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Research-in-Progress (Doctoral Consortium)

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Abstract

Online learning systems are the norm in today's educational institutions. However, students also use social networking applications for learning, and we seek to understand the use and effectiveness of such informal (social networking application based learning) systems on learning. We analyze the design characteristics of formal and informal learning systems, in an educational environment, to develop and test a model of their impact on learning outcomes. We find students attention, volume, velocity, access to information, and their degree of control over their use of the learning systems drives their learning success.

Keywords: Virtual learning Environments, Learning systems, Social networking applications, Learning success.

Introduction

Learning is a progressive knowledge development that requires students to learn through an iterative learning process (Halawi et al. 2009). Each iteration requires that students pay *attention* to the learning information, memorize what was learned (*retention*), and then apply what they have learned (*reproduction*) (Mikropoulos and Natsis 2011; Yi and Davis 2003). When a student completes a learning task (through attention, retention, and reproduction), it is expected that the student acquires the required knowledge. The student then uses the acquired knowledge to work on increasingly challenging learning tasks. These processes continue until the final learning goal is achieved, resulting in, for example, the completion of a subject or a degree.

A Virtual Learning Environment (VLE) is a technologically enabled learning environment that facilitates communication and interactions among participants and resources (Piccoli et al. 2001; Wilson 1996). VLEs facilitate students to communicate and interact better to achieve the desired learning outcomes (Alavi and Leidner 2001; Piccoli et al. 2001). Technology enabled VLEs are the norm in many of today's educational institutions (Mueller and Strohmeier 2011; Piccoli et al. 2001). The demand for online learning is significant as it satisfies teaching needs, provides more learning opportunities, and offers much-needed flexibility in learning for students (Educause 2016). Additionally, VLEs provide students with better access to learning resources, independent of geographical constraints, and provide greater communication options (Piccoli et al. 2001). The increased reliance on technology enabled learning of a dynamic nature highlights the importance of VLEs. Therefore, continued improvements to the design of VLEs are required to ensure VLEs support

evolving learning practices (Mueller and Strohmeier 2011; Zhang et al. 2015). VLEs are usually known as Learning Management Systems (LMSs) (e.g., Blackboard). LMSs are used to disseminate learning information, manage assessments, communicate with students, support students' group learning activities, and provide access to the learning system, independent from geographical constraints. In addition to LMS, students use social media to support their learning. Social media refers to a class of information technologies that support interpersonal communication and collaboration using online environments (Kane et al. 2014; Zhang et al. 2015). There is a wide range of practical applications of social media (Zhang et al. 2015) and we focus on the social networking application (SNA) type of social media (example: *Facebook*). Students desire communication and interaction among their peers during a learning period (Chiu et al. 2007; Piccoli et al. 2001). For such interaction and communication with peers, students use SNAs. Students' familiarity with the use of SNAs, regular use of SNAs, improved access to SNAs, and immediacy of information through SNAs have also been shown to be contributors for learning (Cheung et al. 2011; Zhang et al. 2015).

LMSs and SNAs, however, differ from each other to varying degrees. SNAs are primarily controlled by the student whereas the LMS is primarily controlled by the institution. Furthermore, learning through SNAs is often informal, whereas the activities undertaken via the LMSs are more formal (Wodzicki et al. 2012). Formal LMSs together with informal learning through SNAs may contribute to learning by facilitating an effective online learning environment (Joshi et al. 2010). However, the exact nature of contemporary VLEs is not yet fully understood. Accordingly, the overarching research question for this study is, ***what is the role of virtual learning environments (through formal and informal learning) in achieving learning success?***

The success of information systems (ISs) can be measured by evaluating general IS characteristics consisting of, information, systems, and service characteristics (DeLone and McLean 2003; Mueller and Strohmeier 2011). Information characteristics and system characteristics are associated with higher use, higher user satisfaction, and higher IS success (DeLone and McLean 2003). Service characteristics, however, do not directly influence learning (Mueller and Strohmeier 2011). VLEs are an instance of an IS. Accordingly, the design characteristics together with the behavioral characteristics of VLE effect VLE outcomes (Mueller and Strohmeier 2011; Piccoli et al. 2001). Social learning theory explains how people learn from their social environment (Bandura 2001). Therefore, accommodation of behavioral characteristics of using VLE is necessary. Accordingly, this study will investigate the role of formal (LMS) and informal (SNA) learning systems on learning success, in accordance with the research question. Thus, this study focuses on the characteristics of information, system, and human behaviors augmented by VLEs for learning. The learning success is informed by the learning performance, satisfaction, and efficacy (Piccoli et al. 2001).

