UNDERSTANDING E-LEARNING SYSTEM USERS´
POST-ADOPTION USAGE BEHAVIOR AND ITS OUTCOMES:
A Study of a Learning Management System

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ACKNOWLEDGEMENTS

If you can't explain it simply, you don't understand it well enough.

Albert Einstein

My PhD process has been very smooth and the time I spent as a full time PhD student has been the best time of my career. This has been possible due to the help and support of many individuals and organizations. And now it's the time to thank them.

I am very lucky to have had a supervisor like Dr. Timo Lainema. He has been a friend to me during the entire process and allowed me to do independent research, but was always there to help me with any practical issue – Timo, thank you for your kindness. Dr. Jonna Järveläinen was appointed as my second supervisor during the middle of my studies and was a great source of help, not only in the writing of this dissertation, but also in the writing of some of my articles – Jonna, thank you very much for your help.

I thank my two pre-examiners, Professor Øystein Sorebo from Buskerud University College and Professor Erkki Sutinen from the University of Eastern Finland, for the quality of their reviews, which have been of great benefit for this dissertation.

I have also had the great benefit of working very closely with Dr. Matti Mäntymäki and Dr. Honxiu Li in Turku Centre for Computer Science (TUCS). Many of the informal discussions I have had with you were a tremendous help in my research. I wish to thank Professor Jari Salo from University of Oulu for helping me improve the dissertation. I also thank Professor Hannu Salmela for taking the time to write letters of recommendation for me to different foundations. I also thank Professor Reima Suomi and Professor Jukka Heikkilä for providing me with the opportunity to work in the department.

During my study period, I shared an office with Doctoral student Olli Sölbolm, who has been so friendly and funny that I was motivated to go to the office every day. Thank you very much Olli. I wish to thank all my other colleagues, Doctoral student Eeva Heiro, Jani Merikivi, Timo Kestilä, Jose Teixeira, Kimmo Tarkkanen, Neeraj Sachdeva, and Tingting Lin for their friendliness and help. The assistance of the TUCS secretary Irmeli Laine in many practical issues is acknowledged. Finally, the help of the secretary Birgit Haanmäki in arranging the defense of my dissertation is greatly appreciated.

Turku 20th May, 2012
Najmul

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1   INTRODUCTION

You learn more quickly under the guidance of experienced teachers. You waste a lot of time going down blind alleys if you have no one to lead you.

W. Somerset Maugham

This chapter presents the starting points of this research. First, the background of the research is introduced. Then the motivation and the purpose of the research are discussed. Next the research questions are presented. After that the sources of empirical data are discussed. Then the research process is presented. Finally, a summary of the structure of this dissertation is presented.

1.1   Research Background

As information and communications technology (ICT) advances, organizations invest significant resources in ICT to support all aspects of organizational work from group work to individual teaching, training, and learning (Isakowitz et al. 1998). In recent years, the traditional context of learning has experienced a radical change (Wang et al. 2007). E-learning has become an inseparable part of today's teaching and learning. The Sloan Foundation reported that in 2006 approximately 3.5 million students were using various forms of online education in higher education institutions in the United States (US) (Allen & Seaman 2007). The same report forecasted an annual growth of 12 to 14 percent in users for virtual learning platforms. Recently, Ambient Insight reported that the US e-learning market reached USD 18.2 billion in 2010. It has been forecasted that the US market for self-placed e-learning will grow to USD 24.2 billion by 2015[1]. E-learning has been widely employed in both the public and private sectors in Europe, too. E-learning had a high priority within the eEurope 2002 Action Plan[2] political initiative. The initial target of connecting all schools to the Internet was achieved by 2002. The eEurope 2005 Action Plan therefore provided much atten-

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[1] Ambient Insight Reports Resilient US eLearning Market
http://www.prweb.com/releases/2011/01/prweb4987604.htm
[2] eEurope 2005
http://ec.europa.eu/information_society/eeurope/2005/all_about/elearning/index_en.htm

tion to ensuring better connections and the wider educational use of the Internet. Several targets were set regarding e-learning, such as launching the e-learning program, analyzing the European e-learning market, virtual campuses for all students, broadband connections in schools and universities, and launching grids for e-learning. E-learning is also one of the objectives of the Information Society Technologies (IST) programme, which is part of the European Union (EU) Research Framework Programme[3]. The objective of this programme has been to utilize the opportunities of the emerging information society for all European citizens and companies.

The rapid extension of the Internet as the delivery platform, combined with trends toward location-independent education and training programmes have further boosted both public and private organizations adoption and use of e-learning systems to facilitate learning in both the US and Europe.

There are three major themes regarding the benefits of e-learning for an organization[4]. The first benefit is related to scalability, which refers to the ability of e-learning to easily adapt to increased demands by reaching more learners with minimal effort and low cost. This benefit allows both public and private organizations to save large amounts of money. For example, Xerox was able to save 10% on its travel expenses in Europe and saved USD 150,000 on a single event for a Canadian business unit[5]. E-learning is also considered an important way to save public sector money in the United Kingdom (UK)[6]. The second benefit relates to learning agility, which refers to how e-learning can facilitate an organization's ability to respond to change by preparing employees with required knowledge and skills. Reducing the time spent on preparing and delivering learning materials is essential for enhancing an organization's learning agility. E-learning can increase the speed of information disseminated across the organization and may facilitate "just-in-time" learning (Rosenberg 2001). This benefit allowed Toshiba to reduce training time by one third[7]. Michigan Office of Public Health Preparedness (MOPHP) was able to create on-demand learning resources for its employees[8]. The final benefit relates to the fact that e-learning can induce and reinforce a culture of continuous learning through engaging learning activities, collaboration and the sharing of information. Sales Readiness Group (SRG), a training company was able to improve learner engagement and revenue through

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[3] The future of ICT and learning in the knowledge society, 2005
http://ftp.jrc.es/EURdoc/eur22218en.pdf
[4] Arth, B. (2011). The business impact of next-generation e-learning: How today's e-learning drives business results
http://wwwimages.adobe.com/www.adobe.com/content/dam/Adobe/en/products/adobeconnect/pdfs/elearning/092111-rr-nextgen-elearning-ba-ctcrevised-vendor.pdf
[5] http://www.adobe.com/showcase/casestudies/xerox2010/casestudy.pdf
[6] http://www.learningpool.com/saving-public-sector-money-with-e-learning/
[7] http://www.adobe.com/showcase/casestudies/toshiba/casestudy.pdf
[8] http://www.adobe.com/showcase/casestudies/michcommhealth/casestudy.pdf

their usage of e-learning in their training courses[9]. The revenue was realized due to a larger number of repeat customers for e-learning courses.

Many studies have debated the appropriateness of e-learning in achieving better learning outcomes (Shih et al. 2008). In relation to this, Buckley (2003) found no difference in the learning outcomes of students in terms of course grades between web-supported and traditional classroom-based courses. Sanchez & Aleman (2011) in their recent opinion survey among university educators found that the use of e-learning or ICT in general in education demands a change in educators' practices, such as teaching strategies, roles and functions. This increases educators' workload and requires extra effort. They also found that the use of ICT may improve communication and interaction among educators and students and facilitate the accessibility of course content. Accordingly, it may improve teaching quality significantly. Hsieh et al. (2011) found that if teaching and learning styles match, student learning outcome is significantly improved. Following these findings, it can be argued that e-learning may provide at least equal results in terms of student learning outcomes. In addition, it can add flexibility and convenience by delivering learning resources online.

Due to the increasing use of e-learning, the importance of attracting and retaining existing users (Larsen et al. 2009; Roca et al. 2006), as well as measuring e-learning use outcomes (Liaw 2008; McGill & Klobas 2009) has been widely recognized. Thus, in addition to examining how e-learning systems are adopted, recent studies have focused on the post-adoption behavior of e-learning system users.

Several information system (IS) research studies have put more importance on the post-adoption stage than the adoption stage. For example, Parthasarathy & Bhattacherjee (1998) argued that retaining users is very important for a service provider as acquiring new users requires five times more effort compared to retaining existing users. The acceptance of an IS can lead to productivity gains, positive economic returns, and enhanced productivity. However, the return on investment is typically accrued in the post-adoption stage of the IS (Bhattacherjee 2001a; Brynjolfsson & Hitt 1996; Jasperson et al. 2005; Santhanam & Hartono 2003).

1.1.1 What is an E-learning System?

Although the term, e-learning has been widely used in education since the mid-1990s, the definition of e-learning has not been clearly agreed on (Lee et al. 2009b). Many scientists define e-learning as the acquisition, use and delivery of

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[9] http://www.adobe.com/showcase/casestudies/salesreadiness/casestudy.pdf

learning resources by use of any sort of electronic means, such as audio/video tapes, DVD/CD-ROMs, interactive TV, satellite broadcast, intranets, and the Internet (Engelbrecht 2005; Wentling et al. 2000). Other scientists define e-learning as web-based learning utilizing web-based communication to collaborate, transfer knowledge and train individuals (Kelly & Bauer 2004). These definitions suggest that e-learning can be used as a flexible term to describe teaching and learning activities using ICT. Recently, Hung et al. (2011) discussed three fundamental criteria for an e-learning system. First, it should be under a network with the capability for storage/retrieval, instant updating, distribution, and the sharing of information. Second, it should be able to deliver information to users via a computer that uses standard Internet technology. Finally, it should focus on a broader view of learning by going beyond the traditional paradigm of learning.

Many researchers view e-learning systems as a type of general IS (Roca et al. 2006). However, Shee & Wang (2008) argue that e-learning systems are distinct from other information systems to some extent. They argued that an e-learning system offers educators and students "possibilities", instead of "ready to use" resources. In this regard, while the effectiveness of a general information system is based on the performance of individuals, an e-learning system's effectiveness largely depends on collaboration between individuals (both educators and students). The collaborative environment introduces different factors that may cause user dissatisfaction and the discontinuance of the use of an e-learning system. These factors include, for example, a lack of verbal communication, a lack of face-to-face contact, a lack of cues, isolation, hardware/software and network connectivity problems (Buckley 2003). In addition, educators' roles and teaching models also affect student learning outcomes (Coppola et al. 2002).

E-learning systems can be of two types: synchronous or asynchronous (Hrastinski 2008). In synchronous e-learning, real time communication, such as online chatting, teleconferencing, and video conferencing is implemented. On the other hand, in asynchronous e-learning, other means of communications that do not require real time responses are utilized. Such communications include email, threaded discussions, blogs and online forums.

E-learning can be conducted solely through online applications without instructors (Horton & Horton 2003). In such cases, the application program guides learners to take the necessary action to achieve the learning outcomes. E-learning can also be instructor-led as discussed by Horton & Horton (2003). Many educators prefer to include some face-to-face teaching with online learning to create a blended (or hybrid) learning environment (Garnham & Kaleta 2002).

E-learning systems can be grouped into five types[10]:

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[10] http://iit.bloomu.edu/Spring2006_eBook_files/chapter4.htm#h4_2

1) Synchronous collaboration applications such as NetMeeting, Horizon Wimba, and Centra. These applications provide the possibility to have real-time verbal communication via voice and video. In addition, these applications offer virtual whiteboards, chat, and application sharing capabilities.
2) Applications supporting asynchronous communications such as email, blogging, surfing the web, CDs and DVDs.
3) Games, such as business simulation games to train business managers.
4) Social media. For example, in Second Life educators and students can participate in courses using their avatars.
5) Learning management systems such as Blackboard, Moodle, and Desire2Learn.

This research has been conducted by investigating a learning management system. To take the readers closer to the context, the author describes learning management systems in more detail in the next sub-section.

1.1.2 Learning Management Systems

A learning management system (LMS), also known as course management system (CMS) or virtual learning environment (VLE) is web-based software used for the delivery, tracking and managing of education/training. It contains features for distributing courses over the Internet and online collaboration. Since the late 1990s, the utilization of LMSs for online education has steadily increased in higher education (Morgan 2003). LMSs can be categorized into two types: open source LMSs and proprietary LMSs[11]. Examples of open source LMSs are aTutor, Chamilo, Claroline, Dokeos, eFront, Canvas, Moodle, Sakai, WebWork, etc. Examples of proprietary LMSs are Absorb, Blackboard, CCNet, Desire2Learn, eCollege, GeoLearning, GlobalScholar, etc.

Nowadays, LMSs have become almost indispensable tools in education. Whether focusing on distance education or classroom based education, most universities now use LMSs to support and improve learning and teaching processes (Dalsgaard 2006). For example, in 2005, 95% of all higher education institutions in the UK were using course management systems (Browne et al. 2006).

Market surveys show that Blackboard and Moodle are currently the two biggest players in the LMS market. Blackboard Inc. developed Blackboard LMS and later acquired WebCT and ANGEL to become the biggest player in the LMS market. However, due to the cost issue, more and more organizations are moving to the open source LMS, Moodle. Blackboard still dominates in several markets,

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[11] McIntosh, D. (2011). Vendors of learning management and e-learning products
www.trimeritus.com/vendors.pdf

especially in the US. However, analysts expect that Moodle will gain market share day by day. For example, the eLearning Guild Survey results showed that over 24% of the respondents selected Moodle, while 21.02% of the respondents selected Blackboard as their primary LMS[12]. An ITC survey in 2011 reported a 6% drop in Blackboard usage but a 10% growth of Moodle usage[13]. This research is conducted with Moodle, hence more statistics on the market for Moodle are presented in the following paragraph.

According to Moodle's official website[14], as of December, 2011 there were 66,926 registered Moodle sites in 216 countries. In Finland, 326 Moodle sites have been registered. Every month new organizations are registering Moodle sites. Figure 1 depicts this.
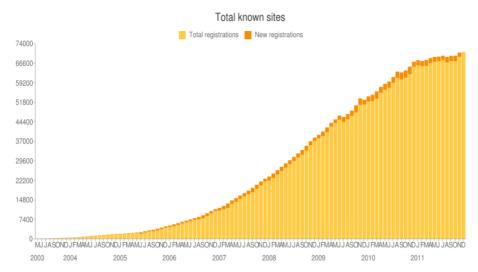
Figure 1   Moodle website registrations from March, 2003 to Dec., 2011

The implementation of an LMS like Moodle by educational institutions has promised better quality and learner-centered education. LMSs have the potential to offer new learning and teaching methods that meet present educational needs. Usually, the LMSs include a wide variety of features that can be utilized to support both distance and traditional teaching. The Internet is usually introduced through the use of LMSs in education (Kember et al. 2010). In addition, there are several individual and organizational benefits to be gained from the deployment

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[12] Moodle moves to the front of the LMS adoption pack, 2009
http://www.learningsolutionsmag.com/articles/111/
[13] Blackboard usage drops 6%; Moodle grows to 10% market share according to ITC survey, 2011
http://www.moodlenews.com/2011/blackboard-usage-drops-6-moodle-grows-to-10-market-share-according-to-itc-survey/
[14] Moodle's official website
www.moodle.org/stats

of LMSs (Vovides et al. 2007). Educators can track the progress of students using such software, while students may submit their assignments, download course materials, and track their grades by logging on to the system. They can interact with others, control their own learning, develop deep thinking skills, and develop a sense of community with other learners. Above all, these systems give the students and educators flexibility in terms of place, time, and studying at their own pace (Rainer et al. 2007). Other benefits include cost-effectiveness, consistency, timely content, and customer value (Cantoni et al. 2004; Ellis et al. 2009; Kelly & Bauer 2004). Morgan (2003) found that facilitating communication among students, online quizzing and grade posting, providing additional course materials, the availability of training, and recommendations are the reasons for the utilization of LMSs by educators.

The way in which LMSs are being utilized in education is still evolving and differs between users. Vovides et al. (2007) describe three ways to utilize LMSs. In fact, these three ways can be viewed as three distinct points on the continuum that shows how an LMS is used for a particular course.

First, an LMS can be used to supplement traditional face-to-face classroom teaching. In such cases, the LMS serves as an electronic repository for the course materials. Many faculty educators use the LMSs simply to deliver course materials electronically in order to offer students more flexibility in accessing these materials.

Second, instructors who teach in-class may choose to use a "blended" approach by mixing the traditional teaching environment with e-learning elements. This teaching method is usually called blended learning, and the courses are called hybrid courses (Garnham & Kaleta 2002). The blended approach allows educators to mix in-class time with online activities and offers students a more intellectually engaging learning experience. This approach also allows more flexibility for university administration in, for example, scheduling classrooms. However, the design of hybrid courses requires educators to have sufficient expertise in managing LMSs.

Finally, an LMS can be used in distance education for the delivery of fully online courses. In such courses, educators are required to have sufficient expertise to be able to use the LMS and implement appropriate instructional strategies for designing high quality instruction.

Despite the potential benefits of LMSs, there are several reasons behind the reluctance of students and educators to use them. These include difficulty in use, reliability problems, the required time to learn and use the tool, and incompatibility with the teaching and learning goals (Morgan 2003). As described earlier, many educators simply use an LMS as a delivery system for educational materials. In such cases the integrated features and functionalities are often underutilized. For example, Vovides et al. (2007) found that many LMS features are

often underutilized by both students and educators. Such underutilization may not affect the learning of in-class students, but it may have a negative impact on the learning of students enrolled in an online course. Educational institutions also face several challenges in providing and supporting LMSs, such as increasing acquisition and support costs, student readiness, choosing the most appropriate LMSs according to their needs, and ongoing faculty training (Morgan 2003).

To sum up, LMS adoption brings both opportunities and challenges to an organization. The complexity of utilization in designing high quality instructions, together with the reliability aspect of the Internet based solutions often leads educators and students to discontinue their utilization of LMSs, despite their initial adoption.

1.1.3 *Research Setting - Utilization of Learning Management Systems at the University of Turku*

This research has been conducted in the University of Turku (UTU). The university is located on the southwest coast of Finland. It has 21,000 students and 3,000 employees. It is one of the largest universities in Finland comprising seven faculties. In addition to these faculties, research activities and learning also take place in special units (for example the Open University). Such units offer adult education, and promote personal, organizational and regional development. Different university support activities are also taken care of at these facilities. The special units play a vital role in offering multi-disciplinary and international research environment.

UTU started to use LMSs in the late 1990s. Initially, it started to use two different LMSs: WorkMates[15] and WebCT. WorkMates was developed at the University of Turku. It was used for university education to augment the traditional face-to-face teaching. WebCT was used by the Open University to provide distance courses. Later, UTU adopted Moodle as the main LMS for both university education and Open University education. There were two main driving forces for adopting Moodle. First, the Open University was looking for a modern learning platform that would suit distance education. The in-house LMS, WorkMates was originally targeted to campus users, and thus was not able to meet the requirements of the Open University. It was not possible to further develop it due to limited development resources. Second, at the same time, UTU aimed to use only one LMS for both faculty education and Open University education for cost savings, better security and better administration.

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[15] UTU's Workmates website
https://wm.utu.fi/

A working group was set up that compared some of the most popular platform options. There were two main options to choose from: WebCT and Moodle. The licensing cost of WebCT was quite high while at the same time Moodle was gaining market share. As Moodle is an open source platform, the working group found the possibility to tailor it and pay no license fee to be attractive and advantageous. Thus, Moodle was chosen and it replaced WebCT in 2007. At present, all faculties and the Open University use Moodle[16] as the main LMS for creating course pages, although WorkMates is still used for some courses by a few faculties.

The perspectives analyzed in this study come from the viewpoints of faculty educators and the students of the UTU. Two important points are to be noted at this point. First, the utilization of Moodle in the university during the data collection period had been somewhat voluntary as the faculty educators were free to choose other methods of creating course pages either under the university domain or by using Workmates. Second, if an educator uses Moodle for a particular course, the students have no choice other than to use it. In this sense, the utilization of Moodle by students is somewhat mandatory.

1.1.4   Defining Key Concepts

The purpose of this study is to investigate the Moodle users' post-adoption usage behavior and its possible outcomes in UTU. Post-adoption can be conceptualized by drawing the five stages of the innovation adoption process proposed by Rogers (2003). The decision process has been depicted in Figure 2. The first three stages can be regarded as the adoption stage while the last two stages can be regarded as the post-adoption stage.

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[16] UTU's Moodle website
https://moodle.utu.fi/
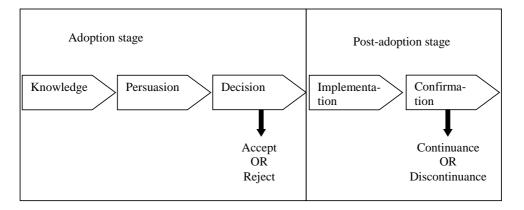
Figure 2   Innovation adoption process (adapted from Rogers 2003)

   Rogers (2003, p. 169) defined these stages in the following way.
   Knowledge occurs when an individual is exposed to an innovation's existence and gains an understanding of how it performs. Persuasion occurs when an individual forms a favorable or unfavorable attitude towards the innovation. Decision takes place when an individual engages in activities that lead to the choice to adopt or reject the innovation. Implementation occurs when an individual puts the new idea into use. Finally, confirmation takes place when an individual seeks the reinforcement of the innovation-decision already made, although he or she may reverse this previous decision if exposed to conflicting messages about the innovation. According to Rogers (2003) accept or reject may occur at any stage, however, if it happens at the confirmation stage, it is called continuance or discontinuance.
   The presence of the adoption and post-adoption stages has been discussed in IS research since the 1980s. For example, Zmud (1982) discusses IT implementation and Kwon & Zmud (1987) discuss IT incorporation. Cooper & Zmud (1990) describe a six stage model of IT implementation, which incorporates a number of post-adoption activities such as routinization and infusion. In general, prior research conceptualized a number of post-adoption behaviors, such as adaptation, assimilation, continuance, infusion, individual feature adoption, individual feature use, individual feature extension, recommendation, routinization, and complaints (Chea & Luo 2008; Jasperson et al. 2005; Karahanna et al. 1999). Among these post-adoption behaviors, continuance is the most used post-adoption behavior in IS research (De Guinea & Markus 2009). This dissertation also investigates IS continuance.
   IS continuance can be defined as a post-adoption behavior which refers to the decision to continue using an IS after an initial adoption decision has been made (Bhattacherjee 2001a). Following the Theory of Reasoned Action (TRA), this study assumes that continuance is determined by continuance intention (Ajzen &

Fisbein 1980) and focuses on investigating continuance intention. Following Bhattacherjee (2001a), this study further assumes that continuance intention is determined by satisfaction during the post-adoption stage. This leads to define satisfaction.

Bailey & Pearson (1983) define user satisfaction as the sum of one's positive and negative reactions to a set of factors. Doll & Torkzadeh (1988) describe it as the affective attitude toward a specific computer application by someone who interacts with the application directly. Oliver (1980) defines it as a judgment that a product or service feature, or the product or service itself, provided a pleasurable level of consumption-related fulfillment, including a level of under or over fulfillment. From these definitions, one can conclude that users develop satisfaction after having hands-on experience with a product.

Finally, the post-adoption stage is the longest phase of an IS's lifecycle, and is the phase during which the benefits from IS begin to occur (Jasperson et al. 2005). The benefits are usually expected when the IS is used to perform job tasks. The benefits can be measured by usage outcome variables such as individual impact and organizational impact (DeLone & McLean 1992). IS usage outcomes can be defined as the evaluation of users to which extent the IS usage has actually contributed to achieve their goals.

1.2 The Motivation and Research Gaps

E-learning has been an important research topic in several disciplines including IS (Limayem & Cheung 2008; Roca et al. 2006). It is interesting for IS researchers because organizations are increasingly investing financial resources into building their e-learning platforms and virtualizing education. An e-learning platform may provide a cost effective education solution to an organization. The practices of providing education by using e-learning systems are still evolving, thus attracting more research (Ellis et al. 2009). Indeed, a significant amount of research has been conducted on e-learning and its impact on learning. However e-learning research often lacks a theoretical underpinning as described by McGill & Klobas (2009). In particular, the author has found three major research gaps in the prior literature that motivated him for this research.

Regarding the *first research gap*, increasing the amount of e-learning system users is an important task from a managerial point of view. However, Ma et al. (2005) point out that despite the emerging trend for using e-learning systems to facilitate teaching and learning activities, the number of users of e-learning systems is not increasing as fast as expected. Consequently, it would seem important to emphasize the importance of educators' willingness to utilize e-learning systems to boost the utilization of such systems by students. A lack of educators'

willingness to utilize e-learning systems may lead to the underutilization of such systems by students, and to reduced learning outcomes. It has been pointed out in prior literature that, although educators adopt an e-learning system initially, often they either discontinue their usage at a later stage or continue using it on a very limited scale (Vovides et al. 2007). Prior studies have tended to put much effort into investigating the factors that drive educators' decisions to adopt a new e-learning system (acceptance or adoption) (Larsen et al. 2009). Only a little attention has been paid to the post-adoption stage where educators decide either to continue or discontinue their usage of an e-learning system. Bhattacherjee (2001a) discussed the distinctions between initial IS adoption and post-adoption behavior. Following Bhattacherjee (2001a), it can be argued that initial e-learning system acceptance is an important first step toward gaining success but the long-term viability of an e-learning system and its eventual success depend on its continued use rather than its initial acceptance. This is because the discontinued use of an e-learning system – after initial adoption – results in a waste of both financial and human resources for developing and supporting the e-learning system. It may also reduce the benefits that an educator could get from such systems in their teaching. Likewise, students often do not benefit from such e-learning systems in their study. As such, an organization's decision-makers are less concerned with educators' initial adoption and focus more the on post-adoption of e-learning systems. Despite the importance of the educators' perspective, very few studies have focused on it. If decision-makers want to increase the usage of a particular e-learning system during the post-adoption stage, clearly they need to know what factors drive the continued usage intention of educators with respect to an e-learning system at the individual level.

Investigating satisfaction is very important due to its theoretical and practical significance. It has been viewed as a pre-requisite of IS use and IS success in the IS success model (DeLone & McLean 1992). It is regarded as one of the main determinants of IS continuance according to the IS continuance model (Bhattacherjee 2001a). It has also been adopted as a primary surrogate for IS success (Bailey & Pearson 1983). Organizations often allocate significant financial and human resources to the measurement and analysis of user satisfaction, and its subsequent improvement. A significant amount of research has also been conducted on IS user satisfaction over the last two decades (Bailey & Pearson 1983; Benson 1983; Doll & Torkzadeh 1988; Muylle et al. 2004).

Although satisfaction has been studied extensively in IS research, most of the prior studies ignored the adoption process, and eventually ignored the distinction between the adoption and post-adoption stages (Khalifa & Liu 2003). Those studies selected a number of attributes of the system or service when measuring user satisfaction but without considering the adoption stage, although IS continuance research has pointed out that the psychological motivation behind initial

acceptance and continuance are different (Bhattacherjee 2001a). To overcome such limitations, the IS continuance model can be used. However, the original IS continuance model and its extensions are not sufficient. Indeed, the IS continuance model examines user satisfaction from a solid theoretical base and explains it in terms of the adoption process and a single post-adoption belief (perceived usefulness) (Bhattacherjee 2001a). However, it ignores many important variables, such as system characteristics and the availability of support. Subsequent studies built upon the IS continuance framework pointed the use of a single belief (perceived usefulness) as the basis of satisfaction and continuance intention to be one of the major limitations of the model (Hong et al. 2006; Thong et al. 2006). Eventually, these studies added more post-adoption beliefs such as perceived ease of use (Hong et al. 2006), perceived playfulness (Roca & Gagne 2008), and perceived enjoyment (Kang et al. 2009). However, most of the prior studies presuppose that, to find out how a user feels about a particular system or service, it is enough to analyze his/her satisfaction and perceptions about a number of system attributes, measured by use of an ordinal scale (highly dissatisfied-neutral-highly satisfied). This approach may not be enough in at least two senses.

First, users are usually asked only about a limited number of attributes of a system or service. Specifically, attributes that are considered to be positive and which are often associated with the very reason why users use a system are asked in the survey. These lists of attributes generally exclude possible negative system features or service experienced by users. Nevertheless, users will use the negative experiences to assess their overall level of satisfaction and their subsequent future use (De Guinea & Markus 2009).

Second, studies of consumer satisfaction indicate that a one-dimensional concept of satisfaction can be insufficient (e.g., Chan & Baun 2007). The one-dimensional construct assumes that a single factor can generate both satisfaction (when everything goes well) and dissatisfaction (when things do not go well). However, past studies provide evidence that the presence of certain attributes generates satisfaction, yet their absence does not necessarily generate dissatisfaction. The reverse is also true given that certain factors may generate dissatisfaction but their absence will not generate satisfaction (e.g., Chan & Baun 2007; Herzberg et al. 1959). IS researchers have also found that the effect of the performance factors of an IS on user satisfaction might be asymmetric (Cheung & Lee 2005; Zhang & von Dran 2000). The IS continuance model assumes that dissatisfaction may result in the discontinuance of an IS after initial adoption. However, prior IS continuance research falls short in explaining why users discontinue their usage of a system after accepting it. Thus, a dissatisfaction-based evaluation might answer the adoption-discontinuance anomalies.

