Investigating Pedagogical Value of Wiki Technology

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ABSTRACT

This exploratory study investigates the potential of Wiki technology as a tool for teaching and learning. Wikis are a component of Web 2.0 technology tools that provide collaborative features and active learning opportunities in a web-based environment. This research study sought to empirically determine the pedagogical value of using Wiki technology in university courses. An instrument comprised of four constructs: Learning/Pedagogy, Motivation, Group Interaction, and Technology was developed and tested using reliability and validity as being capable of assessing student perceptions of value of Wiki technology. Hypotheses were tested to determine if factors such as age, gender, work experience, and web development experience influence students' satisfaction with Wiki technology. Best practices for using Wikis in the classroom, student concerns, and lessons learned by the researchers when implementing Wikis for instruction are discussed in this study. The authors hope that understanding the use of Wiki technology will provide practitioners and researchers an opportunity to develop pedagogically effective Wiki learning environments.

Keywords: Distance Learning, Web-based Instruction, eLearning Pedagogy, Collaborative Learning, Web 2.0, Wiki.

1. INTRODUCTION

Use of Web 2.0 tools (such as Blogs, Podcasts, and Wikis) is increasing in academia. Since the earliest use of the World Wide Web for teaching and learning, one of the most powerful elements has been the ability to engage learners in an interactive format (Hazari & Schnorr, 1999; Chandra & Lloyd, 2008). As technology continues to become commonly used for global communication and productivity, technology skills must be incorporated by educators in the delivery of curriculum content. Schrand (2008) suggests the use of technology in education has several benefits for motivating students. Schrand further states that technology can facilitate more active student learning in the classroom, and appeal to multiple intelligences, and different learning styles. Wikis are one such tool in the Web 2.0 arsenal that have shown promise for social computing as part of the Read/Write Web (also known as Web 2.0). Web 2.0 tools have changed the way in which users interact with web content. No longer are users' passive recipients of information which can only be read or printed; now the same users can add information to the web environment in which they interact with other interested members. Previously, discussion/bulletin board tools were used to foster group collaboration in course management systems (Ansorge & Bendus, 2004). Now with social computing platforms being widely available, several Wiki tools have emerged, and research is needed to determine pedagogical efficacy of these tools for teaching and learning.

1.1 Web-Based Learning
E-learning in education has made rapid progress with commercialization and adoption of enterprise web course management tools (such as WebCT, Blackboard, eCollege, and Moodle) that permit schools, colleges, and universities to offer a standard platform for courses which can support collaborative learning (Leslie, 2003). Course components within these tools allow for presentation of material in text and multimedia format, synchronous and asynchronous discussion tools, library access, and the ability for an instructor to monitor student progress, and provide online assessments. Course materials can also be accessed on mobile platforms such as laptop computers, wireless phones, and other handheld devices. To promote student participation in group settings, the most commonly used course component has been the discussion board. Student

involvement in the discussion board includes group work, community building, and shared student portfolios. Traditional features of first generation course environments are now giving way to a new generation of Web 2.0 components which have been developed due to technological advancements that integrate mobile learning, collaboration, and social interaction. Although most course development platforms have not yet integrated all these features in a seamless environment, instructors have taken individual components of Web 2.0 tools and tried to determine efficacy of these for teaching and learning (Turban, Leidner, McLean, & Wetherbe, 2007). Since the Web 2.0 technology is in its initial stage, more empirical research is needed to explore benefits offered by such tools.

1.2 Purpose of the Study

The purpose of this exploratory study was to investigate pedagogical value of Wiki technology by identifying its relationship with factors that may have the potential for improving learner outcomes. For the purpose of this study, pedagogical value was defined as the capacity of students to be engaged in learning by exhibiting interest in course assignments, retaining more material, participating actively, being motivated learners, and collaborating using constructivist learning principles (such as group interaction). A scale comprised of four factors (Learning/Pedagogy, Motivation, Group Interaction, and Technical features) was developed from extant literature and examined for reliability and validity.

The paper is organized as follows: Review of research on Web 2.0 components (particularly Wiki technology) is presented along with extraction of variables from the literature that determines usefulness of Wiki technology. Exploratory Factor Analysis is used for proposing variables in the study, and the research design is provided. Along with data analysis, results of the study are then explained, which is followed by discussion and applications to practice. Due to the nature of research design used in this study, limitations are also explained. The study also provides best practices for use of Wikis, and investigates assessment component in Wikis. This will provide empirical evidence to an area which has been identified as lacking in research (Hsu, 2007) and provide directions and guidance for future studies.

The study involved development and validation of a scale which was could be used to determine pedagogical value of Wiki technology. Research questions guiding this study are as follows: 1) What factors contribute to pedagogical value of Wiki technology? 2) What is the relationship between these factors? An analysis of these factors can help educators design effective Wiki environments that promote collaborative learning, which is the main intent why Wiki technology was originally designed (Parker & Chao, 2007).

