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A 'USES AND GRATIFICATIONS' APPROACH TO UNDERSTANDING THE ROLE OF WIKI TECHNOLOGY IN ENHANCING TEACHING AND LEARNING OUTCOMES

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Abstract

The use of the Wikis in both post-graduate and undergraduate teaching is rapidly increasing in popularity. Much of the research into the use of this technology has focused on the practical aspects of how the technology can be used and is yet to address why it is used, or in what way it enhances teaching and learning outcomes. A comparison of the key characteristics of the constructivist learning approach and Wikis suggests that Wikis could provide considerable support of this approach, however research into the motivations for using the technology is required so that good teaching practices may be applied to the use of Wikis when utilized in the higher education context. This study articulates a research design grounded in the Technology Mediated Learning (TML) paradigm that could be used to explore teachers and students' motivations for using Wiki technology to enhance teaching and learning outcomes. Using the 'Uses and Gratification' approach, a popular technique used for understanding user motivation in technology adoption, a two-stage research design is set out. Finally, the paper concludes with a discussion of the implications for both information systems researchers and higher education.

Keywords: Wiki technology, constructivist learning, uses and gratifications approach (U&G), technology-mediated learning (TML), motivations

1 INTRODUCTION

The introduction of Web 2.0 technologies into the university teaching environment is transforming the traditional e-learning world (O'Reilly 2006). The shift from static Web 1.0 technologies to the interactive potential of Web 2.0 provides the opportunity of improving the learning behaviors of the learners as they are no longer just consumers of preconfigured content, but participants in the creation, collation and sharing of the learning content, playing a much more important role in the entire learning context (Ebner & Walder 2007).

Of the various applications that fall under the Web 2.0 umbrella, Wiki is the one that has most rapidly proliferated in higher education (Choy & Ng 2007, Elgort 2007). As "a social networking adaptive technology that emphasizes a more task-oriented collaborative editing of content and development of 'collective' interlinked knowledge" (Duffy & Bruns 2006), Wikis have been put to a wide range of uses in a broad range of contexts. Research into Wikis use in academia is relatively new (Parker & Chao 2007) and although some research has examined Wikis in learning (Bruns & Humphreys 2005, Cook 1998, Duffy et al. 2006, Elgort 2007, Elgort, Smith & Toland 2008), these studies have tended to focus on characterizing Wiki learning activities or establishing guidelines to aid in the implementation of Wikis (Forte & Bruckman 2007).

Two significant gaps are evident in the research. Firstly, there is a gap in the understanding of the use of Wikis in learning as it relates to people's motivations with respect to that use (Wagner 2004). This deficiency mirrors that found in most research into Technology-Mediated Learning (TML), in which there is seen to be little consideration of the important internal social and psychological process through which learning occurs (Alavi & Leidner 2001). These authors call for greater depth and breadth of TML research in the Information Systems (IS) domain in order to understand how technologies can enhance learning. In this regard, the 'Uses and Gratifications' (U&G) perspective to the study of technology use has been found to offer some insight into the reasons why people adopt an emergent technology (Flanagin & Metzger 2001), although the level of granularity used when studying the Internet may have damped the results. The other 'gap' relates to understanding the way in which Wikis enhance a learner's learning as, despite its use as a teaching tool, it is not clear how, and in what contexts, a learner's use of Wikis enhances his/her learning (Forte et al. 2007).

It is understandable that these areas are yet to be investigated, given the newness of Web 2.0 technologies in university teaching, but as Flanagin and Metzger (2001, p154) point out, "this rate of change, however, only underscores the importance of a rigorous examination of new communication technologies' development and use." This study sets out a research design by which these two knowledge gaps can be investigated and hopefully addressed. It employs the U&G approach to examine (1) what motivates educators and students to use Wiki technology in teaching and learning, and (2) which groups of motivations does Wiki technology fulfil best? The paper commences by defining Wiki technology and discussing its adoption in the education sector. An overview of good teaching practices then follows. The potential role of Wikis in that practice is then explored followed by an explanation of U&G perspective. The research questions are then posed and the research design by which the proposed research questions could be investigated is then articulated and discussed. The paper concludes with an outline of the anticipated implications of the proposed research.