Altogether, the *second research gap* relates to the fact that the determinants of educator satisfaction with an IS cannot be restricted to the factors specified in the

IS continuance model and its proposed extensions. From a practitioner's viewpoint the model or its extensions provides only limited guidance on how to influence satisfaction by use of the design and implementation factors from the Human-Computer Interaction (HCI) perspective. Benbasat & Barki (2007) argued that to increase practical relevance for the HCI field, an IT artifact's design and implementation attributes must be included in the research models. Following this, Benbasat (2010) recommended that such design attributes should be tested as antecedents of the constructs of interest. He further argues that adoption research reflecting only surrogate variables like perceived usefulness cannot generate any specific design advice for HCI practitioners. For example, HCI practitioners receive feedback regarding usefulness in a broad sense, but they rarely get actionable feedback about the important features of a system's characteristics. Furthermore, the support teams do not receive feedback on the quality of support they provide, and managers do not get feedback on how to avoid dissatisfaction. Hence, the IS continuance model cannot address the adoption-discontinuance anomalies.

To sum up, the IS continuance model does not provide enough feedback on how to continuously improve a system or service. Such feedback is very important for e-learning systems as distance courses using e-learning systems are still evolving. Thus, more research is necessary to investigate educator satisfaction in the post-adoption stage.

The *final research gap* is related to the fact that most of the prior e-learning adoption studies assumed usage to be the final dependent variable and investigated the antecedents and determinants of the student e-learning usage intention (Lee et al. 2003). Eventually, such studies overlooked the outcomes of e-learning usage. Indeed some studies went beyond use to explore the outcomes of e-learning systems usage (Liaw 2008; McGill & Klobas 2009). However, these studies have been conducted with a variety of outcome and explanatory variables, thus they lack a solid theoretical underpinning compared to the adoption studies. Carswell & Venkatesh (2002) argue that most research into web-based learning has been atheoretical, anecdotal or descriptive in nature, consisting of discussions about "how-to" guides and the experiences of educators and students. They further argue that quantitative information often consists of surveys on student satisfaction that use invalidated instruments. Thus, these studies fall short in explaining the relationship between the antecedents of the adoption and use of e-learning systems and their use outcomes, and the relationship between the use of an e-learning system and use outcomes from the student perspective. In order to understand the impact of e-learning systems on study and take advantage of e-learning systems, research that has a solid theoretical framework and addresses the outcomes of e-learning systems adoption and use is needed. Knowing the outcomes of e-learning system usage from the perspective of students is particu-

larly important for evaluating the success of such systems. It can also help to plan for the future development of such systems as well as teaching strategies in the e-learning context, in order to achieve better learning outcomes and meet educational goals.

Altogether, due to the significant importance of educator satisfaction, the educator continued use intention, and student use outcomes, it is important to study e-learning system users' post-adoption behavior at the individual level. Understanding user post-adoption behavior can provide insights into factors that can be leveraged to promote the effective utilization of an e-learning system after its initial adoption.

1.3   Research Objective and Questions

The objective of this dissertation is to investigate the post-adoption behavior of e-learning system users and the resulting outcomes by incorporating a wide variety of variables from different theoretical perspectives. To that end the following main research question is formulated:

> *RQ: How can e-learning system users' post-adoption usage be determined and what consequences can it have?*

The IS continuance model proposed by Bhattacherjee (2001a) is one of the most important and dominant research frameworks for investigating user behavior in the post-adoption stage. Given that the stream of research examining users' post-adoption behavior using the IS continuance model is expanding and also as it has been used as one of the major theoretical perspectives to investigate educators' post-adoption behavior in this dissertation, it becomes viable to scrutinize the consistency of its key relationships in prior literature. Thus, the following research sub-question has been addressed in this dissertation:

> *SRQ1: To what extent have the relationships of the IS continuance model been empirically proven to be consistent in prior studies?*

In order to answer this research sub-question, the author (with Dr. Matti Mäntymäki) has performed a systematic literature search following Webster & Watson (2002) to find relevant studies that utilized the IS continuance model to investigate post-adoption satisfaction and continuance intention. Then, a meta-analysis of these studies was conducted. To calculate the mean effect sizes, the guidelines drawn up by Hunter & Schmidt (2004) were followed. The results are summarized in Paper 1 included in this dissertation.

To fill the three research gaps explained in section 1.2, the following three research sub-questions are introduced:

> *SRQ2: How can educators' satisfaction with an e-learning system in the post-adoption stage be determined?*

> *SRQ3: How can educators' continued use intention of an e-learning system in the post-adoption stage be determined?*

> *SRQ4: To what extent does the utilization of an e-learning system assist students in their study?*

SRQ2 is related to examining the factors that determine educator post-adoption satisfaction with an e-learning system. To answer this question, the IS continuance model has been employed. In principle, factors from adoption and user satisfaction literature were drawn and the IS continuance model was used as the main theoretical framework to underpin the most important factors shaping the post-adoption satisfaction of educators with e-learning system utilization. The proposed model was empirically tested with the data collected from the survey of the educators and is summarized in Paper 2. The qualitative evidence from the open-ended survey questions are also used to identify important factors and are summarized in Paper 3.

SRQ3 is related to investigating educators' continuance intention. To answer this research sub-question, both the IS continuance model and the Unified Theory of Acceptance and Use of Technology (UTAUT) have been employed. The proposed models are empirically tested with data collected from the survey among the educators and are summarized in two articles (Paper 4 and Paper 5) in the spirit of theory advancement in IS post-adoption research.

Finally, SRQ4 is related to investigating the possible outcomes of e-learning system use during the post-adoption stage. To answer this research question, the TAM model was used. In practice, the relationships between the TAM variables and the e-learning system use outcome variables were investigated. The model is empirically tested with the survey data collected among the students, and the results are summarized in Paper 6.

In this dissertation, some suggestions will be made to help universities improve their existing e-learning systems, keep users satisfied, retain existing users, and get maximum benefit from their e-learning systems. The results are potentially useful for e-learning system designers, faculty educators, heads of departments, and rectors seeking to improve existing e-learning systems and their use.

1.4   Introducing the Collected Empirical Data of the Study

The empirical data of this dissertation consists of the following.

- Interviews with 7 university educators from different departments of the UTU. The interview questions are presented in Appendix 1. The primary objective of the interviews was to confirm the possible list of factors that were found important in the literature review regarding educator satisfaction and the continuance intention.
- A survey among UTU educators using questionnaire. The questionnaire had questions related to the factors as well as open-ended questions. The final questionnaire is presented in Appendix 2. The survey produced 175 usable quantitative cases. In addition, many respondents answered the open-ended questions which resulted in qualitative survey data.
- A survey among UTU students. This questionnaire also had questions related to the constructs as well as the open-ended questions. The final questionnaire is presented in Appendix 3. The survey resulted in 249 usable responses. In addition, answers to the open-ended survey questions produced qualitative data.

The quantitative data from the survey has been used to test research models, while the qualitative survey data has been used for the following three purposes:

- The qualitative data is used to support the findings of the quantitative analysis results.
- The qualitative data is used to find factors not included in the quantitative models.
- Finally, the qualitative data is used to investigate what factors are critical for educators – with regard to e-learning systems – when generating satisfaction and what factors are critical for generating dissatisfaction. This helped to address the acceptance-discontinuance anomalies.

1.5   Research Process

The design process of this research is depicted in Figure 3. The author presents the research process in a linear set of steps/activities for ease of readers' understanding, although the actual research process has been cyclical. The process consists of seven major activities: the literature review, conducting interviews, model development, questionnaire development, conducting surveys, testing models, and interpreting findings. Each activity has one or more inputs and outputs except for the final activity of interpreting findings which has inputs but no

outputs. Six articles, which are included in this dissertation, were produced during this process.
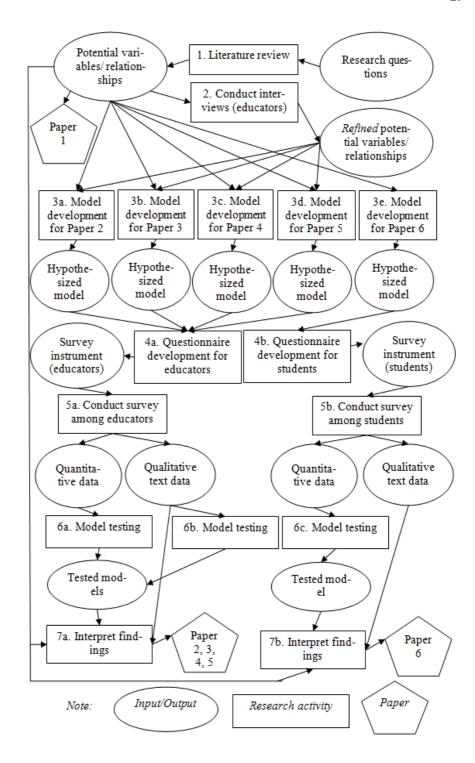
Figure 3   Research process

This research starts with a literature review activity. The input to this activity is the set of research questions discussed in section 1.3. The output of this activity is the list of possible preliminary variables and their interrelationships. This led to produce Paper 1.

The list of preliminary variables and their interrelationships are the input for the second research activity of conducting interviews among educators. In practice, the purpose of this activity was to refine the list of preliminary variables and their relationships through interview data analysis.

The third research activity is related to developing models for individual articles. This research activity can be divided into five sub-activities. Both the preliminary and refined list of variables and their interrelationships are the inputs for the sub-activities 3a, 3b, 3c, and 3d. The purpose of these sub-activities is to develop models for Papers 2, 3, 4, and 5. To develop a model for Paper 6 (sub-activity 3e), only the preliminary list of variables and their interrelationships were utilized. Overall, the output of this entire research activity is the hypothesized models.

The fourth research activity is related to developing the questionnaires. This activity can be divided into two sub-activities. The first sub-activity (4a) develops a questionnaire for educators while the second sub-activity (4b) develops a questionnaire for students. The corresponding hypothesized research models are the input for these research sub-activities. The survey instruments, one for the educators and one for the students, are the output of the research activity.

The fifth research activity relates to conducting surveys. Again, this research activity can be divided into two sub-activities. The corresponding survey instruments are used to conduct surveys among educators (sub-activity 5a) and students (sub-activity 5b). The output of each sub-activity is two sets of data: one set contains quantitative responses corresponding to the constructs of the hypothesized research models, while the other set contains qualitative text data responses from the open-ended survey questions.

The quantitative survey data has been mainly used to test the hypothesized research models (sub-activity 6a) developed for the educators, although Paper 3 uses only qualitative text data to test the model (sub-activity 6b). To test the hypothesized research model for students, only quantitative data has been utilized (sub-activity 6c). The output of this activity is the tested models.

Finally, potential variables and their interrelationships, plus tested models and qualitative text data have been used to interpret the findings. The findings are reported in Papers 2, 3, 4, 5, and 6.

1.6   The Structure of the Dissertation

This dissertation is organized into two parts: an overview of the dissertation and the original research papers.

There are five chapters in the overview. This part begins with this introductory chapter which presents the research background, motivation and purpose of the research, the research objectives and questions, the sources of the empirical data, and an outline of the overall dissertation. Chapter 2 presents the literature review in which the major theoretical frameworks of adoption research, post-adoption IS research, e-learning research, and e-learning post-adoption research are discussed. In addition, it scrutinizes the theoretical frameworks and their applications from a philosophical perspective and develops an overall theoretical framework. Chapter 3 describes the methodological considerations of this study such as methodological choice, the research design, instrument validation, and data analysis issues. Chapter 4 introduces the articles included in this dissertation and describes how individual articles are connected with the research sub-questions as well as the main research question of this dissertation. Chapter 5 describes the conclusions of this research. It presents summarized answers to the research question, describes the contribution of the research, the limitations of the study, and possible future research directions.

Six original articles are presented in the second part of this dissertation. Table 1 summarizes these articles.

Table 1   Articles included in this dissertation, their themes and links to the research questions

Article	Theme	Empirical data used	Research question (s) addressed
Paper 1: *Culture and student samples as moderators of continued IT usage: A meta-analysis of IS continuance literature.* 15th Pacific Asia Conference on Information Systems (PACIS), July 7-11, 2011, Brisbane, Australia *(in cooperation with Dr. Matti Mäntymäki)*	Evaluating the consistency of an IS continuance model using meta-analysis	Literature review of existing IS continuance literature	SRQ1
Paper 2: *The determinants of the post-adoption satisfaction of educators with an e-learning system.* Journal of Information Systems Education (JISE), Vol. 22, No. 4, 2011, pp. 319-332	This paper finds the most important determinants of educators' post-adoption satisfaction by drawing on a wide variety of variables from IS acceptance, IS satisfaction, and IS continuance literature	Educators' survey data (only quantitative data)	SRQ2
Paper 3: *Information systems post-adoption satisfaction and dissatisfaction: A study in the e-learning context.* 15th Pacific Asia Conference on Information Systems (PACIS), July 7-11, 2011, Brisbane, Australia	Utilizing the open-ended survey data, this paper identifies the factors that may generate satisfaction as well as the factors that may generate dissatisfaction during the post-adoption stage	Educators' survey data (only qualitative data)	SRQ2
Paper 4: *Understanding the continued usage intention of educators toward an e-learning*	This paper identifies the motives behind educators'	Educators' survey data	SRQ3

system. International Journal of E-Adoption (IJEA), Vol. 3, No. 2, 2011, pp. 54-69	continued use of the investigated e-learning system. This paper utilized UTAUT to build the research model.	(only quantita-tive data)	
Paper 5: *The role of perceived system quality as the educa-tors' motivation to continue e-learning system use.* AIS Transaction of Human Com-puter Interaction (THCI), Vol. 4, No. 1, pp. 25-43	This paper extends the IS continuance model using per-ceived system quality.	Educa-tors' sur-vey data (only quantita-tive data)	SRQ2, SRQ3
Paper 6: *Understanding e-learning systems usage Out-comes in hybrid courses.* 45th Hawaii International Confer-ence on System Sciences (HICSS), Jan 4-7, 2012, Ha-waii, USA	This paper investi-gates how beliefs (perceived useful-ness and perceived ease of use) and the use of an e-learning system might influence use outcomes	Students' survey data (both quantita-tive and qualita-tive data)	SRQ4

2   LITERATURE REVIEW

Those who cannot remember the past are condemned to repeat it.

George Santayana

This chapter presents a literature review in which the major theoretical frameworks as well as variations on them in prior adoption and post-adoption research are presented. They are followed by a discussion of prior IS post-adoption research, e-learning research, and e-learning post-adoption research. Next, a discussion scrutinizing adoption theories from a philosophical perspective is presented. Finally, an overall research framework that serves as the 'umbrella' fitting the six articles included in this dissertation is presented.

2.1   Theoretical Frameworks

In a general sense, this dissertation investigates individual-level technology post-adoption behavior and its possible outcomes. So it is necessary to review the theoretical frameworks that have been used to investigate individual-level technology adoption and post-adoption behavior in prior research.

   Individual-level technology adoption and post-adoption research is one of the most prominent research streams in prior IS literature (Venkatesh & Bala 2008). Several theoretical frameworks have been developed in IS to investigate users' adoption and post-adoption behavior. Among these the technology acceptance model (Davis 1989) and its several extensions (Venkatesh et al. 2003; Venkatesh & Bala 2008) are widely used for investigating individual-level technology acceptance (and sometimes continuance), while the expectation-confirmation based IS continuance model (Bhattacherjee 2001a) is widely used for investigating individual-level technology continuance. These theories have also been utilized for investigating users' acceptance and continuance behavior in the e-learning context (Larsen et al. 2009; Lin 2011).

   The IS continuance model is regarded as a post-adoption model while TAM can be considered an adoption model (Bhattacherjee 2001a). As the IS continuance model has been considered a post-adoption model in prior literature, the author decided to use this model as the starting theoretical lens for investigating

users' post-adoption behavior. In the following section, the IS continuance model and its extensions in prior literature are summarized.

2.1.1   IS Continuance Model

The IS continuance model was developed from the Expectation-Confirmation Theory (ECT) (Oliver 1980) by Bhattacherjee (2001a). ECT has been extensively used to explain consumers' satisfaction and repurchase decisions in a variety of post-purchase contexts (Bhattachejee 2001a; Churchill & Surprenant 1982; Oliver 1980). ECT was originally adapted from the Consumer Satisfaction/Dissatisfaction Model (CS/D), which aims to predict the determinants of consumer satisfaction and dissatisfaction.

According to ECT, when buyers decide their product/service repurchase, they follow a process, which comprises five major stages. First, buyers develop expectations about a product/service before purchase. Second, they purchase and accept the product/service, and form their perceived performance belief by consuming it. Third, buyers compare their perceived performance of the product/service with their pre-purchase expectations, and evaluate to what extent their pre-purchase expectations are fulfilled. This leads the buyer to either confirm or disconfirm the pre-purchase expectations. A buyer's expectations are confirmed when the product/service performs as much as expected but are negatively confirmed when it performs worse than expected, and positively confirmed when it performs better than expected. Fourth, based on pre-purchase expectations and the level of confirmation after consumption, buyers form their satisfaction level. Finally, a buyer's level of satisfaction with a product/service either enhances or inhibits their repurchase or service continuance intention.

The ECT model is shown in Figure 4. The definitions of the core constructs of ECT are given in Table 2. According to this model, consumer satisfaction with a product/service determines their repurchase or service continuance intention. It also posits that pre-purchase expectations and a dissonance between pre-purchase expectations and perceived performance determines a consumer's satisfaction with the product/service. The dissonance is simply the difference between the pre-purchase expectations and perceived performance of a product or service, and this is often captured by the confirmation construct. Both consumers' pre-purchase expectations and confirmation are assumed to be positively associated with satisfaction. Pre-purchase expectations are the reference level used by the consumers to evaluate the product/service. It is suggested that low pre-purchase expectations and high perceived performance will lead to positive confirmation, while high pre-purchase expectations and low performance will lead to negative confirmation.

Expectation

Confirmation + Satisfaction + Repurchase intention

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\+

\+

Perceived performance +
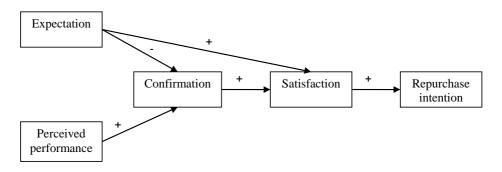
Figure 4   Expectation-Confirmation Theory (Oliver 1980)

Table 2   ECT constructs and their definitions

Core construct	*Definition*
Expectation	The perceived belief probabilities of the outcome of a product or a service (Oliver 1980)
Perceived performance	The perceived actual outcome of a product or a service (Oliver 1980)
Confirmation	A (mis)match between the customer's level of expectation toward a product or a service and the perceived actual performance of the product or service (Oliver 1980)
Satisfaction	A judgment that a product or service feature, or the product or service itself, provided a pleasurable level of consumption-related fulfillment, including a level of under- or over-fulfillment (Oliver 1980)

ECT has been validated across a wide variety of product repurchasing and service continuance contexts, such as automobile repurchasing (Oliver 1993), photography products repurchasing (Dabholkar et al. 2000; Spreng et al. 1996), business professional services (Patterson et al. 1997), restaurant service (Swam & Trawick 1981), and compact disc players (Tse & Wilton 1988).

The ECT was first used to explain IS continuance by Bhattacherjee (2001a). He argues that users' continued IS usage decision is similar to customers' repurchase decisions because both decisions follow an initial acceptance or purchase decision, are influenced by the initial use and experience of an IS or product, and can potentially lead to ex post reversal of the initial decision (Bhattacherjee 2001a, p. 355).

Drawing attention to the substantial difference between initial adoption and continued usage, Bhattacherjee (2001a) developed and empirically tested the information system continuance model in a voluntary environment. Despite the

structural adaptation from the ECT, Bhattacherjee's information system continuance model possesses three major differences.

First, Bhattacherjee (2001a) highlighted the importance of post-adoption expectations rather than pre-adoption expectations in the post-adoption stage. A user continuously updates his expectations about a system as he or she gains more experience of using it. After the assimilation of such experiences, the user's expectation can alter to be different to his/her initial expectations prior to using the system (Bhattacherjee 2001a). From this perspective, the IS continuance model posits that post-adoption expectations (rather than pre-adoption expectations) are the relevant determinants of satisfaction. Second, the IS continuance model selected perceived usefulness as the surrogate for post-adoption expectation. ECT defined expectation as individual belief or a sum of beliefs about the level of attributes possessed by a product/service (Churchill & Surprenant 1982). Bhattacherjee (2001a) reviewed prior IS adoption research and concluded that perceived usefulness is the most consistent and salient cognitive belief in determining user intention over time. Following this he used perceived usefulness as the measure of expectation. Finally, perceived performance was not included in IS continuance model as Bhattacherjee (2001a) argues that the effect of perceived performance could be captured by the confirmation construct.

To sum up, the IS continuance model posits that users – after first time acceptance and a period of initial use – will form an opinion on whether their pre-acceptance expectations are confirmed or disconfirmed (Confirmation). Based on this confirmation, the users will form an opinion about the benefits (Perceived usefulness). After a period of time, both confirmation and perceived usefulness will form the basis of their satisfaction with the IS (Satisfaction). Finally, perceived usefulness and satisfaction will impact on their willingness to continue using the IS (Continuance intention). The information system continuance model is shown in Figure 5. The definitions of the key variables are presented in Table 3.
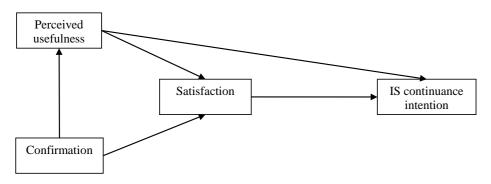
Figure 5   IS continuance model (Bhattacherjee 2001a)

Table 3　　　Definitions of the constructs of IS continuance model

Core construct	Definition
Confirmation	Users' perception of the congruence between expectation of use of the IS and its actual performance (Bhattacherjee 2001a, p. 359)
Satisfaction	Users' affect with (feelings about) prior use of the IS (Bhattacherjee 2001a, p. 359)
IS continuance intention	Users' intention to continue using the IS (Bhattacherjee 2001a p. 359)
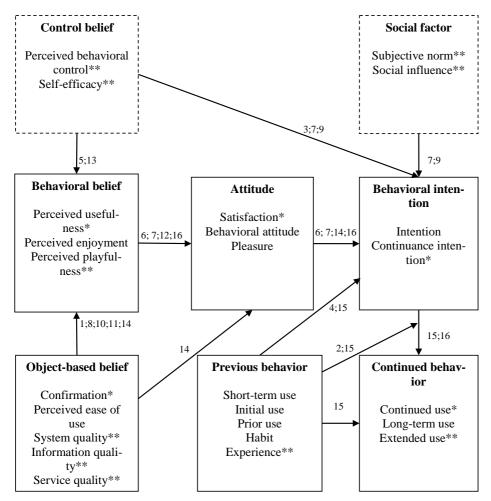
The IS continuance model has been widely used to examine continuance behavior in different contexts such as e-government (Bhattacherjee et al. 2008), e-learning (Chiu et al. 2005; Larsen et al. 2009; Liao et al. 2009), e-commerce (Bhattacherjee 2001b; Cenfetelli et al. 2008; Hsu & Chiu 2004; Lin et al. 2005), virtual communities (Chen 2007), Internet usage (Limayem et al. 2007), online banking (Bhattacherjee 2001a; Vatanasombut et al. 2008), and mobile Internet usage (Hong et al. 2006; Thong et al. 2006).

As discussed earlier, due to its widespread use in investigating post-adoption behavior in different contexts – including e-learning, it seems reasonable to use the IS continuance model as the starting point of this research. This implies that satisfaction and continuance intention are the two dependent variables of interest in this research. The original IS continuance model predicts continuance intention by satisfaction and only one post-adoption belief, perceived usefulness. Using only one post-adoption belief has been argued to be one of the major limitations of the IS continuance model (Hong et al. 2006). According to the author's evaluation, the IS continuance model in its original form is able to provide only a limited understanding of the phenomenon under study. Thus, its proposed extensions are reviewed and summarized in the following sub-section.

2.1.2　Extensions of the IS Continuance Model

By drawing constructs from other theoretical frameworks, several extensions have been proposed to the IS continuance model. Figure 6 illustrates the constructs that were used to extend the IS continuance model in prior IS literature. The figure has been adapted and extended from Hong et al. (2008). This figure categorizes the major constructs that were used to extend the IS continuance model. The categories are behavioral beliefs, object-based beliefs, control beliefs, social factors, attitude, previous behavior, behavioral intention, and continued use behavior. Object-based beliefs are concerned with the characteristics of the target IS, while behavioral beliefs are concerned with the consequences of IS us-

age (Hong et al. 2008). Control beliefs are concerned with the presence of factors that facilitate the performance of IS use. Attitude is an overall affective reaction after using an IS (Hong et al. 2008). Social factors are concerned with individual's social networks influences on performing the target behavior.

(1)Bhattacherjee 2001a, (2) Limayem et al. 2007, (3) Bhattacherjee et al. 2008, (4) Kang et al. 2009, (5) Hsu et al. 2004, (6) Lin et al. 2005, (7) Lee 2010, (8) Larsen et al. 2009, (9) Liao et al. 2007, (10) Hong et al. 2006, (11) Thong et al. 2006, (12) Liao et al. 2009, (13) Sorebo et al. 2009, (14) Roca et al. 2006, (15) Limayem & Cheung 2008, (16) Hsieh & Wang 2007.

* Indicates the constructs of the original IS continuance model proposed by Bhattacherjee (2001a)
** New constructs that are not present in Hong et al. (2008)

Dotted boxes are new major constructs that are not present in Hong et al. (2008)

Figure 6   Extensions of the IS continuance model (adapted and extended from Hong et al. 2008)

Figure 6 shows that the IS continuance model has been extended utilizing different variables – mainly from Technology Acceptance Model (TAM) and its various extensions. To gain more insight into the employed variables it is necessary to review TAM and its popular extensions TAM 2, TAM 3, and the Unified Theory of Acceptance and Use of Technology (UTAUT).

2.1.3   Technology Acceptance Model

The Technology Acceptance Model (Davis 1989) has been the most influential and most widely applied model for explaining users' intention regarding IT use (Lee et al. 2003). TAM was originally developed from Ajzen & Fisbein's (1980) theory of reasoned action (TRA).

TRA argues that if a person intends to commit a behavior it is likely that the person will actually do it. According to TRA, a person's behavioral intention depends on a person's attitude towards the behavior as well as the subjective norm (Ajzen & Fisbein 1980). Attitude is the combination of the user's beliefs about the consequences of performing the behavior and his or her evaluation of these consequences. The subjective norm is the combination of the relevant referents' expectations and the user's motivation to comply with these expectations.

TAM is an adaptation of TRA to the context of IS (Davis 1989; Davis et al. 1989). TAM posits that perceived usefulness and perceived ease of use are the factors that determine an IS user's attitude, which, along with perceived usefulness, determines behavioral intention. Finally, behavioral intention determines actual IS use. Perceived usefulness is described as being directly influenced by perceived ease of use. The definitions of the core constructs are given in Table 4. Figure 7 presents the relationships between the core constructs in TAM.

In contrast to TRA, TAM does not include subjective norm. In a further test of TAM, Davis et al. (1989) found that attitude does not completely mediate the relationship between belief and intention. They argue that in a work environment, behavioral intention may be based on the anticipated impact on job performance, regardless of the individual's overall attitude toward the system. Hence, they excluded the attitude construct from the latter version of the model.

Table 4   TAM constructs and their definitions

Core construct	Definition
Perceived ease of use	The degree to which the prospective user expects the target system to be free of effort (Davis et al. 1989, p. 985)
Perceived usefulness	The prospective user's subjective probability that using a specific application system will increase his or her job performance (Davis et al. 1989, p.985)
Attitude	The degree of a person's positive or negative feelings about performing the target behavior (Davis et al. 1989, p.984)

Figure 7   Technology Acceptance Model (Davis 1989)

TAM allows the provision to add more variables as the antecedents of the two beliefs (perceived ease of use and perceived usefulness) in terms of external variables. External variables can be, for instance, system design characteristics, training, support and documentation (Davis et al. 1989). Regardless of the type of external variables, perceived ease of use and perceived usefulness are expected to mediate their impact on attitude or behavioral intention.