The following hypotheses were studied:

H1: Previous web development experience is associated with pedagogical value of Wiki (PVW) score.
H2: Previous work experience is associated with PVW score
H3: Gender is associated with PVW score.
H4: Age is associated with PVW score.

For testing the above hypotheses, PVW score was measured by using the composite score of indicator items in each of the four subscales used in the instrument.

2. WEB 2.0 TECHNOLOGY

Web 2.0 technology offers shared content of text, graphics, audio, and in a social network. It represents the second generation of Internet services that is changing the form of interaction and collaboration online (O'Reilly, 2005). Web 2.0 participants can create virtual online communities where members can engage in collective thought and shared ideas and where physical distance is no boundary. One of the most important features of this new generation of Web technology is active collaboration among its users. Driscoll (2007) states, "Today's tech-savvy student generation is actively participating in social networking and other online communicates, so most students not only understand how to use Web 2.0 teaching tools, they thrive in the environment when Web communication solutions are integrated in the classroom" (p. 10).

2.1 Characteristics of Web 2.0

Web 2.0 technology can be considered to be an extension of the previous generation of web technology tools that presented information to the user, but did not allow for much interaction. Information was presented in a "read-only" mode and any interaction would take place in a different environment (Hodgkin & Munro, 2007). The new generation of Web 2.0 tools encourages participatory approaches in which users become active contributors and producers of content. Doering, Beach, and O'Brien (2007) (as cited by Jenkins, 2006) described Web 2.0 as a media convergence that has created a new culture, termed "collective intelligence." Collective Intelligence is an idea that individuals can build collectively on each other's knowledge by forming "participatory communities". Jenkins (2006) described the participatory culture as a community where all members contribute and pool collective knowledge, and compare collective intelligence occurring in participatory communities to a pedagogical process called "scaffolding." Pedagogical scaffolding occurs in the classroom where the teacher uses prior knowledge and mastered skills to provide support until confidence is built.

2.2 Social Computing

The new set of Web 2.0 tools includes Blogs, Wikis, Podcasts, Instant Messaging, RSS feeds, Digital Storytelling, and Social Bookmarking (Parmeswaran & Whinston, 2007). Some of the popular websites associated with Web 2.0 are FaceBook, LinkedIn, YouTube, Flickr, and del.icio.us. The underlying tenet of all these tools is the social networking aspect where a community of users is involved in a common goal. Interaction and sharing of knowledge is made possible by shared access to knowledge that resides in people, documents and databases, and this access is available in a web-based environment presented on desktop computers or mobile devices. The environment fosters collaboration and helps build a social connection that goes beyond the formal environment such as a classroom or workplace (Richardson, 2006).

Technology tools (such as Blogs and Wikis) can empower students by giving them a chance to express their

views. It can also help students with reading, writing, reflective, and collaborative learning skills (Leight, 2008) which benefits students by providing them positive psychological consequences, and helps organizations leverage a flexible environment that encourages collaboration and also keeps up with technology innovation (Evans & Wolf, 2005).

The use of Wikis has been explored as a teaching tool in schools, colleges and universities (Raman, Ryan & Olfman, 2005; Parker & Chao, 2007; Konieczny, 2007). A major appeal of Wikis is that collaborative content can be created, changed, and tracked easily. Users are able to quickly start expanding any page or site for discussion, posting assignments, and various collaborative projects. Wiki technology makes it easy to work on a collaborative document, track work in progress, and see how much each individual in a group has contributed (Andrew, 2008). Use of Wikis in group settings encourages students to produce work that they can use later in electronic portfolios and job interviews. Since most businesses use groupware software that allows collaboration similar to Wikis, students develop skills associated with teamwork and sharing of ideas when using technology tools.

Despite the potential benefits of using Wikis for course assignments, grading of Wiki assignments can pose a challenge to instructors**.** With new types of customized Web learning environments, it is necessary to determine if these environments are meeting the needs of learners. Mechanisms must be incorporated in Web-based environments to evaluate the medium, content, format, design and structure so timely intervention can occur if a problem is identified. Riel and Harasim (1994) indicate user feedback is one way of examining if the learning environment is successful in meeting learning outcomes. As an example, in this study, when the first Wiki assignment was made available, one student inquired by emailing the instructor, "*Are the grades for the Wiki assignments based on actually writing a portion of the final document and/or providing references? Or do you measure participation by involvement in the discussion and decision-making too? There are concerns about jeopardizing others' grades if their quotes or references aren't included in the final document.*" Keeping such student concerns in mind, a Wiki rubric should set clear performance expectations, and include consideration for both the process and product used by team members to develop the final deliverable for the assignment.

3. THEORETICAL FOUNDATION

The theoretical framework for this study was based on *Constructivism* and *The Engagement Theory*.