Our initial literature review found limited empirical evidence to explain the role of formal and informal learning systems in achieving learning performance. Accordingly, the research method followed is a multi-method approach consisting of two phases: an exploratory phase and a confirmatory phase. During the exploratory phase literature reviews were conducted to define the research scope which was then refined through exploratory interviews and surveys. The initial research model was developed based on the IS Success model and later refined to accommodate design characteristics of VLEs and behavioral characteristics in learning (DeLone and McLean 2003). Measurement items for each variable were extracted from the literature and modified to suit the research context. The confirmatory phase then validated the research model through quantitative analysis. Participants were selected from a tertiary educational institution who use a formal learning system as well as an informal learning system. Confirmatory phase data analysis includes, but is not limited to, reliability and validity by structured equation modelling (Bharati and Chaudhury 2004).

The research contributes to the body of academic literature by developing and testing a new model that details the role of design characteristics of a VLE. From a practitioner's perspective, the results from this research will assist in the effective design and development of LMS's. Practitioners will be able to understand the characteristics of formal and informal learning systems and their effect on learning success to further enhance online learning environments.

Theoretical Foundations and Research Development

Conceptual Model

Individuals learn from the environment they live-in (Bandura 1991; Bandura 2001). Completing learning tasks require students to communicate and interact with their instructor, peers, and the learning system. Such communication and interaction can occur through messaging, discussions, observations, and use of the system. During the learning process, students continue such interactions until the learning goals are achieved, while developing the knowledge progressively. Therefore, learning requires progressive development of the knowledge on the subject matter. Development of knowledge can be achieved by transferring the knowledge by the expert to the novice and creating new knowledge (Leidner and Jarvenpaa 1995; Swan 2005).

Formal learning systems (LMSs), such as the *Blackboard* learning system provide educational institutions with the required functionality and useful learning spaces, and are managed by educational institutions. Educational institutions use these formal learning spaces to enhance traditional classrooms. Formal learning systems improve communications, improve equity, facilitate access to learning (independent of geographical constraints), and allow educators to control the learning process. In such contexts, interaction and communication among individuals is necessary for success in learning and technology now plays a significant role in how students interact and communicate with each other. For example, students use SNAs for their interactions and communication with friends, family, and peers.

SNAs provide a platform for information, facilitate communication, and facilitate user control. Students' use of SNAs is further improved by the widely available internet and the capabilities of their mobile devices. Improved access, increased use, and greater user control have increased the usefulness of SNAs for social and learning activities (Jin et al. 2015; Kane et al. 2014; Zhang et al. 2015). Consequently, social networking applications have become not only a tool for socializing, but also an instrument for learning. Thus, the understanding of the role of formal and informal learning on students' learning success is the aim of this study.

The learning process requires a progressive development of knowledge in phases consisting of paying attention to the learning, retaining the learning, and reproducing the learning (Mikropoulos and Natsis 2011). These phases can be supported through ISs by supporting the attention to the learning, promoting the retention of the learning, and facilitating the retaining of the learning. Attention is supported by sending the information quickly, sufficiently, and comprehensively (through the learning system) (Yi and Davis 2003). Retention is promoted by making the learning information available and encouraging progressive development of the knowledge (through the learning system). Reproduction is facilitated by using and reusing the learning through the system. Additionally, reproduction is facilitated through active progressive learning. During the learning process, instructors disseminate information through the learning system (information transmission), students communicate with the instructor/peers to develop their knowledge (information transmission and progressive learning), and students manage their learning (access/control). In summary; information transmission (volume, velocity, variety, and volume), learning process (attention, retention, and reproduction), control/access, and IS quality characteristics have an impact on learning. These factors and their dimensions are found in Figure 1.

