

Investigating faculty decisions to adopt Web 2.0 technologies: Theory and empirical tests

Haya Ajjan, Richard Hartshorne*

University of North Carolina at Charlotte, United States

ARTICLE INFO

Article history:

Accepted 6 May 2008

Keywords:

Web 2.0
Emerging technologies
Faculty perceptions
Faculty adoption
Decomposed theory of planned behavior
Factor analysis

ABSTRACT

While students are increasing their use of emerging technologies such as text messaging, wikis, social networks, and other Web 2.0 applications, this is not the case with many university faculty. The purpose of this study was to assess faculty's awareness of the benefits of Web 2.0 to supplement in-class learning and better understand faculty's decisions to adopt these tools using the decomposed theory of planned behavior (DTPB) model. Findings indicated that while some faculty members feel that some Web 2.0 technologies could improve students' learning, their interaction with faculty and with other peers, their writing abilities, and their satisfaction with the course; few choose to use them in the classroom. Additional results indicated that faculty's attitude and their perceived behavioral control are strong indicators of their intention to use Web 2.0. A number of implications are drawn highlighting how the use of Web 2.0 could be useful in the classroom.

Published by Elsevier Inc.

Internet technologies such as e-mail, course websites, and news-groups have added value to traditional classroom knowledge delivery and have impacted the course delivery and design in many colleges and universities (Barnett, Keating, Harwood, & Saam, 2004). In the past few years a new wave of Internet technologies, Web 2.0, has emerged with the potential to further enhance the teaching and learning environment in higher education. With the use of Web 2.0, students no longer access the web only for course information; instead they access and create collective knowledge through social interactions (Maloney, 2007). Now, the use of Web 2.0 enables students to connect different pieces of information and create new information that could be shared with others (Maloney, 2007).

Many studies in the past have shown that technology use in the classroom has increased over the past years; however, this use has been primarily limited to content delivery, such as accessing course materials (Maloney, 2007). Because of this, coupled with the emergence of Web 2.0 technologies into the everyday life of students, it is important to explore faculty use of Web 2.0 technologies to support teaching and learning in higher education. The purpose of this study was to assess faculty's awareness of the potential of Web 2.0 technologies to supplement the classroom learning and to assess their adoption of such technologies using the decomposed theory of planned behavior as the theoretical foundation (Taylor & Todd, 1995).

The following two research questions were addressed in this study:
Research Question 1: Are university faculty aware of the benefits of using Web 2.0 technologies to supplement the traditional classroom instructions?

Research Question 2: What factors best predict faculty's decision to adopt Web 2.0 technologies to supplement the traditional classroom instructions?

1. Review of the literature

Web 2.0, sometimes referred to as the "read/write Web", provides online users with interactive services, in which they have control over their own data and information (Madden & Fox, 2006; Maloney, 2007). Examples of Web 2.0 participatory technologies include wikis, blogs, instant messaging, internet telephony, social bookmarking, and social networking sites. These new technologies make sharing content among users and participants much easier than in the past and change the way documents are created, used, shared, and distributed (Dearstyne, 2007). In fact many companies have adopted Web 2.0 applications to foster internal knowledge sharing and collaboration through document sharing portals (Dearstyne, 2007). In the past few years, the blooming of online social networks to exchange personal information, photos, videos (Facebook, Flickr, YouTube), and the increased need for tools to quickly create, analyze, and exchange the ever increasing amount of information, along with the ease of use of Web 2.0 collaboration software, have fueled a surge in the emergence of Web 2.0 technologies (Dearstyne, 2007). In this review of the literature, a brief history of Web 2.0, an overview of a variety of Web 2.0 applications, and pedagogical affordances of Web 2.0 applications are discussed.

* Corresponding author. Department of Educational Leadership, University of North Carolina at Charlotte, College of Education, 9201 University City Blvd., Charlotte, NC 28223, United States. Tel.: +1 704 687 8711 (Office).

E-mail address: rhartsho@unc Charlotte.edu (R. Hartshorne).

1.1. Web 2.0

The Web 2.0 “read/ write” idea is not new. Prior to wikis, blogs, social bookmarking, and social networking, there were listservs, groupware, and web-based communities linking people with common interests (Alexander, 2006). However, the openness of these new applications, allowing anyone to modify content, make Web 2.0 technologies different (Alexander, 2006). Users now play a more fundamental and active role in information architecture (Alexander, 2006). Web 2.0 applications replace the traditional authoritative media delivery institutions with the wisdom of the crowd (Madden & Fox, 2006). In this study, there was a focus on the following four types of Web 2.0 collaboration tools: blogs, wikis, social networking, and social bookmarking.

1.1.1. Blogs

Blogs (abbreviated from weblogs) are user journal entries in the form of text, images, and links to web content, such as websites or other blogs. Blogs have a variety of formats and might include the user expressing their opinion about a topic or documenting activities. Blogs are interactive in the sense that other users could provide comments on the information posted by the blog author. Educational applications of blogs include researching, tracking, interpreting, and evaluating blogs for political commentary (multiple perspectives), cultural events, business, or other news and for examining changes over time (Alexander, 2006).

1.1.2. Wikis

Wikis (What I Know Is) refer to collaborative websites that allow users to interact by adding, removing, or editing site content. The most well-known wiki implementation is Wikipedia (<http://www.wikipedia.org/>). Wikipedia allows users to modify encyclopedic entries by creating a reviewer and editing structure (Alexander, 2006). Wikipedia is shaped by the wisdom of the users and it is the richest source of information and terms especially for younger people (Madden & Fox, 2006). Illustrating the increasing popularity of wikis, a recent study conducted by the Pew Research Center found that 30% of Internet users visit Wikipedia to search terms and meanings (Madden & Fox, 2006). Interestingly, 24.25% of these users are between the ages of 18–24. In this same age group, only 14.94% use Encarta's Online Encyclopedia (<http://encarta.msn.com/>). Wikis are useful in educational settings in that they support individualized learning, allowing for more socially defined search structures and promote collaboration through group editing and peer review (Alexander, 2006).

1.1.3. Social networking

Social networks allow users to create personal profiles and establish a variety of networks that connect him/her with family, friends, and other colleagues (Lenhart & Madden, 2007). According to a recent Pew Research Center survey, about 55% of all online Americans between the ages of 12 and 17 use online social network sites (Lenhart & Madden, 2007). Additionally, almost half of these users check their account either once a day or several times a day. While the increase in the use of these sites has generated concerns among parents, school officials, and government officials about the potential risks posting personal information on these sites, it is evident they have a series of positive pedagogical implications (Lenhart & Madden, 2007). Currently, users utilize these sites to stay in touch with their friends, to make plans, make new friends, or flirt with somebody online (Lenhart & Madden, 2007). Extending this idea, these sites could be used to establish a series of academic connections or to foster cooperation and collaboration in the higher education classroom.

