A Theoretical Model Of E-Learning Ability To Support Attainment Of Students’ Graduate Attributes

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A THEORETICAL MODEL OF E-LEARNING ABILITY TO SUPPORT ATTAINMENT OF STUDENTS’ GRADUATE ATTRIBUTES

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Abstract:
This research-in-progress study aims to propose – and later test – a theoretical model to review the impact of e-learning environments on student learning outcomes and graduate attributes. While the use of web-based technologies has increased rapidly in higher education, the different factors impacting on actual learning outcomes remain poorly understood in such e-learning environments. This paper presents the development of a theoretical model for e-learning effectiveness. The authors look through Webster and Hackley’s (1997) four dimensional lens, the Interaction-Based Model of e-learning (Anderson, 2003), the Task-Technology-Fit (TTF) Model (Goodhue and Thompson, 1995), and the Integrated Model for Perceived e-Learner Satisfaction (Sun et al., 2008) in order to refine their concise theoretical model. This research concludes with both an outline of the empirical section of this research as well as a broader research agenda.

Keywords: e-learning; learning outcomes; graduate attributes; e-learning environments; e-learner satisfaction.
1 INTRODUCTION

In recent years, many educational institutions, organizations, and individuals have adopted e-learning technologies and methods. The overall global market for e-learning products is estimated to be US$52 billion by 2012 (Ramasundara, 2008). Currently, the US is the largest buyer of e-learning products and services which reached US$958.7 million in 2010. The forecast five year compound growth rate for e-learning products is 13.7% per annum (KINEO, 2011) and the demand for e-learning products in the US is growing by 7.4% per year (Liao and Lu, 2008b). According to a recent report by Ambient Insight, the US market for self-paced e-learning is projected to grow to $23.8 billion by 2014 (ICLM, 2012). In Japan, the total market size of the domestic e-learning market in 2011 was 110 billion Yen (over US$1 billion), with an expected 10% annual growth (YANO, 2011). In summary, the market for e-learning technologies is growing rapidly both across educational institutions as well as the workplace.

As the technology has grown more pervasive and ubiquitous, there have also been an increasing number of studies in the field of e-learning over the past decade (Lonn and Teasley, 2009; Chen et al., 2010). Much research has been undertaken on the practical factors in the application of e-learning, such as e-learning infrastructure (Davis, 2004; Fahy, 2004; McGreal and Elliott, 2004), e-learning quality (Frydenberg, 2002; Roffe, 2002), e-learning evaluation (Wang et al., 2007; Papastergiou, 2006), and e-learning implementation (Xu and Wang, 2006). However, few studies have focused on the theoretical grounding for e-learning in relation to student learning outcomes and graduate attributes from an information systems perspective. This is concerning as a theoretical underpinning is necessary for any scientific discipline (Jarvelin and Ingwersen, 2004).

In this research-in-progress, we propose a synthesized theoretical model for evaluating the effects of e-learning environmental characteristics on students’ learning outcomes and ultimately on their graduate attributes. In many of today’s universities “graduate attributes” are underpinning their learning and teaching strategies. Below is part of the learning and teaching strategy in a research-intensive Australian university:

“(The university) aspires to develop graduates who are rigorous scholars, capable of leadership and professional practice in a global community. The university has, thus, articulated the following Graduate Attributes as desired learning outcomes for all students: (i) understanding of their discipline in its interdisciplinary context, (ii) capable of independent and collaborative enquiry, (iii) rigorous in their analysis, critique, and reflection, (iv) able to apply their knowledge and skills to solving problems, (v) ethical practitioners, (vi) capable of effective communication, (vii) information literate, and (viii) digitally literate” (UNSW, 2012).