Proposition Development

Propositions are developed based on common characteristics of Information, learning processes, information quality, and behavioral characteristics. These common characteristics affect the usefulness or the ease of use of the system, which in turn affects use and in particular performance, satisfaction and efficacy.

Information characteristics

Information characteristics refer to the information transmission characteristics, ie., volume, velocity, and variety (Dennis et al. 2008). The volume of information available for learning increases the comprehensiveness of information, resulting in greater usefulness of the VLE. The immediacy (ie.,

velocity) of information available for learning helps students to progress in learning without delay thus increasing the usefulness of the VLE (Gikandi et al. 2011). The variety of useful information for learning increases the richness of the information and a better understanding of the learning task (Dennis et al. 2008). When there is a wide range of useful learning information available through VLE's, students believe a VLE is useful for their learning. Therefore, *Greater volume (P1), velocity (P2) and variety (P3) of information is positively related to the greater usefulness of the learning system.*
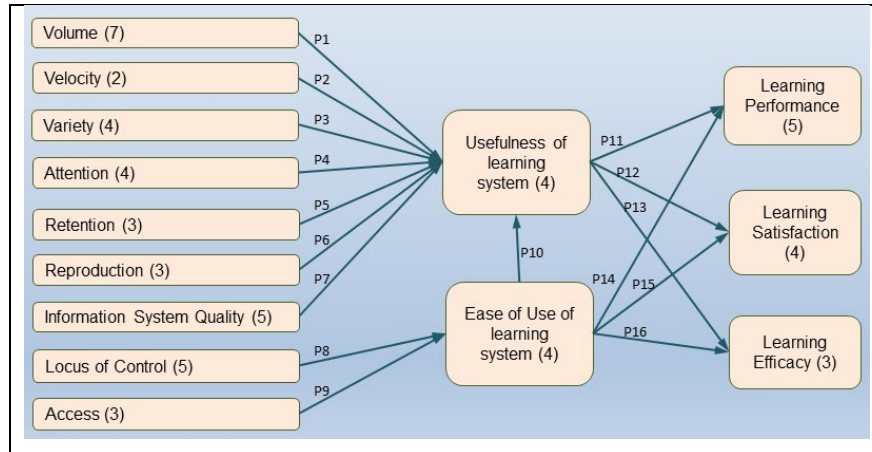
Figure 1. Characteristics of VLE in Learning

Learning System (learning process) characteristics
Learning requires students to pay attention to the learning, retain the learning, and use (reproduce) the learning (Jin et al. 2015). When a VLE supports students' attention for learning, students believe the VLE is useful for learning. When a student is able to retain the learning (enabled through the VLE), students use the VLE more, understanding that they can learn easily with the help of a VLE. This realization encourages students to continue to use the VLE, resulting in a better learning performance. When students continuously use a VLE, students can complete learning tasks, and progress in learning with increased confidence and satisfaction. Accordingly, *greater attention (P4), greater retention (P5) and greater reproduction (P6) (enabled through the VLE) is positively related to the greater usefulness of the learning system.*

Information System characteristics
Both the information and the system must be accurate, timely, and reliable for purpose. Such attributes are manifest as IS quality. When IS quality is higher, students believe that the VLE is more useful for learning. Accordingly, *P7: Greater information system quality of the learning system is positively related to the greater usefulness of the learning system.*

Behavioral characteristics
VLEs facilitate students' use of the system independent of geographical constraints and encourage student's responsibility in learning (Piccoli et al. 2001). SNAs provide students with more control while a LMS promotes equity in learning. Improved access and control contributes to the continuous use of the VLE. Regular use of the VLE helps students to be more familiar with the VLE resulting in increased ease of use of the VLE. The improved access and control of the VLE helps provide students with greater options and experience in learning. Accordingly; *Greater learning control (P8) and greater learning access (P9) are positively related to the ease of use of the learning system.*

The use of VLE
VLE are useful for students to access information, transfer information, and interact among peers and staff. Students continue to use a VLE when they find that it is useful for completing learning tasks. Students complete learning tasks and progressively develop knowledge of the subject. When students are able to improve learning, they are satisfied with the VLE and they develop confidence in using the

VLE for learning. Accordingly, *Greater usefulness of the learning system for learning is positively related to learning performance (P11), learning satisfaction (P12) and learning efficacy (P13).*