1.1.4. Social bookmarking

Social bookmarking sites allow users to store, describe, and share numerous web addresses with others. Users can explore bookmark collections of others by subscribing to their bookmark pages. If users

are interested in a site they could tag it using few words to help others find it easily. Educators could use social bookmarking to facilitate collaborative information discovery (Alexander, 2006). They could create a social bookmarking page to save important pages about a topic. Students could also collaborate on group projects using bookmarking sites, sharing links, and uploading resources discovered, while educators could follow their students bookmark pages to gain insight on their research process and progress (Alexander, 2006).

1.2. Why Web 2.0?

As previously mentioned, Web 2.0 concepts are now new. Listservs and other web-based communities designed to bring people with shared interests together have existed for quite some time (Alexander, 2006). While not designed specifically for educational purposes, Web 2.0 applications have a number of affordances that can make them useful in teaching and learning environments and are rooted in strong pedagogical underpinnings of constructivism (Ferdig, 2007). The increasingly ubiquitous access, ease of use, functionality, and flexibility of emerging Web 2.0 technologies have made them much more appealing as instructional tools (Boulos, Maramba, & Wheeler, 2006; Chen, Cannon, Gabrio, Leifer, & Bailey, 2005). Moreover, Web 2.0 applications can support pedagogical approaches such as active learning, social learning, and student publication, by providing environments and technologies that promote and foster these interactions (Ferdig, 2007).

1.2.1. Digital natives and the changing nature of the web

Prensky (2001) refers to the next generation as ‘digital natives’; individuals for whom digital technology has become ubiquitous. These digital natives are participating in social networks, social bookmarking, blogging, and other Web 2.0 activities on a regular basis (Pence, 2007). This, coupled with the changing nature of the web from primarily a source of information and content to a new tool for fostering the development of communities, creating information and knowledge, and sharing ideas, presents unique challenges and potential benefits for higher education (Maloney, 2007).

1.2.2. Supporting social and active learning

Many constructivist theorists posit that learning is a social process and that learning occurs through interactions and sharing information with each other (Bruner, 1996; Lave & Wenger, 1991; Vygotsky, 1978). Additionally, researchers have found that collaborative learning help students retain information better than students working individually (Johnson & Johnson, 1986). In addition to social learning, many theorists cite active participation as a major component of effective learning environments (Ferdig, 2007; Linn, 1991). While many traditional web applications focus on the delivery of content, Web 2.0 applications, such as blogs, wikis, social networks, and social bookmarks, focus more on social connectivity. These Web 2.0 applications are driven by user contributions and interactions, unlike most of the sites of the Web 1.0 era. Thus, Web 2.0 applications provide venues for collaboration and sharing of information to support the networks necessary for social and active learning. Using Web 2.0 technologies such as wikis and social networks to supplement in-class instructions could create an interactive, collaborative learning experience for students in a media they are familiar with. This is especially true to college students who are considered “digital natives” of the world of the Internet and computers (Prensky, 2001).

1.2.3. Venues for student publication

Web 2.0 applications provide numerous opportunities for learners to publish their work globally, which provide for a number of pedagogical benefits. For example, Dixon and Black (1996) and Routman (1991) found that publication of student work resulted in increased motivation for many students. Riley and Roberts (2000), as well as Schofield and Davidson (2002), reported that, as a result of the publication of student

work to the World Wide Web, students had more positive attitudes toward the subject matter and student achievement increased. Other studies have reported that student web publication promotes reflection regarding individual growth and development and provides opportunities for students to visualize the purpose of their work much more clearly (Snyder, Lippincott, & Bower, 1998; Spitz, 1996; Willet-Smith, 1993). Additionally, learning environment that include student publication afford opportunities for students to examine problems in different ways, establish new connections, and ultimately develop a new entity that can be shared globally (Maloney, 2007).

While Web 2.0 applications have many characteristics that support teaching and learning, research related to this area is limited. To date, the majority of studies have been comparative in nature and have focused primarily on social networking tools, such as Facebook and MySpace and their uses in many extracurricular educational contexts (Pence, 2007). Additionally, while the use of Web 2.0 technologies is commonplace among “digital natives” (Prensky, 2001), it is important to explore perceptions of the teaching and learning implications of Web 2.0 applications, as well as actual use of Web 2.0 technologies to support teaching and learning of faculty. In this study, faculty awareness of the potential of Web 2.0 technologies to supplement the classroom learning experience, as well as factors that influence the adoption of such technologies using the decomposed theory of planned behavior as the theoretical foundation (Taylor & Todd, 1995) were explored.

2. Theoretical framework

This study employs the decomposed theory of planned behavior (Fig. 1) as the theoretical framework to understand faculty's intention to use Web 2.0 (Taylor & Todd, 1995). The decomposed theory of planned behavior originated from theory of planned behavior (TPB) that posits that actions are determined by a combination of people's behavioral intentions and perceived behavioral control (Ajzen, 1991). Both the theory of planned behavior and the decomposed theory of

planned behavior assert that behavior is a direct function of behavioral intention and both view behavioral intention as a function of attitude, subjective norms, and perceived behavioral control. In the decomposed theory of planned behavior attitude, subjective norms, and perceived behavioral controls are all decomposed into lower level belief constructs (Taylor & Todd, 1995). Using the decomposed model not only allows us to better understand the antecedents' relationship, but also it allows us to uncover specific factors that impact the adoption or use of new technology (Taylor & Todd, 1995). Taylor and Todd (1995) showed that the decomposed model has better explanatory power over the theory of planned behavior. Therefore, this model was selected to explain the adoption intention and use of Web 2.0 technologies to supplement in-class learning by faculty.

2.1. Attitude

Attitude is defined as the degree to which the individual favors the behavior being examined (Ajzen, 1991). This study focuses on three attitudinal components: perceived usefulness, perceived ease of use, and compatibility. *Perceived usefulness* is defined as the degree to which the individual believes that a technology would improve his/her job performance (Davis, 1989). The higher the perceived usefulness (or perceived advantage) the more likely it is for the individual to adopt the new technology (Rogers, 2003). *Ease of use* represents the degree to which an innovation is easy to understand and operate (Rogers, 2003) or the degree to which the particular technology is free of effort (Davis, 1989). Technologies that are perceived to be less complex to use have higher possibility of acceptance and use by potential users. Ease of use has been found to be an important determinant in the technology adoption decision (Davis, 1989). *Compatibility* is defined as the degree to which technology fits with the potential existing values and experiences (Rogers, 2003). Tornatzky and Klein (1982) found that an innovation is more likely to be adopted when it is compatible with the job responsibility and value system of an individual. As the ease of use,