3.1 Constructivism
Constructivism is inquiry-based, discovery learning in which learners construct personal interpretation of knowledge based on their previous experience and application of knowledge in relevant context (Hazari, 2004). For example, in a Wiki environment, student teams would be given a topic to come up with a solution to a business problem. The teams would work together by accessing resources located in a shared workspace so team members can create task lists, update relevant portions, and include content and links to various internal and external resources. When using shared learning environments, researchers (Honebein, 1996; Lebow, 1993; Knuth & Cunningham, 1993) have recommended using constructivist theory for effective learning. The constructivist theory and instructional strategies focus specifically on students' motivation to learn and their ability to use what they learn. Constructivist strategies attempt to account for and remedy perceived deficiencies in behaviorist and information-processing theories and the teaching methods based on them (Buck, 2004). The constructivist approach incorporates pedagogical goals in the knowledge construction process by providing appreciation for multiple perspectives, social interaction, embedding learning in relevant contexts, encouraging ownership in the learning process, embedding learning in social experience, encouraging use of multiple modes of representation, and encouraging self awareness of the knowledge construction process (Vygotsky, 1986; Bruner, 1990). Leidner and Jarvenpaa (1995) also described a related concept of *Collaborativism*, which encourages socialization in a learning context to create and share knowledge.

3.2 Engagement Theory
The Engagement Theory is more specific to technology-based teaching and learning, and provides a conceptual framework that encourages collaboration and student engagement by use of technology tools and systems (Kearsley & Shneiderman, 1999). It focuses on human interaction in group activities, and synergistic efforts using problem-based learning. The Engagement Theory has three components: Relating, Creating, and Donating. The Relating component refers to encouraging students to articulate the problem by providing their interpretation thereby facilitating solutions. In today's diverse and global business environment, this component exposes students to multiple perspectives. Creating refers to application of ideas to a specific context (such as the case study being discussed by the group in the Wiki) where individuals take control over their learning. Donating refers to the use of authentic learning environment to contribute intellectual efforts to a business or external organization, for example, where a CEO might be invited to look at not only the end product but also the process by which the solution was reached. This approach has shown to increase student motivation and satisfaction (Keller, 1987).

The Wiki environment addresses all components addressed in the Engagement Theory as it provides an opportunity for involving cognitive processes for problem solving in a group environment that encourages shared ideas, dialog, interaction, decision-making and presentation.

4. EMERGENT FACTORS

Using the theoretical foundation given above, and based on review of literature on educational uses of Wikis, different dimensions of Wiki based learning were identified. Items were developed for each dimension to capture the underlying construct of Wiki based learning. The researchers listed all items, and then classified these into one of the four constructs that emerged from review of literature. Exploratory Factor Analysis (EFA) was used to hypothesize four factors from review of literature, and to develop the

questionnaire items. The purpose of using EFA was to investigate the underlying structure of collection of identified variables. Details of these four factors are given below:

4.1 Overall Learning/Pedagogy

Chickering and Gamson (1987) identified seven principles that are kinds of teaching and learning activities needed to improve learning outcomes. They stated that good teaching develops reciprocity and cooperation among students, encourages active learning, gives prompt feedback, emphasizes time on task, communicates high expectations, and respects diverse talents and ways of learning. Some of these principles can be used when developing Wiki-based instruction. Technology has initiated an overall shift in pedagogical emphasis from teaching to learning.

Current theory to practice literature for teaching and learning with technology emphasizes engaging learners and teaching students how to learn. Engaging learners is highly emphasized using concepts such as scholarship of teaching, theories of teaching and learning, student-centered learning, active learning, curriculum design, feedback on student learning, e-learning, and use of digital resources (O'Neill, Moore, & McMullin, 2005). Teaching students how to learn is a second area of emphasis. As online learning pedagogical frameworks evolve, there is growing evidence that online learning environments that include technology tools can develop higher order learning and critical thinking in students. The questionnaire used in this study included five items within the Overall Learning/Pedagogy factor to assess information about students' perception of interest in course, retention of material, active learning, and use of course material to meet learning objectives.

4.2 Motivation

Shroff, Vogel, and Coombs (2008) state that intrinsic motivation has a positive effect on learning and academic achievement. However, little is known about the impact of different technology-supported learning activities on student intrinsic motivation or whether such learning activities significantly enhance student intrinsic motivation compared to traditional classroom environments without technological support. A wide gap exists between knowing that learning must be motivated and identifying the specific motivational components of any particular act. Instructors must therefore focus on learning patterns of motivation for an individual or group, with the realization that errors will be common. The basic learning principle involved is that success is more predictably motivating than is failure. However, no technique will produce sustained motivation unless the goals are realistic for the learner. Having learners assist in defining goals increases the probability that they will understand and achieve the goals (Weller, 2005).

Keller's (1987) *Attention, Relevance, Confidence, and Satisfaction* (ARCS) model is concerned with providing strategies to motivate students in an effort to increase academic performance. This model of motivation is a problem solving approach designed to capture the motivational aspects of learning environments to stimulate and sustain students' motivation to learn and can be used in the Wiki environment. Small (2000) defines the four strategies used in the ARCS model as follows: a) Attention strategies for arousing and sustaining curiosity and interest; b) Relevance strategies that link to learners' needs, interests and motives; c) Confidence strategies that help students develop a positive expectation for successful achievement; and d) Satisfaction strategies that provide extrinsic and intrinsic reinforcement for effort.