This study is organized as follows. First, we provide a review of the current literature focusing on theoretical models that may be relevant to the evaluation of the relationships between e-learning environmental characteristics and the learning outcomes and graduate attribute of students. Furthermore, we discuss the strengths and limitations of each model in relation to the research problem. Third, we propose a synthesized model of e-learning environmental characteristics as an analytical tool for evaluating the effects of e-learning systems on students’ learning outcomes—measured by the ability of the system to aid in the attainment of students’ graduate attributes. We conclude with an outlook for the empirical section of this study, as well as a general research agenda.
2 LITERATURE REVIEW

E-learning has been used increasingly in both educational institutions and corporate organizations in recent years (Wang et al., 2007). A number of factors have influenced this trend, including rapid improvements in technological advancement, competitive pressure, and positive experiences (Kedia and Harvinston, 1998; Salmon, 2000; Arbaugh and Duray, 2002). Researchers tend to agree that e-learning can be defined as the delivery of educational instruction through a web-based, web-distributed, or web-enabled information technology (e.g., Nichols, 2003; Zhang and Nunamaker, 2003; Cappel and Hayen, 2004; Sun et al., 2008).

Much research has been conducted on the comparative benefits of e-learning over traditional learning. These benefits include increased flexibility and convenience, as e-learning is both time and place independent (Taylor, 1996; Harasim, 1999; Arbaugh and Duray, 2002; Xu and Wang, 2006), greater perceived opportunities for communication with better access to instructors (Hiltz and Wellman, 1997; McCloskey et al., 1998), and learner-centric activities that foster more engagement and active participation from learners (Burgstahler, 1997; Beam, 1999; Zhang and Nunamaker, 2003). Research has also been conducted on how e-learning positively affects students' performance (Lu et al., 2003; Douglas, 2004) and satisfaction (Sun et al., 2008; Ozkan and Koseler, 2009).

In contrast, there have been some concerns about the lack of face-to-face interaction with teachers and peers in e-learning (Arbaugh and Duray, 2002) and the lack of required levels of self-efficacy in using e-learning systems (Lindner and Murphy, 2001; Siragusa, 2002; Breen et al., 2003). Yet, Wells et al., (2008) found no empirical evidence to support the above claims. There are several similar contradictory results in the current literature and this was another reason for adopting an integrated theoretical approach for the current study in order to investigate the phenomena in a more holistic theoretical space.

Another group of studies have focused on operational aspects of using e-learning systems. Research has been conducted on e-learning infrastructure (Davis, 2004; Fahy, 2004; McGreal and Elliott, 2004), e-learning quality (Frydenberg, 2002; Roffe, 2002), e-learning evaluation (Wang et al., 2007; Papastergiou, 2006), and e-learning implementation (Xu and Wang, 2006).

From a tertiary education perspective, there has been increasing pressure on universities to demonstrate the quality of education they provide (Barrie, 2006). Throughout the past decade – drawing on the work of Bowden et al., (2000) and Barrie (2006) – many universities have identified various qualities of their graduates and have explicated them in the form of a set of student graduate attributes (qualities that a student is expected to possess upon graduation). Students’ learning outcomes are often used as a measure of how much the student has achieved by the end of a particular course or subject (Barrie, 2006; Bowden et al., 2000). To this end, it is important for tertiary educational institutions to understand how e-learning may impact on the achievement of these learning outcomes.

By adopting an information systems perspective to analyze results, this study investigates the relationship between e-learning and students' learning outcomes and graduate attributes. The use of e-learning within educational institutions (especially universities) that employ such learning outcomes as the major goals of pedagogy is widespread. Hence, it is clear that more research needs to be conducted on this topic by adopting non-pedagogical perspectives and the current study is one such attempt.
Four broad categories of e-learning environmental characteristics have been identified as having an impact on students’ perceived learning outcomes (Webster and Hackley, 1997). Building on this work, the following four categories of characteristics are used in the current study: student characteristics, instructor characteristics, course characteristics, and technology characteristics. Details of these characteristics follow:

1. Student characteristics: Students can be characterized by maturity, motivation, computing attitude, computer anxiety, self-efficacy, and prior experience with Learning Management System (LMS) (Piccoli et al., 2001; Arbaugh and Duray, 2002; Wang and Newlin, 2002). Piccoli et al., (2001) found a strong relationship between student maturity and motivation, and the effectiveness of e-learning.

2. Instructor characteristics: Instructor characteristics include technology control, computing attitude, teaching style, self-efficacy, and availability (Piccoli et al., 2001; Thurmond et al., 2002). Webster and Hackley (1997) identified instructors as principal participants in the learning process, and found that instructors’ attitudes have a high impact on the outcomes of e-learning.

