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Antecedents and consequents of a mobile website's interactivity

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Abstract
The value proposition of mobile technology for education is expected to grow as forecasts speak of mobile internet users exceeding desktop internet users by 2014. A key concern for higher education administrators will be how to implement a mobile website that attracts and retains students in its use. To answer this question, a scenario-based study of 288 USA college students was conducted involving two wireframes of a mobile website design varying only in its degree of interactivity. A PLS-based data analysis offered support for the positive effects of 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 (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
Adoption, ease of use, enjoyment, interactivity, mobile, mobile web, PLS, technology acceptance model, usefulness

Introduction

With the advent of mobile technology, students are increasingly becoming nomadic learners. The former stationary nature of desktop computing restricted the 'anytime-anyplace'

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potential of e-learning to a setting where a learner was in front of his or her desk (Steinfield, 2003). However, according to Klopfer et al. (2002), handheld computers can facilitate social interactivity, context sensibility and individuality, in addition to portability and connectivity, which support educational interaction anytime-anyplace. In the context of education, mobile internet access can promote situated learning, allowing for enhanced educational experiences because of the potential to draw on a student's environment and activities (Naismith et al., 2004). Mobile technologies are also versatile and interactive allowing users to share text-based information, as well as media (e.g. images, audio, and video) from the world around them without any 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 and Schiefner, 2008). In higher education, mobile devices can be used by students to gain access to course materials, as well as for timely notifications, for example, regarding changes in due dates or class events (Corlett et al., 2004). It seems clear that the value of mobile technology in a university context will continue to grow, as increasingly more students and more instructors leverage mobile content and corresponding services. A study by the EDUCAUSE Center for Applied Research (ECAR) found that more than half (51.2 percent) of over 7000 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 et al., 2009). More recently, according to 'Internet Trends' (Morgan Stanley, 2010), internet enabled devices are being quickly adopted and it is expected that mobile internet users will exceed desktop internet users by 2014. A key concern for higher education administrators will be how to implement a mobile website for their institution that attracts and retains students in its use.

In commerce, how a company interacts with its customers becomes a critical success factor. As electronic commerce (e-commerce) and its subset, mobile commerce (m-commerce), make it possible for customers to interact with salespeople even when the two cannot be collocated, the significance of interactivity increases (Bae et al., 2006). However, a limited number of empirical studies have examined the importance of such interactivity online and over new media more broadly. In earlier research, such as the proposal of the Technology Acceptance Model (Davis, 1989), emphasis had been placed on the constructs of perceived usefulness and perceived ease of use as predictors of technology adoption. It was not until 15 years later that Teo et al. (2003) tested a model in which perceived interactivity was shown to affect the cognitive constructs of 'effectiveness and efficiency', two usability measures that parallel those of ease of use and usefulness (Coursaris and Kim, 2011). Then, Johnson et al. (2006) obtained support for the positive impact of perceived interactivity on customer attitudes toward websites. More recently, interactivity was also found to be related to the behavioral intention to return to a website (Jiang and Benbasat, 2007). Hence, it is reasonable to expect that perceived interactivity would affect other related cognitive constructs in addition to ease of use and usefulness. Also, affective elements have more recently received attention as important predictors of desired outcomes; for example, enjoyment impacting attention (Kim et al., 2007; Sun and Zhang, 2006; Tractinsky, 2004), white space impacting perceptions of attractiveness and subsequently usability (Coursaris and Kripintiris, 2012), and color combinations influencing perceptions of aesthetics and in turn usability (Coursaris et al., 2008). What emerges from this aggregate body of knowledge is that when either or both

cognitive and affective elements are considered in design implementations, users are more likely to visit a website (Cyr et al., 2006).

Most past studies on factors influencing a user's behavioral intention to visit a website have been conducted in the context of e-commerce (Cyr et al., 2007, 2009) or m-commerce (Yang, 2008). Such past studies had investigated the effects of perceived interactivity solely on cognitive components (Coursaris et al., 2007, 2012; Teo et al., 2003), on both cognitive and affective components but excluding perceptions of interactivity (Cyr, 2006), or on satisfaction and the behavioral intention to use the technology (Chou, 2003; Yang, 2008). More recently, Cyr et al. (2009) did investigate both cognitive and affective components inclusive of perceived interactivity; however, due to the research design employed, it was unclear which features contributed to either the increasing or decreasing levels of website interactivity.