The questionnaire in this study included five items within the Motivation factor to assess student's perception about motivation to use Wikis by investigating criteria such as effort, time, interest, benefits, recommendations for use of Wikis, and also preference toward use of Wikis for other courses.

4.3 Group Interaction

Research has shown a positive relationship between group learning and learning effectiveness (Janz, 1999) as well as student performance (Ocker & Yaverbaum, 2004). Business students especially must be able to work well in teams, and courses should include critical elements that encourage teamwork and group skills (Payne, Monk-Turner, Smith, & Sumter, 2006; Snyder, 2008). Moller, Huett, Holder, Young, Harvey, and Godshalk (2005) further state that interaction levels between learners' draws them to a deeper level of participation.   In Wiki-based learning, this increased participation has the potential for enhancing communication and social interaction, which may result in deeper knowledge retention. The use of collaborative and group assignments requires planning on the part of instructors. For instructors not familiar with team assignments, this can pose several challenges. Questions such as how to form groups (e.g. by last names, randomly, self-selection, or by using students' learning styles), how to manage teams that may have students from different background, how to establish project scope or foster teamwork need to be addressed before student teams are given the assignment.

Students also may be unsure of their role in a group as they may not have interacted previously with team members. This becomes more challenging if the course is taught online where students may not be available to form groups in person (as was the case in this study). Leaders usually emerge in this situation based on work a student may have done in the past with other groups, or with the task at hand. For example, Figure 1 shows a Wiki discussion board transcript of one students' initiative to get others in the group involved with the task.

The questionnaire in this study included five items within the Group Interaction factor to assess students' group interaction, consensus building, collaborative and cooperative learning.

4.4 Technology

Technology is widely used to facilitate communication and collaboration (e.g. email and instant messaging). Jonassen, Howland, Marra and Crismond (2008) state that technology can be only effective in the learning process when it meets a learning requirement. This can happen when the activity learners pursue is active, constructive, intentional, authentic, and cooperative. In addition, access to technology related multimedia has previously been shown (Agarwal & Karahanna, 2000) to improve cognitive engagement and cognitive absorption in users. Ellison and Wu (2008) state

that instructors should investigate technical implementation of software that best supports pedagogical goals and needs of students prior to implementation.

In this study, the questionnaire included five items within the Technology factor to assess students' perception about ease of use, user interface, technical issues, comparison between Wikis and the course management tool (WebCT) that was also used in the course.

From: vwillia5
Subject: We need to treat this like a business

We are all business/education professionals. We need to practice what we are preaching (not to say that we aren't) but we have to get organized. Let's Plan first. How many members in our group? Are we going to split the tasks up by questions or we all answer then collaborate? When is the deadline? Total assignment? Individual assignments? Group collaboration and editing? Who is going to edit? Best way to communicate amongst team? via Internet? phone? best time?

I need some help answering these questions.

After that we need to delegate responsibilities...

Figure 1: Student Entry in Wiki Discussion Board

5. METHODOLOGY

Several Wiki tools are available from different vendors. Some of these are Curriki (2009), MediaWiki (2009), and PBWorks (2009). For the purpose of this study, a Wiki service called Wikispaces (2009) was selected. This was done because Wikispaces most closely resembled the WebCT Vista course environment that students were familiar with, and some features (such as Discussion forum) were common in both systems. It was assumed that by having a consistent user interface, the transition to a new tool would be easier, as compared to working in a totally new environment. Students were given an orientation to Wikispaces by providing key features of the tool, as well an instructor-developed video clip that provided information on how the features should be used for the assignments.

5.1 Wiki Assignments
Hsu (2007) lists different assignments that are suited for a Wiki. Some of these assignments are brainstorming activities, group discussions, knowledge base creating, and collaborative writing. For the purpose of this study it was important that assignments be chosen that emphasized a collaborative aspect and group interaction expectation. The assignments selected were journal article critique (where the group critiqued a common article), and a management consultant case report (case analysis and online presentation). All of these assignments required students to assign roles and responsibilities, set protocol for interaction, establish deadline, and proofread results before final submission deadline. To control for treatment diffusion and expectancy threats, the same instructor taught all four courses that used the Wiki assignments in this study. Since the Wiki assignments were being used for the first time in the courses, less than ten percent of Wiki grade was included as part of overall course grade.

5.2 Scale Development
Using the four factors mentioned previously, 20 items (five under each factor) were selected and adapted from other scales to focus on the context of this study. For the Learning/Pedagogy subscale items were modified from research conducted by Selwyn (1997); Tsai *et. al.* (2001); Wozney, Venkatesh, and Abrami (2006); Braak and Tearle (2007). For the Motivation subscale, items from Cassidy and Eachus (2002); Barbeite and Weiss (2004); Shroff, Vogel, and Coombs (2008) were selected. For the Group Interaction subscale, items from Beebe, Barge, and McCormick (1995); and Yoo and Alavi (2001) research were selected. For the Technology subscale, items from Doll and Torkzadeh (1988); Moore and Benbasat (1991); Davis (1989) research were selected.