3. Course characteristics: Course characteristics in relation to e-learning have not been investigated by many researchers. The literature on traditional (non e-learning) teaching, identified course characteristics as flexibility (timing/duration, location, and methods), structure, class size, course level, and subject area (Cranton and Smith, 1986).

4. Technology characteristics: Technology characteristics include quality, reliability, and availability (Piccoli et al., 2001). Leidner and Jarvenpaa (1995) posit that certain technologies support certain learning theories. The interactive, collaborative, and student-centered nature of e-learning suggests that it is suited for objectivist, constructivist, or collaborative learning theories (Leidner and Jarvenpaa, 1995).

2.1 Review of Existing Theoretical Models

Several theoretical models have been developed that could provide insights into the relationships between various environmental characteristics and students’ performance. These models are briefly described below along with an evaluation of their suitability for the current study.

The Technology Acceptance Model (TAM) first proposed by Davis (1989) – based on Ajzen and Fishbein (1980) – is a widely used prediction model for technology adoption and use. Several studies have been conducted using TAM to explore e-learning environmental characteristics in relation to user satisfaction and adoption (e.g., Liao and Lu, 2008; Arbaugh and Duray, 2002). The general premise of TAM is that a user’s perceived ease-of-use of a technology will influence their perceived usefulness of the technology, and that in turn, both of these will affect their intention to adopt the technology. However, one major limitation of TAM is the assumption that the usage of a technology is volitional, whereas in the majority of today’s educational environments the use of e-learning technologies is mandatory. We conclude that this model will have limited explanatory power for our current study.

Another relevant theoretical model is the Expectation-Confirmation Model (Oliver, 1980). This model is used to understand factors influencing perceived user satisfaction. The general premise of the model is that user satisfaction is affected by perceived performance of a system in comparison to user expectations (Oliver, 1980). If the system outperforms expectations, then user satisfaction will be higher than if the opposite had occurred. Again, there are limitations to this model’s applicability to our current study. Firstly, the model assumes that learners already possess preconceived expectations
of an e-learning system. Secondly, it does not account for differences in student characteristics such as self-efficacy and level of experience with e-learning (which may affect outcomes and expectations). Finally, this model only explains learner (student) satisfaction, which may not necessarily equate to whether the student actually achieves the required learning outcomes and graduate attributes. Hence, the model is also limited in its explanatory power for our study.

The Interaction-Based Model of E-Learning (Anderson, 2003) provides a high-level overview of the different types of interactions within an e-learning environment. There are six possible interaction flows between the three entities of student, content, and teacher (instructor), as depicted in Figure 1.

While the model provides an adequate explanation for the interactions among the three entities within an e-learning environment, it is not sufficient by itself to provide a measure for students’ perceived learning outcomes. Anderson (2004) suggests that an effective e-learning environment should be learning-centered, content-centered, community-centered, and assessment-centered – but provides little guidance on how this can be translated in terms of actual design of the e-learning technology.

![Figure 1: Interaction-Based Model of E-learning (Anderson, 2003)](image)

Goodhue and Thompson’s Task-Technology-Fit (TTF) model (1995) has been used as a predictor of performance in a technology context. The general premise of the TTF Model is that if an information system has a good fit with the tasks it supports, it will have a positive impact on the user’s performance of the task. The concept of “fit” defined by Goodhue and Thompson (1995) is the extent to which a technological system provides necessary features and support required by a task. The TTF Model is depicted in Figure 2.
Figure 1: Task-Technology-Fit (TTF) Model (Goodhue & Thompson, 1995)

The Integrated Model for Perceived E-Learner Satisfaction (Sun et al., 2008) was developed for theorizing individual learning in higher education. The model identifies e-learning characteristics (dimensions) which impact upon learner satisfaction in a tertiary education context: learner, instructor, course, technology, design, and environment. The model is depicted in Figure 3. The focus of the model is on perceived satisfaction, and not on perceived performance. Perceived performance has been identified as an antecedent of perceived satisfaction (Chiu et al., 2005). Naturally, however, one construct – satisfaction – cannot be used as a substitute for the other construct – performance. Therefore, the model is also limited in its applicability for our current study, as we are primarily concerned with perceived performance in relation to student learning outcomes.