TAM has been validated across time, population, and contexts (Venkatesh et al. 2007). TAM is well-established in IS research as well as other domains (Lee et al. 2003). Venkatesh et al. (2007) argues that TAM has become nearly a law-like model and that it often serves as a basis for studies in other areas. TAM and its constructs have been used in areas outside technology adoption such as information adoption (Sussman & Siegal 2003), marketing (Dabholkar & Bagozzi 2002), and advertising (Rodgers & Chen 2002). In addition, TAM has been used as a basis for comparing SEM techniques — PLS vs. LISRELL (Chin & Todd 1995).

Despite TAM's popularity, it has a number of limitations as discussed by leading IS researchers (Bagozzi 2007; Benbasat & Barki 2007; Goodhue 2007). These are as follows.

- TAM lacks investigating and understanding both design- and implementation-based antecedents, as well as the behavior- and performance-based consequences of IT adoption and acceptance.
- Perceived usefulness and perceived ease of use are regarded as black boxes with little research effort into investigating what makes a system useful or easy to use. Hence, TAM studies often lack actionable guidance for practitioners.
- TAM assumes that more use is better. In other words, more utilization of a technology increases performance. However, only a few prior adoption studies verify a relationship between use and performance outcomes.
- Parsimony is TAM's Achilles' heel. TAM predicts intention using only two beliefs, but there could be more beliefs.
- TAM uncritically accepts the association between intention and actual behavior. However, intentions may not predict actual behavior.

Applying TAM (along with the original IS continuance model) without addressing the above listed limitations does provide a limited understanding of the phenomenon. To address these limitations, several TAM extensions have been proposed in prior literature. In the following, the author describes some of the most popular extensions of TAM.

2.1.4 Extensions of TAM

Over the years, many studies extended TAM by incorporating other important variables into it, such as the determinants of perceived ease of use and perceived usefulness, moderators of TAM relationships, and additional belief variables drawn from other theoretical perspectives (Agarwal & Prasad 1999; Lee et al. 2003; Venkatesh 2000; Venkatesh & Davis 2000; Venkatesh & Bala 2008). The first most popular extension of TAM was made by Venkatesh & Davis (2000). They proposed TAM 2 to underpin the determinants of perceived usefulness. TAM 2 adds five determinants to perceived usefulness: subjective norm, image, job relevance, output quality, and result demonstrability. In addition, experience and voluntariness have been added to the TAM 2 framework as moderators for the relationships with the subjective norm. TAM 2 is shown in Figure 8. The definitions of the additional variables are shown in Table 5.
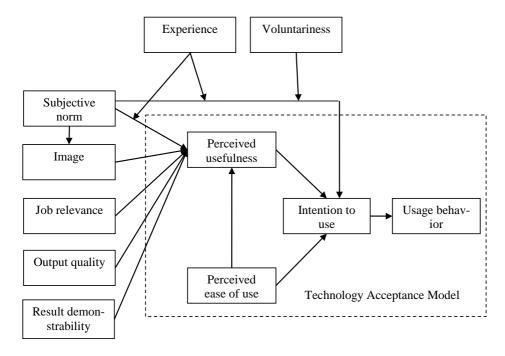
Figure 8   TAM 2 (Venkatesh & Davis 2000)

Table 5   Additional TAM 2 constructs and their definitions

Core construct	Definition
Job relevance	An individual's perception regarding the degree to which the target system is relevant to his or her job (Venkatesh & Davis 2000, p. 191)
Output quality	The degree to which an individual believes that the system performs his or her job tasks well (Venkatesh & Davis 2000, p. 191)
Subjective norm	An individual's perception that most people who are important to him/her think he/she should or should not perform the behavior in question (Fishbein & Ajzen 1975, p. 203)
Image	The extent to which the use of an innovation is perceived as enhancing one's image or status (Moore & Benbasat 1991, p. 195)
Voluntariness	The degree to which use of the innovation is perceived as being voluntary, or free will (Moore & Benbasat 1991, p. 195)
Result demonstrability	The tangibility of the results of using an innovation (Moore & Benbasat 1991, p. 203)

Venkatesh (2000) identified the determinants of perceived ease of use. He argues that several anchor variables related to the general beliefs of individuals regarding computers and computer use are responsible for developing their early perceptions of the perceived ease of use of an IS. These anchors include computer anxiety, computer self-efficacy, perceptions of external control (or facilitating conditions), and computer playfulness. Venkatesh (2000) also suggests that while anchors are responsible for developing initial judgments of perceived ease of use, direct hands-on experience of the IS adjusts these judgments. According to Venkatesh (2000), perceived enjoyment and objective usability will play important roles in determining perceived ease of use after individuals gain hands-on experience of a new IS.

Venkatesh & Bala (2008) extended TAM 2 by incorporating Venkatesh's (2000) model of the determinants of perceived ease of use into it and named it TAM 3. In TAM 3, the determinants of perceived ease of use are suggested to exert no influence on perceived usefulness, and the determinants of perceived usefulness are suggested to have no influence on perceived ease of use. In addition, TAM 3 also suggests that experience moderates the relationships between: i) perceived ease of use and perceived usefulness; ii) perceived ease of use and intention to use; iii) computer anxiety and perceived ease of use; iv) computer playfulness and perceived ease of use; v) perceived enjoyment and perceived ease of use; and vi) objective usability and perceived ease of use. TAM 3 is presented in Figure 9 and the additional variables' definitions are presented in Table 6.
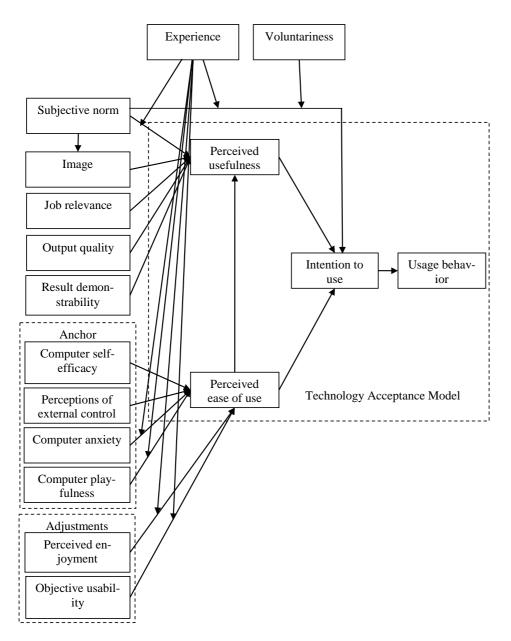
Figure 9   TAM 3 (Venkatesh & Bala 2008)

Table 6   Additional TAM 3 constructs and their definitions

Core construct	*Definition*
Computer anxiety	The degree of an individual's apprehension, or even fear, when he or she is faced with the possibility of using computers (Venkatesh 2000, p. 349)
Computer playfulness	The degree of cognitive spontaneity in microcomputer interactions (Webster & Martocchio 1992, p. 204)
Perceived enjoyment	The extent to which the activity of using a specific system is perceived to be enjoyable in its own right, aside from any performance consequences resulting from system usage (Venkatesh 2000, p. 351)
Objective usability	A comparison of systems based on the actual level (rather than perceptions) of effort required to complete specific tasks (Venkatesh 2000, p. 350-351)
Computer self-efficacy	An individual's control beliefs regarding his or her personal ability to use a system (Venkatesh & Bala 2008, p. 278)
Perceptions of external control	An individual's control beliefs regarding the availability of organizational resources and the support structure for facilitating the use of a system (Venkatesh & Bala 2008, p. 278)

Another important extension of TAM is the Unified Theory of Acceptance and Use of Technology (UTAUT) developed by Venkatesh et al. (2003). They conducted a review of the constructs in different IS adoption models such as the TRA, TAM, the Motivational Model (MM), the Theory of Planned Behavior (TPB), the Model of PC Utilization (MPCU), Innovation Diffusion Theory (IDT) and Social Cognitive Theory (SCT) to examine individual acceptance of technologies and synthesized constructs from different models as the variables of UTAUT, in order to predict both IS user intention and usage behavior. According to UTAUT, there are four core determinants of user acceptance and use: performance expectancy, effort expectancy, social influence, and facilitating conditions. Furthermore, gender, age, experience and voluntariness have been theorized as being moderators between the associations of behavioral intention/behavior and the other core constructs. The UTAUT model is shown in Figure 10 and the definitions of the key constructs are presented in Table 7.
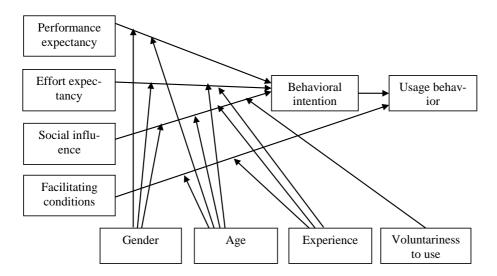
Figure 10   UTAUT (Venkatesh et al. 2003)

Table 7   UTAUT constructs and their definitions

Core construct	*Definition*
Performance expectancy	The degree to which an individual believes using the system will help him or her to attain gains in job performance (Venkatesh et al. 2003, p. 447)
Effort expectancy	The degree of ease associated with the use of the system (Venkatesh et al. 2003, p. 450)
Social influence	The degree to which an individual perceives that important others believe he or she should use the new system (Venkatesh et al. 2003, p. 451)
Facilitating conditions	The degree to which an individual believes that an organizational and technical infrastructure exists to support the use of the system (Venkatesh et al. 2003, p. 453)

The extensions to TAM are able to address many of the limitations of the original TAM. In particular, TAM 2 and TAM 3 made important theoretical contributions by identifying the determinants of perceived ease of use and perceived usefulness. However, these popular TAM extensions cannot be used directly to investigate e-learning system post-adoption behavior and its outcomes. This is because the popular TAM extensions as well as the IS continuance model do not include any usage outcome related variable. In addition, these models do not provide any concepts for influencing behavior and its outcomes through the design characteristics of an e-learning system. In order to provide practical instruc-

tions for HCI practitioners, it is necessary to test the impact of an e-learning system's design characteristics on the constructs of interest, such as satisfaction, intention, and usage outcomes.

To address the above mentioned limitations, the author performed a literature review on generic IS adoption research, e-learning research, and e-learning post-adoption research. In the following sections, the author discusses prior research in these areas.

2.2   IS Post-adoption Research

In order to achieve the long-time viability and ultimate success of an IS, the importance of post-adoption behavior has been emphasized. This issue has been discussed and addressed in IS literature over the years using different theoretical perspectives (Jasperson et al. 2005).

In IS post-adoption research, continued system use has been seen as the key post-adoption behavior (Bhattacherjee 2001a). It is often argued in the literature that intention causes behavior (system use) and, following this, post-adoption literature has mostly used intention as the final dependent variable.

In IS post-adoption research, two schools of thought have been evolved. The first school of thought assumes post-adoption is an extension to IS adoption. This school has used the IS acceptance variables to predict IS continuance by extending the underlying models in a longitudinal setting (Karahanna et al. 1999; Venkates & Davis 2000; Venkatesh et al. 2003). These studies are mainly built by employing TAM and its extensions. Some of these prior studies found that the determinants of initial user acceptance are, to some extent, different from that of IS continuance (Karahanna et al. 1999; Venkatesh & Moris 2000). Bhattacherjee (2001a) argues that although IS users may form some beliefs and initial judgments about an IS, their beliefs and initial judgments are modified during their actual usage of the IS, which in turn determines IS continuance. This idea evolved to produce the second school of thought in IS post-adoption research. Bhattacherjee (2001a) introduced the ECT (Oliver 1980) to add a new theoretical perspective to individual user IS continuance research and proposed an IS continuance model that explicitly focuses on post-adoption beliefs, and post-adoption satisfaction.

A considerable amount of post-adoption research has been conducted using the IS continuance model. According to this model, satisfaction along with perceived usefulness causes a user's continued use intention during the post-adoption stage. The literature that uses the IS continuance model has placed greatest importance on satisfaction and use intention, and investigated the determinants of these variables. In doing so, prior studies have extended the IS con-

tinuance model by using additional variables. For example, Hong et al. (2006) incorporates perceived ease of use as another determinant of both satisfaction and continuance intention. Sorebo & Eikebrokk (2008) incorporate perceived ease of use to predict satisfaction in a mandated IS use context. Thong et al. (2006) used perceived ease of use and perceived enjoyment as another two determinants of satisfaction and continuance intention. Deng et al. (2010) gave greatest importance to satisfaction and utilized perceived utilitarian performance (a similar variable to perceived usefulness) and perceived hedonic performance to predict the post-adoption satisfaction of mobile internet service users. Recker (2010) incorporates a user characteristics related variable called grammar familiarity to complement perceived ease of use and perceived usefulness when predicting user satisfaction with process modeling grammars. Both Hsu et al. (2004) and Bhattacherjee et al. (2008) found self-efficacy, another user characteristic-related variable, to be an important determinant of continuance intention. Lin et al. (2005) add perceived playfulness as a determinant of both satisfaction and continuance intention. Kang et al. (2009) hypothesize that regret has a negative impact on both satisfaction and continuance intention, while self-image congruity is hypothesized to have a positive impact on continuance intention. Their empirical test results suggest that regret has a negative impact on continuance intention. In addition, self-image congruity has a weak impact on continuance intention. Kim (2010) found perceived fee to have a negative impact on user satisfaction, while social norms and perceived behavioral control were found to have a strong impact on continuance intention in the mobile data service usage context. Indeed, some studies went beyond the intention to investigate the behavior. Bhattacherjee et al. (2008) found that continuance intention along with facilitating conditions causes continued use. Limayem et al. (2007) investigated the role of habit in continued IS use. They found that habit negatively affects the relationship between intention and behavior.

Several other theoretical frameworks have been used to investigate satisfaction and continuance intention such as Innovation Diffusion Theory (Shih 2008), Theory of Planned Behavior (Hsieh et al. 2008), TRA (Karahanna et al. 1999), Commitment-Trust theory (Vatanasombut et al. 2008), the original ECT (Hsieh et al. 2010; McKinney et al. 2002), IS Success Model (Brown & Jayakody 2009; Ifinedo et al. 2010; Schaupp 2010), and the self-developed models, which were developed by taking different constructs from different theoretical perspectives (Garrity et al. 2005; Kuan et al. 2008; Kang & Lee 2010; Lee et al. 2009b; Li et al. 2011; Park et al. 2010).

In the reviewed literature, the two TAM variables, perceived usefulness and perceived ease of use have often been used to build the research models. Core constructs from the IS success model like information quality, system quality and

service quality are also widely used to build research models. In this sense, post-adoption research has evolved from both IS adoption and IS success literature.

A summary of post-adoption literature examining satisfaction and/or continuance intention in different contexts (except for e-learning) from different theoretical perspectives is presented in Appendix 4. To take the literature review closer to the domain of interest the next subsection focuses on prior research in the e-learning context.

2.3 Literature Review of E-learning Studies

E-learning has become a widely accepted learning module in recent years, although there are numerous studies that debate its appropriateness (Shih et al. 2008). A major focus of prior e-learning research was related to cognition in learning. For example, Shih et al. (2008) reviewed major journals published from 2001 to 2005 from the Social Sciences Citation Index (SSCI) database and found that almost half of the e-learning related studies examined cognition in learning. They categorized the studies of cognition in e-learning into seven broad categories:

1) Motivation: Articles in this research topic explore variables like beliefs or attitudes toward an e-learning system and their interrelationships during the pre- and post-adoption stage. For example, McGill & Klobas (2009) found that LMS utilization can be predicted by attitude and LMS use beliefs. In addition, they also found that LMS use has a positive impact on student learning outcomes.

2) Individual style: This category includes studies that discuss participants' learning style and its impact on the learning process. For example, Treffinger et al. (2008) found that when individuals understand their style they may use e-learning tools more effectively in their learning.

3) Instructional approaches: The focus of this category is to examine different types of instructional approaches like cooperative, collaborative, situated, problem-based learning that are used in an e-learning environment. For example, Solimeno et al. (2008) compared the efficacy of face-to-face and collaborative instructional approaches in increasing academic performance.

4) Learning environment: This category focuses on learning experiences in an e-learning environment. For example, Sanprasert (2010) studied the application of an LMS to enhance autonomy in learning English as a foreign language. The study found that LMS played a prominent role in the creation of autonomy.

5) Prior knowledge: Articles in this category examine the role of prior technology knowledge and experience on participants' learning process and outcomes. For example, Steel & Hudson (2001) found that prior experience with educational technology helps both educators and students understand the role of technology in teaching and learning.

6) Metacognition: These articles examine the metacognition status of participants, such as perception, awareness, self-evaluation, etc. and its influence during the process of learning. For example, Metzger et al. (2003) found that students rely heavily on the web for both general and academic information. However, they do not verify the credibility of the found information when learning.

7) Cognitive psychology characteristics: These articles focus on examining the cognitive psychological characteristics of participants such as concept maps, mental models and cognitive loads in their e-learning process. For example, Papanikolaou et al. (2002) discussed the need to adapt an e-learning system's contents and appearance to protect participants from cognitive overload.

In this dissertation the post-adoption beliefs, satisfaction, intention to use, and the use outcomes of users are explored. In this sense, this research falls under the 'motivation' category. Hence, this category is discussed in more depth below. It should be noted that parts of this research may fall into other categories. As explained by Shih et al. (2008), many studies may deal with more than one category and the categories should be viewed as tentative rather than rigid.

Motivation research in e-learning can be categorized into two broad groups: e-learning system acceptance or adoption (Chen 2011) and e-learning system post-adoption research (Chiu et al. 2005; Wang et al. 2007). Sumak et al. (2011) conducted a meta-analysis of articles examining e-learning acceptance and found that 86% of all studies used TAM, 4% used UTAUT, 2% used TPB, and 6% used some other theoretical frameworks to explain e-learning systems adoption. They also found that the majority of the studies were based on student populations, while only a few used educators and organization employees. Their meta-analysis revealed that the TAM relationships were generally consistent in e-learning acceptance research. Examples of the empirical studies on e-learning acceptance are presented in Appendix 5.

As the author is interested in exploring post-adoption behavior rather than acceptance behavior in this research, he discusses prior post-adoption research in e-learning in greater detail. The following section presents prior research on e-learning post-adoption.

2.4 E-learning Post-adoption Research

In the recent years, e-learning post-adoption research has received much attention in IS research. A significant amount of research has been conducted on understanding e-learning systems post-adoption. A review of the relevant literature published on e-learning post-adoption has been conducted in this dissertation. The author searched the ABI/INFORM, Business Source Complete, Electronic Journals Service, ScienceDirect, and Wiley InterScience databases to find prior studies. The search was conducted by using keywords: expectation-confirmation, expectation-disconfirmation, information systems continuance, e-learning continuance, and e-learning post-adoption use. Webster & Watson (2002) suggest going through a journal's table of contents with a keyword-based search. Thus, to ensure that the relevant articles were included, the author performed a manual search for each issue of the six highest ranked journals from Senior Scholars' basket of IS journals: MIS Quarterly, Information Systems Research, Information System Journal, Journal of the Association of Information Systems, Journal of Management Information Systems, and European Journal of Information Systems.

Several empirical studies on e-learning post-adoption were found. Table 8 summarizes these studies.

Table 8   E-learning post-adoption research

Article	Theories used	Target population	Key findings
Chiu et al. (2005)	ECT	Students on online courses	Usability, usability confirmation, quality, and value affect satisfaction. Satisfaction affects continuance intention
Chiu et al. (2007)	Fairness theory	Students on online courses	Distributive fairness, interactional fairness, intrinsic value, attainment value, and utility value affect satisfaction. Satisfaction and utility value affect continuance intention
Chiu & Wang (2008)	UTAUT	Students on online courses	Computer self-efficacy, attainment value, utility value, perceived playfulness, performance expectancy, and effort expectancy affect continuance

			intention
Cho et al. (2009)	TAM	Students on online courses	Perceived usefulness, satisfaction, and prior experience affect continuance intention. Perceived interface design issues affect continuance intention through perceived usefulness
Freeze et al. (2010)	IS success model	Students on hybrid courses	Information quality and system quality affect both satisfaction and e-learning system use behavior
Hayashi et al. (2004)	IS continuance model	Students on an online course	Computer self-efficacy does not affect satisfaction and continuance intention. Social presence does not necessarily improve end user experience
Ho (2010)	IS continuance model, TAM, Self-determination theory	Mixed users of an e-learning platform. The users were recruited from an online forum	Confirmation, and perceived usefulness affect satisfaction. Satisfaction, attitude, and perceived usefulness affect continuance intention
Hung et al. (2011)	IS continuance model, Attribution theory	School educators	Confirmation, and perceived usefulness affect satisfaction. Satisfaction, causal attributions, and perceived usefulness affect continuance intention
Karaali et al. (2011)	TAM	Workers in the automotive industry	Social influence, Perceived usefulness, and attitude affect continuance intention
Larsen et al. (2009)	IS continuance model, Task technology fit	University faculty educators	Confirmation affects satisfaction. Satisfaction and utilization affect continuance intention
Lee & Lee (2008)	self-developed model	Students on online courses	Satisfaction leads to better academic performance. Satisfaction is predicted by perceived usefulness, service quality, and information representation quality

Lee (2010)	IS continuance model, TAM, TPB, Fairness theory	Students on online courses	Confirmation and perceived usefulness affect satisfaction. In turn, satisfaction, perceived usefulness, attitude, concentration, subjective norm, and perceived behavioral control affect continuance intention
Liao et al. (2007)	IS continuance model, TPB	Students on online courses	Confirmation and perceived ease of use affect satisfaction. Satisfaction, subjective norm, and perceived behavioral control affect continuance intention
Liao et al. (2009)	IS continuance model, TAM	Students on online courses	Confirmation and perceived usefulness (only for short-term users) affect satisfaction. In turn, satisfaction, perceived usefulness (only for initial adopters), and attitude affect continuance intention
Liao & Lu (2008)	Innovation diffusion theory	Students on online course	Compatibility and result demonstrability affect continuance intention
Limayem & Cheung (2009)	IS continuance model	Students on hybrid/mixed courses	Confirmation and perceived usefulness affect satisfaction. Perceived usefulness, and satisfaction affect continuance intention
Lin (2011)	TAM	Students of online courses	Satisfaction (only for less experienced users), and attitude affect continuance intention. Satisfaction is negatively affected by negative critical incidents
Lin & Wang (2012)	IS success model, Task technology fit	Students on hybrid courses	Satisfaction is predicted by confirmation and perceived usefulness. Continued use intention is predicted by perceived usefulness and satisfaction

Liu et al. (2010)	TAM	High school students on online courses	Perceived usefulness, perceived ease of use, and perceived interaction affect continuance intention
Liaw (2008)	self-developed model	Students on hybrid courses	Learner characteristics (self-efficacy and self-directedness) affect satisfaction. In turn, satisfaction, and usefulness affect continuance behavioral intention. E-learning effectiveness was found to have a high correlation with behavioral intention
Mahdizadeh et al. (2008)	self-developed model	University faculty educators	Perceived added value, opinions about computer-assisted learning, and opinions about web-based activities affect e-learning use
McGill & Klobas (2009)	Task technology fit	Students on hybrid courses	Attitude, instructor norms, and expected consequences affect e-learning use. Task-technology fit and e-learning system use affect perceived impact on learning. Finally, perceived impact on learning together with task-technology fit determine student grades
Pituch & Lee (2006)	TAM	Students on hybrid courses	System functionality, perceived ease of use, and perceived usefulness affect use of supplementary learning. System functionality, system interactivity, perceived usefulness, perceived ease of use, and use of supplementary learning affect use of distance education
Roca et al. (2006)	IS continuance model, TAM, TPB	Students on online courses	Information quality, system quality, service quality, confirmation, perceived usefulness, cognitive absorption, and perceived ease of use affect satisfaction. Satisfaction affects

			continuance intention.
Roca & Gagne (2008)	TAM, Self-determina-tion theory	Students on online courses	Perceived usefulness, perceived playfulness, and perceived ease of use affect continuance intention
Sorebo et al. (2009)	IS continu-ance mod-el, Self-determina-tion theory	University faculty educators	Confirmation, perceived use-fulness and perceived playful-ness affect satisfaction. Per-ceived usefulness and per-ceived playfulness affect con-tinuance intention
Wan et al. (2008)	self-developed	Students on online courses	ICT experience related factors affect learning effectiveness and satisfaction through the mediation of virtual competen-cy

Three important points are found in this literature review.

First, e-learning systems post-adoption research has evolved in a similar fashion to IS post-adoption research. The studies have mostly utilized IS adoption and usage theories (TAM, IS continuance model, UTAUT, etc.) to explain e-learning system users' post-adoption satisfaction and continuance intention. Two schools of thought have been employed in e-learning post-adoption research. The first school implicitly views e-learning system post-adoption behavior as an extension of the e-learning system users' initial acceptance behavior, and uses the same set of variables to explain both acceptance and continued use (Cho et al. 2009; Lin 2011). These studies have utilized TAM, TPB (Ajzen 1991), Self-Determination Theory (Deci & Ryan 1995), UTAUT, etc. to explain the continuance intention of e-learning system users. The second school has utilized the IS continuance model and dominates e-learning system post-adoption research. To enrich this school, researchers have integrated other theoretical frameworks, such as TAM (Davis 1989), the TPB (Ajzen 1991), the IS success model (DeLone & McLean 2003), Fairness Theory (Lind et al. 1993), Self-Determination Theory (Deci & Ryan 1995), Attribution Theory (Heider 1958), and Task-Technology Fit (Goodhue & Thompson 1995) with the IS continuance model.

Second, the majority of the studies examined students participating in online courses that had little or almost no face-to-face interaction. A few studies researched faculty educators who use an e-learning system to support their face-to-face teaching.

Third, most of the prior studies mainly investigated the factors that affect the use of e-learning systems, but do not consider how these factors, or the use of the

e-learning system itself are associated with e-learning system use outcomes. Indeed, few studies have gone beyond use to explore the factors associated with learning outcome. For example, McGill & Klobas (2009) found that e-learning system utilization influences perceived impact on learning. Lee & Lee (2008) also discovered a number of e-learning environment quality-related variables that affect satisfaction with e-learning. In turn, satisfaction was found to influence academic achievement. Liaw (2008) found a high correlation between the intention to use e-learning and e-learning effectiveness.

2.5 Scrutinizing the Introduced Theories and Their Applications

Silva (2007) argues that although TRA derived adoption theories have been widely used, IS researchers have not carefully scrutinized the philosophical and epistemological foundations of these models. He further argues that scrutinizing is important when conducting research that utilizes these theories. Accordingly, the author scrutinizes these theories and describes the rationale behind using them.

In a particular model, all factors are represented at the same level of aggregation, whereas the actual world is a complex interweaving of different structures at many levels. Such a complex world cannot be captured with a theory like TAM or the IS continuance model. Indeed such models have been confirmed a thousand times in prior IS literature. However, Popper (1972) advises that researchers should not accept a theory as scientific, even if there is a large amount of evidence to confirm it. He argues that humans find regularities in nature due to their habit of jumping to conclusions too quickly. He suggests that researchers should put maximum effort into conducting experiments with the aim of falsifying theories. The alternative to this approach is to set up a theory and look for evidence to confirm that theory. According to Silva (2007), many studies utilizing the adoption models follow the latter approach. This can be hazardous because the world is sufficiently complex and some confirming evidences can be found, no matter how unlikely the theory may be. Following Popper (1972), it can be argued that researchers also need to keep their eyes open and find types of computer adoption that cannot be explained by TAM or the IS continuance model. However, in prior research, it might be almost impossible to find a technology adoption behavior that cannot be explained by the models.

Silva (2007) argued that a scientific theory cannot explain all types of human behavior. According to Ajzen & Fishbein (1980), TRA is designed for studying virtually any human behavior. Following Popper (1972) it can be argued that if TRA can account for all types of human behavior, then it is not a scientific theo-

ry. Such a theory can be called pseudo-science. Scientific theory is falsifiable, pseudo-science is not. Popper (1972) notes the following.

> "*Every good scientific theory is a prohibition: it forbids certain things to happen. The more a theory forbids, the better it is….*"

Ogden (2003) in his review of psychological literature found that TRA is weak in predicting certain behavior. However, he also discovered that in such situation instead of rejecting the theory the researchers provided several explanations, such as the model should be accepted but the variables were not operationalized properly or the model should be accepted but the sample characteristics may explain the results.