2 WIKI TECHNOLOGY: DEFINITION AND USE IN EDUCATION

Wiki, a term that means "quick" in Hawaiian, was originally developed by Ward Cunningham and further defined by Leuf and Cunningham as a "freely expandable collection of interlinked Web pages, a hypertext system for storing and modifying information—a database where each page is easily editable by any user with a forms-capable Web browser client" (Leuf & Cunningham 2001, p14).

According to Duffy and Bruns, (2006), the key characteristics of Wikis are:

- A website that allows a user to add content, and allows that content to be edited by any other user.
- Can be personal, but are usually open to collaborate.
- Involve the creation of documents without the user having a detailed knowledge of HTML.
- Tend towards expressing ideas as relationships between pages, thus creating a network of interrelated topics that is based on a topical approach.
- Are a-temporal, that is, the nodes (or interlinking textual references) change not according to time, but by way of development of the evolving and edited text.
- Track the changes to individual pages over time and allow users to browse the history of a page.
- Encourage cross-linking and are dominantly spatial in structure.
- Provide a space where knowledge becomes networked (situated, contextualized) but remains ephemeral; it changes, and can be changed and mediated by the community.

Wiki technology has been found to be useful in teaching, especially where collaboration and knowledge sharing are important (Raman, Ryan & Olfman 2005) and has been used to support activities such as project management (Xu 2007), developing and maintaining software projects (Malani & Dwyer 2005), supporting writing instructions (Lamb 2004), arranging information and sharing knowledge (Elgort et al. 2008), online teaching and assessment (Bruns et al. 2005), and online collaboration in the e-learning environment (Raitman, Augar & Zhou 2005).

3 GOOD TEACHING PRACTICES

In seeking to understand the role that Wikis can play in higher education, this study assumes a constructive perspective of learning, with the deep approach to learning and student-focused approach to teaching being important contributions of the constructivist paradigm of learning.

A student's approach to learning is typically categorized as either a surface learning approach or a deep learning approach. The surface approach to learning involves the students seeking to avoid failure but having no inherent desire to work too hard. This approach usually leads to satisfactory performance in assessment but to very poor learning outcomes over the longer term (Biggs 2003, Gibbs 1992, Ramsden 1992). The characteristics of the surface approach to learning include: the intention to complete task requirements; memorizing information needed for assessment; the failure to distinguish principles from examples; treating task as an external imposition; focusing on discrete elements without integration; and unreflectiveness about purpose or strategies (Entwistle 1987). In contrast, the deep approach to learning involves students being intrinsically motivated, seeking integration between components and between tasks, playing with ideas (Gibbs 1992), engaging with the materials of the subject and re-constructing their own world view as a consequence of what they have learned (Biggs 2003, Gibbs 1992, Ramsden 1992). The major characteristics of the deep approach to learning include intention to understand; vigorous interaction with content; relating new ideas to previous knowledge; relating concepts to everyday experience; relating evidence to conclusions; and examining the logic of the arguments (Entwistle 1987). The deep learning approach is seen as superior as it is considered to produce better performance in assessment and deliver better learning outcomes over the longer term (Biggs 2003, Gibbs 1992, Ramsden 1992).

An educator's approach to teaching can be classified into five different types (Trigwell, Prosser & Taylor 1994):

1). A teacher-focused strategy with the intention of transmitting information to students;

2). A teacher-focused strategy with the intention that students acquire the concepts of the disciple;

3). A teacher/student interaction strategy with the intention that students acquire the concepts of the disciple;

4). A student-focused strategy aimed at students developing their conceptions;

5). A student-focused strategy aimed at students changing their conceptions.