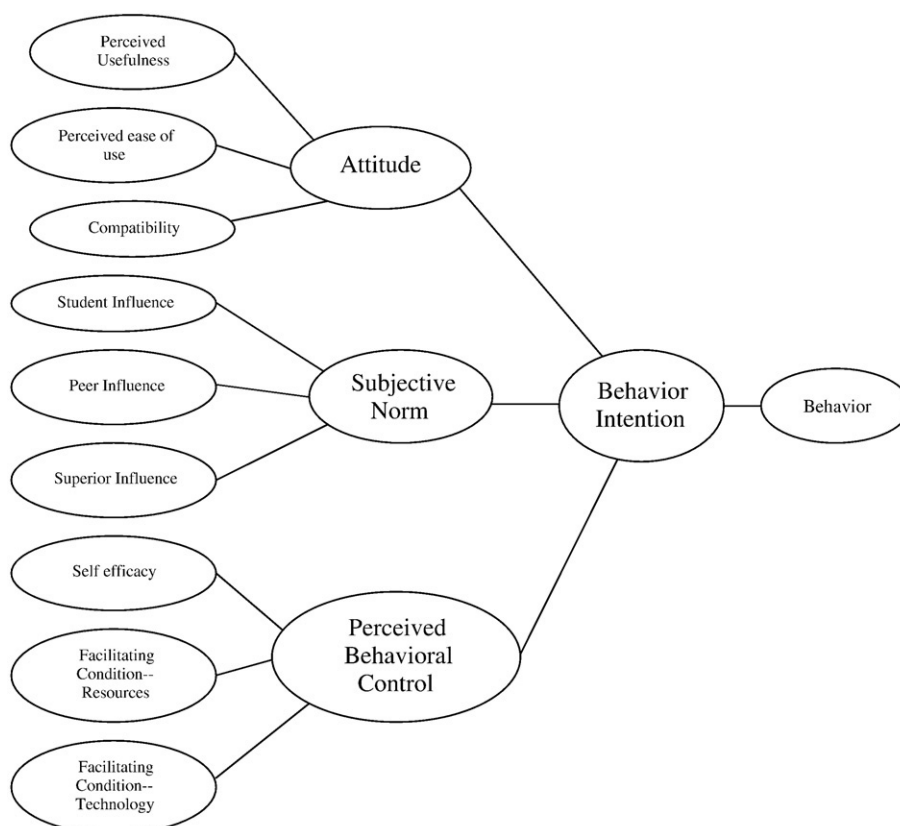


Fig. 1. Faculty adoption of Web 2.0 technologies in the classroom – based on the decomposed theory of planned behavior.

usefulness, and compatibility increase, the attitude toward using the technology is likely to become more positive.

2.2. Subjective norms

Subjective norms refer to the social pressures that make an individual perform a particular behavior (Ajzen, 1991). Different social groups might have different opinions regarding the adoption of a particular technology (Taylor & Todd, 1995). For this study, three groups were considered: superiors, peers (other faculty), and students. While superiors might feel that adopting Web 2.0 technology may improve student's learning or ratings, other faculty might feel that it requires an undesired change in the current process. Students, on the other hand, might be more supportive since their level of comfort with Web 2.0 technologies is high (Prensky, 2001).

2.3. Perceived behavioral control

Perceived behavioral control accounts for situations where individuals do not have complete control over their behavior and are made of two components (Ajzen, 1991). The first is *self-efficacy* reflecting the personal comfort with using technology (Bandura, 1982). The other component includes *facilitating conditions* (Triandis, 1979) reflecting the availability of resources such as time, money and other resources needed to use the technology. Greater self-efficacy to use technological applications is likely to lead to higher level of behavioral intentions and actual usage (Compeau & Higgins, 1995; Taylor & Todd, 1995). However, according to Taylor & Todd, (1995), the absence of facilitating conditions can negatively impact the intention and usage of technology.

3. Research hypotheses

3.1. Attitude

Past literature has shown that attitude influences behavioral intentions (Ajzen & Fishbein, 1980). Attitude in regard to the use of Web 2.0 technologies is defined as the faculty desirability to use Web 2.0 to support in-class learning. Attitude's positive relationship to behavioral intention has received a strong empirical support in previous research (Ajzen & Fishbein, 1980; Taylor & Todd, 1995). Therefore, it is expected that faculty's favorable attitude to use Web 2.0 to positively influences their intention to use Web 2.0.

Hypothesis 1. Attitude of users towards using Web 2.0 positively affects behavioral intentions.

3.2. Subjective norms

Subjective norms are concerned with how an individual's behavior is influenced by the desire to act as other important referents think we should act or as they act themselves (Taylor & Todd, 1995). Applied to faculty use of Web 2.0, subjective norms will reflect the faculty's perception of whether their behavior is encouraged and accepted within their circle of influence. A positive relationship between subjective norms and intention to use Web 2.0 to supplement in-class learning is hypothesized:

Hypothesis 2. Subjective norms of users in relation to usage of Web 2.0 positively affect behavioral intentions.

3.3. Perceived behavioral control

The individual's perception on how easy or difficult it is to carry out the behavior is referred to as perceived behavioral control (Ajzen, 1991). This is closely related to the individual's perception of control over carrying out a behavior. Past literature has demonstrated that perceived behavioral control is an important determinant of intention

and use of technology (Taylor & Todd, 1995). Applied to Web 2.0, perceived behavioral control reflects the faculty belief regarding the resources and self-confidence in their ability to perform the behavior. A positive relationship is hypothesized between perceived behavioral control and intention to use Web 2.0. Therefore,

Hypothesis 3. Perceived behavioral control of users in relation to usage of Web 2.0 technologies positively affects behavioral intentions.

3.4. Behavioral intention

Behavioral intention is concerned with the motivational factors when a subject intends to take a specific action (Ajzen, 1991). The theory of planned behavior (Ajzen, 1991) suggests that behavioral intention is the most important determinant factor in predicting the decision to take a specific action or not. Past studies have used behavioral intention to forecast specific behavior, given the close relationship between intention and behavior (Ajzen, 1991). A meta-analysis study showed that an average correlation of 0.53 has been reported between intentions and behavior (Sheppard, Hartwick, & Warshaw, 1988). A positive relationship between intention and actual behavior when it comes to using Web 2.0 technologies to supplement in-class learning was expected.

Hypothesis 4. Behavioral intention to use Web 2.0 positively affects behavior.

3.5. Decomposed behavior

The initial set of hypotheses are based on TPB; as mentioned earlier Taylor and Todd (1995) recommended decomposing the three measures of attitude, subjective norms, and perceived behavioral control into multidimensional constructs to provide a better understanding of each behavior. Also, this has been recommended to provide higher explanatory power and better predictive validity (Taylor & Todd, 1995).

3.6. Perceived usefulness

Perceived usefulness is the degree to which the subject believes that the use a technology will enhance performance (Davis, 1989). Perceived usefulness of using Web 2.0 technologies is defined as the extent to which faculty members believe that using Web 2.0 will enhance their effectiveness in the classroom. Past literature has found that perceived usefulness to influence behavioral intention through attitude (Davis, 1989; Taylor & Todd, 1995). Therefore,

Hypothesis 5a. Perceived usefulness positively affects attitudes towards usage of Web 2.0.

3.7. Perceived ease of use

Perceived ease of use has to do with the person's belief that the use of the new technology will be free of effort (Davis, 1989). Perceived ease of use of using Web 2.0 technologies is defined as the extent to which faculty members believe that using Web 2.0 technologies would be free of effort. The effect of perceived ease of use has been found to impact intention to use through attitude (Davis, 1989; Taylor & Todd, 1995). Thus,

Hypothesis 5b. Perceived ease of use positively affects attitudes towards usage of Web 2.0.