These indicator items were presented randomly to respondents in an online survey. Data was collected using a seven-point Likert scale with "Strongly Disagree" and "Strongly Agree" as anchors and "Undecided" as midpoint. The survey was pilot tested with a small group, and items were modified based on feedback. Subjects in the study were 70 Business students at a university in the Southeast United States. The survey was administered in four courses over two semesters. The scale was constructed to reflect Pedagogical Value of Wiki (PVW) which is identified as a second-order construct derived from four first-order latent factors, and calculated using composite scores of the four sub-scales.

Using questionnaire design recommendations of Deng, Doll, Al-Gahtani, Larsen, Pearson, and Raghunathan (2008), Figure 2 shows *á priori* schema from first-order factors to the higher-order factors in this study. Since the research was in early stages, multivariate analysis through Partial Least Square (PLS-Graph, version 3.00, build 1130) method of path analysis (Johnson & Wichern, 1982) was utilized to analyze the structural model of the instruments, and determine how well the measurement items relate to the hypothesized constructs. PLS method was used since it places minimal demands on measurement scales and residual distributions, and can be used with sample sizes, but is also recognized to be lower in power than other SEM approaches (Wold, 1985; Chin, 1998).

6. RESULTS

Reliability and validity of the instrument was calculated before proceeding with fitting the structural model using path analysis. Cronbach alpha, a measure of internal consistency (or Reliability), was calculated for the scale and subscales. For the subscales, Learning had an alpha of 0.92, Motivation alpha was 0.93, Group interaction alpha was 0.87, and Technology alpha was 0.85. All subscales individually exhibited good internal consistency. Nunnally (1978) and Thorndike (1996) have stated that overall Cronbach alpha of 0.8 is considered acceptable criterion for internally consistent scales. In this case, Cronbach alpha reliability value of the overall scale (α) was found to be 0.97. However, since this was a new scale, Leech, Barrett, & Morgan (2005) caution that a high alpha (> .90) can also indicate that the items are repetitive, or there are more items in the scale than are necessary for a reliable measure of the concept. As part of Factor Analysis requirement, Kaiser-Meyer-Olkin
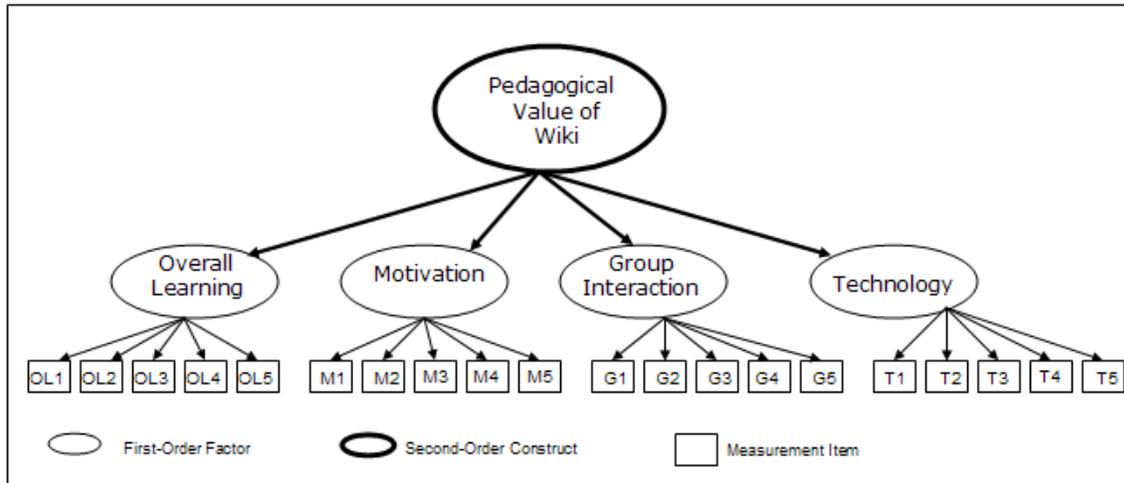
Figure 2: Pedagogical Value of Wiki instrument model

Gender	Male	25	35.7
	Female	45	64.3
Work Experience	1-2 years	13	18.6
	3-5 years	16	22.9
	> 5 years	06	08.6
	None	35	50.0
Age	18-25	14	20.0
	26-45	40	57.1
	> 45	16	22.9
Web Design Experience	Beginner	41	58.6
	Intermediate	27	38.6
	Expert	2	02.9

Table 1: Demographic Information

(KMO) measure of sampling adequacy (Kline, 1994) was calculated and was found to be 0.93. A value greater than 0.7 is considered the minimum requirement for obtaining distinct and reliable factors (Kline, 1994). Also Bartlett's test of sphericity (Kline, 1994) was found to be significant ($p<.001$) which shows a relationship between variables, and the diagonal elements of the anti-image correlation matrix was 0.5. Item analysis was conducted to determine instrument validity. As recommended by Gerbing and Anderson (1988), the convergent and discriminate validity of the scale was investigated where each item was correlated with its own scale (with the item removed), and then with other scales. Item analysis showed that all items were highly correlated with their own scale in comparison to items in the other subscales therefore supporting validity of the measure.