The teacher-focused strategy focuses on teachers and represents teaching as being mainly about passing on knowledge, whereas student-focused strategy focuses on students and represents teaching as helping the students develop their own knowledge (Trigwell et al. 1994).

The teacher-focused strategy has been found more likely to encourage students towards a surface learning approach than the student focused strategy (Trigwell & Prosser 1996), hence suggesting that the student-focused approach to be the preferable approach. Trigwell, Prosser and Waterhouse (1999) give the key characteristics of student-focused teaching strategy as:

- The teacher believes that what the student does and not what the teacher does determines what the student learns;
- The teacher is one who encourages self directed learning;
- The teacher is one who makes time for students to interact and to discuss the problems they encounter;
- The teacher is one who assesses to reveal conceptual change;
- The teacher is one who provokes debate and raises and addresses the taken-for-granted issues;
- The teacher is one who uses a lot of time to question students' ideas, and to develop a "conversation" with students in lectures.

These views are consistent with Biggs's writing on how a learning environment can be transformed to achieve quality outcomes: good teaching as the encouragement of a deep approach to learning (Biggs 2003). The key component in this transformation is the transition from teacher-centered practice, where student learning is seen as a result of what the teacher does, to student-centered practice, where student learning occurs as a result of what the student does (Housego & Freeman 2000). Four key elements being identified as a good teaching are (Biggs 1989):

- Motivational context: deep learning is more likely when students' motivation is intrinsic and when the student experiences a need to know something;
- Learning activity: students need to be active rather than passive since deep learning is associated with doing;
- Interactions with others: it is often easier to negotiate meaning and to manipulate ideas with others than alone; and
- A well structured knowledge base: without existing concepts it is impossible to make sense of new concepts.

Both the deep approach to learning and student-focused approach to teaching are important contributions of constructivist paradigm of learning. In this paradigm knowledge as well as meanings are seen as constructed rather than given (Jonassen 1999, Parker et al. 2007) and are seen to embody a number of key principles (Miers 2004, p.4):

- Active and manipulative: engaging students in interactions and explorations with learning materials and providing opportunities for them to observe the results of their manipulations;
- Constructive and reflective: enabling students to integrate new ideas with prior knowledge to make meaning and enable learning through reflection;
- Intentional: providing opportunities for students to articulate their learning goals and monitor their progress in achieving them;
- Authentic, challenging and real-world (or simulated): facilitating better understanding and transfer of learning to new situations;
- Cooperative, collaborative and conversations: providing students with opportunities to interact with each other to clarify and share ideas, to seek assistance, to negotiate problems and discuss solutions.

Constructive perspective of learning has become the dominant paradigm of learning and its implications for how educators teach and learn to teach are seen as considerable, but necessary if the students within each educator's charge are to succeed (Jonassen, Hernandez-Serrano & Choi 2000).

4 USE OF WIKIS TO FACILITATE CONSTRUCTIVE LEARNING

Information technologies have been used extensively to enhance learning outcomes and a great deal of research has examined the influence of various technologies on instructional methods and learning outcomes (Alavi et al. 2001, Jonassen et al. 2000). Predominately these studies have focused on the influence of technology features on learning outcomes by comparing various forms of technology mediated learning with traditional learning environments (Alavi et al. 2001) and while these studies have answered questions of 'does the technology enhance learning?', they have not readily provided answers on 'how the technology enhances learning?'. The framework proposed by Alavi and Leidner (2001) (set out below in Figure 1), addressed this issue by shifting the attention to explicit examination of the relationships between technology features, instructional strategy, and psychological processes that impact learning outcomes in a given learning context. As they argued, "it is not the technology features, in and of themselves, that matter. It is the mutual influence of technology features, instructional strategy, and psychological processes that impact learning outcomes." (p.6)

From a student-focused, constructivist perspective, learning technologies are tools for mediating the practice of learning (Jonassen et al. 2000). Jonassen (1997) emphasized that "technologies should be used to keep students active, constructive, collaborative, intentional, complex, contextual, conversational, and reflective. Current popular online course delivery and management systems, such as WebCT, do not support constructivist perspective of learning (cf: Miers 2004, p.9).

