
CON3	**.76**	.75	.70	.64	.69
PU1	.71	**.86**	.70	.69	.70

PU2	.72	**.86**	.72	.70	.74
PU3	.72	**.85**	.71	.71	.70
PU4	.76	**.91**	.77	.71	.77
PU5	.70	**.85**	.69	.63	.70
PU6	.67	**.84**	.65	.62	.69
PU7	.68	**.81**	.70	.62	.72
PU8	.72	**.81**	.69	.67	.70
PU9	.77	**.88**	.75	.71	.73
PEOU1	.81	.78	**.93**	.72	.74
PEOU2	.81	.76	**.93**	.73	.71
PEOU3	.77	.75	**.91**	.69	.69
PEOU4	.81	.78	**.93**	.70	.72
PE1	.74	.71	.70	**.93**	.74
PE2	.78	.78	.76	**.90**	.74
PE3	.74	.72	.70	**.95**	.73
PE4	.73	.72	.70	**.94**	.72
PE5	.76	.76	.73	**.94**	.76
BI1	.76	.81	.75	.75	**.97**
BI2	.74	.79	.72	.76	**.95**
BI3	.77	.82	.76	.77	**.97**

Table 9

Hypotheses validation

Hypo's	**From**	**To**	**Beta**	**t-Value**	**p-Value**	**Sig**	**Status**
H1	PI	TWO	.63	7.77	.0000	***	
	PI	AC	.61	7.92	.0000	***	
	PI	RICH	.71	9.87	.0000	***	Supported
	PI	SYN	.82	20.85	.0000	***	
	PI	CON	.71	11.95	.0000	***	
H2	PI	PU	.38	4.20	.0000	***	Supported
H3	PI	PEOU	.65	6.76	.0000	***	Supported
H4	PU	BI	.13	2.17	.0154	*	Supported
H5	PEOU	BI	.23	2.14	.0166	*	Supported
H6	PI	PE	.59	6.76	.0000	***	Supported
H7	PE	BI	.48	4.98	.0000	***	Supported

Table 10

Difference in constructs for the high and low interactive conditions

	High		Low		Sig	
Constructs	Mean	SD	Mean	SD	t value	P value
Perceived Interactivity	3.82	.65	3.24	.77	6.03	.000
Two-way communication	3.43	.84	2.69	1.06	6.35	.000
Active control	4.00	.71	3.42	.88	5.93	.000
Richness of content	3.71	.69	3.16	.82	5.88	.000
Synchronicity	3.77	1.01	2.87	1.15	6.82	.000
Connectedness	4.04	.79	3.71	.81	3.46	.001
Perceived Usefulness	3.78	.75	3.40	.78	3.88	.000
Perceived Ease of Use	3.83	.87	3.10	1.03	6.30	.000
Perceived Enjoyment	3.25	.89	2.78	1.01	4.02	.000
Behavioral intention	3.88	.95	3.36	1.04	4.25	.000

Figures

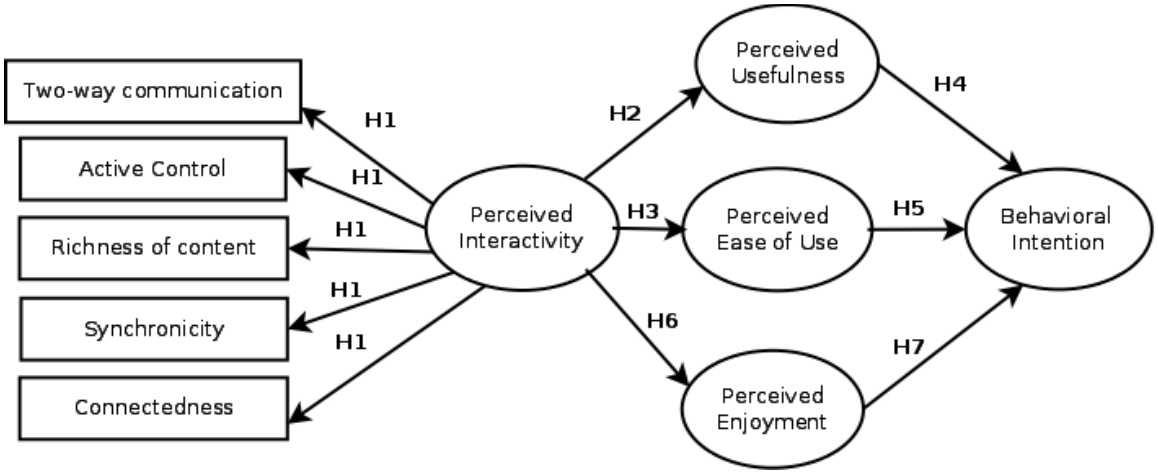
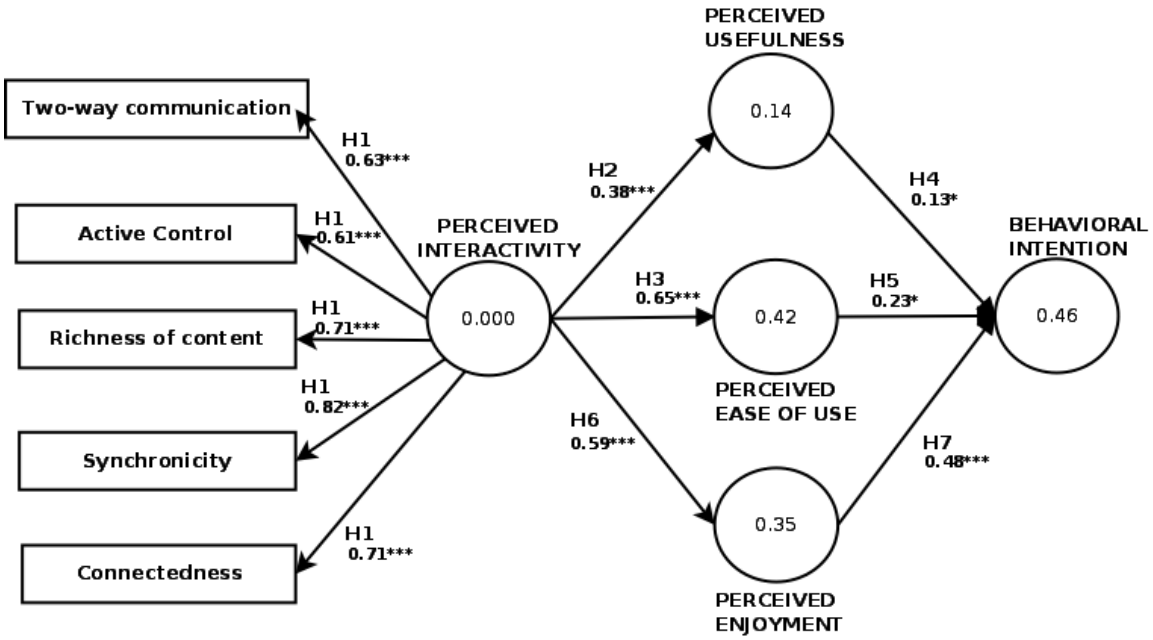


Figure 1. Proposed Research Model



*p < .05, **p < .01, ***p < .001

Figure 2. The Structural Model