There were 70 respondents to the questionnaire which included 45 females and 25 males. Other demographic information is shown below in Table 1.

The survey included four constructs: Learning/Pedagogy, Group Interaction, Motivation, and Technology. Each construct was represented by measurable indicators in the survey. Table 2 shows correlation between the four constructs was significant at the .01 level.

The average extracted variance for questionnaire data was greater than .5, which met Fornell and Larcker's (1981) assessment of shared variance coefficient for establishing convergent validity. Taken together, the four factors explained 95.3% of variance in PVW score.

Hypothesis 1
Web development experience was examined in relation to PVW score. A weak correlation that was not significant was found ($r_s(68)=0.045$, $p>.05$). Web development experience was not related to PVW score in this study.

Table 3 shows the measurement model with item factor loadings, path coefficients, variance extracted.

Hypothesis 2
When work experience was examined in relation to PVW score, moderate correlation that was significant was found ($r_s(68)=-0.39$, $p<.01$). Students with no full time work experience scored higher on the PVW scale in comparison to students with more than five years' work experience. A one-way ANOVA was computed to compare the PVW score of students with different work experience. A significant difference was found among the students groups ($F(3,$

	Learning	Motivation	Group Int.	Technology
Learning $(\alpha=.92)$	--			
Motivation $(\alpha=.93)$	.939**	--		
Group Int. $(\alpha=.87).877**$		.843**	--	
Technology $(\alpha=.85)$	.880**	.881**	.838**	--

** Correlation is significant at the 0.01 level (2-tailed).

Table 2: Correlation of Latent Variables

Items	M	SD	Subscale Reliability Coefficient	Item Factor Loading	Portion of variance extracted
Factor 1: Learning/Pedagogy					
1 Use of the Wiki enhanced my interest in the course (OL1)	4.37	1.95	.92	.889	.944
2 I would like to see Wikis used in other courses (OL2)	4.54	2.10		.899	
3 I will retain more material as a result of using the Wiki (OL3)	4.04	1.78		.890	
4 I participated in the assignment more because of using the Wiki (OL4)	4.11	2.04		.866	
5 Use of the Wiki aided me in achieving course objectives (OL5)	5.06	1.64		.808	
Factor 2: Motivation					
6 Benefit of using the Wiki is worth the extra effort & time required to learn it (M1)	4.97	1.91	.93	.919	.925
7 I would recommend classes that use Wikis to other students (M2)	4.80	1.91		.934	
8 I would prefer classes that use Wikis over other classes that do not use Wikis (M3)	4.27	2.03		.912	
9 I will continue to explore use of Wikis for education (M4)	5.36	1.80		.872	
10 I stayed on the task more because of using the Wiki (M5)	4.30	1.82		.794	
Factor 3: Group Interaction					
11 I liked seeing other students' interaction with material I posted in the Wiki (GI1)	5.59	1.32	.87	.661	.871
12 Use of the Wiki for the assignment helped me interact more with students (GI2)	4.80	1.97		.862	
13 Because of using the Wiki, my group was able to come to a consensus faster (GI3)	4.27	2.02		.842	
14 I learned more because of information posted by other students' in the Wiki (GI4)	4.60	1.82		.878	
15 Use of the Wiki promoted collaborative learning (GI5)	5.57	1.57	.85	.814	
Factor 4: Technology					
16 The Wiki interface and features were overall easy to understand (T1)	5.77	1.33		.733	.894
17 Benefits of using the Wiki outweighed any technical challenges of its use (T2)	4.76	1.96		.875	
18 Browsing/editing information in the Wiki was easy (T3)	5.46	1.53		.668	
19 Compared to WebCT discussion board, the Wiki was easier to use (T4)	4.31	2.10		.820	
20 Technical features in the Wiki helped enhance my learning (T5)	4.60	1.80		.849	

Table 3: Assessment of Measurement Model

66)=4.76, *p*< .05). Tukey's HSD was used to determine the nature of differences between the student groups. This analysis revealed that students with more than five years' experience scored lower (m=67.17, sd=30.682) than students with no work experience (m=103.26 , sd=26.78) and students with 1-2 years work experience (m=103.77, sd= 16.00). Students with 3-5 years experience (m=82.25, sd=33.53)

were not significantly different from either of the other two groups.

Hypothesis 3
Gender was examined next in relation to PVW score by using point-biserial correlation. Males scored higher on the PVW scale (m=111.52, sd=24.202) as compared to females

(m=95.46, sd=29.406). A moderate correlation that was significant was found (r_{pb}(68)=-0.41, p<.01).