Unfortunately, a similar thing has also been done for TAM according to Silva (2007). The original TAM had only two beliefs for predicting IS use: perceived usefulness and perceived ease of use. When TAM is applied to explain the adoption of a mobile service, it can be thought that the users adopt a mobile service due to its usefulness and ease of use. However, if we consider the adoption of an Enterprise Resource Planning (ERP) system in an organization, the system might be difficult to use and disruptive to employee work, but still they use it. TAM researchers argued that such adoption can be explained by subjective norm, i.e. the influence of authorities. The original TAM model did not include subjective norm, but whenever researchers have found that TAM may not be able to explain a particular adoption, they have added more variables to it.

This approach to conducting research is similar to the concept of research programme described by Lakatos (1970). According to him, a research programme is an organic unity which contains both rigid components (essential, structural components) and non-essential components. The essential structural components are the hard core and positive heuristic of the research programme. The hard core is composed of some theoretical assumptions to which a research community is committed. The committed scientific community of the research programme defends the credibility of the hard core against any threat imposed by others. Yet the research programme contains or generates components which could be given up or replaced without abandoning the hard core. Non-essential, replaceable components of the research programme are called the protective belt of the research programme. The protective belt can be viewed as the auxiliary hypotheses defending the hard core.

As explained by Silva (2007), in the TAM derived research programme the hard core is the TRA. The protective belt is the addition of the different researchers committed to the TAM derived research. New constructs have been added and auxiliary hypotheses have been offered to explain unexpected results without questioning the hard core. For example, a number of TAM studies (Gefen &

Straub 2000; Ma & Liu 2004) have noticed that perceived ease of use has not been consistently linked to adoption. These studies explain TAM's anomalies by suggesting that the role of perceived ease of use depends on the task. However, according to Silva (2007), that is an auxiliary hypothesis. Lee et al. (2003) in their review found that about 24% of prior studies did not find a significant relationship between perceived ease of use and behavioral intention. However, many of these studies did not challenge TAM, instead they provided auxiliary explanations. Silva (2007) noted the following.

> "*In the light of Lakatos methodology of scientific research programs, I argue that the complementary constructs and additional theoretical explanations were added by TAM researchers to protect the hard core. The additions can be considered auxiliary hypotheses that have been incorporated in the protective belt. In this sense, it is also worth mentioning that in my reading of TAM literature, I could not find papers that challenged the hard core.*"

Following Popper (1972), such auxiliary hypotheses can be regarded as ad hoc and eventually a "bad thing". Following Lakatos (1970), it can be argued that changing the protective belt may not be bad for a research programme. Instead of investigating a theory's falsifiability, it is more important to investigate whether the research programme is progressive or degenerative. A progressive research programme discovers novel facts, develops new experimental techniques, and performs precise predictions. A research programme is degenerative if it is not able to produce novel facts by changing the protective belt. In such cases, the hypotheses added to the protective belt can be considered ad hoc and not acceptable according to Lakatos (1978).

According to the author's critical evaluation, the TAM derived research programme is progressive. For example, TAM researchers have added several new constructs to the original TAM, such as age, gender, prior experience, management support, and voluntariness, to explore the boundary conditions for TAM (Lee et al. 2003; Silva 2007). Researchers have discovered that the psychological motivation behind initial use and subsequent use is different, and thus have placed more importance on post-adoption behavior than adoption behavior (Bhattacherjee 2001a; Jasperson et al. 2005; Karahanna et al. 1999). In this regard, the IS continuance model has been developed from ECT to study post-adoption behavior. In addition, leading IS researchers also point out that there are still many unexplored research areas regarding IS adoption and use, such as testing the effect of an IT artifact's design characteristics on perceived usefulness and use (Benbasat & Barki 2007; Benbasat 2010), investigating actual usage and its relation to objective performance measures (Benbasat & Barki 2007; Lee et al.

2003), and exploring the organizational and societal adoption and use of IS (Lee et al. 2003) to name a few.

According to the author's critical evaluation, TAM derived models are falsifiable although the way these have been used in many studies might give the illusion that no data can be collected to falsify the theory. This illusion becomes even stronger when the author discusses the analytic nature of the relationships among beliefs, attitude, intentions and behavior in the next paragraphs.

TAM derived models follow TRA's tradition of examining the relationship between beliefs-attitude-intention-behavior. According to Rosenberg (1995), an action consists of desires and beliefs. Both desires and beliefs together give meaning to an action. For example, the action of carrying an umbrella by an individual is meaningful only when it is explained by his belief that it is going to rain and his desire not to get wet. This indicates that the intention to carry an umbrella is linked to an individual's beliefs and desires. Following this it can be argued that there cannot be actions without intentions. Silva (2007) argued that the individual might carry an umbrella for other reasons; it might be a part of his attire or for protection. Following this, it is clear that identifying intentions will give an action its meaning rather than predict it (Silva 2007). Hence, self-reported behavior and intentions measured in a cross-sectional survey are linked by their definitions. Anscombe (1957) and Melden (1961) called this "the logical connection argument".

There might be two kinds of connections between two variables: contingent and analytical (Silva 2007). The difference between these two types of connections is that a contingent entity depends on a natural process to occur, while an analytic one does not depend on a natural process (Honderich 1995). An analytic truth is true by definition (Ogden 2003). A chemical reaction may have contingent connections as it is based on the conjunction of several natural factors. On the other hand the statement "a rectangle has four sides" is true by definition (it is an analytical truth). Empirical science based on experiments and observation can deal with contingent entities. Ogden (2003) argued that the relationships in TRA or TPB derived models in many studies are often analytical in nature. His review revealed that researchers often measure different constructs with similar statements. For example, he observes that researchers measured perceived behavioral control and behavioral intention using similar questions and attempted to calculate the correlation between them. In such situations it is very likely that there will be a high correlation between the two variables. This makes the theory analytical. A good theory should avoid analytical truth or it will be tautological (Ogden 2003). In such cases, belief, attitude, and intention cannot be linked causally. Silva (2007) states the problem in the following way.

> *"The problem is that intentions, stated in terms of desires and beliefs, constitute only a re-description of the action they are thought to be predicting."*

It implies that when beliefs, attitude, and intentions are linked analytically, the causal relationships between them are not falsifiable by use of empirical testing. Hence, in such a situation the causal links of TAM or the IS continuance model cannot be regarded as scientific according to Popper (1972). According to the author's critical evaluation, TAM or the IS continuance model's relationships have not been analytical in prior literature. For example, Lee et al. (2003) reports examples of many studies where TAM relationships were inconsistent. If the relationships are truly analytical, then such inconsistency should not be visible. However, the author accepts that adoption researchers need to be more careful in their research design, especially when operationalizing the constructs of their models to avoid an analytical nature. In this regard, Ogden (2003) suggests researchers avoid similar statements when measuring different constructs. Straub & Burton-Jones (2007) argue for the use of objective measures for both beliefs and behavior when testing theories like TAM or the IS continuance model. This can not only eliminate common method bias but also avoid the analytical nature of the constructs. The author follows Ogden (2003) in ensuring that different constructs are not measured with similar questions in this research. According to the author's critical evaluation, this prevented the analytical nature of the constructs occurring in the research models – at least to some extent.

To sum up, there is no problem in using TAM derived models when studying a particular phenomenon as long as proper attention has been paid to the research design.

2.6   Developing the Overall Research Framework

While developing the overall theoretical framework, the author decided to address the limitations of TAM and the IS continuance model. First, as discussed earlier, because these models use only behavioral beliefs, TAM and the IS continuance model have been criticized for their inadequacy in generating actionable guidance for practitioners (Benbasat 2010). In this regard the author decided to use other beliefs, such as object-based beliefs and control beliefs in the research model, in order to provide more implications for researchers as well as practitioners. The author has used confirmation, perceived support, perceived compatibility, perceived result demonstrability, perceived usefulness, perceived behavioral control, and perceived system quality to investigate user satisfaction and to extend the IS continuance model so that it can provide more actionable feedback

to practitioners. In addition, open-ended survey questions are used to gain a deeper insight into the phenomenon. Such analysis might offer important guidance for practitioners as well.

Second, TAM and IS continuance research has been criticized for putting more focus on usage behavior and ignoring usage outcomes. Thus in this research the author has investigated the outcomes of e-learning system usage which has been regarded as one of the most important research directions for IT adoption researchers (Lee et al. 2003). In practice, the author has adapted two outcome variables from prior research: perceived learning assistance (McGill & Klobas 2009), and perceived academic performance (Lee & Lee 2008).

In principle, to address the limitations of prior e-learning post-adoption research and to provide the answer to the research question of this study, the author develops a complete theoretical framework that considers user beliefs, emotion/behavior, and outcomes. Figure 11 illustrates the conceptual framework for investigating the e-learning system post-adoption stage. It has three main boxes: beliefs, emotion/behavior, and outcomes.

The first box from the left contains a number of beliefs such as confirmation, perceived system quality, perceived support, perceived compatibility, perceived result demonstrability, perceived usefulness, and perceived behavioral control. These beliefs are included in the framework as they were found important in widely employed theoretical frameworks such as TAM, TAM 2, TAM 3 and the IS continuance model as well as prior post-adoption research in the e-learning context. In addition, the presence of these beliefs was confirmed by analyzing the interview data. These beliefs can be of three types as explained in section 2.1.2 and shown in Figure 10. First, beliefs can be object-based beliefs that are concerned with the characteristics of the system such as perceived system quality and perceived compatibility (Hong et al. 2008). Second, beliefs can be behavioral beliefs that are concerned with the consequences of IS use, such as perceived usefulness (Wixom & Todd 2005). Finally, beliefs can be control beliefs that are concerned with the presence of factors that facilitate the performance of IS use, such as perceived behavioral control and perceived support.

The second box contains variables related to emotion and behavior. Satisfaction is regarded as an affective or emotional response to the use of technology (De Guinea & Markus 2009). Satisfaction is one of the most important constructs in both the IS continuance model and the IS success model (DeLone & McLean 2003). It was found to be strong in determining behavioral intention in different contexts, including e-learning (Bhattacherjee 2001a; Hong et al. 2006; Larsen et al. 2009; Roca et al. 2006). At its most fundamental level behavior of e-learning use is driven by e-learning use intention (Davis 1989).

The third box contains e-learning system use outcome variables. Perceived learning assistance refers to the extent to which the e-learning system assists an

individual in his/her learning. Such assistance provided by the e-learning systems may positively impact on a student's perceived academic performance.
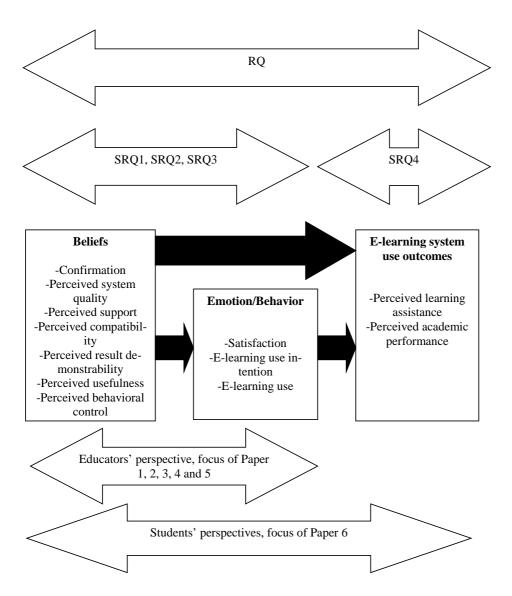
Figure 11   Overall conceptual model

The developed framework is conceptually supported by both the IS adoption/post-adoption models, TAM (Davis 1989) the IS continuance model (Bhattacherjee 2001a), and the IS success model (DeLone & McLean 2003). In particular, both the IS continuance model and the IS success model posit that a number of beliefs determine satisfaction and use intention. Following this, the framework posits that these beliefs cause e-learning system user satisfaction, use

intention, and use. On the other hand, according to the IS success model, IS use brings benefits to individuals and organizations. Similarly, according to the framework presented in Figure 11, e-learning system use will positively impact on perceived learning assistance and perceived academic performance.

Beliefs may have an effect on e-learning outcomes in two ways. First, the beliefs can have a direct impact on e-learning outcome variables. For example, a useful and/or easy to use e-learning system may assist students in their study. Such benefits may also help students improve their academic performance. The direct relationship between beliefs and learning outcomes is supported by a number of prior studies (Carswell & Venkatesh 2002; Lee & Lee 2008; McGill & Klobas 2009). Second, these beliefs can have an indirect effect on e-learning outcomes through the mediation of e-learning use. As discussed earlier, the relationship between use and use outcomes is conceptually supported by the IS success model which posits that IS use has a positive effect on individual impact (DeLone & McLean 1992).

Sorebo et al. (2009) argues that educators play a role as administrators or facilitators of the student utilization of e-learning systems. They point out that an educator's motivation for utilizing an e-learning system is very important for increasing student utilization of such systems. Thus, in this dissertation, more focus has been placed on the beliefs of educators in explaining their satisfaction and continuance intention toward the targeted e-learning system. Papers 2, 3, 4, and 5 investigate educators' satisfaction and continuance intention. To understand whether students' utilization of e-learning systems assists them in their study, Paper 6 investigates the perspective of students.

When investigating the educators' perspective, a number of post-adoption beliefs that are salient in shaping educators' post-adoption satisfaction and continuance intention toward e-learning systems were identified and it corresponds to the first two boxes of the conceptual framework. Furthermore, the effects of beliefs and e-learning system use on students' e-learning system use outcomes are also investigated, and it corresponds to all three boxes of the conceptual framework.

The sub-research questions: SRQ1 (*To what extent have the relationships of the IS continuance model been empirically proven to be consistent in prior studies?*), SRQ2 (*How can educators' satisfaction with an e-learning system in the post-adoption stage be determined?*), and SRQ3 (*How can educators' continued use intention of an e-learning system in the post-adoption stage be determined?*) are answered by evaluating the causal relationships between beliefs and emotion/behavior, i.e. the relationships between the first and second box of Figure 11.

The sub-research question, SRQ4 (*To what extent does the utilization of an e-learning system assist students in their study?*) is answered by evaluating the

causal relationship between behavior and e-learning system use outcomes, i.e. the relationships between the second and third box of Figure 11.

The main research question, RQ (*How can e-learning system users' post-adoption usage be determined and what consequences can it have?*) has been answered considering the causal links among the beliefs, emotion/behavior, and e-learning system use outcomes, i.e. among all three boxes of Figure 11.

3   RESEARCH METHODOLOGY

*Nothing has such power to broaden the mind as the ability to investigate system-
atically and truly all that comes under thy observation in life.*

<div align="right">Marcus Aurelius</div>

This chapter discusses the research methodology followed in this research. First,
the three main research paradigms that are followed in IS research as well as the
author's view in positioning this research in these paradigms are discussed. Then
the meta-analysis method is introduced. Following that the web-survey method
used to collect the main empirical data for this research is discussed. Next, the
data collection procedures are presented. Following that a discussion on instru-
ment validation is presented. Finally, the data analysis methods that have been
followed in this research are discussed.

3.1   Research Paradigm

Interpretive and positivist are the two dominant research paradigms in the IS
field (Orlikowski & Baroudi 1991). Positivism has a strong association with the
physical and natural sciences. Ontologically, positivistic research makes the as-
sumption that reality is stable, observable and objective (Hirschheim & Klein
1989). Positivism developed on the basis of the assumption that there are univer-
sal laws that govern social events, and therefore, by discovering these laws, re-
searchers are able to describe, predict and control social phenomena. Epistemo-
logically, positivists prefer the hypothetical deductive approach for the verifica-
tion or falsification of the theories (Chen & Hirschheim 2004). In contrast to pos-
itivism, interpretive research regards reality as socially constructed, instead of
objectively determined (Husserl 1965). It is developed on the basis that research-
ers can better understand people's perceptions about their activities by putting
them in their social contexts (Hussey & Hussey 1997). Interpretive researchers
argue that as reality is socially constructed, scientific inquiry should not assume
hypothetic deductive reasoning but strive for an understanding of human and so-
cial interaction through which a subjective meaning of reality can be constructed
(Walsham 1995). Recently, critical realism has been introduced to IS research
(Mingers 2004). Critical realism accepts the independent existence of structures

and mechanisms, some of which may be non-physical and unobservable, for example ideas and social structures (Mingers 2006). Through their complex interactions, these mechanisms are seen to causally generate those actual events that might occur. Researchers can empirically observe only a subset of this domain of events, as described by Mingers (2006).

Although critical realism has become as one of the most popular research paradigms in recent years, the paradigm war in IS has traditionally been between positivism and interpretivism. Many researchers argue that qualitative data is related to the interpretive paradigm, while quantitative data is characteristic of the natural sciences and positivist paradigm (Sanders 1982; Thompson et al. 1989; Arnold & Fischer 1994). However, this kind of separation of qualitative and quantitative data into different paradigms has been argued as obsolete by Klein & Myers (1999). They argue that qualitative and interpretive are not synonyms. Weber (2004) argues that the meta-theoretical assumptions about these two paradigms are not relevant for their differences, but the real difference is in their data collection methods. They note that positivist researchers prefer experiments or surveys, while interpretive researchers choose ethnographic or case studies. There has been much debate among researchers, as some often favor one paradigm over the other (Orlikowski & Baroudi 1991). Kim (2003) states that both paradigms have merit and limitations. He further argues that these research paradigms are not necessarily incompatible, and that the research context and the subject of the research should be assessed when deciding which approach to apply. Similarly, Benbasat et al. (1987) argued that no strategy is more appropriate than any other for all research purposes.

According to many researchers, these two research paradigms are not separable. Hence, researchers even suggest using pluralist methodology in order to gain richer results (Orlikowski & Baroudi 1991). In this regard, critical realism can be viewed as the bridge between positivism and interpretivism (Smith 2006). Mingers (2004) criticizes the philosophies of both positivism and interpretivism by presenting their limitations and arguing that critical realism has the potential to overcome these limitations. Mingers (2001) argues that it is possible to detach research methods (and perhaps even methodologies) from a paradigm and use them, critically and knowledgably, within a context that makes different assumptions. Furthermore, Lee (1991) also argues that both positivist and interpretive paradigms have advantages, which should be utilized.

This research project began with a literature review, which provided the author with a pre-understanding of the topic area such as the wide variety of factors that are important for predicting user post-adoption satisfaction and continuance intention as well as the possible outcomes of e-learning system usage. From this, the author chose a number of possible factors to include in the overall research model. Then the author conducted seven interviews with open-ended questions to

confirm the factors identified in the literature review as well as identify other possible factors, if any, that are salient to the post-adoption satisfaction and continuance intention of educators. Then a questionnaire containing questions aimed at gauging educators' perceptions of the e-learning system and their experience of using the e-learning system as a teaching aid was developed. A similar questionnaire containing questions regarding students' perceptions about e-learning system usage outcomes was also developed to collect data from students. The questionnaires were mostly quantitative, but did contain qualitative open-ended questions. The quantitative data was analyzed using descriptive and inferential statistics. The qualitative data was analyzed using content analysis to identify different factors and the frequency of each factor was counted. The results were summarized in the several articles included in this dissertation.

In a broad sense, the articles utilized adoption models, such as TAM, IS continuance model, and UTAUT, to build research models to study users' post-adoption behavior. These articles utilized statistical analysis of the survey data to test the validity of the hypothesized models. Developing hypotheses and utilizing descriptive and inferential statistics to test the hypotheses mostly shift these articles into a positivistic research category (Chen & Hirschheim 2004; Mingers 2006; Orlikowski & Baroudi 1991). Hence, according to the author's evaluation, these articles can be classified as belonging within positivistic research.

Positivist research in IS is very common. For example, Mingers (2006) noted the following.

> "....Surveys of the information systems research that is published, especially in N. American-oriented journals, is generally of a positivist nature and, more specially, relies on some form of statistical analysis and modeling....Nearly 50% of empirical research published in the top IS journals employed observation, experiments, surveys of simulations and would thus involve some sort of statistical analysis. When positivistic case study research was included this portion rose to 75% ...."

Despite such dominance, both interpretive and critical research traditions tend to be very critical of positivism, especially when referring to statistical analysis. In IS research, researchers have also criticized the use of TAM or TAM derived theories from these perspectives (Silva 2007). Their main argument against positivism is that the social world is inherently different to the material world, and a human construction cannot be quantified and fully captured in statistical models, like TAM.

Many of the critiques also apply to the articles included in this dissertation. Thus, the author performed a critical evaluation of these articles and summarizes them in this dissertation. According to the author, the discussion on critical eval-

uation is very important when evaluating the articles or the dissertation itself or when interpreting the findings of this research project. The purpose of this is to provide readers a re-constructive criticism from the philosophical viewpoint regarding the work done by the author, as well as by other researchers who utilize statistical modeling and TAM derived models in their research. Such an approach may provide adoption research with fresh insight.

To fulfill the goal, the author has scrutinized the TAM derived models from a philosophical perspective in section 2.5. Second, the author presents a critique of statistical analysis – especially structured equation modeling (SEM), and his reflections on these critiques in section 3.6.1. Third, researchers often need to decide on many important things related to modeling based on ad hoc criteria. Such ad hoc decisions may have a significant impact on the results found in a piece of research. In section 4.5 the author describes these ad hoc decisions and discusses the possible implications of such decisions on the final outcomes of this research.

3.2   Meta-analysis Research Method

Meta-analysis refers to the statistical analysis of a large collection of analysis results from individual studies for the purpose of integrating the findings (Glass 1976). By using meta-analysis, it is possible to discover the "patterns of relatively invariant underlying relations and causalities, the establishment of which will constitute general principles and cumulative knowledge" (Hunter, et al. 1982, p. 26). The advantage of meta-analysis is that it combines all the research on one topic into a single study and provides cumulative knowledge.

Meta-analysis was chosen as the method for analyzing prior studies in order to answer research question SRQ1. As the research question is related to the investigation of the reliability and validity of the IS continuance model in prior IS literature, the meta-analysis would seem to be the most appropriate research method. The following steps have been followed in the meta-analysis.

Step1: Defining the theoretical relationships of interest.
Step2: Collecting the relevant studies that provide data on the relationships.
Step3: Coding the studies and computing the effect sizes.
Step4: Examining the distribution of the effect sizes and analyzing the impact of the moderating variables.
Step5: Interpreting and reporting the results.

Although meta-analysis has been widely employed in research, it is not free from criticism. Some of these criticisms are worth mentioning at this point. It has been regarded as an exercise of mega-silliness by Eysenck (1978). Feinstein

(1995) called meta-analysis statistical alchemy for the 21st century. These critiques share some common concerns that are well summarized and addressed by Borenstein et al. (2009), and are presented in the following:

- One number is used to summarize the research field. One of the most common criticisms of meta-analysis is that it calculates the sum of the effect sizes across many studies, and eventually ignores the fact that the effect may vary from study to study. Borenstein et al. (2009) argues that the objective of meta-analysis is to synthesize the effect sizes rather than report the summary effect sizes. They advised researchers to report both summary effect sizes and possible dispersions to avoid this criticism.

- The file drawer problem invalidates meta-analysis. Meta-analysis is based on the mathematically sound synthesis of the prior studies. However, if the studies included in the meta-analysis are biased, then the overall mean effect reported by the meta-analysis will reflect this bias. Borenstein et al. (2009) argued that this kind of problem also exists in narrative review.

- Mixing apples and oranges. In meta-analysis, researchers combine different kinds of studies in the same analysis. The danger is that accumulating a large set of different studies usually leads to the construct definitions being imprecise. Thus, the results become difficult to interpret meaningfully. This critique can even be viewed as an advantage of meta-analysis in the sense that meta-analysis is able to ask question about fruit for which both apples and oranges contribute valuable information (Borenstein et al. 2009). This implies that meta-analysis is able to produce more generalizable results.

- Garbage in, garbage out. If many low-quality studies are included in the meta-analysis, then the errors of the original studies are also carried over to the meta-analysis. This critique can be avoided by properly setting inclusion criteria for including a certain study in the meta-analysis.

- Important studies are ignored. Another criticism is that important studies might be left out. Again, this critique can be avoided by a systematic literature search and setting appropriate inclusion criteria.

- Meta-analyses are performed poorly. Meta-analysis is so complicated that it is easy to make mistakes. This critique is not related to meta-analysis but its application. If a researcher knows how to conduct a successful meta-analysis, this critique can be avoided.

3.3 Web Survey Research Method

Survey research is one of the most widely used research methods in IS research (Palvia et al. 2003). Following Gable (1994) and Pinsonneault & Kraemer (1993) the characteristics of survey research are summarized in the following.

- Survey research is able to produce quantitative descriptions of some aspects of the study population.
- Survey research collects data by using structured and pre-defined questions.
- Survey research collects data from a fraction of the population in such a way that it is possible to generalize the findings to the whole population.
- The central questions of interest in a survey research are "What is happening?" and "How and why is it happening?" Survey research is especially well-suited for answering questions about what, how much and how many, and to a greater extent than is commonly understood, questions about how and why.
- Survey research is useful when control of the independent and dependent variables is not possible or not desirable.
- In survey research, the phenomena of interest are studied in their natural setting.
- Survey research can be used to investigate a phenomenon that is occurring in current time or has occurred in the recent past.

The choice of methodology depends on the research questions, not on the research philosophy, or paradigm approach preferences (Galliers 1997). The research questions of this dissertation are typical "what" and "how" questions. Hence, survey research is seen as the appropriate research method for this study. By collecting numeric data using a survey questionnaire and analyzing it with statistical methods, it is possible to test the relationships among a set of variables. In addition, prior IS research literature shows that survey research has been one of the most popular research methods for studying individuals' IS usage behavior (Davis 1989; Venkatesh & Davis 2000; Venkatesh et al. 2003).

The word "survey" is a generic term that can be used to describe different data collection procedures. Pinsonneault & Kraemer (1993) note that several data collection and measurement processes, for example, marketing surveys or political polls, can be regarded as surveys. However, these are distinct from survey research. They point out that survey research is conducted to advance scientific knowledge and to validate theory. Survey research can be used when testing a specific model that will be used to study the expected relationships among dependent and independent variables.

Survey research can be used for different purposes: for exploration, for description, and for explanation (Pinsonneault & Kraemer 1993). Explorative sur-

vey research is used to find preliminary concepts and become more familiar with the research topic. The purpose of descriptive survey research is to discover what situations, events, opinions or attitudes are occurring in the population. Finally, explanatory survey research tests theory and causal relationships. In explanatory research the hypotheses are made before the actual testing based on the theory.

According to the author's evaluation, the surveys conducted in this research explore, describe and explain the phenomena of interest. First, it is exploratory because the author included open-ended survey questions in order to get qualitative text responses. These text responses helped the author to become more familiar with the topic of interest. In addition, new factors beyond the measured constructs also emerged from the text responses. Second, the conducted surveys can also be regarded as descriptive. For example, demographic information on the sample population and descriptive statistics of the measured constructs are presented in this dissertation. This helps discover what situations, perceptions, attitudes or opinions are occurring in the population. Finally, the proposed research models and hypotheses of this research were developed using well-established theories and prior empirical research findings in the IS domain. The theoretical frameworks of this research are the IS continuance model, TAM, and UTAUT. The relationships between the constructs of these frameworks have been tested in prior studies. In addition to testing the causal relationships between the variables, discussions about why the relationships exist are also offered in this dissertation. Hence, this research is explanatory too.

The author considered collecting the postal addresses of the individuals who use the e-learning system and sending out a paper-based survey questionnaire as a possible way to collect survey responses. However, there was an opportunity to implement a web-based survey using Webropol[17], as UTU had purchased this service for its staff. In addition, the target user group was Internet based e-learning system users and therefore it was assumed that they frequently use Internet services and read emails. It was easy to collect the email addresses of the targeted e-learning system users from the IT support team. This led the author to choose a web-based survey alternative. There are several advantages of web-based survey that further drove the author to choose it. The advantages include the following (Llieva et al. 2002; Wright 2005):

- The web-survey approach is regarded as rapid. Sending and receiving a paper based survey questionnaire to a large number of respondents requires a huge amount of time.
- It is also considered to be cheaper than the paper based approach.
- A web-based questionnaire is easy to answer. Most of the time, it only needs simple mouse clicks.

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[17] http://w3.webropol.com/

- In the web-based survey, data is directly stored in a database. Thus, it does not require manual entry and therefore ensures error free data.

The survey research method has several limitations, which need to be considered when evaluating this research. Kraemer & Dutton (1991) argue that survey research is unable to yield cumulative knowledge, is atheoretical, and is ill-suited to addressing the subtleties of IT in complex settings. Järveläinen (2004) in her dissertation also listed several deficiencies of the survey research method. These are as follows.

- It ignores social influence on the measured variables.
- It puts equal value on each opinion.
- Responses come from only one place and time in a cross-sectional study.
- It is functional only in the cultural frame of reference of the researcher.
- It ignores the possibility for other response alternatives.