Wiki characteristics and features make it possible to facilitate constructive learning (Bruns et al. 2005). The left hand columns of Table 1 below present the key characteristics of a constructivist learning environment (Miers 2004) as well as learning resources, activities, or supports required to facilitate such a constructivist learning environment (Oliver 2001). And the right hand column of Table 1 provides a list of wiki features found in the literature. We propose a possible link between these two parts. In other words, in order to empirically examine how Wikis can be used to enhance learning outcomes, we attempt to identify various reasons (motivations) for teachers and learners to use various Wiki features in the learning contexts. If motivations for using Wikis are consistent with characteristics of the constructivist perspective of learning and associated activities (left hand columns in Table 1), it will help answer our questions of how and why Wikis can enhance learning outcomes.

5 USES AND GRATIFICATIONS APPROACH

Derived from the mass communication literature, the U&G approach provides a user-centered perspective on the relationship between users and technology. The U&G perspective focuses on explaining the social and psychological motives that shape why people use technologies and that motivate them to select certain technologies in order to gratify a set of psychological needs behind those motives (Katz, Blumler & Gurevitch 1974, Rubin 1994). According to Katz et al (1974), one basic assumption of this approach is that media users are goal-directed in their behavior, and the personal use of media is an active choice made to satisfy needs. The second assumption of this approach is that media users are aware of their needs and select the appropriate media to gratify those needs.

The U&G approach has found to be a useful vehicle to explore people's motivation for engaging one specific mediated technology over another (Newhagen & Rafaeli 1996 , Ruggiero 2000). Technology studies that have taken a U&G approach have focused on a number of technologies, such as television, VCR, telephone, cable TV, and the Internet (Ruggiero 2000). Indeed, the U&G approach has been used to investigate users' motivations for using a particular mediated technology whenever a new technology becomes available (Elliott & Orosenberg 1987).

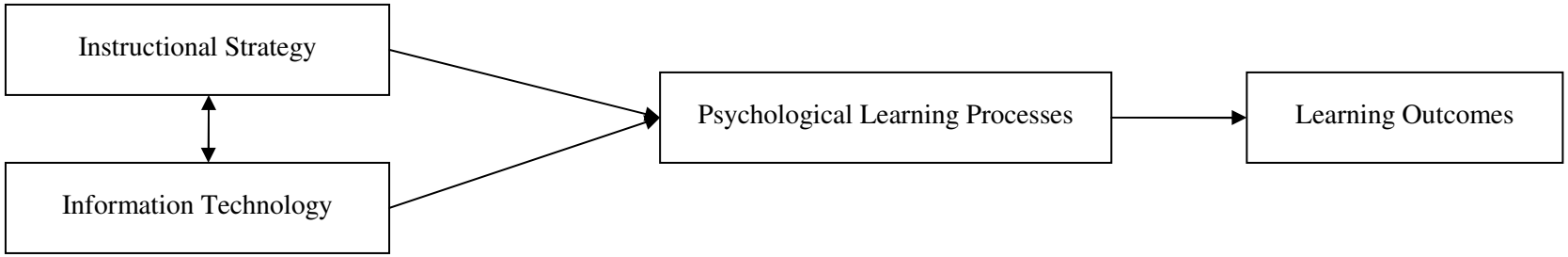

Figure 1: A framework for technology-mediated learning research (Source: Alavi et al. 2001)