This study examines the effects of perceived interactivity on users' behavioral intention to use a higher education institution's mobile website, while exploring the effects of both cognitive and affective perceptions on the latter. The manipulation involved in this study involved two mobile web usage scenarios, which varied solely in terms of the level of interactivity afforded by each design and the included site features. This research aims to extend our understanding of mobile website adoption and offer actionable recommendations to practitioners tasked with the design and development of mobile websites.

Theoretical foundations and research model

The 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, as any human–computer interaction experience is highly contextual (Coursaris and Kim, 2007), numerous studies have offered support for additional variables adding to the explanatory power of a TAM-based adoption model. For example, Information Systems scholars have offered support for the effects of 'Perceived Enjoyment (PE)' on the adoption of various information technologies (Childers et al., 2001; Cyr and Head, 2008; Cyr et al., 2007; Moon and Kim, 2001). Another construct that is likely to have a similar effect on adoption is perceived interactivity, given its potential benefits, such as increased engagement, performance quality (Schaffer and Hannafin, 1986; Szuprowicz, 1996), and time efficiency (Cross and Smith, 1996). In addition to these potential benefits of perceived interactivity, Teo et al. (2003) found a positive relationship between interactivity and PU, and between the former and PEOU. Moreover, Cyr et al. (2009) found a positive relationship between PE and perceived interactivity in a screen Web setting.

This study will build on Yang's (2008) research and will investigate the effects of perceived interactivity on the user's experience in the context of a university mobile website. 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 use 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.

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, allow the communicator to have more control over the content, structure, and pace of the communication. In addition, Liu and Shrum (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 (Goggin and Spurgeon, 2007; Quiring, 2009; Richard, 2006; Shin et al., 2011; Sohn, 2011; Tremayne, 2008); however, their general concept of interactivity entails a sense of connection with and a successful provision of information to users, who perceive the information system as being responsive. Interactivity has been mentioned in many information systems studies and has been regarded as a key value to successful communication, marketing, advertising, commerce, and course management systems (Chou et al., 2010; Cyr et al., 2009; Goggin and Spurgeon, 2007; Larsson, 2011; Lee, 2005; Liu and Shrum, 2002; Macias, 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 degree of an information system's interactivity (see Table S1 in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1). In other words, the number of features a certain website incorporates in its design determines how interactive the website is (or is not). In addition, the type of features a certain website includes also impacts its level of interactivity. For example, in the 'feature-oriented' approach, prior research has assessed the relative impact of different interactivity dimensions on the appeal of the website (Chou, 2003; Chou et al., 2010; Ghose and Dou, 1998; Häubl and Trifts, 2000; Zeng and Li, 2006). Moreover, Teo et al. (2003) manipulated the level of interactivity by including certain website features and analyzing their effect on user satisfaction, effectiveness, and efficiency.

On the other hand, the 'perception-oriented' approach is concerned with users' perceptions of interactivity; that is, it is contingent on a subjective evaluation of interactivity, rather than a more objective one based on the actual design features that may impact interactivity (see Table S2 in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1); this approach has been considered by many scholars in their respective works (Chen and Yen, 2004; Cyr et al., 2009; Dholakia et al., 2000; Downes and McMillan, 2000; Gao et al., 2010; Ha and James, 1998; Johnson et al., 2006; Lee, 2005; Liu, 2003; McMillan and Hwang, 2002; Wu, 2000).

With regard to both of these approaches, Yang's (2008) research is of particular relevance. Yang (2008) conducted a qualitative study to determine the kinds of features that would have a positive effect on the perceived interactivity experienced in a mobile commerce (m-commerce) setting, and identified five relevant constructs: (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 enhance interactivity (see Table S3 in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1) and why they are important. Yang (2008) allocated terms to these five constructs based on various definitions offered in prior literature and by interviewees' explanations. Cyr (2009) also employed certain features to manipulate the level of interactivity and to investigate its effect on three constructs: namely, user control, connectedness, and responsiveness; through these three constructs, Cyr represented perception-oriented interactivity. However, the level of manipulation was not significantly different. On the other hand, according to Yang (2008)'s study, each of the five constructs of interactivity was found to be associated with perceptions of higher levels of interactivity. Therefore, this study will adapt the interactivity features and the five constructs as described by Yang (2008), which are described in more detail further below.