3.4   Data Collection Procedures

To answer the research questions SRQ2, SRQ3, and SRQ4, two separate surveys: one among educators and one among students were conducted. Sub-section 3.4.1 describes the survey design and data collection procedures used for educators, while sub-section 3.4.2 describes the survey design and data collection procedures used for students. All items corresponding to the constructs in both surveys have been measured using a seven-point Likert scale, with answer choices ranging from "Strongly disagree (1)" to "Strongly agree (7)".

In both surveys, the final questionnaire comprises three parts: a motivation letter, questions regarding the demographic information of the respondents, and questions regarding the constructs included in the research models and open-ended questions. The motivation letter encourages and motivates the respondents to participate in the survey. Following this, respondents are requested to answer the questions regarding their demographic information such as age, gender, and faculty. The respondents are also asked to report information about their Moodle usage, such as experience, what functionalities they have used, and for how many courses they use Moodle during that particular academic period. This information can then be utilized to determine whether a respondent is an existing user or a new user of Moodle. Finally, the respondents are asked to answer questions regarding the constructs. Plus, to gain richer data that goes beyond the operationalized constructs, several open-ended questions were also added.

3.4.1 Collecting Data from Educators

A questionnaire was designed in order to collect quantitative data from the educators. Using validated constructs from the relevant literature has become very common since it is strongly encouraged in the field of IS (Boudreau et al. 2001). Following this, most of the items for the constructs are adapted from the relevant literature, with only minor changes in wording in order to reflect the target technology. The measured constructs and their references are shown in Table 9.

Table 9   Measured constructs among educators

Variables	References
Confirmation, Perceived usefulness, and Continuance intention	Bhattacherjee 2001a; Limayem et al. 2007
Satisfaction	Liao et al. 2007
Perceived ease of use	Venkatesh & Davis 2000
Perceived access	Lee et al. 2009
Perceived reliability and Perceived integration	Wixom & Todd 2005
Perceived compatibility and Perceived result demonstrability	Moore & Benbasat 1991
Social influence and Perceived support	Venkatesh et al. 2003
Perceived behavioral control	Taylor & Todd 1995

After the questionnaire was drafted, it was first sent to two academic researchers for their review and revised according to their comments and suggestions to make the wording of the items more precise. Then, the questionnaire was sent to 30 educators at the university, so that they could review it. Overall, the educators indicated that the questionnaire was relatively clear and easy to complete. A number of suggestions were made concerning the wording of several items and the overall structure of the questionnaire. The questionnaire was revised according to the given suggestions. The pilot study helped ensure that the final questionnaire would be well understood by the respondents. The constructs in the questionnaire and their descriptions are presented Table 10.

Table 10   Operationalization of the variables

Construct	Description
Perceived usefulness	The educators were asked whether using the e-learning system was a benefit for them in their teaching tasks
Confirmation	The educators were asked whether actual usage of the e-learning system fulfilled their prior expectations
Satisfaction	The educators were asked to indicate their overall satisfaction, pleasure, and level of contentment with the e-learning system
Perceived access	Access was measured using items related to the responsiveness, accessibility, stability, and availability of the e-learning system
Perceived integration	Integration contained items asking if the e-learning system provides the facility to integrate information from various course pages into a new course page
Continuance intention	The educators were asked whether they intend to continue their e-learning system utilization in the future
Perceived ease of use	Ease of use was measured by asking if the e-leaning system was easy to use and whether interacting with the e-learning system took a lot of mental effort
Perceived compatibility	Compatibility contained items that asked if the e-learning system was compatible and fitted with the educators' teaching tasks
Perceived result demonstrability	The educators were asked if the consequences of using the e-learning system was apparent to them and if they could communicate and explain the consequences to others
Perceived support	The educators were asked to indicate whether they had received assistance from the support team or from an instruction manual when they had difficulties with the e-learning system

   The sample was the faculty educators of the University of Turku who had experience of using Moodle for conducting their teaching. In order to identify the educators with Moodle usage experience, a list of the educators' email addresses was collected from the Moodle support team at the university.

   A total of 1012 email invitations were sent to the educators, who were registered Moodle users at the university in August, 2010. Two reminders were sent to increase the response rate after gaps of two weeks. The survey ran for approximately one and half months. After filtering invalid and incomplete responses a total of 207 survey responses (approximately a 20.5% response rate) were received. The demographic information of the collected sample is shown in Table 11.

Table 11   Educators' demographic information

		Frequency	Percentage
Gender	Male	86	41.5
	Female	116	56.0
	Missing	5	2.4
Age	21–30 years	29	14.0
	31–40 years	74	35.7
	41–50 years	65	31.4
	51–60 years	26	12.6
	>61 years	5	2.4
	Missing	8	3.9
Experience with the target system	< 6 months	19	9.2
	>6 months – 1 year	24	11.6
	>1 year – 1 year 6 months	17	8.2
	>1 year 6 months – 2 years	30	14.5
	>2 years – 2 years 6 months	29	14.0
	>2 years 6 months – 3 years	28	13.5
	>3 years	56	27.1
	Missing	4	1.9
Number of courses conducted during the particular academic period	0	28	13.5
	1	50	24.2
	2	40	19.3
	3	28	13.5
	4	22	10.6
	5	17	8.2
	6	4	1.9
	7	4	1.9
	8	4	1.9
	9	6	2.9
	Missing	4	1.9

The response rate is low in the study. However, two points are important to note. Firstly, it should be noted that many of the registered Moodle users were from special units (for example the Open University) of the university. Such users use Moodle for project management purposes. It was not possible to distinguish between educators and personnel from the special units in the registered Moodle user database. Secondly, many faculty educators are registered as Moodle users but do not use it. This is because such educators are busy with other tasks and ask their assistants to do their Moodle related tasks. It was also difficult to filter out such users. Based on this, the response rate is acceptable, according to the author's evaluation.

The functionalities of Moodle that are used by the respondents are shown in Figure 12.
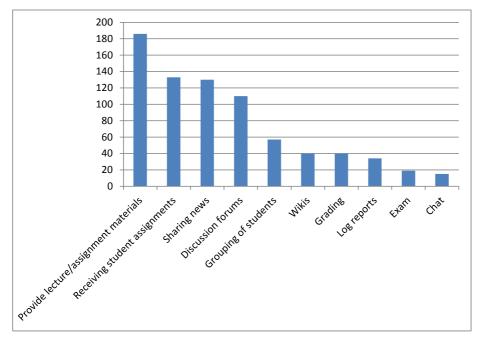
Figure 12   The functionalities of Moodle used by the educators' sample

As the author is particularly interested in investigating continuous IS usage behavior, only those respondents who had conducted at least one course using Moodle during that academic period are included in the data analysis. After filtering the survey responses according to this criterion, the author ended up with 175 usable responses.

3.4.2   Collecting Data from Students

Similarly, another questionnaire was designed in order to collect quantitative data from the students. Again, most of the items for the constructs are adapted from the literature, with some minor changes in the wording to reflect the target technology. The measured constructs and their references are shown in Table 12.

Table 12   Measured constructs among students

Variables	*References*
Perceived usefulness	Limayem et al. 2007
Perceived ease of use	Venkatesh & Davis 2000
E-learning system use	Sun et al. 2009
Perceived learning assistance	Liaw 2008
Perceived academic performance	Lee & Lee 2008

After the questionnaire was drafted, it was first sent to two academic researchers for their review and revised according to their comments and suggestions to make the wording of the items more precise. Then, the questionnaire was sent to 10 students at the university, so that they could review it. Overall, the students indicated that the questionnaire was relatively clear and easy to complete. Thus, no more changes were made to the questionnaire. The constructs in the questionnaire are presented in Table 13.

Table 13   Operationalization of the variables

Construct	*Description*
Perceived usefulness	The students were asked whether using the e-learning system was a benefit for them in their studies
E-learning system use	The students were asked if they used the e-learning system frequently and heavily in their studies
Perceived ease of use	Perceived ease of use was measured by asking if the e-leaning system was easy to use and whether interacting with the e-learning system took a lot of mental effort
Perceived learning assistance	The students were asked if the e-learning system assisted them in their study in terms of flexibility, motivation, efficiency, and performance
Perceived academic performance	The students were asked to indicate if they received higher grades in courses where the e-learning system was used

The sample was the students of the University of Turku who had experience in using Moodle in their studies. In order to identify the students with Moodle usage experience, a list of the students' email addresses was collected from the Moodle support team at the university.

A total of 1100 email invitations were sent to the randomly selected students at the university who were registered Moodle users in May, 2011. One reminder was sent after a gap of one week to increase the response rate. The survey ran for approximately two weeks. After filtering invalid and incomplete responses a total

of 263 (23.9% response rate) survey responses were received. The demographic information of the respondents is shown in Table 14.

Table 14   Students' demographic information

		Frequency	Percentage
Gender	Male	110	41.8
	Female	148	56.3
	Missing	5	1.9
Age	less than 21 years	30	11.4
	21-30 years	166	63.1
	31-40 years	30	11.4
	>41 years	28	10.6
	Missing	7	2.7
Experience with the target system	< 6 months	19	7.2
	>6 months – 1 year	63	24.0
	>1 year – 1 year 6 months	13	4.9
	>1 year 6 months – 2 years	47	17.9
	>2 years – 2 years 6 months	14	5.3
	>2 years 6 months – 3 years	27	10.3
	>3 years	71	27.0
	Missing	9	3.4
Number of courses attended during the particular academic period	0	13	4.9
	1	40	15.2
	2	55	20.9
	3	65	24.7
	4	45	17.1
	5	28	10.6
	6	11	4.2
	7	3	1.1
	8	1	0.4
	9	1	0.4
	Missing	1	0.4

The functionalities of Moodle that are used by the respondents are shown in Figure 13.
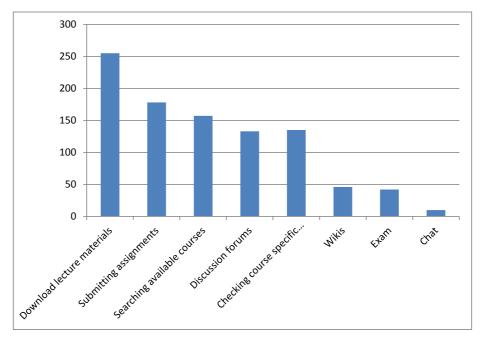
Figure 13   The functionalities of Moodle used by the students' sample

As the author is particularly interested in investigating e-learning system usage outcomes, only those respondents who had attended at least one course using Moodle during that academic period are included in the data analysis. After filtering the survey responses according to this criterion, the author ended up with 249 usable responses.

3.5 Instrument Validation

Instrument validation is necessary to ensure that the instrument used for data collection accurately measures what it is supposed to measure. If research data is gathered using instruments that lack solid validation, the very scientific basis of the research is threatened (Straub 1989; Straub et al. 2004). Thus, it is very important to ensure instrument validity for maintaining rigorousness in IS research. The guidelines recommended by Straub (1989), Gefen et al. (2000), Boudreau et al. (2001), Starub et al. (2004), and Lewis et al. (2005) have been followed in order to validate the survey instrument used in this research.

Content validity refers to the degree to which items in an instrument reflect the content to which the instrument should be generalized (Cronbach 1971). Content validity is desirable in instruments for ensuring that constructs are drawn from the theoretical essence of what they propose to measure (Straub et al. 2004). There are different recommendations for ensuring content validity. According to

Straub (1989), content validity can be ensured via literature reviews and expert judges or an expert panel. The constructs included in this research have been derived from the literature review in the IS discipline. In addition, as described in sub-section 3.4.1 and 3.4.2, pilot testing of the instruments was conducted. Thus, according to the author's evaluation it ensures sufficient content validity.

Construct validity is based on how the items move together in such a way that they can be considered one construct (Boudreau et al. 2001). It focuses on whether the selected items work together and whether they can be considered as an intellectual whole to reflect the essence of the represented construct, but not the substance of the items (Straub 1989). Convergent and discriminant validations are done to ensure construct validity.

Convergent validity is the degree to which the measurement used to reflect constructs that are assumed to be theoretically associated are also related in reality. It can be assessed by inspecting the factor loadings of the items on the respective constructs (Chin 1998a), the composite reliabilities (CR) of the constructs, and the average variance extracted (AVE) of the constructs. Fornell & Larcker (1981) suggested using the following thresholds to ensure convergent validity.

- All the items' factor loadings should be significant and exceed 0.7.
- Construct reliabilities should be at least 0.8.
- AVE should exceed 0.5.

The factor loadings, CRs, and AVEs for all the constructs of the educators' data are included in Table 15. This shows that the calculated loadings, CRs and AVEs comply with the recommendations made by Fornell & Larcker (1981).

Table 15   Quality indicators of educators' sample

Construct	Item	Loading	t-stat
Continuance intention (Composite Reliability = 0.90; AVE = 0.76)	INT-1	0.91	39.52
	INT-2	0.87	25.14
	INT-3	0.81	11.89
Satisfaction (Composite Reliability = 0.94; AVE = 0.81)	SAT-1	0.89	47.53
	SAT-2	0.93	83.17
	SAT-3	0.86	25.08
	SAT-4	0.91	56.42
Perceived usefulness (Composite Reliability = 0.91; AVE = 0.72)	PU-1	0.84	27.91
	PU-2	0.78	11.07
	PU-3	0.85	15.41
	PU-4	0.86	19.96
	PU-5	0.80	12.99
Confirmation (Composite Reliability = 0.91; AVE = 0.76)	CON-1	0.90	54.26
	CON-2	0.90	46.93
	CON-3	0.82	22.96
Perceived integration (Composite Reliability = 0.90; AVE = 0.81)	INTGR-1	0.91	59.42
	INTGR-2	0.90	46.78
Perceived reliability (Composite Reliability = 0.95; AVE = 0.91)	REL-1	0.95	100.9
	REL-2	0.96	161.9
Perceived ease of use (Composite Reliability = 0.93; AVE = 0.76)	PEOU-1	0.87	41.06
	PEOU-2	0.78	18.80
	PEOU-3	0.94	133.6
	PEOU-4	0.90	50.53
Perceived access (Composite Reliability = 0.86; AVE = 0.77)	ACCESS-1	0.88	31.69
	ACCESS-2	0.88	28.19
Perceived result demonstrability (Composite Reliability = 0.88; AVE = 0.71)	RD-1	0.83	17.80
	RD-2	0.85	35.93
	RD-3	0.84	18.23
Perceived compatibility (Composite Reliability = 0.91; AVE = 0.77)	COMP-1	0.92	38.76
	COMP-2	0.89	47.43
	COMP-3	0.83	27.95
Perceived support (Composite Reliability = 0.93; AVE = 0.86)	SUP-1	0.91	25.25
	SUP-2	0.95	60.80
Perceived behavioral control (Composite Reliability = 0.90; AVE = 0.71)	PBC-1	0.84	22.62
	PBC-2	0.84	23.85
	PBC-3	0.85	17.93
	PBC-4	0.80	13.23
Social influence (Composite Reliability = 0.83; AVE = 0.62)	SI-1	0.83	13.47
	SI-2	0.84	12.83
	SI-3	0.68	5.37

Similarly, factor loadings, CRs and AVEs for all constructs of the students' data are included in Table 16. Again the table shows that the calculated loadings,

CRs and AVEs comply with the recommendations made by Fornell & Larcker (1981).

Table 16   Quality indicators of students' sample

Construct	Item	Loading	t-stat
Perceived usefulness (Composite Reliability = 0.91; AVE = 0.76)	PU-1	0.87	16.38
	PU-2	0.91	33.99
	PU-3	0.84	16.50
Perceived ease of use (Composite Reliability = 0.93; AVE = 0.77)	PEOU-1	0.86	21.04
	PEOU-2	0.87	20.85
	PEOU-3	0.90	25.34
	PEOU-4	0.88	21.51
Perceived learning assistance (Composite Reliability = 0.93; AVE = 0.76)	PLA-1	0.81	18.38
	PLA-2	0.93	11.71
	PLA-3	0.92	40.63
	PLA-4	0.83	49.52
Perceived academic performance (Composite Reliability = 0.91; AVE = 0.83)	PAP-1	0.91	38.82
	PAP-2	0.91	31.05
E-learning system use (Composite Reliability = 0.96; AVE = 0.92)	USE-1	0.96	86.20
	USE-2	0.96	94.87

Overall, the results of Table 15 and Table 16 suggest that the survey instruments have acceptable internal consistencies and reliabilities, supporting sufficient convergent validity.

The test of discriminant validity is related to checking whether the items measure the construct in question or other (related) constructs. In this research, discriminant validity was verified with both correlation analysis and factor analysis as recommended by Gefen & Straub (2005). First, the inspection of discriminant validity among the variables is based on the correlation between the variables and the square root of their respective average variance extracted (Fornell & Larcker 1981). In the research papers (Papers 2, 4, 5, and 6), the square root of average variance extracted value for the variables is consistently greater than the off-diagonal correlation values, suggesting satisfactory discriminant validity among the variables. Second, all items have cross loading coefficients lower than the factor loading on their respective assigned latent variable, suggesting that discriminant validity on the item level is met for all the constructs in all the articles. For further details, the readers are requested to see individual articles included in the second part of this dissertation.

3.6   Data Analysis Methods

3.6.1   *Structured Equation Modeling*

In the four research papers included in this dissertation (Papers 2, 4, 5, and 6), structure equation modeling (SEM) has been used to evaluate the research models and hypotheses. Compared with the regression-based approach, which analyzes only one layer of linkages between dependent and independent variables at the same time, SEM, as a second generation statistical technique, allows the simultaneous modeling of relationships among multiple independent and dependent variables (Gefen et al. 2000). The first generation statistical techniques are not able to model random error and systematic error (Churchill 1979). Thus SEM has received widespread popularity among IS researchers. Gefen et al. (2000) argue that SEM enables researchers to answer a set of research questions in a single, systematic, rigorous, and comprehensive analysis. They further argue that SEM assesses the structural model (the assumed causation among a set of dependent and independent variables), and measurement model (loadings of the observed items on their expected latent variables) in the same analysis. These benefits led the author to use SEM in this research. However, there are several critiques of the use of SEM in a scientific inquiry. In the following these critiques as well as the author's reflection on how this research avoided or addressed these critiques are discussed.

First, regression in an SEM model depends on the association between variables. According to Mingers (2006), such associations can hold for the following different reasons:

- A genuine causal relationship exists.
- It could stem from a mutual relationship with a third underlying variable.
- The causal relationship could be in the opposite direction.
- It might be a coincidence.

In this regard, when a researcher finds a causal relationship between two variables, he or she cannot be sure whether the relationship actually holds or not. To clarify this, Mingers (2006) provided the following examples.

> "*One can certainly imagine developing an appropriately specified regression model of the relationship between barometric pressure and rainfall or indeed the cockerel crowing and the sunrise but in neither case does the first cause the second even though they are strongly associated*"

Pearson, one of the founders of modern statistics denied the notion of causation (Mingers 2006). Following these, it can be well-argued as to whether the found causal relationships in an SEM model are true or not. Could a particular causal relationship stem from a mutual relationship with a third underlying variable, or could it be in opposite direction, or could it be a coincidence. In this research the hypotheses are developed using solid theoretical base from prior studies as well as strong argumentation has been offered behind each hypothesis. Thus, according to the author's critical evaluation the relationships found in this research have the potential to avoid this critique.

Second, while testing a research model using statistical analysis, major assumptions are made about closure. Closure can be of two types as described by Mingers (2006): extrinsic closure and intrinsic closure. Extrinsic closure is related to the assumption that the factors not included in the developed research model will not change, or will not have important effects on the overall model if they do. In practice, there would be huge number of variables in a social system. But only some of them are measured and taken into analysis. There is no way to control the unmeasured variables in the model to be tested. These might have significant effects on the phenomena being studied (Liu 1960). In fact, any research model a researcher develops is an abstraction of reality. A good model abstracts in a useful way while a poor model does not. If the model ignores some genuinely important factors, its predictions can be contradicted — at least when an ignored factor exerts an important influence on the outcome. It can be described with an example. When a researcher has a hypothesis to be tested, he also needs to include auxiliary hypotheses, covering things like the conditions in which the test was carried out, the features which were to remain unchanged during the test, and many more. The number of such auxiliary hypotheses can be infinite in a social system. In the end, the researcher ends up with a hypothetical syllogism where the antecedent consists of many conditions. Let's denote the original hypothesis by H, auxiliary hypotheses by A1, A2, A3, … An, and consequence by P. Now, the syllogism goes like the following.

1. *If (H and A1, A2, . . ., An) is true, then P is true;*
2. *P is not true . . .;*
3. *So, the conclusion is (H and A1, A2, . . ., An) is not true.*

From this, the researcher concludes that the compound antecedent is not true. However he might be wrong. It is because the falsity of the compound antecedent may possibly come from the falsity of any of the auxiliary hypotheses, even if the original hypothesis, H, was actually true. In other words, the researcher is never able to test a hypothesis using statistical analysis in isolation. It is always tested with its accompanying auxiliary hypotheses. For this research the author devel-

oped the preliminary research models based on a literature review. Then he confirmed the constructs and identified other possible important factors from the interview data analysis. This ensured that no important factors were omitted in the research models.

Intrinsic closure is related to the assumptions about the properties of the measured data. For example the most common assumption that is typically made in an SEM model is that the explanatory variables are all normally distributed and independent from each other. In general, the data rarely conforms to the statistical assumptions underlying the methods (Mingers 2006). In this research, the author used partial least squares based SEM, which is said to perform well, even for non-normal data (Thomas 2005).

Third, researchers must depend on a significance test to conclude whether to accept or reject a hypothesis. However, nothing is ever absolutely certain. In support of this, Popper's (1972) example can be raised. A theory of "all swans are white," can be formed by an observer who repeatedly sees white swans. According to Popper (1972), no matter how many white swans an observer reports, these observations would not confirm the theory as being true. Following this, we may assume that some of the things which we now think are true may turn out to be false, and some of the things which we currently think are false may turn out to be true. This means that the researcher can never be certain of his hypotheses, yet he can assess the balance of available evidence. The data analysis may reveal some hypotheses to be true while some may turn out to be false. However, practical decisions to accept or reject hypotheses are often regarded as tentative. Researchers expect that they make the correct decision in accepting or rejecting a hypothesis. However, there is a high possibility that they may make two kinds of errors: they can reject a hypothesis that is true, and they can accept a hypothesis that is false.

The possibility of making an error cannot be eliminated when testing a theory against observations although it can be controlled. In statistics, the method of control is to decide in advance how large a risk to take in accepting a hypothesis. It has become a common practice to accept/reject a hypothesis based on the significance level of 5% or 1%. The tendency is that if researchers have a value of 4.9%, they are happy that their hypothesis is supported by the data and publish it. However, if the value is 5.1%, researchers assume that their hypothesis is not supported by the data, and often may decide not to publish it.

Researchers argue that only those variables are important for managerial implications that are found to have significant impact on the dependent variable. However, the problem is that there are many assumptions that an SEM test rests on, and the data that has been measured may not fully meet these assumptions in practice; even the researcher may not know whether they are met or not. The best the researcher can do is to test the data using other significant tests. Thus, a re-

searcher cannot really decide whether the significant/non-significant results he gets from an SEM model are real or result from the inaccuracy of the data. Thus, deciding which variables are important and which are not by basing the decision on a significance test might be incorrect. On this issue, Lipsey & Courant (1996) note the following.

> "*When action must be taken, some rule of thumb is necessary, but it is important to understand, first, that no one can never be certain about being right in rejecting any hypothesis and, second, that there is nothing magical about arbitrary cutoff points. Some cutoff point must be used whenever decisions have to be made.*"

> "*....the rejection of a hypothesis is seldom the end of inquiry. Decisions can be reversed if new evidence comes to light....*"

In addition, Lakatos (1970), referring to Lykken (1968), warns researchers against concentrating on statistical significance testing in order to claim scientific contributions.

> "*Statistical significance in psychology is perhaps the least important attribute of a good research experiment; it is never a sufficient condition for claiming that a theory has be usefully corroborated, that a meaningful empirical fact has been established, or that an experimental report ought to be published*"

In this investigation the author reported both significant and non-significant relationships in his research articles. He explained the reason behind the found significant/non-significant relationships by finding supporting evidence from prior studies as well as evidence from the study's context. In addition, when the author observed a certain variable as non-significant (or very weak) in determining the dependent variable, he further tested whether other important variables mediate the effect or not. Finally, he has called for further research to test the relationships that were at borderline of significance test. Overall, the author did not depend exclusively on significance testing to conclude whether a relationship existed or not.

3.6.2   Covariance-based SEM vs. Variance-based SEM

In general there are two approaches with which to estimate the parameters of an SEM model, namely the covariance-based approach and the variance-based (or

component based) approach. According to Chin & Newsted (1999), covariance-based SEM minimizes the difference between the sample covariance and that predicted by the theoretical model. It has received tremendous popularity among social science researchers during the last few decades and, thus it has become synonymous with SEM (Chin 1998b). There are several tools available for covariance-based SEM analysis such as EQS, AMOS, SEPATH, COSAN, LISREL, etc.

The other side of the coin, the variance-based SEM using the Partial Least Squares (PLS) approach has become popular among IS researchers. Gefen et al. (2000) conducted a review among the research studies from three high ranked IS journals between 1994 and 1997, and found that 171 articles used some sort of data analysis. Among these 171 articles, 31 used SEM. Out of these 31 articles, 12 used PLS, 12 used covariance-based SEM, and the remaining 7 used other techniques.

PLS, first introduced by Wold (1975) under the name NIPALS (nonlinear iterative partial least squares) that focuses on maximizing the variance of dependent variables explained by the independent variables, instead of reproducing the empirical covariance matrix. In this research, the author has used variance-based SEM using PLS. In the following, details of PLS as an analysis technique as well as the reasons for choosing PLS for this research are discussed.

Like any SEM, a PLS model consists of a structural part reflecting the relationships between the latent variables, and a measurement part reflecting how the latent variables and their indicators are related. PLS has the advantage that it does not need assumptions about the population or scale of measurement (Fornell & Bookstein 1982). Hence, it has been argued that PLS works without distributional assumptions and with nominal, ordinal, and interval scaled variables (Thomas 2005). In addition, by using Monte Carlo simulation Cassel et al. (1999) showed that PLS is very robust in coping with the inadequacies of data and models, such as skewness, the multi-collinearity of the indicators, and the misspecification of the structural model. In addition they found that latent variable scores always conform to true values in a PLS analysis.

PLS is usually preferred to any other SEM when the constructs are measured with formative measures and the sample size is small (Thomas 2005). PLS has enjoyed increasing popularity in IS research for its ability to model latent constructs under the condition of non-normality (Chin 1998a). The variables collected in the surveys were non-normal, leading the author to prefer PLS instead of the covariance-based SEM. Additionally, the sample sizes of the surveys were small to use covariance-based SEM. For example, Marsh et al. (1998) recommend a minimum sample size of 200 for covariance-based SEM analysis. On the other hand, a rule of thumb for the required sample size in PLS is that the sample size should be at least ten times the most complicated multiple regression in the

model (Barclay et al. 1995). The sample size meets the minimum sample size requirement for each research model in the research articles. Thus, PLS is the right technique for conducting the analysis. The author has used the smartPLS tool (Ringle et al. 2005) to test the research models.

As discussed earlier, PLS is assumed to have some practical advantages over covariance-based SEM which led the author to choose the PLS model. However, critics point out that such advantages are vague. Hence, the author mentions two important criticisms in this dissertation and urges readers to be careful while interpreting the findings.

First, PLS is often chosen with the claim that the variables in the collected data are non-normal. It is true that PLS does not need normal variables, however, it is not entirely true that covariance-based SEM does need normal variables. There are ways to deal with non-normal variables in covariance-based SEM as discussed by Thomas (2005). Second, it is true that PLS works with small sample sizes but one must interpret the results carefully. Small sample sizes lead to large parameter standard errors, thus reducing the quality of the estimates.

4   EMPIRICAL STUDIES AND FINDINGS

In science, 'fact' can only mean 'confirmed to such a degree that it would be perverse to withhold provisional assent.' I suppose that apples might start to rise tomorrow, but the possibility does not merit equal time in physics classrooms.

Stephen Jay Gould

This chapter summarizes each article included in this dissertation, answers each research sub-question and discusses their links to the main research question. Finally, a critical evaluation of these articles is offered.

4.1   Consistency of the IS continuance Model

This section answers the research sub-question, SRQ1 (*To what extent have the relationships of the IS continuance model been empirically proven to be consistent in prior studies?*)

To test the consistency of the IS continuance model, a meta-analysis was conducted based on existing IS continuance literature. As described in the literature review, the IS continuance model has been the dominant framework for investigating users' post-adoption behavior. Eventually it was viewed as one of the main theoretical frameworks for investigating educators' post-adoption behavior in this research. However, the author observed two areas where the prior literature offers mixed or inconclusive empirical evidence.