Constructivist Learning Environment Characteristics (Miers 2004)	**Learning Resources, Activities, or Supports that Facilitate Constructivist Learning Environment (Oliver 2001)**	**How does Wiki Technology Support These Resources, Activities, and Supports?**
Active and manipulative	• Learning objects, animations and simulations that allow students to explore content, test their hypotheses and obtain feedback • Websites that facilitate exploratory, non-linear learning • Intuitive navigation that between activities and resources that guides and scaffolds but enables learner control	• Wikis versioning capability can show the evolution of thought processes as students interact with the site and its contents (Duffy et al. 2006, Wagner 2004). • Wiki pages are highly flexible in structure. Pages can cite other pages based on a powerful back link function (Wagner 2004, Xu 2007). • Navigation varies. Users can organize Wiki pages in any predetermined order to enable control (Duffy et al. 2006).
Constructive and reflective	• Concept mapping software such as inspiration to record prior knowledge • Chat and forums to share and discuss prior knowledge and reflect on learning and receive feedback • Online journals/weblogs to share learning • Note taking form on a webpage that enables notes to be saved, viewed, added to and reflected on form any location	• Once a Wiki has been created it will persist and can be built up as a knowledge repository (Hester 2008, Raman et al. 2005). • Wiki is a discussion medium for group work. Students can easily get instant feedbacks from peers or instructors (Wagner 2004). • Online journals are provided (Rauschmayer 2008). • Wikis are being used as e-portfolios, a tool for collection and reflection at any time, from anywhere (EduCause Learning Initiative 2005)
Intentional	• Microsoft Word or online rubric generators to construct rubrics to record negotiated learning outcomes and monitor progress • Calendar a tool to enable teachers to inset important dates	• The ability of Wiki to export notes to Microsoft Word makes reporting easy (EduCause Learning Initiative 2005) • Calendar tools are provided or integrated with external applications which help students to keep track of their own learning process

	and allow students to add their own dates to keep track of their learning • Concept mapping software such as Inspiration to record learning goals and reflect on them • Collaborative opportunities to discuss learning goals and obtain constructive feedback from the teacher and peers by means of private email and email listservs • Online self-assessment surveys or quizzes to evaluate and reflect on learning • Teacher and peer assessment opportunities through the ability to upload, edit and exchange files as well as make and attach notes	⇨	(Richardson 2008, Schwartz, Clark, Cossarin & Rudolph 2004). • The asynchronous written mode of Wiki web pages enables self-paced study by students (Elgort et al. 2008). • Wiki as a knowledge repository can support reflection on previous learning (Elgort et al. 2008, Hester 2008). • Email and group discussion is provided to facilitate efficient communication between instructors and students (Buffa 2006, Schwartz et al. 2004) . • Online self-assessment surveys or quizzes can be set up by instructors. After students' response, instructors can easily add comment (Liu, Chen & He 2008). • The functions such as uploading, editing and exchanging files and attaching notes are provided (Challborn & Reimann 2005).
Authentic, challenging and real-world (or simulated)	• Problem-solving, task-based activities in which learners are actively engaged in dealing with open-ended questions inquiries and tasks such as: online projects, slam-dunk digital lessons, learning quests, and ask an expert.	⇨	• Wiki pages can be linked to external information sources such as web sites relevant to a particular topic/problem (Duffy et al. 2006). • Wikis support exploratory learning by providing problem manipulation space (Wagner 2004).
Cooperative, collaborative, and conversational	• Discussion groups to pose and discuss questions, share ideas, seek support and negotiate issues • Forums to pose questions, provide opinions and gain exposure to other ideas • Group collaboration on a task • Chat to discuss and share ideas informally • Online journals/weblogs to record and share thoughts, ideas and learning • Interactive whiteboard for collaborative sharing • Online notice-boards that enable both the teacher and the learner to share ideas • Online polling tools to question, canvass and survey student opinions on a variety of issues • Video-conferencing tools that enables students to see the instructor or other students in a chat session	⇨	• Wikis enable collaborative content creation, peer assessment; individual as well as group reflection on learning experiences, user-centric up-to-date information regarding changes in collaborative spaces which all facilitate knowledge sharing and group collaboration (Duffy et al. 2006). • Online journals/ notice-boards are provided to enable feedback and ideas sharing among peer or between students and instructors (Duffy et al. 2006). • Collaborative projects enabled by Wikis can help promote "pride of authorship" and ownership in the team's activities (EduCause Learning Initiative 2005, Raitman et al. 2005). • Online polling tools can be integrated with Wikis to support survey and assessment (Yang, Wu, Koolmanojwong, Brown & Boehm 2008).