Ease of Use

Increased technology adoption and familiarity with SNAs help students to be fluent in using SNAs (Kane et al. 2014; Lin et al. 2014). Increased use of SNAs is further contributed to by advances in mobile technology and increased demand for online learning. Such fluency could influence continuous use of SNA with ease for learning. Often, students use SNA for social interaction so they do not need to access another system to check their learning related information. Such uses of SNA make students happy with the system, as they are frequently connected to SNA for online social interaction (Cheung et al. 2011). As explained earlier, continuous use of the system improves the knowledge about the system, thus students become happy with the system and become confident in using the system. Since the VLE provides access to learning information and facilitates interaction among peers, students are able to better complete their learning tasks. Also, LMS facilitates the communication with instructors and students as needed. Therefore, in addition to the satisfaction and confidence about the system, students are able to achieve learning performance through VLE enabled learning support. Accordingly; *Greater Ease of use of the learning system is positively related to the Usefulness of the learning system (P10), learning performance (P14), learning satisfaction (P15) and learning efficacy (P16).*
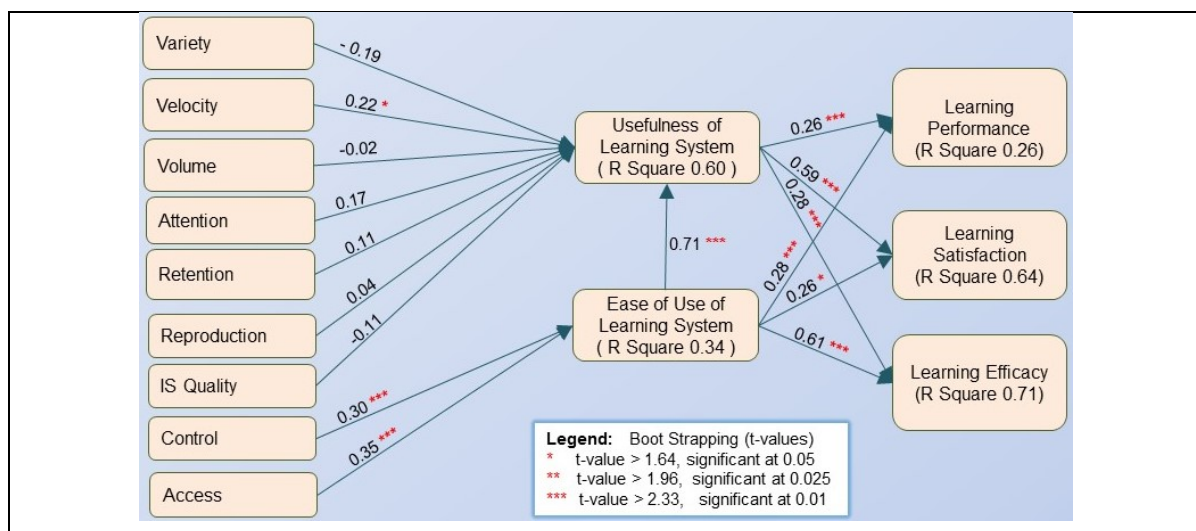
Learning Success

Learning success can be gauged through performance, satisfaction, and efficacy (Piccoli et al. 2001). Learning performance is measured by capturing students' perceived learning performance. Learning satisfaction is captured by students' perceived satisfaction, and the efficacy is assessed through students' perceived confidence in learning. Alternatively, students' learning results can be an indication of the learning performance.

Research Methodology, Data Collection, Results and Analysis

Prior to data collection, construct validity was examined. A cross-sectional survey was conducted to capture students learning experience to validate the research model (Oh et al. 2016). Participants from a tertiary educational institution were asked to complete one of two online surveys to capture either their formal (LMS) or their informal learning (SNA) experience. A total of 213 responses were received: 107 responses were received for the LMS survey and 106 responses for the SNA survey.

SmartPLS was used to analyze the data. Initial analysis reveals a number of significant relationships as indicated in Figures 2 and 3 below.