3.8. Compatibility

Compatibility has to do with the fit between the new technology with the individual's existing experiences and job responsibility (Rogers, 2003). Applied to Web 2.0 technologies, compatibility is defined as the extent to which faculty members believe that using Web 2.0 technologies would be compatible with their job responsibilities. The role of compatibility is mediated by attitude (Taylor & Todd, 1995). Hence,

Hypothesis 5c. Perceived compatibility positively affects attitudes towards usage of Web 2.0.

3.9. Referent groups

Given that expectations among different referent groups might differ, the literature recommends the decomposition of the referent groups into superiors, peers, and subordinates (Taylor & Todd, 1995). Faculty intention to use Web 2.0 technologies could be impacted by several referent groups in their social circle such as superior, peer, and student. Referent groups' impact on intention to use Web 2.0 is mediated by subjective norms (Taylor & Todd, 1995). Therefore,

Hypothesis 6a. Superior influence to use Web 2.0 technology positively affects subject norms.

Hypothesis 6b. Peer influence to use Web 2.0 technology positively affects subject norms.

Hypothesis 6c. Student influence to use Web 2.0 technology positively affects subject norms.

3.10. Self-efficacy

Self-efficacy is defined as individual's perceived capabilities to perform a behavior. Previous studies have found that higher self-efficacy is related to higher levels of behavioral intention and usage (Compeau & Higgins, 1995; Taylor & Todd, 1995). Applied to Web 2.0 use, self-efficacy describes faculty judgment of their own capabilities to use Web 2.0 technologies to support their in-class learning environment.

Hypothesis 7a. Self-efficacy of using Web 2.0 technologies positively affects perceived behavioral control.

3.11. Facilitating conditions

The absence of the required facilitating resources could present a barrier to usage and to the formation of intention (Taylor & Todd, 1995). In order to use Web 2.0 technologies, faculty members need to have facilitating condition available in terms of resources such as time, money and compatible technology. Thus,

Hypothesis 7b. Facilitating resource conditions of using Web 2.0 technologies positively affect perceived behavioral control.

Hypothesis 7c. Facilitating technology conditions of using Web 2.0 technologies positively affect perceived behavioral control.

4. Methods

4.1. Participants

In an effort to determine the intention of faculty members to adopt Web 2.0 technologies as tools in their courses, a survey was conducted during the fall semester of 2007. The participants in this study consisted of instructional personnel at a large university in the southeastern United States. Participation in the survey was completely voluntary and was open to all clinical, visiting, assistant, associate, and full professors at the university. In sum, there were 136 participants (Table 1), including 57 males (41.9%) and 79 females (58.1%). Ages of participants varied significantly. Two (1.5%) of the participants were under 30 years of age, 46 (33.6%) were between 30 and 39 years of age, 32 (23.4%) were between 40 and 49 years of age, 36 (26.3%) were between 50 and 59 years of age, and 21 (15.3%) were over 60 years of age.

4.2. Instrument

A survey instrument (Table 2) was designed using the decomposed theory of planned behavior as its guiding framework. The survey items

Table 1
Profile of respondents

| Variable | Value | Frequency | Percentage |
|--------------------|---------------------|-----------|------------|
| Gender | Male | 61 | 43 |
| | Female | 81 | 57 |
| Age | Under 30 | 3 | 2 |
| | 30–39 | 46 | 34 |
| | 40–49 | 32 | 23 |
| | Over 50 | 58 | 41 |
| | Lecturer | 28 | 20 |
| Role at university | Assistant Professor | 53 | 37 |
| | Associate Professor | 35 | 25 |
| | Professor | 16 | 11 |
| | Other | 11 | 7 |

were adapted from previous studies (Baylor & Ritchie, 2002; Davis, 1989; Taylor & Todd, 1995) and focused on items exploring comfort level with Web 2.0 technologies (blogs, wikis, social networking software, and social bookmarking), actual usage of specific Web 2.0 technologies in the classroom, and attitudes toward specific Web 2.0 technologies. Additionally, the instrument consisted of a series of items using a five point Likert-scale (strongly disagree to strongly agree) to examine factors that influence faculty intentions to utilize Web 2.0 technologies in their courses. Items focused on areas of actual usage, behavioral intention, attitude, ease of use, perceived usefulness, subjective norms, perceived behavioral control, peer influence, superior influence, student influence, compatibility, facilitating conditions (technology and resources), and self-efficacy. All survey items are included in Table 2.

4.3. Preliminary analysis

Cronbach's alpha was used to assess the internal reliability of the instrument (Table 2). The resulting values ranged from 0.67 to 0.98, which is acceptable for exploratory research (Nunnally, 1978). The instrument was pilot tested on a small sub-section of the intended sample (instructional personnel). Issues such as wording of items, and order of information were modified based on pilot-test results. Appendix A includes the final survey.

4.4. Statistical procedure for analysis

One of the main areas of focus of this study is the development of factors that influence behavioral intention related to the use of Web 2.0 in the classroom. Given the multivariate context of the variables involved in the study, path analysis models were used to test the hypothesized relationships (Wright, 1921). Before testing the models, collinearity among the variables in the study was tested. All correlations are significant and in the right direction with no correlation exceeding 0.83. The results of the path analysis show the factors determining the use of Web 2.0 technologies are shown in Table 3.

4.5. Data analysis

Using path analysis pioneered by Wright, real effects can be isolated from spurious effects (Wright, 1921). Also, path analysis is concerned with estimating the magnitude of the linkage between variables and to use these estimates to provide information regarding underlying causal processes. Based on the decomposed theory of planned behavior, the causal order among the exogenous and endogenous variables has been established (Cohen & Cohen, 1983). Thus, the research hypotheses were tested using path analysis.

4.6. Descriptive statistics

A profile of the respondents to this study is displayed in Table 1. Information in this table shows that 20% of the responding faculty were lecturers, 37% were Assistant Professors, 25% were Associate