Active control (Gao et al., 2010; Hoffman and Novak, 1996; Steuer, 1992; Williams et al., 1988; Yang, 2008) and two-way communication (Bretz and Schmidbauer, 1983; Gao et al., 2010; Yang, 2008) have been long regarded as the core components of interactivity. First, active control, commonly referred to as user control, refers to a user's capability to have control over all of the activities occurring on mobile websites, such as choosing content, timing, and sequence of a communication. Furthermore, active control is associated with the ease of information use and the reduced efforts to complete the task (Cyr et al., 2009; Gao et al., 2010; Yang, 2008). However, in mobile communications, perceived user control may be understood differently. For example, if a technology pushes information automatically to update individuals, some may perceive it as active control, while others may become annoyed by it (Gao et al., 2010; Yang, 2008). Therefore, individuals may be more likely to experience 'active control' when they feel empowered with control over the communication exchange and without feeling disturbed by it. The second construct of two-way communication follows the concept of reciprocity, which speaks to a 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 engage in mutual communication rather than a monologue. Mobile communication is particularly suited to facilitate two-way communication; therefore, individuals are expected to give and receive feedback more so on their mobile devices than through their PCs (Gao et al., 2010; Kiousis, 2002).

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., 2000). When two parties communicate, a 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 and James, 1998; Johnson et al., 2006; Liu, 2003; McMillan and Hwang, 2002). As mobile communications are often held 'on the go,' speed becomes particularly important as instant responses are often needed; therefore, there is an increasing need for a fast connection speed (Gao et al., 2010).

While synchronicity concentrates on diminishing the time lag between sending and receiving messages, connectedness represents the ubiquitous access to the mobile

internet, which allows people to connect with others anytime, anywhere (Yang, 2008). Such access also includes links to related information, channels, and alerts to timely events or newsletters. These possible connections could increase 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 the mobile internet's flexible access. In accordance, Lee (2005) included 'Connectedness' as an additional construct defining mobile interactivity.

Lastly, content richness refers to the provision of entertaining documents and/or context-aware services (Yang, 2008). Compared to PCs, mobile devices are arguably used more so in the fulfillment of those needs, and the provision of these features is likely to encourage individuals' greater involvement with the content.

Based on the articulated definitions of the five constructs comprising perceived m-interactivity, the latter can be conceptualized as a second-order construct. Therefore, the latent reflective construct of m-interactivity is a composite measure based on five manifest constructs in user control, two-way communication, synchronicity, connectedness and richness of contents. Hence, the following hypothesis is proposed:

H1: The higher the level of interactivity afforded by a mobile website, 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, interactivity was shown to have a positive effect on both efficiency and effectiveness (Cyr et al., 2009; Teo et al., 2003).

The Technology Acceptance Model (TAM) proposed that perceived usefulness (PU) and perceived ease of use (PEOU) of IT are key drivers 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 shape the attitude toward actual system use, which in turn impacts the behavioral intention (BI) to use the said technology. Finally, the behavioral intention to use a technology has been shown to lead to its actual use. Within TAM, PEOU and PU constructs have been considered as important criteria in determining the acceptance and use of IT in the past decades (Keil et al., 1995; Malhotra and Galletta, 1999; Moon and 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 and Kim, 2001). Likewise, mobile technology can be a good example of such nuances, 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 (Schaffer and Hannafin, 1986) and time savings (Cross and 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 level of the perceived interactivity, for example 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), interactions with computers and computer-based devices penetrate people' 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 multifunctionality and expandability, a mobile phone is being used for all kinds of non-work (i.e. leisurely) activities, including entertainment (e.g. playing games, listening to music, watching TV), information searching, and supporting one's social life. As a result, new consumer purchase criteria, such as being user 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 and 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 those users' intention to use the particular IT product/service (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 and Cappel, 2005;