First, there is flux regarding the correlations between the key constructs of the IS continuance model. Some studies have reported high correlations (e.g., Limayem & Cheung 2008; Lin et al. 2005; Sorebo et al. 2009), while others have found the correlations to be either low or negative (e.g., Hong et al. 2006; Lee 2010; Recker 2010). Second, Bhattacherjee (2001a) did not include perceived ease of use in his original model whilst subsequent studies (e.g., Tao et al. 2009; Thong et al. 2006; Lee 2010) found significant relationships between perceived ease of use and the constructs of the original IS continuance model.

As a result, research examining the extent to which the main relationships of the IS continuance model have been empirically proved to be consistent, and whether incorporating perceived ease of use is a meaningful addition to the original model, were seen as important first steps in this research.

One potential reason for the somewhat mixed results obtained in prior litera-
ture may relate to the moderating effects caused by the sample characteristics.
Hence, an analysis of the prior IS continuance literature to examine the effect of
one contingent factor (the geographical area where the data were collected) and
one individual related factor (students compared with non-students) was con-
ducted.

First, as IS continuance studies have been conducted in several geographical
areas such as Hong Kong, Norway, South Korea, Taiwan, Ukraine, and USA, the
author investigated whether the results vary across different geographical areas.
Second, the use of student samples in empirical studies has been much debated in
the literature (Oakes 1972; Schultz 1969). Prior literature has found stronger rela-
tionships among TAM constructs in studies that use student samples (Schepers &
Wetzels 2007). Thus, the author investigated whether IS continuance varies
across students and non-students samples.

Table 17 shows the meta-analysis results.

Table 17   Meta-analysis results

Correla-tion	Total N	k	Mean	S.D	95% confidence interval		Failsafe value to reduce the mean effect size to 0.1	Decision
					Lower limit	Upper limit		
CON-PU	7712	22	0.48	0.20	0.40	0.56	84	Sig.
CON-SAT	7712	22	0.57	0.30	0.44	0.70	103	Sig.
PU-SAT	7712	22	0.45	0.29	0.33	0.57	77	Sig.
PU-INT	7351	20	0.67	0.12	0.62	0.72	114	Sig.
SAT-INT	7351	20	0.57	0.12	0.52	0.62	94	Sig.
CON-PEOU	5273	10	0.48	0.21	0.35	0.61	38	Sig.
PEOU-PU	5273	10	0.49	0.33	0.29	0.69	39	Sig.
PEOU-SAT	5273	10	0.50	0.24	0.35	0.65	40	Sig.

Note: Confirmation (CON), Perceived Usefulness (PU), Perceived Ease of Use (PEOU), Satis-
faction (SAT), Continuance Intention (INT)

Cohen & Cohen (1983) established the following criteria to judge the magnitude of the effect sizes.

- The correlation is strong if it is above 0.5.
- The correlation is moderate if it is above 0.3 but less than 0.5.
- The correlation is weak if it is above 0.1 but less than 0.3.

As can be seen from Table 17, the relationships are moderate to strong. The 95% confidence interval reveals that there is no interval containing zero. It suggests that all the relationships are significant. The Fail-Safe value ensures the robustness of the findings. A rule of thumb is that the Fail-Safe value should be at least twice the number of the studies (k) in the meta-analysis. All of the correlations had a ratio of Fail-Safe value to the number of studies that was greater than 2.0. Thus, all the correlations of the original IS continuance model were significant. This indicates that the IS continuance model is fundamentally a robust theoretical tool. In addition, the correlations between perceived ease of use and the other constructs were also significant.

The author further investigated the presence of moderators that could explain the flux regarding the correlations between the key constructs of the original IS continuance model. The moderator analysis results are shown in Table 18.

Table 18   Moderator analysis

Correla-	Type of culture		Type of respondent	
tion	Non-western	Western	Student	Non-student
CON-PU	0.52*	0.61*	0.62*	0.31*
CON-SAT	0.62*	0.71*	0.63*	0.38*
PU-SAT	0.39*	0.60*	0.55*	0.68*
PU-INT	0.69	0.65	0.65*	0.50*
SAT-INT	0.56*	0.72*	0.63*	0.38*

*: Differences are significant in 0.05 level

Note: Confirmation (CON), Perceived Usefulness (PU), Satisfaction (SAT), Continuance Intention (INT)

As can be seen from Table 18, in distinguishing between the studies that have been conducted in two geographical areas (Western and non-Western), it was found that the effect sizes for Western studies were higher in general. The difference was significant for confirmation-perceived usefulness, confirmation-satisfaction, perceived usefulness-satisfaction, and satisfaction-intention relationships. The only relationship that was not moderated by geographical area was perceived usefulness-intention. The interpretation of this finding is that respondents from both geographical areas put almost equal importance on perceived usefulness when deciding to use an IS. Again, distinguishing between students and

non-students demonstrates the difference was significant for all relationships. The correlation coefficients of student samples were greater than that of non-student samples for all the relationships except the relationship between perceived usefulness and satisfaction. A possible interpretation of this finding is that students perceive satisfaction as being determined by other factors, such as the intrinsic dimensions of an IS.

Based on above discussions, the explicit answer to the research sub-question, SRQ1 can be put forward as follows:

All the correlations of the original IS continuance model are significant. The strength of the correlations is moderate to strong. The flux regarding the correlations was due to the research settings, especially the geographical areas where the research was conducted and the type of respondents. Overall, the IS continuance model was found to be a robust theoretical tool for explaining and predicting IS continuance intention.

The findings of the analysis regarding SRQ1 make an important contribution to the main research question, RQ (*How can e-learning system users' post-adoption usage be determined and what consequences can it have?*). The findings suggest that IS continuance is an important post-adoption behavior that can be determined by the IS continuance intention. In order to investigate the IS continuance intention, the IS continuance model can be used. Perceived ease of use retains its importance during the post-adoption stage too. Due to the fact that IS continuance intention is determined by satisfaction according to the IS continuance model, it becomes necessary to investigate the determinants of satisfaction. The following section investigates the determinants of educators' satisfaction.

4.2   Investigating Educators' Post-adoption Satisfaction

This section answers the research sub-question, SRQ2 (*How can educators' satisfaction with an e-learning system in the post-adoption stage be determined?*)

To investigate educators' post-adoption satisfaction, evidence from both quantitative and qualitative data was used. To perform a quantitative analysis to understand educators' post-adoption satisfaction, a research model based on the overall conceptual framework was developed. In practice, the author developed a research model where he hypothesized several post-adoption beliefs along with confirmation of the initial expectations influence educators' post-adoption satisfaction. The IS continuance model puts forward the hypothesis that confirmation and post-adoption beliefs are the primary determinants of satisfaction. In this re-

gard, the developed research model is theoretically supported by the IS continuance model.
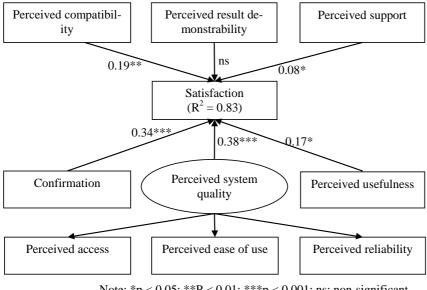
In the developed research model regarding educators' post-adoption satisfaction, it is hypothesized that confirmation of initial expectations, perceived system quality (comprising perceived access, perceived ease of use, and perceived reliability), perceived usefulness, perceived compatibility, perceived result demonstrability, and perceived support are the determinants of educators' post-adoption satisfaction. Most of the variables' definitions were presented in chapter 3. The other variables are conceptualized as in Table 19.

Table 19   The operationalization of variables in the research model

Factor	Definition
Perceived access	The degree of accessibility, responsiveness, and availability of the e-learning systems (Lee et al. 2009a)
Perceived reliability	The degree of the dependability of the e-learning system's operation (Wixom & Todd 2005)
Perceived support	The degree to which assistance is available when educators face difficulties with an e-learning system

After evaluating the research model using PLS analysis, the author ended up with Figure 14.

Note: *p < 0.05; **P < 0.01; ***p < 0.001; ns: non-significant

Figure 14   The determinants of educators' satisfaction

Based on the result, perceived system quality was found to have the strongest effect on educators' post-adoption satisfaction. Confirmation of initial expectations was also found to have a very strong impact on educators' post-adoption satisfaction. While prior studies found confirmation to be the strongest predictor of satisfaction (Bhattacherjee 2001a; Bhattacherjee et al. 2008; Deng et al. 2010; Recker 2010), this study found both confirmation and perceived system quality to have almost equal influence on satisfaction. User satisfaction studies as well as the IS success model often found system quality and information quality to be the main determinants of user satisfaction (DeLone & McLean 1992; DeLone & McLean 2003). The association between system quality and user satisfaction has been validated in many studies in different contexts (Freeze et al. 2010; Halawi et al. 2008; Nagesh et al. 2003). Thus, the finding regarding the relationship between perceived system quality and satisfaction is in line with prior literature. Since e-learning systems are generally web-based systems, system quality related factors such as perceived access and perceived reliability were expected to be very important in shaping educators' satisfaction. The analysis of the open-ended survey questions provided further support for this finding. The analysis also resulted additional system quality related variables such as security (the educators felt the e-learning system was capable of sharing information securely), functionality (the educators felt the system had enough functionalities to meet their needs), and mobility (the educators felt the system was usable from any place).

Sample quotes from the open-ended survey questions regarding the system quality related variables are given below.

> *"....At the beginning I found the system to be very complex but I am very happy that I now find the system to be very easy to use...."*--- Coded as Perceived ease of use.

> *"....I find the system mostly available when I need to check something...."*--- Coded as Perceived access.

> *"....The good thing is that I can share lecture materials securely...."*--- Coded as Security.

> *"....I can use Moodle through net, thus it is not bound by place...."*--- Coded as Mobility.

> *"....The wiki is excellent-it saves a lot of emailing and you don't have to remember specific password for everything...."*--- Coded as Functionality.

The strong role of confirmation as a determinant of satisfaction suggests that educators place strong emphasis on confirmation when forming their level of satisfaction. The finding regarding this association is supported by many studies. For example, Hong et al. (2006) and Thong et al. (2006) found similar results in the mobile services context. Liao et al. (2007) validated it in the e-learning system usage context. Chea & Luo (2008) and Lin et al. (2005) found similar results in the e-service continuance context. Sorebo & Eikebrokk (2008) validated it even in mandated use context. The association suggests that if educators' pre-adoption expectations are realized during actual e-learning system use then satisfaction occurs, which may lead to the continued use of the e-learning system. The results found in Paper 3 may shed more light on this. According to the findings of this paper, educators' pre-adoption expectations were fulfilled with the job-specific outcome factors (these factors are considered to be an end themselves). These factors include for example, easy knowledge sharing, improved control, students' appreciation, and flexible teaching. These factors generated satisfaction among educators. On the other hand, the educators' expectations were not fulfilled with regard to the environmental factors (these factors are the means to a set of ends). These mainly include system quality and available support related factors. Thus, although these factors were found to cause satisfaction in Figure 13, they are also very critical to generate dissatisfaction among educators. According to the ECT, dissatisfaction may lead users to discontinue IS use. Thus, it

can be argued that the environmental variables are crucial in leading to e-learning discontinuance. This finding opens up opportunities for preventing potential acceptance-discontinuance anomalies in e-learning systems use.

Perceived compatibility was also found to have a strong impact on educators' satisfaction during the post-adoption stage. Educators carry distinct knowledge about their teaching/training situations, which they use as the basis for determining what tasks can be performed with a given e-learning system. The results suggest that if the e-learning platform is compatible with the teaching strategy that an educator wishes to follow, it is most likely that the educators will remain satisfied with the system during the post-adoption stage. Conversely, if the e-learning platform provides lot of important functionalities with a user-friendly interface but does not provide the functionalities that are needed for the completion of their teaching tasks, they may remain satisfied during adoption but eventually become dissatisfied with the system during the post-adoption stage. The relationship between perceived compatibility and satisfaction has not been tested in prior studies, although prior adoption studies found perceived compatibility to have a significant influence on users' IS acceptance and continuance (Chen 2011; Liao & Luo 2008; Moore & Benbasat 1996; Shih 2008). Based on the results of prior studies and this current study, it is possible to conclude that perceived compatibility is important in both the adoption and post-adoption stages. In particular, this study's result suggests that perceived compatibility is very important for predicting educators' satisfaction during the post-adoption stage. The answers to the open-ended survey questions provide further support for the association between perceived compatibility and satisfaction. Some of the sample quotes regarding this are as follows.

> *"....I had courses where students from multiple universities (even from different countries) participated. Moodle was an excellent tool for these courses...."*

> *"....In my teaching I generally share lots of web links with students. For this Moodle is an excellent tool...."*

As expected, perceived usefulness was also found to have a significant impact on satisfaction during the post-adoption stage. Perceived usefulness captures the instrumentality of IS use. Post-adoption research argues that perceived usefulness is one of the primary motivators of satisfaction (Bhattacherjee 2001a). Many studies in different contexts also confirmed the association between perceived usefulness and satisfaction (Bhattacherjee & Premkumar 2004; Hong et al. 2006; Hsieh & Wang 2007; Kang et al. 2009; Limayem et al. 2007; Recker 2010). Thus, the finding regarding the association between perceived usefulness and

satisfaction is in line with prior literature. However, its impact on satisfaction was not as strong as expected. For example, Bhattacherjee (2001a) argues that perceived usefulness is the only post-adoption belief that shapes satisfaction during the post-adoption stage. Many studies echo that view (Ho 2010; Hung et al. 2011; Lee 2010; Limayem & Cheung 2009; Lin et al. 2005). However, the findings of this study suggest that there are other factors that are even stronger in determining satisfaction during the post-adoption stage of e-learning system usage. In fact, this finding is in line with Wixom & Todd (2005). They argue that behavioral beliefs, such as perceived usefulness, weakly predict satisfaction, while object-based beliefs, such as perceived system quality, are strong in predicting satisfaction. In addition, a number of prior studies conclude that perceived ease of use, which can be regarded as a perceived system quality related variable, is stronger than perceived usefulness in determining satisfaction (Hong et al. 2006).

It was also observed that perceived support has a significant (although very weak) influence on educators' post-adoption satisfaction. The positive impact of support on user satisfaction is supported by the IS success model as well as service quality research (DeLone & McLean 2003). This study's result implies that if the educators receive help from a support team and user manuals when they face problems in completing a task, they will remain satisfied. The answers to the open-ended survey questions also provide further qualitative support for this finding. For example, one educator commented the following.

> *"....Moodle is an excellent tool as well as its' support is available in UTU...."*

In addition, it was also observed (discussed in Paper 3) that lack of support was crucial in generating dissatisfaction among the educators in the context of this study. For example, one educator commented the following.

> *"....Lack of support and answers like look at from the manual is very frustrating...."*

Perceived result demonstrability was found to have an insignificant direct impact on educators' post-adoption satisfaction. Based on prior literature, this result is somehow unexpected. For example, Agarwal & Prasad (1997) examined the effect of result demonstrability in the context of current and continued usage of the Internet. They found result demonstrability to be significant in determining continued usage but non-significant in determining current usage. Empirically, it was observed that perceived result demonstrability had a high correlation with perceived usefulness in this research (see Table 5 of Paper 2). The possible reason for a high correlation between the two variables is that a causal relationship

exists between them. In this regard, a post-hoc analysis to test the effect of perceived result demonstrability on perceived usefulness was conducted. The post-hoc analysis revealed that perceived result demonstrability strongly predicts perceived usefulness. Thus, although perceived result demonstrability had an insignificant direct impact on satisfaction, it had an indirect effect on satisfaction via perceived usefulness. The relationship between perceived result demonstrability and perceived usefulness is theoretically supported by TAM 3 (Venkatesh & Bala 2008). The findings suggest that educators, after gaining experience of using an e-learning system, develop result demonstrability belief, which, in turn, influences their perceived usefulness beliefs about the e-learning system. This implies that educators will be satisfied if the co-variation between usage and positive results are readily observable and communicable. Conversely, if the e-learning system produces the effective results desired by the educators, but does so in an obscure fashion, educators are unlikely to remain satisfied with the system.

Based on above discussions, the explicit answer to research sub-question SRQ2 is:
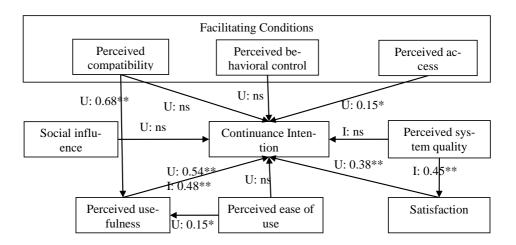
Educators' satisfaction during the post-adoption stage of e-learning system usage can be determined by the confirmation of initial expectations, perceived system quality, perceived usefulness, perceived compatibility, and perceived support. Important system characteristics related features include ease of use, access, security, mobility, reliability, integration, and functionality. The advantages of using an e-learning system (perceived usefulness) from educators' perspective include easy knowledge sharing, improved control, students' appreciation, and flexible teaching.

The findings regarding the analysis of SRQ2 also make an important contribution to the main research question, RQ (*How can e-learning system users' post-adoption usage be determined and what consequences can it have?*). Following the IS continuance model framework, the results suggest that confirmation, perceived system quality, perceived usefulness, perceived compatibility, and perceived support are important factors that may affect continuance intention through the mediation of satisfaction. In addition, there is the possibility that these factors might also have direct impact on continuance intention. For example, according to the IS continuance model perceived usefulness has a direct impact on continuance intention. The following section investigates the determinants of continuance intention.

4.3   Investigating Educators' Continuance Intention

This section answers the research sub-question, SRQ3 (*How can educators' continued use intention of an e-learning system in the post-adoption stage be determined?*).

   In order to investigate educators' continuance intention, two approaches have been followed. First, utilizing the IS continuance model, the author hypothesized that perceived usefulness and satisfaction are the determinants of continuance intention. Second, utilizing the UTAUT framework it was hypothesized that perceived usefulness, perceived ease of use, facilitating conditions, and social norms determine educators' continuance intention. The results of these two approaches are summarized in Figure 15.

Note: U: UTAUT evaluation; I: IS continuance model evaluation; *p < 0.05; **P < 0.001; ns: non-significant

Figure 15   The determinants of educators' continuance intention

   Perceived usefulness was found to be a significant predictor of educators' e-learning system continuance intention. The IS continuance model based evaluation revealed that perceived usefulness had the strongest impact on continuance intention. Similarly, the evaluation of the UTAUT-based model also revealed that perceived usefulness had the strongest impact on continuance intention. In general, research focusing on individual-level technology adoption and post-adoption has traditionally focused on workplace IT, and thus focused on the role of IT in improving job performance. In most of these studies, perceived usefulness has been found to be the strongest predictor of intention in different usage contexts (Davis et al. 1989; Venkatesh 2000; Venkatesh & Davis 2000; Ven-

katesh & Bala 2008). The investigated e-learning system in this research is mostly used by the educators for utilitarian purposes - to improve their teaching performances. Thus, the finding is in line with prior studies.

The IS continuance model-based evaluation also revealed that satisfaction is very strong in predicting educators' continuance intention to use the e-learning system. This finding is also in line with prior literature in the e-learning context that has found satisfaction to be one of the strongest predictors of continuance intention (Hung et al. 2011; Limayem et al. 2007; Lee 2010; Roca et al. 2006). Similar findings also exist in other contexts. For example, both Hong et al. (2006) and Thong et al. (2006) found satisfaction to be a strong predictor of continuance intention in the mobile services usage context. Recker (2010) found satisfaction to be a significant predictor of the intention of users to use process modeling grammars. Lin et al. (2005) and Hsu et al. (2004) found satisfaction significant in determining continuance intention in the web portal usage context.

The evaluation of the UTAUT model revealed perceived access, which was conceptualized as a part of facilitating conditions as another important predictor of continuance intention. This result suggests that if the web-server, where the e-learning system is hosted responds quickly and remains available to its users (both educators and students), educators will be interested in continuing their usage of the system. Thus, it is expected that higher accessibility has a positive influence on educators' continuance intention. Because the e-learning system is a web-based system, it can be argued that access remains important in predicting continuance intention at all stages of e-learning system usage. This argument is further supported by the post-hoc analysis. The post-hoc analysis was conducted by dividing the respondents into two groups (short-term users and long-term users). Short-term users were classified as those who had 0–18 months experience with the target system, while the long-term users were those who had more than 18 months experience. The post-hoc analysis results reveal that the two factors (perceived behavioral control and access) that were used to conceptualize the facilitating conditions are significant for short-term users, while for long-term users only access retains its significance. Interestingly, perceived compatibility was not found not to be significant in predicting continuance intention for both short- and long-term users. This result is inconsistent with prior findings. For example, the innovation diffusion theory describes compatibility as one of the five innovation characteristics behind IT adoption (Rogers 2003). In a meta-analysis of 75 articles, Tornatzky & Klein (1982) found compatibility as one of the three important factors behind innovation adoption. Moore & Benbasat (1996) examined the effect of compatibility on continued usage intention and found a significant positive relation. Empirically, user adoption has been linked to other research that uses variables similar to perceived compatibility including job-relevance (Venkatesh & Davis 2000), cognitive fit (Vessey 1991), task-

technology fit (Goodhue & Thompson 1995), etc. The reason behind the non-significant impact in this study is related to the fact that the correlation between perceived usefulness and perceived compatibility was high. As both perceived usefulness and compatibility were hypothesized to predict continuance intention, a high correlation between the constructs means that they partly share the explained variance for continuance intention. In addition as perceived usefulness was very strong in determining continuance intention it diminishes the impact of perceived compatibility. Due to the high correlation between perceived compatibility and perceived usefulness, perceived compatibility was found to determine perceived usefulness strongly. Thus, even though the direct influence of perceived compatibility on continuance intention was found to be non-significant, the role of compatibility should not be neglected. In fact the qualitative data revealed that compatibility is indeed important. A quote in this regard is given in the following.

> *"….In my course I have no learning material to deliver or no assignment to receive from students except lecturing in the class-room. That is why I don't use Moodle…."*

The qualitative data revealed availability of time, which can be conceptualized as part of the facilitating conditions is another important factor when deciding whether to use Moodle or not for a particular course. Some educators point out that often they have teaching as well as other organizational duties. Hence, they are quite overloaded with work. In such a situation they can hardly find time to use Moodle to build a course page. They further point out that if they do build a course page, it requires time and effort to keep the pages up-to-date as well as do conversation with students. Overall, the findings suggest that facilitating conditions (the organizational and technical infrastructures) are very important for facilitating educators' e-learning system usage.

The IS continuance model based evaluation revealed that perceived system quality had an insignificant impact on educators' continuance intention (see Paper 5). This is somewhat contradicted by the IS success model (DeLone & McLean 1992; DeLone & McLean 2003). IS success model assumes that system quality predicts IS use. However, the problem with this assumption is that no matter how good a system is, it cannot be a sufficient condition for IS use; IS use must be based on expectations about the consequences of utilizing the IS. For example, a person may like a system for its ease of use, reliability, and accessibility, but on the other hand have high expectations about its impact on his job. In such a situation, a favorable evaluation of system quality is not sufficient to cause IS continuance. Rather, potential users will use the system because they hope that the system will offer them the greatest benefits. Following this reason-

ing, it is expected that perceived system quality might have an insignificant impact on educators' continuance intention. In fact, Seddon (1997) in his modified IS success model argues for the removal of the association between system quality and IS use. In addition, Wixom & Todd (2005) argue that object-based beliefs, such as perceived system quality, are weak, but behavioral beliefs, such as perceived usefulness, are strong in predicting IS use. The qualitative analysis provides further support for the fact that, in general, educators use Moodle for its usefulness. Some of the quotes in this regard are as follows.

> *"....I use Moodle because I do not need to send individual emails to the students attaching lecture materials...."*

> *"....I use Moodle because it has lots of possibilities to make my teaching tasks easier...."*

Perceived ease of use was also found to have an insignificant influence on educators' continuance intention. The influence of perceived ease of use on use intention has been inconsistent in prior studies, especially for experienced users. Many studies suggested that as users become experienced and more comfortable with a new system, the influence of perceived ease of use diminishes (Venkatesh & Davis 2000). Following this, perceived ease of use was not included in the original expectation-confirmation based IS continuance model (Bhattacherjee 2001a). Thus, the finding of this study is in line with prior literature that argues that as users become experienced and more comfortable with a system, the direct influence of perceived ease of use on continuance intention diminishes. However, it is argued that despite the fact that its direct influence is insignificant, perceived ease of use influences continuance intention via perceived usefulness (Davis et al. 1989). Similarly, this study found a significant relationship between perceived ease of use and perceived usefulness. In IS continuance literature many studies have found a significant positive relationship between perceived ease of use and perceived usefulness (Hong et al. 2006; Thong et al. 2006). This finding suggests that the role of perceived ease of use should not be neglected during the post-adoption stage of e-learning system usage. In fact, perceived ease of use is an important system quality feature that has a significant impact on educators' satisfaction in this study.

The results also revealed that social influence has an insignificant impact on continuance intention. There are inconsistent findings regarding the effect of social influence on behavioral intention in prior literature. In e-learning continuance research, social influence has been found to significantly affect continuance intention in a number of studies (e.g., Kim 2010; Lee 2010; Sun et al. 2009). However, other studies argue that the influence of social influence remains im-

portant in the early phase of technology usage but loses its importance during the later stages (Hu et al. 2003; Venkatesh & Davis 2000). It was also found that social influence is important in mandatory usage setting but not important when the usage is voluntary (Venkatesh et al. 2003). As this study investigated a voluntary system during the post-adoption stage, it is expected that social influence would have an insignificant impact on continuance intention.

Based on above discussions, the explicit answer to the research sub-question, SRQ3 is:
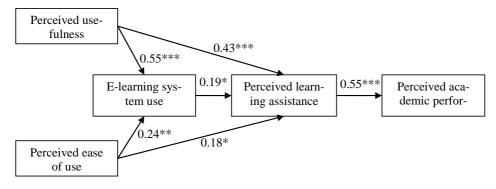
Educators' e-learning system continuance intention can be determined by perceived usefulness, satisfaction, and facilitating conditions (especially perceived access). Educators' satisfaction and perceptions of usefulness are created by the system characteristics-related features of the e-learning system, such as perceived system quality and perceived compatibility. Furthermore, availability of time is an important factor for educators when they decide whether to use e-learning system or not for a particular course.

The findings of the analysis regarding SRQ3 also make important contributions to the main research question, RQ (*How can e-learning system users' post-adoption usage be determined and what consequences can it have?*). The findings suggest that satisfaction and perceived usefulness are the two most important determinants of continuance intention as suggested by the IS continuance model. In addition, perceived access has a significant effect on continuance intention. The other variables' effects on continuance intention are mediated through perceived usefulness and satisfaction.

4.4 Investigating Students' E-learning System Use Outcomes

This section answers the research sub-question, SRQ4 (*To what extent does the utilization of an e-learning system assist students in their study?*).

As shown in the overall conceptual framework in Figure 11, there might be many determinants of students' utilization of e-learning systems. However, the aim of this section is to investigate the outcomes of e-learning system utilization from the perspective of students. Thus, the parsimonious TAM model has been utilized, where only two beliefs (perceived usefulness and perceived ease of use) influence e-learning system use. In addition, it is hypothesized that these two beliefs – along with e-learning system use itself – affect the e-learning system usage outcome variable: perceived learning assistance. Finally, the students' perceived learning assistance contributes to their perceived academic performance. The PLS evaluation of the research model is shown in Figure 16.

Note: *p < 0.05; **P < 0.01; ***p < 0.001; ns: non-significant

Figure 16   E-learning system usage outcomes

It can be seen from Figure 16 that perceived learning assistance can be pre-
dicted by the parsimonious TAM variables (perceived usefulness, perceived ease
of use and use). However, it is interesting to witness the strength of the effects
that these variables have on perceived learning assistance. It can be observed that
perceived usefulness had the strongest impact on perceived learning assistance. It
suggests that when students decide whether or not a particular e-learning system
helps them in their study, they put the highest importance on perceived useful-
ness. Although the relationship between perceived usefulness and perceived
learning assistance was not tested in the prior studies, some evidence can be
drawn from prior literature that indirectly supports this finding. For example,
Johnson et al. (2008) argue that a particular e-learning system can provide value
in several ways. First, the system may expand either the quality or quantity of
information which the students are able to access. The students can access learn-
ing materials and course-related information from anywhere. This helps students
to remain up-to-date in their course work. Second, the e-learning system helps
the students manage and control their learning process. Many students do not get
enough time to attend lectures, or even examinations. Some educators allow their
students to attend examinations in the learning management system without at-
tending face-to-face lectures. This provides students with more flexibility in their
study and may increase their control of the learning process. In addition, the e-
learning system may contain many features that help the participants collaborate
with each other. Chat, groups, and discussion forums are the possible features
available for collaboration in the e-learning system investigated in this study.
Johnson et al. (2008) further conceptualize course performance and course satis-
faction as the possible outcomes of e-learning. They found perceived usefulness
had a strong impact on both course performance and course satisfaction. Their

findings imply that a useful e-learning system helps students in their learning process, and thus students are satisfied with the course and achieve better grades.