Table 2
Reliability analysis of each construct

| Construct | Item | α value |
|---|---|----------------|
| <i>Actual usage/behavior</i> | | 0.89 |
| AU1 | I believe that I could communicate to others the consequences of using Web 2.0 in the classroom | |
| AU2 | I would have no difficulty explaining why Web 2.0 technologies may or may not be beneficial | |
| <i>Behavioral intention</i> | | 0.951 |
| INT1 | I plan to use Web 2.0 technologies in my classroom | |
| INT2 | I intend to use Web 2.0 technologies within the next semester | |
| INT3 | I will add Web 2.0 technologies to my class next semester | |
| <i>Attitude</i> | | 0.932 |
| ATT1 | Web 2.0 is useful in my teaching | |
| ATT2 | The advantage of using Web 2.0 outweighs the disadvantages of not using it | |
| ATT3 | Using Web 2.0 is a good idea | |
| <i>Ease of use</i> | | 0.9 |
| EU1 | I feel that using Web 2.0 will be easy | |
| EU2 | I feel that using Web 2.0 will be easy to incorporate in my classroom environment | |
| <i>Perceived usefulness</i> | | 0.946 |
| PU1 | I feel that using Web 2.0 will help my students learn more about the subject | |
| PU2 | I feel that using Web 2.0 will improve students' satisfaction with the course | |
| PU3 | I feel that using Web 2.0 will improve students' grades | |
| PU4 | I feel that using Web 2.0 will improve students' evaluation | |
| PU5 | To help my students better learn the material, I will incorporate Web 2.0 technologies in the classroom | |
| <i>Subjective norms</i> | | 0.84 |
| SN1 | My peers are using Web 2.0 technologies in their classroom | |
| SN2 | My superior confirms my ability and knowledge to use Web 2.0 technologies in the classroom | |
| SN3 | My peers think I will benefit from using Web 2.0 technologies in my classroom | |
| SN4 | My superior thinks it is important I use Web 2.0 technologies in my classroom | |
| SN5 | My students thinks it is important I use Web 2.0 technologies in my classroom | |
| <i>Perceived behavioral control</i> | | 0.67 |
| PBC1 | Using the Web 2.0 technologies is entirely within my control | |
| PBC2 | I have the knowledge and ability to use Web 2.0 | |
| <i>Peer influence</i> | | 0.94 |
| PI1 | Peers who influence my behavior would think that I should use Web 2.0 technologies in the classroom | |
| PI2 | Peers who are important to me would think that I should use Web 2.0 technologies in the classroom | |
| <i>Superior influence</i> | | 0.98 |
| | My superior, who influences my behavior would think that I should use Web 2.0 technologies in the classroom | |
| | My superior whom I report to would think that I should use Web 2.0 technologies in the classroom | |
| <i>Student influence</i> | | 0.92 |
| SI1 | Students who influence my behavior think that I should use Web 2.0 technologies in the classroom | |
| SI2 | Students who are important to me think that I should use Web 2.0 technologies in the classroom | |
| <i>Compatibility</i> | | 0.91 |
| Comp1 | Using Web 2.0 technologies are compatible with the way I teach | |
| Comp2 | Using Web 2.0 technologies fit well with the way I teach | |
| <i>Facilitating conditions—technology</i> | | |
| FC1 | The Web 2.0 technologies are compatible with the computer I already use in the classroom | |
| <i>Facilitating conditions—resources</i> | | 0.95 |
| FC2 | I can use Web 2.0 technologies using any computer connected to the Internet | |
| <i>Self-efficacy</i> | | |
| SE1 | I would feel comfortable using Web 2.0 technologies | |
| SE2 | I could easily use Web 2.0 technologies on my own | |
| SE3 | I know enough to use Web 2.0 technologies | |

Professors, and 11% were Full Professors. In terms of the age distribution, 2% were younger than 30, 34% were between the ages of 30–39, 23% were between the ages of 40–49, and 41% were over the age of 50. Finally, in terms of gender distribution 57% were females and 43% were males.

The faculty respondents felt that the use of different Web 2.0 technologies to supplement in-class learning could provide their students with numerous benefits (see Table 4). In terms of Web 2.0 technologies that would improve students' learning, 47% of the faculty

felt that the use of wikis would, 42% felt that about blogs, 16% felt that about social networking, and only 7% felt that about social bookmarking. About 46% felt that the use of blogs would increase the interaction between faculty and students, 24% felt that the same benefits would be attained from using social networking, and 16% felt that about the use of wikis. In terms of improving students' satisfaction with the course, 39% felt that the use of blogs would, 32% felt the use of social networking would, 22% felt the use of wikis would, and only 13% felt the use of social bookmarking would. About 41% of the respondents felt that the use of

Table 3

Path analysis of factors that influence faculty adoption of Web 2.0 technologies in the classroom

| Equation | R ² (adjusted R ²) | Beta (t-scores) |
|------------------------------------|---|-------------------|
| Behavior (B) | 0.442 (0.437) | |
| B = I | | |
| I | | 0.666 (9.991)*** |
| Behavioral intent (I) | 0.760 (0.754) | |
| I = A + SN + PBC | | |
| A | | 0.830 (12.334)*** |
| SN | | −0.060 (−0.952) |
| PBC | | 0.128 (2.218)* |
| Attitude (A) | 0.806 (0.801) | |
| A = PU + PEOU + C | | |
| PU | | 0.615 (7.604)*** |
| PEOU | | 0.144 (2.125)* |
| C | | 0.190 (2.546)* |
| Subjective norm (SN) | 0.641 (0.632) | |
| SN = SI + PI + SUPI | | |
| SI | | 0.356 (5.235)*** |
| PI | | 0.205 (2.344)* |
| SUPI | | 0.396 (5.114)*** |
| Perceived behavioral control (PBC) | 0.534 (0.522) | |
| PBC = SE + FC-R + FC-T | | |
| SE | | 0.518 (6.125)*** |
| FC-R | | 0.185 (1.321) |
| FC-T | | 0.098 (0.706) |

Notes: Figures shown are beta coefficients, t-values in parentheses.

* $p < 0.05$.** $p < 0.01$.*** $p < 0.001$.

blogs would improve students writing, while 29% felt the use of wikis would help with that. In terms of integrating the technologies with the course content 46% felt that the use of blogs could be easily integrated, 38% felt that wikis could be easily integrated, 23% felt that about social networking, and only 12% felt that social bookmarking would be easy to integrate.

Although several faculty respondents felt that Web 2.0 technologies provide many benefits, only few chose to use them (see Table 5). In fact 55% of the faculty did not use wikis and did not plan to use in the near future, and only 19.58% use it occasionally in their classroom to supplement their in-class lectures. Also, 62.24% don't use blogs and plan not to use it and only 9% use it occasionally. Similarly, 74% don't use and don't plan to use social networking, and only 6% use it occasionally. Finally about 80% don't use social bookmarking and don't plan to use it, and only 4% use it occasionally.

The results highlight that while a somewhat considerable proportion of the faculty felt that selected Web 2.0 technologies would likely provide their students with many benefits, only few chose to use it. This might be partially explained by their level of comfort with such technologies. Most of respondents have never used some of these Web 2.0 technologies. In fact, 56% have never used blogs, 60% have never used social networking, and 81% have never used social bookmarking. On the hand, faculty felt more comfortable using wikis, while 29% have never used it, 26% claim that they are novice and 27% felt competent using wikis.

The lack of experience with most Web 2.0 technologies examined in this study could drive faculty members to avoid their adoption,

although they realize that this adoption would provide their students with many important benefits. In order to better understand factors leading to Web 2.0 technologies adoption and use, the decomposed theory of planned behavior was applied.

4.7. Path analysis and research hypotheses

As expected, the decomposed theory of planned behavior is useful for explaining much of the variance in the use of Web 2.0 technologies by faculty. Additionally, most paths in the model were statistically significant. Using the results of the path analysis, the research hypotheses findings will be presented (see Fig. 2).