Figure 2: Integrated Model for Perceived E-learner Satisfaction (Sun et al., 2008)
3 PROPOSED THEORETICAL MODEL

To meet the research objective of the study – to develop a theoretical model for measuring students’ perceived performance in terms of achievement of their learning outcomes and graduate attributes – we have developed a theoretical framework drawing on the work of Goodhue and Thompson (1995), Anderson (2003), and Sun et al., (2008). The exploratory nature of our research has guided the selection of such an integrated model. As the majority of studies on the topic focus on one specific perspective, we believe that the integration of all these perspectives will best fit our exploratory research, whilst at the same time allowing us to maintain our information systems perspective to analyze results and develop guidelines for our future studies. Furthermore, since the above individual perspectives were not based on fundamentally contradicting assumptions, such integration will not be problematic. Our proposed theoretical model is depicted in Figure 4.

![Figure 4: Proposed Theoretical Model of the Study — e-Learning Environmental Characteristics Model (EECM)](image)

The proposed e-Learning Environmental Characteristics Model (EECM) is based on the TTF model’s ability to predict performance (Goodhue and Thompson 1995). Furthermore, the proposed model also incorporates the interaction between students, instructors, and content within an e-learning environment as suggested by Anderson (2003). The theoretical basis from Sun et al., (2008), helps to identify the e-learning environmental characteristics (or, dimensions) incorporated into our conceptual theoretical model. The notion of fit is used here as the convergence of e-learning environmental characteristics that produce an optimal interaction. In turn, such fit will help to influence teaching effectiveness and perceived performance in relation to student learning outcomes or graduate attributes.

The above model puts forth the following main propositions. Such propositions may be developed in testable hypotheses (Whetten 1989):
- **Student perspective**: Convergence of student, course, and technology characteristics leading to optimal interaction will result in improved perceived performance.
• **Instructor perspective:** Convergence of instructor, course, and technology characteristics leading to optimal interaction will result in improved teaching effectiveness.

• Higher teaching effectiveness will improve students’ perceived performance.

• There exists a combined effect of *course-student-technology-fit* and *course-instructor-technology-fit* on both teaching effectiveness and perceived performance.

• This model presents a holistic and conceptual theoretical view of the relationship between e-learning environmental characteristics, student learning outcomes and student graduate attributes (as measured in perceived performance).

## 4 PROPOSED RESEARCH DESIGN

We plan to adopt a multi-method/mixed-method (MM/MM) approach to empirically ground our proposed model. This will be conducted across a combination of qualitative (interviews) and quantitative (survey questionnaire) methods. MM/MM is useful for triangulation of research, aids in creativity, and is useful for expansion of the study to take on a wider aspect of the situation (Mingers and Brocklesby, 1997; Mingers, 2001). Initially, qualitative interview method will be conducted to help refine the proposed conceptual model, and to operationalize it. After identifying the constructs and relationships, a research design will be developed that constitutes the foundation to design the survey interview questions using the proposed theoretical model for structural equation modeling (Gefen *et al.*, 2000).

## 5 CONCLUSION AND FUTURE WORK

With the increased use of web-based technologies, filling the discussed research gap regarding the different environmental characteristics impacting on actual student learning outcomes and graduate attributes become more and more relevant. This paper presents the extensive development of a theoretical model for e-learning effectiveness. We have taken Webster and Hackley’s (1997) four dimensional lens to build on the Interaction-Based Model of E-learning (Anderson, 2003), the Task-Technology-Fit (TTF) Model (Goodhue and Thompson, 1995), and the Integrated Model for Perceived E-Learner Satisfaction (Sun *et al.*, 2008) in order develop the concise theoretical model.

In a broader perspective, future research on e-learning should look at how the above factors can inform e-learning user interface and technology design questions. Furthermore, e-learning environments are increasingly taking on social media elements. This new trend—and how it relates to e-learning effectiveness as measured by (perceived) performance—is not sufficiently studied and demands further research.

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