Leidner & Jarvenpaa (1995) argue that even in an educator-centered learning structure, IT can be effective and a students' performance can be improved. In fact, the target e-learning system in this study offers several useful facilities that may assist students in their study. Downloading learning materials at any time, receiving course-related news, group discussion facilities with the possibility of storing old discussions for future reference, and online examination are very useful features not only for part-time students but also for full-time students. The system allows participation in many courses while being in different geographical location. Based on these points, it is expected that the perceived usefulness of the target LMS would have a very strong impact on the students' perceived learning assistance. Some of the sample quotes from the students also support this finding.

> "….I often cannot attend the lecture due to my work, however through the Moodle course pages I always get the information about what is going on. It helps me to remain upto date with the course…."

> "….For one course, we had good group discussion on Moodle. The topic was good, and all the students participated and Moodle worked well which made me inspired by the course and assignment in general…."

> "….Finding all course materials in one place is great…."

Both perceived ease of use and e-learning system use had significant (although very weak) impacts on students' perceived learning assistance. Although both of these relationships were not tested in the prior literature, some evidence can be drawn from prior studies that support these findings. First, the technical design and format affect how effectively participants can share learning materials and collaborate with each other (Lim et al. 2007). When students perceive an e-learning system as easy to use, they are better able to concentrate on their learning instead of putting effort into learning the system itself. The system provides them with an easy way to collaborate with others, which eases the group work. Thus, perceived ease of use was found to have a significant impact on perceived learning assistance. However, it was interesting to observe that the impact was very weak compared with the impact of perceived usefulness. Some evidence from the adoption studies can be used in support of this finding. Adoption studies often point out that as users become more experienced with a particular IS, the effect of ease of use on intention deteriorates (Davis et al. 1989). Following this,

it can be argued that when students become experienced with a particular e-learning system, they become more comfortable in using the system to perform their study tasks (downloading materials, uploading assignments, participating in discussion forums, etc.). At this stage of e-learning system usage, the students put low importance on perceived ease of use while evaluating to what extent the e-learning system helps them in their learning process. In this research the students were experienced with the target system (see Table 14). In addition, it was observed in Figure 13 that the functionalities of the targeted e-learning system used by the students were limited. It is easy to become comfortable with such a small number of functionalities. Thus, instead of putting much importance on ease of use of these functionalities, students put more importance on perceived usefulness when evaluating the effect of the e-learning system on their study.

Second, the significant relationship between e-learning system use and students' perceived learning assistance is indirectly supported by prior studies too. It is often argued that replacing some of the in-class activities with online activities resulted in better learning outcomes when compared with traditional face-to-face learning. Liaw (2008) found a high correlation between e-learning system utilization and e-learning effectiveness. In addition, McGill & Klobas (2009) concluded that learning management system usage positively affects students' perceived learning impact. Thus, the association between e-learning system use and students' perceived learning assistance is supported by prior studies. However, as noted earlier the effect of e-learning system usage was not as strong as expected. The interpretation of this finding is that excessive use of an e-learning system does not necessarily help students in their learning. Therefore, the system should be used to develop an appropriate learning environment. Developing a learning environment largely depends on the educators' capabilities. The qualitative data analysis sheds further light on this issue. Some of the sample quotes with this regard are as follows.

> "…..*Not all teachers know how to use Moodle, some teachers know but they don't take full advantage of Moodle….*"

> "….*Moodle sites work best when teachers put timely and valuable information there….*"

> "….*I have the feeling that teachers do not really want us to take full advantage of Moodle. For example, they do not really encourage us to use discussion forums. In addition they do not allow us to put external links on a Moodle page, even if they could be important for learning….*"

Based on above discussions, the explicit answer to the research sub-question, SRQ4 is:

E-learning systems have great potential to assist students in their study. Such assistance may lead to higher academic performance. However, more use of e-learning systems does not necessarily bring benefit for students. In practice, both students and educators need to utilize the systems effectively. Educators are especially required to develop an effective learning environment to match their teaching approach and the type of course by utilizing the system.

The findings of the analysis regarding SRQ4 make important contributions to the main research question, RQ (*How can e-learning system users' post-adoption usage be determined and what consequences can it have?*) as well. The findings suggest that e-learning system usage may affect students' perceived learning assistance, which, in turn, affects students' perceived academic performance.

4.5   A Critical Evaluation of the Articles

This section presents a critical evaluation from a philosophical perspective as well as the author's own experience of the chosen theoretical frameworks and methodology during this research. Such evaluation will help the readers to evaluate and interpret the findings of this dissertation. The critical evaluation can be categorized into three major groups: initial model development, final model development, and the testing of causal relationships. It should be noted that most of the critiques may apply to any scientific inquiry.

4.5.1   *Initial Model Development*

Hendry et al. (1990) argue that developing a research model is atheoretical in the sense that modelers often develop models independent of theory and sometime use ad hoc criteria to choose between different competing models. Fildes (1985) discusses the possibility of developing a research model using input from a variety of sources such as theories, prior empirical findings, unexplained findings in prior research, and by discussions with experts. He suggests converting the theoretical model into a data-driven model.

The author developed the research models of the articles from well-established theories in IS and also prior research. Then he verified the models using qualitative interview data (only from educators). However, at this stage the author was left with a number of competing theoretical models and each model supplement-

ed with additional ad hoc variables. The author had to choose between the variables which led him to investigate only a small part of the phenomenon of interest.

4.5.2 Final Model Development

After collecting the data, a researcher needs to take several decisions. These include outlier deletion, missing data handling, and making decisions about which variables to include or exclude. In addition, the researcher needs to decide which modeling technique to use. Possible alternatives could be SEM, multiple regression, etc. If the researcher decides to choose SEM, then the next question is whether to use co-variance-based SEM or variance-based SEM. Although researchers justify their decisions when choosing a particular method over others, such decisions are often made on ad hoc basis. In addition, many sets of relationships might be possible in the data. Mingers (2006) argues that it is generally not possible to choose between them on purely statistical grounds, so all kinds of other judgmental factors such as ad hoc criteria, personal belief, experience, usefulness, etc. come into play. The result is that the model is always underdetermined by the data. The example of Paper 2 can be presented here. Due to the author's interest, only the direct determinants of post-adoption satisfaction were investigated. It is obvious that there are relationships among the determinants themselves. However, those were not investigated or discussed in this paper.

It can be argued that different researchers may develop different models using the same data. It undermines the claim of researcher independent objectivity. Magnus & Morgan (1999) conducted an experiment that involved eight expert teams analyzing the same set of data using their own statistical approach. Their statistical predictions and forecasts were significantly different from each other. As the results of the statistical modeling, performed by different modelers are different, it resembles the work done by the philosopher Michael Polanyi. He states that into all acts of judgment there enters, and must enter, a personal decision which cannot be accounted for, hence all knowledge is personal knowledge (Polanyi 1958). The emphasis on personal knowledge is meant to correct the positivist view that scientific knowledge is impersonal and thus objective. Polanyi's argument was that science does not rest on any purely objective method but is a system of beliefs to which the scientists are committed (Polanyi 1958). Polanyi notes the following in this regard.

"I hold that the propositions embodied in natural science are not derived by any definite rule from the data of experience, and that they can neither be verified nor falsified by experience according to any definite rule. Discovery, verification and falsification proceed according to certain maxims which cannot be

precisely formulated and still less proved or disproved, and the application of which relies in every case on a personal judgment exercised (or accredited) by ourselves. These maxims and the art of interpreting them may be said to constitute the premises of science, but I prefer to call them our scientific beliefs. These premises or beliefs are embodied in a tradition, the tradition of science."

His argument that all knowledge is personal knowledge sets him in direct opposition to positivists. However, given that different modelers may come up with different models for the same data, when using statistical analysis, his claim is supported, at least to some extent.

The author accepts the fact that the models he has developed in different papers might be different if developed by another researcher. One example is that prior adoption research has modeled perceived ease of use as a direct determinant of satisfaction and behavioral intention, while it has also been seen as a variable related to system quality. The author has modeled perceived ease of use as part of system quality and hypothesized that system quality influences satisfaction or behavioral intention in Paper 2. However, another researcher might model it as a direct determinant of satisfaction or behavioral intention.

4.5.3   Testing Causal Relationships

There are two issues to be discussed regarding causal relationship testing. These two issues can open up future research directions too. The first issue is related to the argument of whether beliefs, attitude, and intention are causally related or not. In most of the articles included in this dissertation, high correlations between the beliefs and satisfaction/intentions were observed. For example, in Paper 4 the correlation between perceived usefulness and intentions was 0.81. In Paper 5, the author deleted some suspicious items but still the correlation between perceived usefulness and intentions was 0.76, although the variables clearly discriminate between each other. One may argue that there might be problems in the research design. However, evidence from prior literature can be drawn at this point. Plenty of prior literature in IS adoption has reported high correlations among beliefs, attitude, and intentions. For example, Roca et al. (2006) found the correlation between perceived usefulness and intention to be 0.73. Liao et al. (2007) found the correlation between satisfaction and intention to be 0.79. Given that there is a strong argument against causal relationships among beliefs, attitude, and intentions – as discussed in section 2.5, and having a set of data that shows high correlations among these constructs, the obvious question is whether to accept the argument that beliefs, attitude, and intentions cannot be causally related. To address this question future research can be conducted with more empirical tests,

probably with objective measures. Straub & Burton-Jones (2007) argue for the use of objective measures of beliefs and behavior to test hypotheses, although they point out that the approach might be time consuming and costly.

The second issue is related to significance testing in accepting or rejecting a hypothesis. In Papers 4 and 6, the author found the significance level of several parameters was at the border line. For example, the parameter estimates of access-intention, perceived behavioral control-intention, compatibility-intention, and perceived ease of use-perceived usefulness relations were on the borderline of the 5% significance test. Given that significance testing has the problems discussed in section 3.6.1, the question is whether or not these relationships actually hold. Hence, future research is necessary to confirm these findings.

5   IMPLICATIONS AND CONCLUSIONS

About the time we think we can make ends meet, somebody moves the ends.

Herbert Hoover

This is the final chapter of this dissertation. First the explicit answer to the research question is provided. Next, the major theoretical implications are discussed, and then the practical implications of this research are presented. Finally, the limitations of this research as well as some future research directions are presented.

5.1   Summary of the Answers to the Research Questions

The main research question is:

RQ: How can e-learning system users' post-adoption usage be determined and what consequences can it have?

The main research question was divided into four research sub-questions. In order to answer the main question, one needs to answer the research sub-questions first. The *first* research sub-question considers the consistency of the IS continuance model in prior literature. The formulated research question is:

SRQ1: To what extent have the relationships of the IS continuance model been empirically proven to be consistent in prior studies?

Based on the discussion in section 4.1, the explicit answer to the research question SRQ1 is:

All the correlations of the original IS continuance model are significant. The strength of the correlations is moderate to strong. The flux regarding the correlations was due to the research settings, especially the geographical areas where the research was conducted and the type of respondents. Overall, the IS continuance model was found to be a robust theoretical tool for explaining and predicting IS continuance intention.

The *second* research question considers educators' satisfaction during the post-adoption stage of the use of an e-learning system. The formulated research question is:

SRQ2: How can educators' satisfaction with an e-learning system in the post-adoption stage be determined?

Based on the discussion in section 4.2, the explicit answer to the research question SRQ2 is:

Educators' satisfaction during the post-adoption stage of e-learning system usage can be determined by the confirmation of initial expectations, perceived system quality, perceived usefulness, perceived compatibility, and perceived support. Important system characteristics related features include ease of use, access, security, mobility, reliability, integration, and functionality. The advantages of using an e-learning system (perceived usefulness) from educators' perspective include easy knowledge sharing, improved control, students' appreciation, and flexible teaching.

The *third* research question considers educators' continuance intention regarding the use of an e-learning system. The formulated research question is:

SRQ3: How can educators' continued use intention of an e-learning system in the post-adoption stage be determined?

Based on the discussion in section 4.3, the explicit answer of the research question SRQ3 is:

Educators' e-learning system continuance intention can be determined by perceived usefulness, satisfaction, and facilitating conditions (especially perceived access). Educators' satisfaction and perceptions of usefulness are created by the system characteristics-related features of the e-learning system, such as perceived system quality and perceived compatibility. Furthermore, availability of time is an important factor for educators when they decide whether to use e-learning system or not for a particular course.

The *fourth* research question considers students' e-learning system use outcomes during the post-adoption stage. The formulated research question is:

SRQ4: To what extent does the utilization of an e-learning system assist students in their study?

Based on the discussion in section 4.4, the explicit answer of the research question SRQ4 is:

E-learning systems have great potential to assist students in their study. Such assistance may lead to higher academic performance. However, more use of e-learning systems does not necessarily bring benefit for students. In practice, both students and educators need to utilize the systems effectively. Educators are especially required to develop an effective learning environment to match their teaching approach and the type of course by utilizing the system.

Based on the answers to the research sub-questions, the explicit answer to the main research question is:

A combination of the IS continuance model and UTAUT can be used as the underlying theory to investigate e-learning system users' post-adoption usage behavior, assuming that behavioral intention determines actual behavior. However, the combined model should be extended to include e-learning system usage outcome variables in order to investigate users' e-learning system usage outcomes. From educators' perspective, behavioral intention can be determined by perceived usefulness, satisfaction, and perceived access. From students' perspective e-learning system usage may influence their perceived learning assistance, which, in turn, affects their perceived academic performance.

5.2   Research Implications

The area of research this study contributes to can be referred to as post-adoption research. Within this area the contextual domain of this study is e-learning systems, the phenomena of interest are satisfaction, IS continued use, and the usage outcomes of e-learning systems. Within this area of interest a number of theoretical gaps in the prior literature were identified. Table 20 presents the research gaps and addresses how the gaps have been addressed in this dissertation. In general, these contributions can be directed to two broad fields of research: IS post-adoption research and e-learning post-adoption research.

Table 20   Summary of the theoretical contributions

Research gap	*Contribution*	*Area of contribution*
Evaluating the consistency of the IS continuance model in prior studies	1. Overall all the correlations of the original IS continuance model are significant. The strength of the correlations is moderate to strong. Type of respondents and the geographical area where the data were collected are the possible two moderators 2. Perceived ease of use remains important in the post-adoption stage	IS post-adoption research
Understanding the determinants of educators' post-adoption satisfaction with e-learning systems	1. Object-based beliefs such as perceived system quality and perceived compatibility in addition to the confirmation of pre-adoption expectations are the focal constructs. Perceived usefulness and perceived support are also important 2. Dissatisfaction-based evaluation may address acceptance-discontinuance anomalies. The sources of satisfaction and the sources of dissatisfaction may differ in a particular context	E-learning post-adoption research
Understanding educators' e-learning system continuance intention	1. IS continuance model has been extended using perceived system quality. The evaluation of the extended model revealed that perceived system quality is shaped by confirmation. In addition it has an indirect effect on continuance intention via perceived usefulness and satisfaction. All the relationships of the original IS continuance model were supported 2. UTAUT based evaluation provides a refined view of educators' e-learning system continuance. The evaluation revealed that educators continuously use an e-learning system due to its usefulness and accessibility	E-learning post-adoption research
Understanding e-learning system usage outcomes from the students' perspective	1. This dissertation went beyond usage and investigated two outcome variables: perceived learning assistance, and perceived academic performance. It discussed how the TAM variables are related to the outcome variables 2. The proposed model can be used as the starting point for future research	E-learning post-adoption research

In the following paragraphs, the contributions presented in Table 20 are discussed in more detail.

5.2.1   Implications for Generic IS Post-adoption Research

This dissertation (also Paper 1) performed a meta-analysis among existing IS continuance literature. To the best of the author's knowledge, it is the first meta-analysis among IS continuance studies. The results found in the meta-analysis have two major theoretical implications for IS post-adoption research.

First, the prior empirical results regarding the correlations between the key constructs of the IS continuance model have not been entirely consistent. Some studies reported high correlations while some studies reported low correlations between the key constructs. The meta-analysis conducted on the existing IS continuance literature found that, overall, all the correlations of the original IS continuance model were significant. The strength of the correlations is moderate to strong. In addition, it was also found that moderating effects are the reason behind this inconsistency. In practice, this dissertation found that the geographical locations where the data were collected and the type of respondents (students compared with non-students) are the two moderators that explain the inconsistency. The possibility to have more moderator variables, such as type of technology and voluntariness is also discussed in Paper 1. Further research could examine the presence of such moderators.

Second, there is an argument in IS literature about whether perceived ease of use is important in the post-adoption stage or not. The meta-analysis of Paper 1 revealed that overall perceived ease of use retains its importance in the post-adoption stage. It is concluded that perceived ease of use is a meaningful extension to the IS continuance model, and suggests that the complexity of the target technology and the users' interaction with it should be more carefully scrutinized and, based on this, researchers should assess whether or not to include perceived ease of use in the research model. It has also been discussed that perceived ease of use might be even more important for those systems that are updated frequently or have a lot of features. Users rarely get enough time to learn such systems. Hence, perceived ease of use may also be a critical factor when deciding either to continue or discontinue IS use.

5.2.2   Implications for E-learning Post-adoption Research

While investigating educators' satisfaction during the post-adoption stage, this dissertation makes the following two useful contributions.

First, this dissertation (also in Paper 2) described the limitations of prior satisfaction studies and argued that the IS continuance model could be the underlying theoretical framework for investigating educators' satisfaction during the post-adoption stage. However, the dissertation also discussed the limitations of the original IS continuance model and incorporated a number of variables, such as perceived system quality, perceived compatibility, perceived result demonstrability, and perceived support as the determinants of post-adoption satisfaction. It is concluded that perceived usefulness – a behavioral belief – is very weak in determining post-adoption satisfaction, while object-based beliefs, such as perceived system quality and perceived compatibility, are very important in determining post-adoption satisfaction. This implies that future research should focus on object-based beliefs to extend the IS continuance model and to understand the formation of the post-adoption satisfaction.

Second, this dissertation (also Paper 3) further argues that in a typical satisfaction survey users are usually asked to rate only a limited number of attributes of a system, and thus have the possibility to exclude many important variables. In addition this dissertation also argues that the IS continuance model cannot explain the acceptance-discontinuance anomalies. In this relation, a dissatisfaction-based evaluation may help to explain acceptance-discontinuance anomalies. Paper 3 analyzed the open-ended survey questions and found that environmental factors (ease of use, access, security, mobility, functionality, support and training) are crucial in generating dissatisfaction, while job-specific outcome factors (easy knowledge sharing, improved control, students' appreciation and flexible teaching) are very critical to generate satisfaction. According to the ECT avoiding dissatisfaction results in discontinuance being avoided (Oliver 1980). Thus, following the findings of Paper 3, it can be stated that improving educators' perceptions regarding environmental related factors would allow practitioners to avoid dissatisfaction. Overall, this paper provides a way to address acceptance-discontinuance anomalies.

In order to investigate educators' e-learning system continuance, this dissertation used both the IS continuance model and UTAUT-based evaluation. It offered the following two major theoretical contributions.

First, prior adoption models such as TAM, IS continuance model and UTAUT do not test the impact of system characteristics on continuance intention. Paper 5 systematically extended the IS continuance model with perceived system quality. Four system quality related factors that are salient during an e-learning system's post-adoption stage were identified based on an exploratory study.

The evaluation of the extended model suggests that perceived system quality can be predicted by confirmation of initial expectations. While prior e-learning continuance studies conceptualized system quality as a pre-adoption belief and placed it as an antecedent of confirmation (see Roca et al. 2006), Paper 5 concep-

tualized it as a post-adoption belief and revealed how it can be shaped by confirmation in the post-adoption stage. In addition, it was also observed that perceived system quality is very important in determining perceived usefulness and satisfaction during the post-adoption stage. However, the direct impact of perceived system quality on continuance intention was non-significant. This finding implies that an object-based belief like perceived system quality does not determine continuance intention. Despite this non-significant impact, researchers could investigate identifying a generic list of system quality features that may apply to a wide variety of systems. In addition, future research can be conducted to investigate different systems that vary in important dimensions, such as strong analytical capabilities compared with high information richness. This may allow researchers to compare how IS continuance might differ from system to system.

Second, this dissertation (also Paper 4) discussed the fact that IS continuance, especially e-learning continuance research was mostly dominated by the IS continuance model from a literature review. Although UTAUT has been shown to be a very powerful tool both in the adoption and post-adoption use of IS, researchers have overlooked this theory in understanding IS continuance. From the theoretical perspective, a UTAUT-based approach followed in Paper 4 provides a refined view of how continuance intention is shaped by its determinants. This may open up opportunities for future research regarding the comparison of different theoretical perspectives and how they affect our understanding e-learning continuance.

The UTAUT-based approach followed in Paper 4 may also address a major limitation of UTAUT, which is the operationalization of the core constructs as described by Venkatesh et al. (2003). Each of the core-constructs in UTAUT has been operationalized by using the highest-loading items from each of the respective scales. The danger of this approach is that the facets of each construct can be eliminated, thus threatening content validity (Venkatesh et al. 2003). To overcome this limitation Paper 4 included three factors that help to conceptualize facilitating conditions, namely perceived access, perceived behavioral control, and perceived compatibility. From amongst these three factors, perceived access was found to have significant direct influence on use intention for both short-term and long-term e-learning system users. The author encourages researchers to look for more context specific factors for facilitating conditions as well as for other core constructs of UTAUT. This kind of decomposed UTAUT may help researchers to better understand both e-learning acceptance and continuance. It may also eliminate the content validity-related limitation of UTAUT.

While investigating the possible outcomes of e-learning system use, this dissertation makes two useful contributions to e-learning research.

First, while most of the prior studies only investigated the adoption and continued use of e-learning systems, this dissertation (and Paper 6) went beyond e-

learning use and provided insights into the possible outcomes of e-learning system adoption and use from the perspective of students. In doing so, two e-learning system use outcome variables have been conceptualized and measured: perceived assistance in learning, and perceived academic performance. Overall, the findings suggest that e-learning systems assist students in their study, which helps them achieve better academic performance. This opens up the field for future studies, such as identifying more outcome variables and investigating their possible relationships with e-learning system usage and user beliefs.

Second, the proposed model in Figure 15 may serve as the starting point for testing the impact of design features on perceived learning assistance and perceived academic performance. Important design features include relevance, clarity, organization, interaction, etc. (Kember et al. 2010). Such research studies will allow researchers to compare different learning platforms as well as different course pages in a single learning platform in terms of their effectiveness and the assistance they offer students in their studies. Such research will be highly valuable for practitioners as well.

5.3 Implications for Practice

The results of this dissertation offer some implications for practice as well. For organizations utilizing e-learning systems, the results offer guidance on how to make the correct strategies for affecting post-adoption satisfaction, retain existing users, and gaining potential benefits from the e-learning systems. In a broad sense, the models proposed in this dissertation can help practitioners assess an e-learning system's design characteristics and facilitating conditions and then investigate their impacts on user satisfaction and continuance intention through the proposed causal chains. This may assist managers when they make decisions such as prioritizing tasks and the allocation of resources; for instance, when a manager discovers that users have become very dissatisfied with a system. In such a situation, he or she may have many options to improve user satisfaction. However, the findings of this dissertation can help focus on the most important factors that would most likely improve user satisfaction. In addition, the model proposed in Paper 6 will help practitioners assess the usage of an e-learning system and its impact on students' studies.

In this regard, this dissertation reports important guidelines for e-learning system designers, IT support teams, educators, head of departments, and rectors – from a university perspective.

5.3.1   *Guidance for Designers*

The study's results highlight the importance of perceived usefulness, perceived compatibility, and perceived system quality during the post-adoption stage of educators' e-learning system usage. In addition, the results also highlight the importance of perceived usefulness and perceived ease of use in affecting students' e-learning system usage outcomes. From these findings, five guidelines can be suggested for e-learning system designers.

First, the proposed models in the individual papers can be used as diagnostic tools at all stages of the system implementation and usage process. An e-learning system like Moodle evolves over time – new functionalities are added and so are architectural changes. In addition, as Moodle is an open source system, local designers also have the option to customize it according to the organizational requirements. In such situations, the models proposed in the individual articles may help designers concentrate on the important factors that may most likely improve user satisfaction, continued use and usage outcomes.

Second, designers are advised to continuously look for opportunities to further improve the already implemented e-learning platforms in order to meet the users' present and future requirements. It is important to conduct user needs tests to increase the likelihood of user acceptance for any new IS. But designers need to remember that user expectations change over time. Hence, they are advised to conduct similar user needs tests after implementing the system as well. Such tests would allow designers to understand the users' tasks and help them plan and develop a more compatible system. Designers are also advised to conduct context analysis during the post-adoption stage. Context analysis includes understanding technical, environmental, organizational and social settings (Zhang et al. 2005). Technical, environmental, organizational, and social settings may change after the initial implementation of a system. If an IS is not updated according to this change, the system may not be useful for its users. A change of context may trigger a change in the users' tasks as well. In this regard, task analysis also needs to be conducted during the post-adoption stage. Task analysis is concerned with understanding what people do to achieve their goals (Zhang et al. 2005).

Third, the results of this dissertation reveal that designers should put effort into making the system easy to use, accessible, and reliable. Usability tests could be conducted among existing users to plan for the future improvement of the system. In general the findings suggest that a user-friendly, visually appealing, accessible and reliable system helps users to assess an IS as useful, and is something that enhances user satisfaction.

Fourth, the instrument developed in this dissertation may help designers to evaluate their design as well. After developing an e-learning system, they can measure, for example, ease of use, usefulness, compatibility, satisfaction, etc. and

check the mean score in order to evaluate their design. This kind of evaluation could be done at any stage of system implementation and usage process.

Finally, the relative influences of system characteristics factors may provide an additional practical implication for designers. If the proposed model in Figure 13 is tested in different contexts, designers can build up and accumulate knowledge about important design guidelines as well as the relative influences of factors across the different contexts. Such accumulated knowledge can be used as the standards in order to build effective e-learning systems.

5.3.2   Guidance for IT Support Team

This study concluded perceived support, perceived access, and perceived reliability were important factors that affect educators' post-adoption satisfaction. In relation to this, the following three guidelines can be given to an IT support team.

First, the support team is advised to improve support functions to keep educators satisfied. The support team may improve their support by responding timely, appropriately and politely when the educators face problems with their system. They should show willingness to help the educators by cooperating with a friendly attitude in all situations. Proper instruction manuals should be made available to educators to complement the help they receive from IT support.

Second, it is advised to the IT support team to ensure that the system is accessible. It has to be remembered that an e-learning system is hosted in a web-server and that many students and educators use that system during an academic period. Hence, an IT support team needs to ensure that the e-learning system is hosted on a web-server that can meet the demands of the users connecting to the service. The response time of the server during its busiest time period needs to be analyzed in order to select the most appropriate web-server.

Finally, IT support is also advised to work cautiously during version updates, as these events may accidentally remove important data from the server. Signing-up for a course, the delivery of learning material, and communication amongst the participants are all implemented online in an e-learning system. Consequently, any e-learning system must be viewed as a repository of large amounts of information and should therefore be reliable and backed up.

5.3.3   Guidance for Educators

The findings of this dissertation suggest that the extensive use of e-learning systems by students may not necessarily help the students to a great extent, although the system may have the potential to be beneficial to the students in their study.

In this regard, the following important guidance can be presented to educators utilizing an e-learning system for their courses.

Educators are advised to choose their teaching approach based on their students' learning approach and the type of the course. They are advised to put sufficient effort into building a learning environment based on their chosen teaching approach for that particular course. They should add enough functionality to a course page to build an effective learning environment that supports the underlying pedagogy. A pre-requisite for this is to learn the system more thoroughly and understand what teaching approaches are supported by the available e-learning platform in order to extract the maximum benefit from it. For this purpose, they are advised to read the instruction manuals and participate in training sessions – when offered. It is obvious that educators are required to play more active roles in course pages, such as keeping them up-to-date, uploading learning material before face-to-face lectures, moderating, and participating in student discussions when necessary. In addition, they are required to encourage students to use the available functionalities so as to gain the maximum benefit. To encourage the students, they could also announce some incentives. For example, they may announce the possibility to give bonus points to those students who actively participate in the discussion forums.