Figure 2. Measurement model – Formal Learning
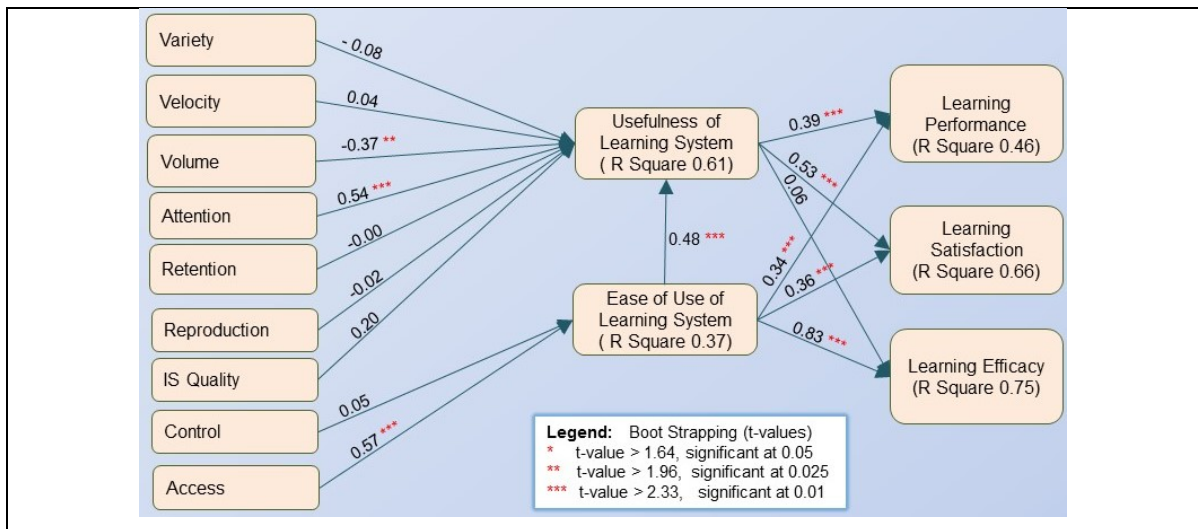
Figure 3. Measurement model – Informal Learning

Conclusion

The research aims to improve the understanding of the role of the design characteristics of VLEs in achieving learning success. Contemporary VLEs consist of formal and informal learning systems. To address the research question, we developed a model based on the IS success model and refined it based on the learning process. Accordingly, independent variables for the model consists of information characteristics (information transmission characteristics: velocity, variety, and volume), system characteristics (learning process characteristics: attention, retention, and reproduction), behavioral characteristics (control, access), and IS quality. Two sets of data collection have been completed by collecting responses from five undergraduate business courses in a University. Participants responded to a single survey by completing survey questions related to either formal (eg: LMS, *Blackboard*) or informal (eg: social media, *Facebook)* learning systems. Data analysis has been completed for the two data sets using the proposed model. Findings show significant similarities and differences while highlighting areas to pay attention to, in developing learning systems. It must be noted that the significance of the support (or non-support) varies.

Findings from the research indicate that both formal and informal learning systems are useful to achieve learning success (performance, satisfaction, and efficacy). The results show higher levels of access and control in formal learning help improve ease of use of VLEs. Greater Ease of use of VLEs help students with greater use of the formal learning system. Further, when students have information immediately, they increase the use of the system which results in higher learning success. In an informal environment, *attention* and *volume* play a greater role in the use of the system for learning, and in turn, in improving performance and satisfaction. This would support the notion that students who pay attention to learning through SNA environment are able to improve learning performance and satisfaction. Further, when students have a greater access to the informal learning environments, they find that the SNA is easy to use for learning which results in higher learning success. Further work needs to be undertaken to determine the effectiveness of VLE use in learning, or whether the cohort of students using VLE for learning are in fact more conscientious. In conclusion, this research supports the use of VLE's in learning to achieve better learning outcomes. As a next step, further refinement of the model and constructs is necessary to better explain non-significant relationships, and to determine whether any other factors support alternative hypotheses.

Current Stage of Research and Plans for Completions

As indicated above the first round of data collection and initial analysis of results has been undertaken. Additional data collection is currently underway to allow the same analysis to be conducted two semesters in a row. The additional data collected forms part of the post-hoc analysis of any relationships that does not appear to be significant and any other unexpected results. This replicability will increase the power of the results. Once final data has been collected and analysis the

thesis chapters will be reworked.

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