Table 1: Key characteristics of a constructivist learning environment and corresponding Wiki characteristics, and features

The characteristics of active choice of technologies and user-centered nature make the U&G approach particular useful for understanding motivations to use Internet-based technologies (Kuehn 1994, Morris & Ogan 1996, Ruggiero 2000) and studies that have focused on this area have found a range of motives at work. Garramone and Anderson's (1986) investigation of electronic bulletin boards in politics found that the needs for surveillance, personal identity and diversion were equally explanatory in that context. Korgaonkar and Wolin (1999) established five motivation factors for the web users: escapism, information control, interactive control, socialization, and economic motivations. Papacharissi and Rubin (2000) also developed a scale of Internet usage motives that consisted of five primary dimensions: interpersonal utility, pass time, information seeking, convenience, and entertainment. Other new gratification dimensions have included: problem solving, persuading others, relationship maintenance, status seeking, and personal insight (Flanagin et al. 2001). Collectively, the U&G perspective has been very useful in understanding motivations and needs for using the Internet. These studies did however look at the Internet in very general terms, seeing it more as a single technology rather than as the bundle of applications and functions (Parker & Plank 2000). These studies also tended to use previously defined mass media gratifications items rather than developing and using the gratification items uniquely associated with Internet technological context. Understanding the teachers and students' motivations associated with using Wikis, through the use of the U&G perspective, coupled with the consideration, from a constructive perspective, of the learning context in which this Wikis will be deployed, should lead towards a better appreciation of how Wikis can be best used to enhance learning. The following research questions formally operationalize the research objectives of this study.

RQ1a: What motivates university teachers to use Wikis in their teaching?

RQ1b: What motivates university students to use Wikis in their learning?

RQ2a: Which groups of teachers' needs do Wikis fulfill best?

RQ2b: Which groups of students' needs do Wikis fulfill best?

6 RESEARCH DESIGN

Due to the lack of research in identifying users' motivations for using Wikis in the learning context, this study will adopt Kuehn's (1994) two-stage research approach for U&G profile development for a comprehensive examination of users' motivation. Specifically, an initial study will be conducted using interviews to identify the different 'need statements' of both university teachers and students. These 'need statements' are motives that shape both teachers and students' Wiki usage patterns in the learning contexts. Then, both teachers and students' Wiki use motivations identified in the first step will be further examined separately in a large scale survey in order to group these statements into profiles representative of specific motivation dimensions for technologies of each user group.

6.1 Stage 1: Understanding the motivations for using Wikis

In order to identify motivations for teachers to implement Wikis to facilitate their teachings and motivations for students to use Wikis in their learning, 15-20 teachers and students will be interviewed using the Repertory Grid Technique (RGT). These staff and students will be purposefully recruited from the Engineering and Business schools at a large Australian university.

RGT was developed by Kelly (1955) to study personal construct systems and is predicated on the idea that individuals use their own personal constructs to understand and interpret events and that these constructs are influenced by each individual's background, personal experiences, beliefs and value systems (Napier, Keil & Tan 2007). RGT involves the generation of a list of concepts (elements) about things or events to be studied and the forming of attributes (constructs) based on the list of concepts (Zhang & Chignell 2001). It is a structured interview process with procedures for uncovering the

cognitive constructs of individuals (Tan & Hunter 2002), and has been widely used in organizational and IS research (e.g., Hunter 1997, Napier et al. 2007, Phythian & King 1992).

The output of this stage includes two parts:

- A comprehensive list (elements) of current technologies (including Wikis) utilized by teachers and students in the learning contexts.
- A set of motivation statements (constructs) unique to both teachers and students in the university context for these technologies (including Wikis).