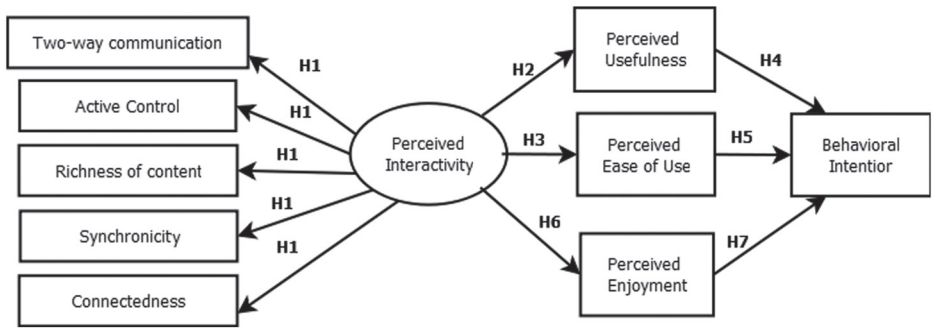

Figure 1. Proposed research model.

Kim et al., 2002; Wu and Liu, 2007). Such continuance of behaviors was also found by Cyr et al. (2007), who found a significant relationship between enjoyment and e-loyalty: that is, 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 to delve into this research question. Cyr et al. (2009) investigated the relationship between interactivity and perceived enjoyment in the context of a screen 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 produces enjoyment. Similarly, the following hypotheses are suggested:

H6: Perceived interactivity will be directly related with 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 involves a university mobile website; therefore, the sample was comprised of college students at a large Midwestern University. A convenience

sample was recruited and screened for mobile phone ownership, 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. Participants had used a mobile phone on average for 6 years, and 86 percent of them had accessed and used the internet through a cell phone or mobile device including a PDA, smart phone, i-touch, etc. (note: laptop computers were excluded from the classification of 'mobile device'). Interestingly, their most used mobile services were social (email and chatting services: 69.5%; and Facebook/Community service: 69.2%) rather than time critical 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 and measures

The survey was created using SurveyGizmo (http://www.surveygizmo.com), and participants required approximately fifteen minutes to complete this web-based 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 their scenario (See supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1). To randomly assign the two scenarios, an '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[1] were adapted from previous research to fit the context of this research. 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 the experience with a mobile website experience while searching for university-related information were developed (see Figure S1 in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1). The reason for using these scenarios is to avoid potential biases from respondents' past experiences with 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.

Table 1. 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

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 S4 in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1). The features corresponding to each interactivity level were adapted from the Yang (2008)'s qualitative study (see Table S3 in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1) and were modified to fit into the university website context. Content validity was performed by asking a panel of five subject matter experts in human-computer interaction/mobile commerce/experience design whether the assigned features were essential in enhancing the corresponding dimension of interactivity. The result was a 100 percent agreement between them, or a content validity ratio of 1.

To make better understanding of the scenarios, wireframes for both the high and low interactivity scenarios were developed and placed alongside them (see supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1). 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 1).

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. Internal consistency was 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

Table 2. Construct validity.

Construct	α value	Composite reliability	AVE
PI	.97	.98	.58
PU	.95	.96	.73
PEOU	.94	.96	.85
PE	.96	.97	.87
BI	.96	.97	.92

discriminant validity for each construct were also demonstrated. Convergent validity (see Table 2) 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 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.

Results

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. PLS is not only used to identify relationship between constructs, but also relationships between items and their corresponding constructs (Chin and 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 they allow 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 percent benchmark recommended by Falk and Miller (Falk and 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 3 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

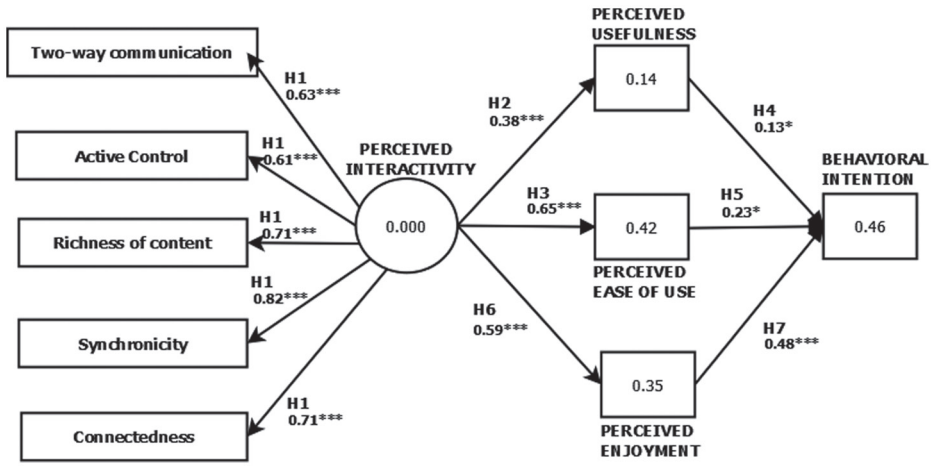

Figure 2. The structural model.
*p < .05, **p < .01, ***p < .001.