4.7.1. Behavioral intention

Regression results confirmed each of the three factors, attitude, behavioral intention, and subjective norm, explains a significant variance (75.4%) in behavioral intention (adjusted R^2). Research hypothesis #1 of this study was that the attitudes of users towards Web 2.0 positively affect behavioral intentions. Path analysis confirmed that attitude ($\beta = 0.830$, $t = 12.334$) was the only determinant that had a very significant effect on behavioral intention. Therefore, this study confirmed research hypothesis #1. Research hypothesis #2 states that subjective norms of users in relation to usage of Web 2.0 positively affect behavior. Examining path analysis results, the subjective norm ($\beta = -0.060$, $t = -0.952$) had no significant effect on the behavioral intention. Thus, this study fails to confirm research hypothesis #2. Finally, research hypothesis #3 states that perceived behavioral control of users in relation to usage of Web 2.0 technologies positively affects behavioral intentions. Path analysis results indicate the perceived behavioral control ($\beta = 0.128$, $t = 2.218$) had a significant effect on the behavioral intention. Hence, research hypothesis #3 is confirmed by the results of this study.

4.7.2. Behavior

Research hypothesis #4 states that behavioral intention to use Web 2.0 positively affects behavior. Examining the path analysis results, behavioral intent ($\beta = 0.666$, $t = 9.991$) has a very significant effect on actual behavior and the behavior equation addresses 43.7% of the variance (adjusted R^2). Therefore, this study confirmed research hypothesis #4.

4.7.3. Attitude

Regression results confirmed each of the three factors, perceived usefulness, perceived ease of use, and perceived compatibility, explain a significant variance (80.1%) in attitude (adjusted R^2). Research hypothesis #5a states that perceived usefulness positively affects attitudes towards usage of Web 2.0. Examining the path analysis results, perceived usefulness ($\beta = 0.614$, $t = 7.604$) of Web 2.0 technologies had a very significant effect on attitudes toward Web 2.0 technologies. Thus, the results of this study confirmed research hypothesis #5a. Research hypothesis #5b states the perceived ease of use positively affects attitudes towards usage of Web 2.0. Additionally, research hypothesis #5c states the perceived compatibility positively affects attitudes towards usage of Web 2.0. Path analysis results indicate that these two determinants of attitudes, perceived ease of use ($\beta = 0.144$, $t = 2.125$) and compatibility ($\beta = 0.190$, $t = 2.546$) of Web

Table 4

Faculty perceptions of the pedagogical benefits of Web 2.0 applications

| | Improve student learning | Increase student–faculty interaction | Increase student–student interaction | Improve student satisfaction with course | Improve student writing | Easy to integrate |
|------------------|--------------------------|--------------------------------------|--------------------------------------|--|-------------------------|-------------------|
| Blogs | 47% | 46% | 52% | 39% | 41% | 46% |
| Wikis | 42% | 23% | 20% | 22% | 29% | 38% |
| Social networks | 16% | 16% | 56% | 32% | 8% | 23% |
| Social bookmarks | 7% | 7% | 25% | 13% | 1% | 12% |

Table 5
Faculty use of Web 2.0 applications

| | Don't use and don't plan to use | Don't use but plan to use | Use occasionally | Frequently use |
|--------------------|---------------------------------|---------------------------|------------------|----------------|
| Blogs | 62.24% | 18.18% | 9.09% | 4.90% |
| Wikis | 55.94% | 12.59% | 19.58% | 4.20% |
| Social networking | 74.13% | 13.99% | 6.29% | 1.40% |
| Social bookmarking | 80.42% | 8.39% | 4.20% | 1.40% |

2.0 technologies with existing technologies both had significant effects on attitudes. Thus, research hypotheses #5b and #5c were both confirmed by the results of this study. Attitudes ($\beta=0.830$, $t=12.334$), in turn, had the greatest effect on behavioral intention.

4.7.4. Subjective norm

Regression results confirmed each of the three factors: superior influence, student influence, and peer influence, explain a significant variance (63.2%) in the subjective norm (adjusted R^2). Research hypothesis #6a states superior influence to use Web 2.0 technology positively affects subject norms. Research hypothesis #6b states that peer influence to use Web 2.0 technology positively affects subjective norms. Finally, research hypothesis #6c states that student influence to use Web 2.0 technology positively affects subject norms. Examining the path analysis results for each of the determinants, superior influence ($\beta=0.396$, $t=5.114$) and student influence ($\beta=0.356$, $t=5.235$) both had very significant effects on subjective norm. Path analysis results for the third individual determinant, peer influence ($\beta=0.205$, $t=2.334$), indicate that it had a significant effect on subjective norm. Thus, research hypotheses #6a, #6b, and #6c are all confirmed by the results of this study.

4.7.5. Perceived behavioral control

Regression results confirmed each of the three factors, facilitating conditions—resources, facilitating conditions—technology and self-

efficacy, explains a significant variance (52.2%) in perceived behavioral control (adjusted R^2). Research hypothesis #7a states that self-efficacy of using Web 2.0 technologies positively affects perceived behavioral control. Additionally, research hypothesis #7b states facilitating conditions of using Web 2.0 technologies positively affect perceived behavioral control. Examining the path analysis results, two of the three individual determinants, facilitating conditions—resources ($\beta=0.185$, $t=1.321$) and facilitating conditions—technology ($\beta=0.098$, $t=0.706$) had no significant effects on the perceived behavioral control. Thus, the results of this study fail to confirm research hypotheses #7a. However, the third determinant, self-efficacy ($\beta=0.518$, $t=6.125$), did have a significant effect on perceived behavioral control. So, the results of this study confirmed research hypothesis #7b.

5. Results

The purpose of this study was to assess faculty's awareness of the benefits of Web 2.0 to supplement in-class learning and to assess faculty's decisions to adopt these tools using the decomposed theory of planned behavior. The following research questions were explored:

Research Question 1: Are university faculty aware of the benefits of using Web 2.0 technologies to supplement the traditional classroom instructions?

Research Question 2: What factors best predict faculty's decision to adopt Web 2.0 technologies to supplement the traditional classroom instructions?

5.1. Research Question 1

The first question examined if, and to what extent, faculty are aware of pedagogical benefits of Web 2.0 technologies. The results are interpreted in the following manner: Many respondents acknowledged pedagogical benefits of Web 2.0 applications in higher education. More specifically, blogs were viewed as the most useful Web 2.0 application in terms of improving student learning (47%), increasing student-faculty