Hypothesis 4
Spearman correlation was used to examine the relationship between age category and PVW score. A weak correlation that was not significant was found (r_s(68)= -0.149, p> .05). Age was not related to PVW score in the study. It was found that younger students (18-25 years) had a PVW mean score of 100.07 (sd=35.66), students who identified themselves in the range 25-45 years had a mean score of 97.2 (sd=25.809), and students over 45 years had a PVW mean score of 87.06 (sd=32.258). Much emphasis has been given to the term Digital Natives vs. Digital Immigrants (Prensky, 2001) which indirectly refers to younger learners being assumed to be more adept with acceptance of technology (especially Web 2.0 social computing). Thus further investigation was done to correlate age of respondents with each of the individual subscales. For the Learning/Pedagogy subscale, a weak correlation that was not significant was found (r(68)=-0.176, p>.05). For the Motivation subscale a weak correlation that was not significant was found (r(68)=-0.139, p>.05). For the Group interaction subscale, a weak correlation that was not significant was found (r(68)=-0.082, p>.05. For the Technology subscale, a weak correlation that was not significant was found (r(68)=-0.167, p>.05). A simple linear regression was also used to predict subjects' PVW score based on their age. The regression equation was not significant (F(1, 68)=1.54, p> .05) with an R^2 of .022. Age cannot be used to predict PVW score. Multiple regression analysis was conducted next to determine the best linear combination of gender, age, work experience, previous web development experience for predicting PVW score. A significant regression equation was found (F(4,65)=7.167, p<.001), with an R^2 of .306. Thus 30.6% of the variance in PVW score was explained by the model. Gender and work experience were significant predictors for the PVW score.

Open-ended comments made by respondents on the survey instrument were also analyzed for common themes. Table 4 summarizes open-ended comments on Wikis made by students who used Wiki technology to complete assignments in the study.

Students compared the Wiki interface to WebCT and noted that the Wiki was not difficult to use. This validated the selection of Wikispaces, as the mechanics of technology itself would be transparent to users; and the focus of students would be more on the content and outcomes of the assignment.

7. LIMITATIONS

This study included assessment of Wiki technology within the Business school only. However, this was intentional to provide a more consistent assignment structure and reliable assessment, without variation that may have resulted if multiple course instructors and different types of assignments were used. Such variation of instruction and assignments may not have clearly represented the four factors being studied. There was no control group as this was not designed as a causal-comparative study. The intention of this study was to measure the value Wiki technology may bring into the classroom.

- Introduces variety and exposes students to different instructional strategy
- Most innovative way of doing group assignments
- Provides opportunities for leadership
- Good collaboration features
- Individual's thought process can be seen in discussion area
- Interface is user-friendly and does not take time to learn
- History feature is useful in identifying procrastinators
_____
- Coordination with students is difficult
- Learning is scattered and frustrating
- Chat feature would be helpful in getting immediate response
- Anyone can make changes to my entry
- Lack of individual's control on grades because it is a group effort
- Does not suit my learning style because I like individual projects
- Benefits were not worth the added learning and technical challenges.

Table 4: Respondents' Open Ended Comments

Although the factors that contribute to proposed pedagogical value of Wikis were extracted from review of literature for the purpose of providing content validity, due to limitations mentioned earlier, confirmatory factor analysis was not used to confirm (or refute) a four-factor solution that was *á priori* assumption of the researchers. It was also found that the inter-correlations between the proposed factors were high (Table 2). This may be because the sample size may not have been large enough in this study. Researchers have given guidelines for the minimum sample size needed to conduct factor analysis. To address this limitation, the scale can be considered unidimensional until additional work is done validating individual constructs.

Despite the limitations of this study, which is typical in exploratory studies, the findings can offer insights to other edu-cators interested in exploring Wikis for teaching and learning in a collaborative setting and serve as a basis for further research.

8. DISCUSSION

This was an exploratory study for the purpose of investigating and contributing to research in the relatively new domain of pedagogical value of Web 2.0 tools that are finding widespread use in education and business. The study provided insights into formative indicators that can be used to measure pedagogical value of Wiki technology so educators can use these factors when designing Wiki assignments.

The study found gender differences and PVW score being higher for males, which is consistent with previous research (Eachus & Cassidy, 2006) that found that males spend more time on the Internet than females, and thereby may be more comfortable with the technology aspect of using the Internet. The scale developed in this study should encourage further research in assessment of Web 2.0 tools since they are being widely used in college and university courses. Educators can use this scale to measure the pedagogical value offered by emerging technologies which encourage social collaboration. This instrument can also be

used to address the gap that exists between proposed use of tools and actual implementation in the classroom by investigating features that students would consider beneficial for learning.