Table 3. Hypotheses validation.

Hypotheses	From	To	Beta	t-Value	p-Value	Sig	Status
H1	PI	TWO	.63	7.77	.0000	***	Supported
	PI	AC	.61	7.92	.0000	***	
	PI	RICH	.71	9.87	.0000	***	
	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

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: that is, 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 behavioral intention, and perceived ease of use and behavioral intention were adapted in the context of the mobile university web and received strong support, as hypothesized (H4: $\beta = 0.13$,

Table 4. Difference in constructs for the high and low interactive conditions.

Constructs	High		Low		Sig	
	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

$p < .05$; H5: $\beta = .23$, $p < .05$). Also, perceived enjoyment was positively related with the behavioral 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 4).

Discussion

This study proposed and obtained support for a new theoretical model that furthers our understanding of first-order constructs and consequents of interactivity in the context of mobile website design and use. Specifically, perceived interactivity was defined and measured as the aggregate experience of increased levels of two-way communication, active control, synchronicity, richness of content, and connectedness. Interactivity was then 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 scholarship 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 form the degree of interactivity, which validates Yang (2008)'s operationalization of the second-order construct, and offered support for its applicability in the context of higher education. This support, in essence, also highlights five dimensions that are critical for the user-system interaction and offers guidance to designers and developers for optimal, user-centered design. This study's findings reinforce that long gone are the days where static presentment of information can offer sufficient value to web visitors and result in continued use of the website. In an era when

personalization can finally be truly achieved via powerful mobile devices and embedded controls, attention needs to be paid indeed to the creation of similarly user-centric, engaging interfaces with the availability of rich content that at the same time offer users access to relevant information or connection to other users.

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 the website. This finding contributes to an expanded understanding of technology adoption beyond what was afforded by TAM, and to a consideration of interactivity as a critical antecedent to perceived usefulness and ease of use, but more importantly as a precursor to positive user experiences and potentially leading to the adoption of a mobile website or interface.

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 services 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: that is, '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 that supports their values and pre-trial expectations, it leads to enjoyment with, and, ultimately, use of the service. Also, perceived interactivity was found to be highly correlated with perceived enjoyment suggesting a highly interactive mobile website is likely to be significantly more enjoyable than one with less interactivity – and, again, is more likely to be used.

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 the research design may be utilized in future studies pertaining to mobile web design or user experience more broadly. Further, when considering implications for practice, mobile web designers or web services' directors (particularly in higher education) interested in attracting and retaining mobile web users will benefit from the visual metaphors of the features illustrated in the Figure S1 (in the supplementary material at http://nms.sagepub.com/content/14/7/1128/suppl/DC1), that afford greater interactivity and produce more enjoyable experiences among users.

Limitations and future research

As with all research, there are limitations associated with this study that prompt future research in this area. First, this study's tasks were simulated through scenarios (even though web design elements were also shown as wireframes). Thus, any sense of realism, 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. While the scenarios show the two possible situations and use circumstantial detail, the wording of scenarios could be suggestive, and, in turn, participants may be influenced and respond with more extreme evaluations than they would perhaps through the use of more neutral language within each scenario. However, as the low-fidelity prototype of the mobile website did not allow for real user interaction, the level of interactivity was manipulated through such suggestive language as would ensure significantly different levels of perceived interactivity, and explore its effects on the consequents of interest – that is, perceived ease of use, usefulness, and enjoyment; this objective was achieved. Third, the concept and first-order constructs of interactivity were adapted from Yang (2008)'s study; however, Yang did not classify which features are explicitly associated with each first-order interactivity construct. This presents an opportunity for future research through interviews or a qualitative study to obtain support for the specific correspondence between design features and interactivity dimensions. Fourth, 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 construct of 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 issue that is likely to grow in importance in the coming years.

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Note

1. http://bit.ly/id3SDo

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