Content analysis will be used to interpret the RGT data, as content analysis allows for the creation of thematic categories from the constructs described in the interviews (Neuendorf 2002). For the categorization of constructs, an adjusted generic core-categorization procedure outlined by Jankowicz (2004) will be used, thus allowing research questions 1a and 1b to be addressed.

6.2 Stage 2: Investigating the relationships between motivations and Wiki uses

Second stage aims to: 1) provide empirical verification and validation of the stage one results; and 2) explore the relationships among learning technologies, teaching strategies, and learners' psychological learning process, as depicted in Figure 1.

Participants will be asked to complete a questionnaire designed to assess their usage of technologies for satisfying their various needs/motivations (as identified in stage one). Respondents will be asked to rate their level of agreement with the motivations for using each of the technologies identified in stage one in learning contexts on a scale of 1- 9 (where 1 = "Strongly Disagree", 5 = "Neutral", and 9 = "Strongly Agree"). For each of included technologies, participants will be asked to report their levels of expertise, level of accessibility, frequency of access and weekly usage. Both teachers and students who have experience of using those technologies will be invited to participate.

Research questions 1a&1b will be further validated by using a principal component factor analysis with varimax rotation to extract and interpret potential motivation dimensions (factors) (Papacharissi et al. 2000). Research questions 2a&2b can be then assessed by using MANOVA with the motivation dimensions of teachers and students separately, as the independent variables, and the mean satisfaction ratings as the dependent variables.

7 IMPLICATIONS AND CONCLUSION

A number of limitations are noted for this proposed study. First, this project may be limited to participants who are studying at one university with the majority of them majoring in business and engineering. Students' majors and university technology use culture may affect their experience with and motivations for using them. Thus, generalizability of the results and conclusions drawn from this study will need to consider the demographics. The U&G perspective has been criticized as being too individualistic by providing little explanation on the formation of social and psychological needs or ignoring the social implications of technology use (Elliott, 1974, Ruggiero 2000, Zhu 2004). To address this issue, a study investigating the psychological and social factors that affect individual's motivations for using technology and the consequences of technology-related behaviors will be conducted in the future.

The proposed research will be of significance to practice in a number of ways. In general, an improved understanding of the social contexts of technology use in universities, from both a teachers and students' perspective, should help the implementation of technologies and flexible teaching and learning models into the learning environment. From a teaching perspective, a better understanding of both the motivation for using Wikis and the efficacy of using Wikis should provide a useful prompt for the rethinking of good teaching practices in the pursuit of supporting socially constructed learning practices (Duffy et al. 2006). When educators understand the motivations that guide student

interactions with the technology, they will be able to accommodate those needs more responsively in their teaching strategies.

This proposed research will contribute to the research effort regarding technology use in education in a number of ways. First, it will demonstrate the usefulness of the U&G approach in this area of research, especially in regard to Web 2.0 technologies. It will be amongst the first studies to conceptualize how both teacher-specific and student-specific technology use motivation scales are constructed by employing a multi-method approach. Most importantly, this proposed study will make progress towards understanding why technologies can be used to enhance learning outcomes by examining the links between technology features and instructional variables that might influence learning outcomes.

University students are among the most computer-savvy and "connected" users of the Internet (Aiken, Vanjani, Ray & Martin 2003). Using various technologies has become so pervasive in the lives of this young generation, that it has become a natural extension of themselves (Hoffman, Novak & Alladi 2004). These students will simply expect that new technologies, such as Wikis, will be an integrated part of their learning. It is important then that we understand how to best harness these technologies so that they enhance good teaching practices and allow us to prepare these future engineers, software developers, business leaders and the like, with the critical, creative, collaborative, and communicative capabilities that are required for their professions (Duffy et al. 2006). Understanding how technologies can be used to facilitate and development of those skills is of considerable importance to educators.

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