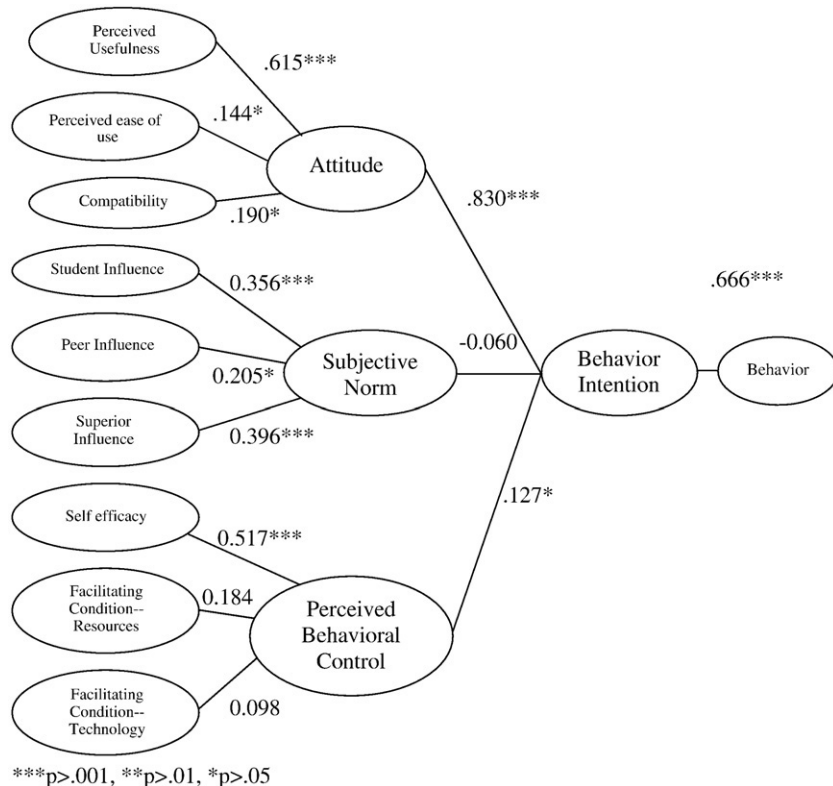


Fig. 2. Path analysis of factors that influence faculty adoption of Web 2.0 technologies in the classroom.

interactions (46%), improving student writing (52%), improving student writing (41%) and ease of integration (46%). In terms of increasing student–student interactions, social networks were viewed as being the most beneficial (56%). Social networks were also viewed as useful tools for improving student satisfaction in courses (32%). For the most part, wikis were viewed as also having significant potential to improve student learning (42%), increasing student–faculty (23%) and student–student interactions (20%), improving student satisfaction with courses (22%), improving student writing (29%), and ease of integration (38%).

While these results provided some initial encouragement, they were quickly overshadowed by an examination of actual faculty use of Web 2.0 in their courses. The majority of respondents do not currently use and have no plans to use either blogs (62%), wikis (56%), social networks (74%), or social bookmarks (80%). Additionally, a small percentage of respondents do not currently use, but plan to use, blogs (18%), wikis (13%), social networks (14%), and social bookmarks (8%). Even smaller percentages of respondents currently use blogs (14%), wikis (24%), social networks (8%), or social bookmarks (6%). Additional factors that influence the limited use of Web 2.0 applications were explored in Research Question 2.

5.2. Research Question 2

The second question examined which factors best predict the adoption of Web 2.0 applications by faculty for instructional purposes. Examining the path analysis results, this study provides evidence that attitudes and perceived behavioral control have fairly strong positive influences on behavioral intention to use Web 2.0 technology, while subjective norm did not influence behavioral intention. This insignificant effect might be explained, in part, by the high degree of independence faculty have when developing their classroom environment (Barnett et al., 2004). As would be expected from the decomposed theory of planned behavior, behavioral intention is a strong determinant of actual behavior or usage of Web 2.0. The results also show that ease of use, usefulness, and compatibility of Web 2.0 are key determinants of subject's attitude to use Web 2.0 technology. Additionally, the influence of three groups: superiors, peers (other faculty), and students has positive influence on the faculty member subjective norms. In other words, these three groups are key determinants of the social influence that determine the use of Web 2.0 technologies. Only self-efficacy was found to influence the perception of behavioral control. One the other hand, facilitating technology and resource conditions do not have an influence on the perception of behavioral control toward the intention and usage of Web 2.0 technologies. These results indicate that training is an important mechanism to influence Web 2.0 usage, while facility conditions in terms of resources and technology are not as important in determining usage faculty usage of Web 2.0 applications.

6. Discussion

The use of Web 2.0 technologies has significant potential to support and enhance in-class teaching and learning in higher education. Currently, for profit organizations are using Web 2.0 technologies to foster work collaboration. For instance, Motorola has more than 2600 internal blogs and 3200 internal wikis to foster knowledge sharing within the organization (Dearstyne, 2007). Now it is up to educators to utilize these technologies to effectively support and enhance their instruction.

The use of technology to support in-class learning has changed over the decades. Most faculty today utilize technology in their instruction as mechanisms for course content delivery, grade delivery, and basic communication (Maloney, 2007). However, an effective learning environment fosters collaboration among students and faculty; allows the student to create and share new knowledge; as well as support the connection of different pieces of information. The results of this study provide evidence that most faculty feel that integrating Web 2.0 tech-

nologies such as blogs and wikis into the classroom learning environment can be effective at increasing students' satisfaction with the course, improve their learning and their writing ability, and increase student interaction with other students and faculty; thus changing the students' role from passive to active learners, allowing them to better create and retain knowledge (Maloney, 2007).

The results also indicate that the faculty attitude and their perceived behavioral control are strong predictors to their intention to use Web 2.0. That is, in turn, a strong predictor of their actual behavior. This suggests that administrators interested in increasing the use of Web 2.0 in the classroom might focus their attention, efforts, and investments on improving faculty attitude and enhance their perceived behavioral control of Web 2.0 use. More specifically, these efforts should focus on improving the perceived usefulness, ease of use, and compatibility (with current practices) of Web 2.0 applications, as well as improving faculty's self-efficacy with these emerging technological tools. Additionally, while these tools show pedagogical promise, "best practices" models are needed to further facilitate the adoption of these emerging technologies as tools for improving teaching and learning in higher education.

From a research perspective, the study results demonstrate the usefulness of the decomposed theory of planned behavior in explaining the determinant and use of Web 2.0 applications by faculty to supplement in-class learning.

7. Recommendations for future research

The goal of this study was to assess faculty's awareness of the benefits of Web 2.0 to supplement in-class learning and assess faculty's decisions to adopt these tools using the decomposed theory of planned behavior. While the initial results related to faculty awareness of pedagogical benefits of Web 2.0 applications were encouraging at times, they also lead to new questions and concerns. The results of this study provide a foundation for future research examining more specific factors that promote and inhibit faculty use of Web 2.0 applications, as well as methods of fostering support for faculty use of Web 2.0 applications. Based on the findings of this study, as well as the disparity of empirical studies related to the use of Web 2.0 in higher education, the following are suggestions for future research:

While this study examined faculty awareness of benefits for teaching and learning of Web 2.0 applications, there was no examination of factors in place to support faculty integration of technology into their courses. For example, did faculty members participate in any technology-based professional development; do colleges provide technological support for open source applications, of which many Web 2.0 applications are; is the use of Web 2.0 applications encouraged by superiors, mentors, or students? As a result, it would be beneficial to further study factors in place to support the integration of technology into courses, as well as the effectiveness of these support factors.

Another interesting future research idea would be to apply the same decomposed theory of planned behavior to understand and predict student's intentions and behavior to use Web 2.0 technologies to supplement their in-class learning. After an analysis of the student data, it could then be compared with faculty expectations from Web 2.0 use in an attempt to understand whether there is a gap in understanding among the students and the faculty and whether or not the same factors influence student and faculty use.