Commercial course management tool vendors are re-designing first generation Web course tools to include Web 2.0 features in new versions of their enterprise systems. These newer versions of course management tools should incorporate Web 2.0 tools to accommodate collaborative features of social computing. There needs to be a shift from instructor-delivered teaching, to student-facilitated learning where peer groups play as important a role as a teacher in a traditional (face-to-face) classroom environment. According to Lamb (2004), true constructive learning requires educators to relinquish control, to some degree in order to foster more collaborative learning activities. The "sage on the stage" model would give way to "guide on the side" paradigm. The new tools could integrate features such as immediacy of response (e.g. instant messaging alert), student-led discussions (e.g. Blogs and Wikis), multimedia presentations, peer editing, and extend course management tools to mobile phones, and PDA type devices that are prevalent among digital natives.

New standards will need to be developed to accommodate interoperability between different course management systems and Web 2.0 tools, and the ability to share learning objects and social pedagogy tools between different environments. The comments made by students in this study can be drivers for innovation in design of future Wiki systems. With broadband connections becoming widely available, one of the biggest needs identified by students is the need for a synchronous video-based chat environment. A group can collaborate more effectively in a "live" Web 2.0 format, as compared to asynchronous messaging used in most existing course- management tools which takes more time to arrive at a consensus between members and limits spontaneous group collaboration.

9. CONCLUSION

Parmeswaran and Whinston (2007) noted that research in social computing should be a priority for researchers because of the changes in communication, computing, collaboration, and commerce that are impacted by this trend. During the past decade the use of Internet has become common in education. Technology has been used as an enabler to facilitate learning. Distance learning has given adult learners an opportunity to interact with other students in web-based environment by using course management tools that integrate or supplement Web 2.0 components. However, it is important to note that no single technology by itself (including Wikis) can impact learning outcomes. Mishra and Koehler (2006) found that variables such as course content, instructional pedagogy, and technology influence classroom learning; and sound instructional practices are also important components in the learning process. Instructors can explore the potential offered by Wikis and realize its benefits if used correctly.

As shown in this study, as well as the experience reported by instructors in other studies such as Elgort, Smith, and Toland (2008), Wikis can promote collaboration in

group assignments, encourage negotiation, and make students comfortable with new generation of technology tools. To incorporate Wiki technology, educators should use participatory approaches in which users become active contributors and producers of content. Students can build collectively on each other's knowledge by forming "participatory communities." Other examples of assignments may include brainstorming activities, group discussions, knowledge base creating, and collaborative writing. The goal is to promote student engagement by the use of technology tools and systems.

9.1 Future Research Direction

Although this research focused on the use of Wiki technology in a Business school, additional research is needed to explore other Web 2.0 technologies (such as blogs, podcasts, and social networking) as they relate to student learning, attitudes, motivation, and learner outcomes. Research can also look at different curricula, disciplines, and learning styles of students which may be better suited to Web 2.0 technologies. Today, although Wiki environments from various vendors use different features, additional research could look at specific features of Wikis that contribute most to student learning. Also, further scale development is needed because a standardized scale measuring pedagogical implications of Wiki (or other Web 2.0 tools) does not exist. Emerging technologies have the potential to have a significant impact on learner outcomes, provided they are structured properly in the curriculum to increase knowledge, motivation, and enthusiasm for learning.

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APPENDIX A

<u>Instructions</u>: The purpose of this survey is to investigate the use of Wikis in courses. Wikis are used in courses to promote collaboration and group interaction. This survey collects information on student perceptions of Wiki technology. Please select the most appropriate option for each statement given below as it applies to you. There is no right or wrong answer.

	SD	D	U	A	SA
The Wiki interface and features were overall easy to understand					
I liked seeing other students' interaction with material I posted in the Wiki					
I would prefer classes that use Wikis over other classes that do not use Wikis					
Browsing/editing information in the Wiki was easy					
Use of the Wiki aided me in achieving course objectives					
I stayed on the task more because of using the Wiki					
I would like to see Wikis used in other courses					
Benefit of using the Wiki is worth the extra effort & time required to learn it					
I participated in the assignment more because of using the Wiki					
Benefits of using the Wiki outweighed any technical challenges of its use					
Use of the Wiki for the assignment helped me interact more with students					
Technical features in the Wiki helped enhance my learning					
Because of using the Wiki, my group was able to come to a consensus faster					
I will retain more material as a result of using the Wiki					
I would recommend classes that use Wikis to other students					
Compared to WebCT discussion board, the Wiki was easier to use					
Use of the Wiki promoted collaborative learning					
I learned more because of information posted by other students' in the Wiki					
Use of the Wiki enhanced my interest in the course					
I will continue to explore use of Wikis for education					

Demographic Information:

(i) For which course are you filling out this survey? _____
(ii) Your name: _____ *(Note: Your name is required for assigning a grade to your Wiki assignment. The questions on this survey do not have right or wrong answer and will not impact your grade)*
(iii) Are you?   Male | Female
(iv) How many years have you been working? 1-2 years | 3-5 years | More than 5 years | Currently Not Working
(v) What is your age range?   18-25 | 26-45 | Over 45
(vi) How would you classify your experience with Web Page Design? Beginner | Intermediate | Expert
(vii) Any additional comments (such as what you liked MOST/LEAST about use of the Wiki?)

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