One limitation of this study was that all faculty members were from the same university, future studies could collect data from multiple universities and colleges. An interesting extension to this study would be to compare the use of Web 2.0 technologies in research-oriented universities and teaching-oriented universities and colleges, to examine whether differences in factors predicting Web 2.0 technologies intention and usage exist.

Another limitation is the general focus of this study on Web 2.0 technologies. There are several types of Web 2.0 technologies and their use and impact on teaching could differ. In order to elevate this

confounding effect, there was a focus on only a few Web 2.0 technologies (e.g. wikis, blogs, social networks, and social bookmark). Still, the effect of each of these on the learning environment could vary. Future studies could control for the type of Web 2.0 application and examine differences in their impact on the learning environment and student achievement.

The use of Web 2.0 technologies offer many powerful information sharing and collaboration opportunities for learners and learning. In this study factors that influence faculty perceptions of several Web 2.0 applications in teaching and learning, as well as actual use of these Web 2.0 technologies, were explored. Future research is still necessary in order to identify the most effective methods of utilizing Web 2.0 technologies to improve teaching and learning productivity; and to better support active, social, and engaging learning environments.

References

- Ajzen, I. (1991). The theory of planned behavior. *Organizational Behavior and Human Decision Processes*, 50, 179–211.
- Ajzen, I., & Fishbein, M. (1980). *Understanding attitudes and predicting behavior*. Englewood Cliffs, NJ: Prentice Hall.
- Alexander, B. (2006). A new way of innovation for teaching and learning. *Educate Review*, 41(2), 32–44.
- Bandura, A. (1982). Self-efficacy mechanism in human agency. *American Psychologist*, 37(2), 122–147.
- Barnett, M., Keating, T., Harwood, W., & Saam, J. (2004). Using emerging technologies to help bridge the gap between university theory and classroom practice: Challenges and successes. *School Sciences & Mathematics*, 102(6), 299–314.
- Baylor, A., & Ritchie, D. (2002). What factors facilitate teacher skill, teacher morale, and perceived student learning in technology-using classroom? *Computer & Education*, 39(1), 395–414.
- Boulos, M., Maramba, I., & Wheeler, S. (2006). Wikis, blogs and podcasts: A new generation of web-based tools for virtual collaborative clinical practice and education. *Journal of the American Dietetic Association*, 107(4), 553–555.
- Bruner, J. (1996). *Culture of education*. Cambridge, MA: Harvard University Press.
- Chen, H. L., Cannon, D., Gabrio, J., Leifer, L. T. G., & Bailey, T. (2005). Using wikis and weblogs to support reflective learning in an introductory engineering design course. Paper presented at the American Society for Engineering Education Annual Conference & Exposition, Portland, OR.
- Cohen, J., & Cohen, P. (1983). *Applied multiple regression/correlation analysis for the behavioral sciences*. Hillsdale, NJ: Lawrence Erlbaum.
- Compeau, D. R., & Higgins, C. A. (1995). Computer self-efficacy: Development of a measure and initial test. *MIS Quarterly*, 19(2), 189–211.
- Davis, F. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13, 319–339.
- Dearstyne (2007). Blogs, mashups, and wikis: Oh my! *Information Management Journal*, 41(4), 24–33.
- Dixon, S., & Black, L. (1996). Vocal point: A collaborative, student run online newspaper. In E. J. Valauskas, & M. Ertel (Eds.), *The Internet for teachers and school library media specialists: Today's applications tomorrow's prospects* (pp. 147–158). New York: Neal-Schuman Publishers, Inc.
- Ferdig, R. (2007). Examining social software in teacher education. *Journal of Technology and Teacher Education*, 15(1), 5–10.
- Johnson, R. T., & Johnson, D. W. (1986). Action research: Cooperative learning in the science classroom. *Science and Children*, 24, 31–32.
- Lave, J., & Wenger, E. (1991). *Situated learning: Legitimate peripheral participation*. New York: Cambridge University Press.
- Lenhart, A., & Madden, M. (2007). *Social networking websites and teens: An overview*. Pew Internet and American Life Project report. Retrieved January 24, 2008 from http://www.pewinternet.org/PPF/r/198/report_display.asp
- Linn, M. C. (1991). The computer as learning partner: Can computer tools teach science? In K. Sheingold, L. G. Roberts, & S. M. Malcom (Eds.), *Technology for teaching and learning*. Washington, DC: American Association for the Advancement of Science.
- Madden, M., & Fox, S. (2006). *Riding the waves of "Web 2.0": More than a buzzword, but still not easily defined*. Pew Internet Project, 1–6. (Unpublished).
- Maloney, E. (2007). What Web 2.0 can teach us about learning. *Chronicle of Higher Education*, 25(18), B26.
- Nunnally, J. (1978). *Psychometric theory*. New York: McGraw-Hill.
- Pence, H. E. (2007). Preparing for the real web generation. *Journal of Educational Technology Systems*, 35(3), 347–356.
- Prensky, M. (2001). Digital natives, digital immigrants. *On the Horizon*, 9(5), 1–6.
- Riley, R. W., & Roberts, L. G. (2000, December). *Putting a world-class education at the fingertips of all children: The national educational technology plan*. eLearning Washington, D.C.: U.S. Department of Education.
- Rogers, E. M. (2003). *Diffusion of innovations*, 5th ed. New York: Free Press.
- Routman, R. (1991). *Invitations: Changing as teachers and learners K-12*. Toronto, Canada: Irwin Publishing.
- Schofield, J. W., & Davidson, A. L. (2002). *Bringing the internet to school: Lessons from an urban district*. San Francisco, CA: Jolley-Bass.
- Sheppard, B. H., Hartwick, J., & Warshaw, P. R. (1988). The theory of reasoned action: A meta-analysis of past research with recommendations for modifications and future research. *Journal of Consumer Research*, 15, 325–343.
- Snyder, J., Lippincott, A., & Bower, D. (1998). The inherent tensions in the multiple uses of portfolios in teacher education. *Teacher Education Quarterly*, 25(1), 45–60.
- Spitz, B. (1996). Imagine the possibilities: Exploring the Internet with middle school students. In E. J. Valauskas, & M. Ertel (Eds.), *The Internet for teachers and school library media specialists: Today's applications tomorrow's prospects* (pp. 181–191). New York: Neal-Schuman Publishers, Inc.
- Taylor, S., & Todd, P. A. (1995). Understanding information technology usage: A test of competing models. *Information Systems Research*, 6(2), 144–176.
- Tornatzky, L. G., & Klein, K. J. (1982). Innovation characteristics and innovation adoption-implementation: A meta-analysis of findings. *IEEE Transactions on Engineering Management*, 29(1), 28–45.
- Triandis, H. C. (1979). *Values, attitudes, and interpersonal behavior*. Lincoln, NE: University of Nebraska Press.
- Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.
- Willet-Smith, S. (1993). Instructional applications of Virginia's Public Education Network (VA PEN): Thomas Jefferson on-line. (ERIC Document Reproduction Service No. ED 363260).
- Wright, S. (1921). Correlation and causation. *Journal of Agriculture Research*, 20, 557–585.