Confirmation of initial expectations was found strong in determining educators' satisfaction during the post-adoption stage. Hence, expert Moodle educators are advised to inform peers about the potential benefits of e-learning systems. This will help inexperienced Moodle educators gain insight into the compatibility, usefulness, result demonstrability, and system quality of the system. Such insight would allow them to positively confirm their expectations. In turn, it would eventually influence satisfaction and continuance intention.

5.3.4   *Guidance for Heads of Departments and Rectors*

This study found the confirmation of initial expectations in determining perceived usefulness, perceived system quality, and satisfaction to be of key importance. In relation to this, the following two guidelines can be given to head of departments and rectors.

First, in general, both departmental heads and rectors are advised to ask educators to utilize e-learning systems. They should inform educators about the possible benefits of using such systems as a supplement to face-to-face teaching. This is necessary for minimizing the resistance of those educators who have adopted a system recently, and simultaneously communicating the appropriate benefits of the e-learning system. Thus, it gives educators a realistic level of perception regarding the system's features and its usefulness in their teaching tasks. An e-

learning system like Moodle is a complex system which contains many functions. Hence, it is obvious that the new users of such a system may have severe anxiety about adopting the system. Educators might also fear that the e-learning system will add an extra load to their teaching tasks and reduce their autonomy and control in the class-room. In such situations, if heads and rectors inform educators about the possible benefits of using the system and its system characteristics, they can build an appropriate level of perception of the system. This appropriate level of perception would generate positive confirmation at a later stage, which, in turn, would generate satisfaction.

Second, the departmental heads should also try to find educators (from their department) who have positive perceptions about the e-learning system and ask them to act as change agents. Such educators are an effective word-of-mouth promotional channel to other educators in a department, regarding the e-learning system.

The qualitative evidence from open-ended survey questions revealed that a lack of training is a major source of dissatisfaction which can be addressed by rectors. Rectors are therefore advised to ask the unit responsible to arrange more training for e-learning systems – not only for educators but also for students. Training has been suggested as an important intervention for IT acceptance. But the findings of this study suggest that training has importance during the post-adoption stage too. In UTU, only basic training for working with Moodle is arranged. The findings of this dissertation suggest that educators feel this training is not enough to be able perform all their Moodle tasks and reap the maximum benefit from it. Hence, more advanced training is necessary. Such training should positively influence educators' perceptions regarding their different beliefs as well as their satisfaction with an e-learning system.

5.4 Limitations

This dissertation has offered some valuable insights into the post-adoption stage of e-learning system usage from both theoretical and practical perspectives. However, it has limitations that need to be acknowledged and these can be viewed as areas for further study too.

5.4.1 The Study Has Been Conducted in a Single Setting

The author conducted this research by collecting data from users (both educators and students) of a particular e-learning system called Moodle at the University of Turku. As the study was conducted in a single setting, caution should be exer-

cised before generalizing the findings of this study to other contexts. Generalizability refers to the validity of a theory in a setting different from the one where it was empirically tested and confirmed (Lee & Baskerville 2003). Generalizability can be of different types as discussed by Lee & Baskerville (2003). Business-school researchers are generally interested in proving the utility of their theory in an actual business setting, although the theory is not actually tested in that particular setting. Hence, they often generalize their theory to different business settings. However, claiming a theory to be generalizable to a setting where it was not tested means accepting the assumption of uniformity of nature as well as accepting responsibility for the possibility that the suggestions derived from the theory may fail.

According to the author's evaluation the findings might be generalizable to another Finnish university where Moodle use is voluntary. However, the author does not suggest generalizing the findings to other settings (e.g. companies, other e-learning systems, other cultures). In this research the author focused more on exploration rather than generalizability and he suggests that similar studies could be conducted in order to test the validity of the proposed research models in other contexts.

5.4.2   The Study is Cross-sectional, Not Longitudinal

In a cross-sectional study, a major assumption is made regarding stability. The assumption is that the relationships underlying the data will remain constant. A model like TAM has been developed to predict IS use. From a management perspective, the model simply states that if a useful and easy to use system is developed and implemented, it will be used. This implies that TAM can predict a group of users' future behavior. There are many situations in which the behavior of a group of users can be predicted successfully. For example, the warmer the weather, the more people will visit the beach and the higher the sales of ice-cream will be. It may be hard to say if or when an individual will buy an ice-cream, but a stable response pattern can be seen among a large number of individuals. Similarly, IS researchers can predict users' IS usage based on the IS's usefulness and ease of use. Although some users might use the IS for other reasons, such as pressure from superiors, the overall response of the users regarding IS use can be predicted by its usefulness and ease of use within a quite a narrow margin of error. However, this does not mean that people never change their minds or that future events can be foretold simply by projecting past trends. We cannot safely say that users will increase their IS use just because the IS is currently useful and easy to use. The IS may turn to be not so useful in the future

due to organizational changes, or because the users may come to know about another IS that is even more useful or easy to use.

Fildes (1985) recommended testing the stability of a model over time. In particular, usage behavior is dynamic and changes over time due to changes in cognition and attitude as users gain experience of the target system. Such changes in cognition and attitude cannot be captured with a cross-sectional study. A longitudinal study is able to capture such changes and is able to provide some deep insights into how changes in user cognition and attitude influence usage behavior. However, the articles included in this dissertation utilized data captured at a single point of time. Thus, it was not possible to test the stability of the models over time.

5.4.3 *Intention Has Been Studied, Not Actual Behavior or Self-reported Behavior*

A vast amount of past adoption research (as well as the articles included in this dissertation) has investigated behavioral intention as the final dependent variable. The assumption behind this is that continued use is driven by conscious intentions that result from a rational decision making process involving beliefs, expectations, reflection on past experience, etc. plus emotions such as satisfaction, frustrations, etc. De Guinea & Markus (2009) argue that emotion may also directly drive continued IS use. This is because the connection between emotion and behavior can occur without a person being consciously aware of the connection; and because the effect of emotion may not create a particular behavioral intention, but instead derail a previously formed behavioral intention about continuing IS use. This suggests that sudden intense emotions, such as frustration associated with a system crash or the pleasure aroused while using an IS, may be more important in its influence on behavior than intention which is driven by stable attitudes and expectations. In addition, it is often argued that frequently performed behavior becomes automatic or habitual, and it ultimately reduces the impact of intention on continued use (Kim et al. 2005; Limayem et al. 2007). Following those observations, it becomes perhaps more important to investigate usage rather than intention. However, when we talk about measuring usage, there can be two types of measures of usage: self-reported usage and actual usage. Self-reported usage is widely used as it is assumed that it is a reasonable predictor of actual system usage in adoption studies (e.g. Agarwal & Prasad 1999; Jackson et al. 1997). However, several studies suggest caution when using self-reported usage instead of actual usage (Lederer et al. 2000; Lee et al. 2003; Rawstorne et al. 2000; Straub et al. 1995; Szajna 1996). For example, Straub et al. (1995) found that research based on self-reported usage shows distinctly different

results from that of actual usage. In addition, self-reported usage was also found to be the major reason for common method bias (Igbaria et al. 1997).

It was not possible to get objective data of actual Moodle use due to the issue of privacy. This prevented the author against testing the relationships between continuance intention and continued use, or between emotions and continued use.

5.4.4   E-learning System Usage Has Been Investigated on an Abstract Level, Not Individual Features

Jasperson et al. (2005) conceptualized post-adoptive behavior as feature adoption decisions, feature use behaviors, and feature extension behaviors made by an individual after an IT application has been installed. After an individual commits to using an IT, he or she may choose to explore, adopt, use, and possibly extend one or more of the application's features. An IT application may have more features than those necessary for work accomplishment. During the post-adoption stage – and as users gain experience of the IT – they may discover ways to apply more features of the IT in accomplishing their work and engage in feature extension behavior.

In this relation, it is necessary to investigate the usage behavior of the individual features of the target e-learning system. Due to time constraints the author was not able to investigate this, although this remains of high interest. However, the author is well-informed about that fact that an LMS like Moodle is often underutilized by users from his investigation. For example, it was found that some educators use Moodle only for delivering learning materials although it has many other features that could be utilized for teaching. Hence, a study on investigating individual feature usage behavior – in the post-adoption stage of e-learning system use – is of great importance and needs to be addressed in future studies.

5.5   Further Research

While conducting this research, the author found ten potential avenues for further research.

First, as described in the section on the limitations of the study, other post-adoption behaviors, especially individual feature adoption, individual feature use, and individual feature extension as proposed by Jasperson et al. (2005), are important to investigate. Research focusing on how to affect such behaviors would be highly relevant for practitioners, especially for a system containing many features. In addition, further research could be conducted on understanding how these behaviors may affect usage outcomes.

Second, this research found that training is also important during the post-adoption stage. Prior research found that game-based training might be more effective than traditional training for the acceptance of new system (Venkatesh 1999). A future research direction could be to investigate which training method is the most effective for enhancing users' continued use of e-learning systems.

Third, this research found that the factors affecting satisfaction may differ from the factors affecting dissatisfaction. In addition, Herzberg et al. (1959) suggests satisfaction and dissatisfaction should be seen as two separate constructs. From this viewpoint, further research can be performed on the operationalization and measurement of satisfaction and dissatisfaction, and factor analysis ought to be conducted to check whether they are separate constructs or not. If they are, the influence of different determinants on these constructs can be calculated using SEM to test whether the factors affecting satisfaction differ from the factors affecting dissatisfaction.

Fourth, a number of determinants of satisfaction have been identified in this research but relationships might exist among these determinants. Further research can be conducted to explore such relationships in order to have a better understanding of the phenomena.

Fifth, an overall confirmation construct was measured in this study. Future research may follow the approach discussed by Staples et al. (2002), which is designed to capture the confirmation of individual expectations such as perceived system quality, perceived compatibility, perceived usefulness, and perceived support. This kind of decomposed approach may provide specific managerial implications.

Sixth, this research found that perceived usefulness affects e-learning system use outcomes. In prior research, intrinsic motivation has been found to be another factor affecting IS usage (Van der Heijden 2004). Based on this, another future research direction could be to investigate the role of intrinsic factors regarding e-learning continued use as well as use outcomes. In addition, research on how to influence intrinsic factors through the use of design characteristics would be highly relevant for practitioners as well.

Seventh, this research investigated only two possible e-learning system usage outcome variables. Future research should focus on identifying more outcome variables and test the effect of beliefs and use on such outcome variables. This kind of research is particularly important because adoption and use do not necessarily bring success. Lee et al. (2003) reviewed TAM based studies and suggested that more research is necessary to investigate the outcomes of usage. Adoption studies assume that the relationship between usage and objective outcome measures (e.g., performance, productivity, quality) is positive. Therefore more studies are necessary to determine whether the assumption can be supported by empirical testing.

Eighth, the literature review suggested that e-learning adoption and post-adoption research mainly used generic IS adoption models, and these models lack important variables related to learning. Hence, an important future research direction would be to find theories that accommodate variables related to e-learning.

Ninth, recent research suggested that intention becomes weak in predicting usage as the behavior becomes habitual (Limayem et al. 2007). For different systems this might be true, for example, use of the Internet may become habitual over time. However, is it also true for organizational systems like an Enterprise Resource Planning (ERP) system, or for a system that is frequently updated. The formation of habit needs a stable context, although organizational context (technical, environmental, and social) may change over time. In such situations, the question remains: Do users really have the possibility to form habits related to an IS? Future studies may address this issue as well.

Finally, this study was conducted using data from only one Finnish university. Future studies ought to be conducted at other Finnish universities in order to test the research models proposed in the individual article. In addition, these models can be also tested in other countries, which would allow e-learning systems post-adoption behavior comparisons across different cultures.

A final observation: while conducting this scientific inquiry, answers to four research sub-questions (one main research question) were given, but several new research questions were raised. The author urges researchers to conduct further research on the post-adoption stage of IS usage in order to answer these new questions.

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APPENDICES

Appendix 1   Interview questions/themes for educators

How did you feel about Moodle when you used it as a teacher for the first time?
How do you feel about your ability about the general computer/Internet user?
Tell me about your use of Moodle in teaching.
Tell me about your general feelings on Moodle.
Tell me a positive and a negative experience with Moodle.

Appendix 2   Survey questionnaire for educators

Moodle Questionnaire for Educators

It is important for UTU computer systems administration to know how well Moodle is functioning for the purpose. The study is also part of an ongoing doctoral research. Thus, your responses are very important. It would require around 10-15 minutes to answer. Your responses will be kept confidential and only aggregate level and/or anonymous responses will be reported to the administration. For any question regarding the survey, please feel free to contact najmul.islam@tse.fi or timo.lainema@tse.fi

Choose your faculty

Please select ▾

Age

● 21-30   ● 31-40   ● 41-50   ● 51-60   ● 61-above

Gender

● Male   ● Female

Did you participate in Moodle training?

● Yes   ● No

How long have you been using Moodle for conducting courses?

Please select ▾

Please try to remember your recent experience with Moodle and answer the following questions

Which Moodle functionalities do you use? (check all that apply)

☐ Provide lecture/assignment materials
☐ Sharing news
☐ Receiving student assignments
☐ Discussion forums

☐ Grading

☐ Grouping of students

☐ Log reports

☐ Chat

☐ Moodle exam

☐ Wikis

☐ Other (please specify-use comma if there is more than one) [   ]

Currently, how many courses are you conducting using Moodle?

[Please select ▼]

If you are not using Moodle for certain courses, please state the reason

[text area]

The following questions regarding the constructs were presented randomly in the survey. However, for readers' better understanding the questions are presented in block together with their corresponding construct. The respondents had the following options to choose their answers for a particular question.
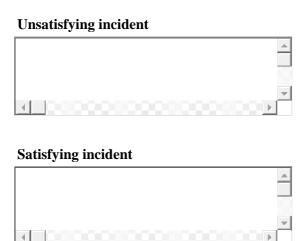
1. Strongly disagree
2. Moderately disagree
3. Somewhat disagree
4. Neutral
5. Somewhat agree
6. Moderately agree
7. Strongly agree

Construct	Item
Satisfaction	SAT-1: My overall experience of using Moodle is very satisfied
	SAT-2: My overall experience of using Moodle is very pleased
	SAT-3: My overall experience of using Moodle is very contented
	SAT-4: My overall experience of using Moodle is absolutely delighted
Continuance intention	INT-1: I intend to continue using Moodle rather than discontinue its use
	INT-2: My intentions are to continue using Moodle than use any alternative means
	INT-3: If I could, I would like to discontinue my use of Moodle
Perceived usefulness	PU-1: Using Moodle increases the control with my teaching plan
	PU-2: Using Moodle enables me to accomplish teaching infor-

	mation sharing more quickly
	PU-3: Using Moodle is of benefit to me
	PU-4: The advantages of Moodle outweigh the disadvantages
	PU-5: Overall, using Moodle is advantageous
Perceived ease of use	PEOU-1: My interaction with Moodle is clear and understandable
	PEOU-2: Interacting with Moodle does not require a lot of mental effort
	PEOU-3: I find Moodle to be easy to use
	PEOU-4: I find it easy to get Moodle to do what I want to do
Perceived access	ACCESS-1: Moodle quickly loads all the text and graphics
	ACCESS-2: Moodle provides good access
Perceived compatibility	COMP-1: Using Moodle fits with the way I like to teach
	COMP-2: Using Moodle fits with my teaching style
	COMP-3: Moodle is compatible with most aspects of my teaching
Perceived reliability	REL-1: Moodle is stable
	REL-2: Moodle operates reliably
Confirmation	CON-1: My experience with using Moodle was better than what I expected
	CON-2: The benefit provided by Moodle was better than what I expected
	CON-3: Overall, most of my expectations from using Moodle were confirmed
Perceived support	SUP-1: A specific person (or group) is available for assistance with Moodle difficulties
	SUP-2: Specialized instruction concerning Moodle is available to me
Perceived result demonstrability	RD-1: I have no difficulty telling others about the results of using Moodle
	RD-2: The result of using Moodle is apparent to me
	RD-3: I have no difficulty explaining why using Moodle may or may not be beneficial
Perceived integration	INTGR-1: Moodle effectively integrates data from existing course pages to a new course page
	INTGR-2: Moodle pulls together information from existing course pages to a new course page
Perceived behavioral control	PBC-1: I am able to use Moodle well for accomplishing my teaching
	PBC-2: Using Moodle is entirely within my control
	PBC-3: I have the resources necessary to use Moodle
	PBC-4: I have the knowledge necessary to use Moodle
Social influence	SI-1: People important to me support my use of Moodle
	SI-2: People whose opinions I value prefer that I use Moodle for doing my teaching
	SI-3: In general, the school has supported the use of Moodle

Try to remember a particular satisfying or unsatisfying incident during your use of Moodle. Describe the incidents in your own word focusing on the following issues.

a. What caused the incident? b. What happened? c. How did you react? d. What did you do?

Unsatisfying incident

Satisfying incident

Appendix 3   Survey questionnaire for students

Moodle Questionnaire for student users

Dear Moodle student users,

It is important for UTU computer systems administration to know how well Moodle is functioning for the purpose. The study is also part of an ongoing doctoral research. Thus, your responses are very important. It would require around **10 minutes** to answer. Your responses will be kept confidential and only aggregate level and/or anonymous responses will be reported to the administration.

1st prize is a Nokia C3 mobile phone. 2nd, 3rd, and 4th fizes are 1GB USB memory sticks. Winners will be randomly selected among the students who will complete this survey and wish to participate in the competition. If you are interested in participating this competition, please provide your email address at the end of this survey.

For any question regarding the survey, please feel free to contact najmul.islam@tse.fi

Regards
Najmul Islam
PhD student
Information Systems Science

Under which unit are you studying *

| Please select | ▾ |

Age

● less than 21 years   ● 21-30   ● 31-40   ● 41-50   ● 51-60
● 61-above

Gender

● Male   ● Female

How long have you been using Moodle in your studies?

Please select ▼

Which Moodle functionalities do you use? (check all that apply)

☐ Download lecture materials
☐ Checking course specific information/news
☐ Submitting assignments
☐ Discussion forums
☐ Searching available courses
☐ Chat
☐ Moodle exam
☐ Wikis
☐ Other (please specify-use comma if there is more than one)

Currently, for how many courses do you use Moodle?

Please select ▼

The following questions regarding the constructs were presented randomly in the survey. However, for readers' better understanding the questions are presented in block together with their corresponding construct. The respondents had the following options to choose their answers for a particular question.

1. Strongly disagree
2. Moderately disagree
3. Somewhat disagree
4. Neutral
5. Somewhat agree
6. Moderately agree
7. Strongly agree

Construct	Item
Perceived usefulness	PU-1: Using Moodle is of benefit to me
	PU-2: The advantages of Moodle outweigh the disadvantages
	PU-3: Overall, using Moodle is advantageous
Perceived ease of use	PEOU-1: My interaction with Moodle is clear and understand-able
	PEOU-2: Interacting with Moodle does not require a lot of mental effort
	PEOU-3: I find Moodle to be easy to use
	PEOU-4: I find it easy to get Moodle to do what I want to do
Perceived learning as-sistance	PLA-1: Moodle provides flexibility of learning with regard to time and place
	PLA-2: Moodle assists learning performance
	PLA-3: Moodle assists learning efficiency
	PLA-4: Moodle assists learning motivation
Perceived academic performance	PAP-1: I anticipate good grades in such courses where Moodle is used heavily
	PAP-2: I anticipate better grades in such courses where some of the in-class activities are replaced by Moodle (online) activities
E-learning system use	USE-1: I use Moodle frequently in this academic period
	USE-2: I use Moodle heavily during my study

Try to remember a particular satisfying or unsatisfying incident during your use of Moodle. Describe the incidents in your own word focusing on the following issues.

a. What caused the incident? b. What happened? c. How did you react? d. What did you do?

Unsatisfying incident

Satisfying incident

Appendix 4   Examples of IS post-adoption research

Article	*Theories used*	*Target population*	*Key findings*
Ahuja & Thatcher (2005)	Theory of Trying (Bagozzi & Warshaw 1990)	263 college students	Goal based construct, trying to innovate is more appropriate to study than intention. Overload and autonomy are the antecedents of trying to innovate
Au et al. (2008)	Equitable Needs fulfillment model	922 responses from hotel and airline sectors	IS performance, equitable relatedness fulfillment, and equitable work performance-related fulfillment determine satisfaction
Bhattacherjee (2001a)	IS continuance model	122 online banking users	Satisfaction is influenced by perceived usefulness and confirmation. Continuance intention is determined by satisfaction and perceived usefulness
Bhattacherjee (2001b)	IS continuance model	172 e-commerce service users	Satisfaction is predicted by confirmation. In turn, satisfaction along with perceived usefulness predicts continuance intention. However, loyalty incentive moderates the relationship between perceived usefulness and continuance intention
Bhattacherjee & Premkumar (2004)	IS continuance model	Two systems have been investigated: 1) a computer based training software (measurement in three different semesters – effective sample size 54). 2) a rapid application development tool (measurement in	IT users' beliefs and attitude toward IT change over time as they become more experienced. Disconfirmation and satisfaction are critical in order to understand these changes

		different semes-ters – effective sample size 77)	
Bhattach-erjee et al. (2008)	IS continu-ance model	81 document management sys-tem users	Satisfaction is predicted by dis-confirmation, and post-usage usefulness. Continuance inten-tion is predicted by satisfaction and IT self-efficacy. Finally, continuance behavior is pre-dicted by continuance intention and facilitating conditions
Chea & Luo (2008)	IS continu-ance model	97 e-service users	Satisfaction is predicted by confirmation and perceived usefulness. Only satisfaction influences continuance inten-tion
Deng et al. (2010)	IS continu-ance model	289 mobile Inter-net users	Satisfaction is predicted by perceived utilitarian perfor-mance, perceived hedonic per-formance, confirmation, and cognitive absorption. In turn, satisfaction causes continuance intention
Devaraj et al. (2002)	TAM, Transac-tion Cost Theory (William-son 1975), SERV-QUAL (Parasura-man et al. 1985)	134 B2C e-commerce users	Perceived usefulness, ease of use, time saving, price savings, empathy, and assurance deter-mine satisfaction with the B2C channel
Gefen et al. (2003)	TAM and trust	213 online shop-pers	Trust, perceived usefulness, and perceived ease of use de-termine continued use
Hong et al. (2006)	IS continu-ance mod-el, TAM	1826 mobile In-ternet users	Satisfaction is predicted by confirmation, and perceived ease of use. Continuance inten-

			tion is predicted by satisfaction, perceived usefulness, and perceived ease of use
Hong et al. (2008)	Expecta-tion-Desire congruen-cy (Oliver 1993; Spreng et al. 1996)	345 web-portal users	Satisfaction is predicted by both expectation-congruency and desire-congruency. Continuance intention is predicted by attitude and perceived switching cost
Hsieh & Wang (2007)	IS continu-ance mod-el, TAM	200 ERP users	Both satisfaction and extended use are predicted by perceived usefulness and perceived ease of use
Hsieh et al. (2008)	Decom-posed TPB	451 Internet-TV users	Attitude, Internet PC ownership (negative impact), and personal network exposure influence continuance intention
Hsu et al. (2006)	TPB, ECT	201 online shop-pers (2 phase sur-vey)	TPB variables before and after use impact on satisfaction via disconfirmation. Continuance intention is shaped by satisfac-tion, attitude after usage, per-ceived behavioral control after usage, and interpersonal influ-ence after usage
Jin et al. (2010)	Decom-posed ECT	240 online com-munity members	Positive disconfirmation of purpose value and positive dis-confirmation of the entertain-ment value are the drivers of satisfaction. Continuance inten-tion is predicted by satisfaction and affective commitment
Kang et al. (2009)	IS continu-ance model	349 web-portal users	Satisfaction is predicted by perceived usefulness and per-ceived enjoyment. Continuance intention is predicted by past use, perceived usefulness, per-ceived enjoyment, satisfaction, self-image congruity, and re-

			gret (negative impact)
Kamis et al. (2008)	Cognitive fit theory (Vessy 1991)	329 decision support system users	Perceived usefulness, perceived enjoyment, and perceived control determine users' intention to continue using the IS
Karahanna et al. (1999)	TRA, IDT	268 (107 adopters, 161 users) Windows users	Attitude and perceived voluntariness (negative impact) affect continuance intention. Only subjective norm affect the adoption intention
Kim et al. (2005)	UTAUT, past use	2075 cross-sectional and 990 longitudinal responses of online news site users	With the increase in past use, user behavior becomes less evaluative and intentional. This supports habit moderates the relationship between intention and behavior
Kim & Malhotra (2005)	TAM, theory of belief updating (Hogarth & Einhorn 1992), self-perception theory (Bem & McConnell 1970)	298 web-portal users (298 users in 1st wave, 189 users in 2nd wave)	Continuance intention is determined by prior use. In addition other beliefs are also determined by prior perceptions related to beliefs and prior use
Kim et al. (2007)	Thinking-Feelings model	218 mobile Internet users	Attitude, usefulness, and pleasure are the drivers of continuance intention
Kim & Son (2009)	Dual model	510 web-portal users	Use intention is a dedication based outcome which is predicted by perceived usefulness and loyalty
Kim (2010)	IS continuance model, TPB	207 mobile data service users	Satisfaction is predicted by confirmation and perceived fee (negative impact). Continuance intention is predicted by perceived usefulness, perceived enjoyment, satisfaction, social

			norms, perceived behavioral control, and perceived fee (negative impact)
Koufairs (2002)	TAM, Flow theory	280 online shoppers	Intention to return is determined by perceived usefulness and shopping enjoyment
Li et al. (2011)	Self-developed	70 SMEs using online direct sales channels	Continuance intention is solely predicted by perceived relative advantage
Limayem et al. (2007)	IS continuance model	227 Internet users	Confirmation and perceived usefulness predict satisfaction. In turn, satisfaction and perceived usefulness predict continuance intention. Continued use behavior is predicted by continuance intention. However, habit moderates this relationship
Lin et al. (2005)	IS continuance model	254 web-portal users	Confirmation and perceived playfulness affect satisfaction. Perceived usefulness, perceived playfulness, and satisfaction affect continuance intention
Parthasarathy & Bhattacherjee (1998)	Adopter classification by Rogers (2003)	443 past and present online service users	Discontinuers rely more heavily on interpersonal influence and less on external influence than adopters
Qureshi et al. (2009)	Trust	383 online shoppers from New Zealand and 362 online shoppers from northern Ireland	Trust fully mediates the relationships between perceived reputation and perceived capability of order fulfillment and the repurchasing intention. Trust partially mediates the relationship between perceived website quality and the repurchasing intention
Recker (2010)	IS continuance model	529 process modeling grammar users	Satisfaction is determined by confirmation, perceived usefulness, perceived ease of use, and grammar familiarity. Continuance intention is determined by

			perceived ease of use, perceived usefulness, and satisfaction
Shih (2008)	Innovation diffusion theory	279 Internet users	Compatibility, playfulness, relative advantage, and complexity affect continuance intention. The impact of complexity is negative
Sorebo & Eikebrokk (2008)	IS continuance model	161 cash transaction system users (mandated use)	Satisfaction is predicted by confirmation, perceived usefulness, and perceived ease of use
Thong et al. (2006)	IS continuance model, TAM	811 mobile Internet users	Satisfaction is predicted by confirmation, perceived ease of use, perceived usefulness, and perceived enjoyment. Continuance intention is predicted by satisfaction, perceived usefulness, perceived ease of use, and perceived enjoyment
Venkatesh & Goyal (2010)	ECT	1143 users of an electronic human resource information system	Curvilinear models are more appropriate than linear models in explaining IS continuance while using ECT
Wang (2008)	IS success model	240 e-commerce users	IS continuance is predicted by perceived value and user satisfaction. Perceived value and user satisfaction are influenced by information quality, system quality and service quality
Wang et al. (2010)	Value based model	298 professional technology temple users	Emotional values shape satisfaction while satisfaction predicts continuance intention

Appendix 5   Examples of e-learning acceptance research

Article	Theories used	Target population	Key findings
Chen (2011)	UTAUT	626 students	E-learning acceptance is driven by intention. Educational compatibility and technology expectancy determine intention. UTAUT variables affect intention through the mediation of technology expectancy
Hu et al. (2003)	TAM	138 educators before training 134 educators after training	Before training intention is predicted by perceived usefulness, self-efficacy, and subjective norm. After training only perceived usefulness and self-efficacy determine intention to use
Lee et al. (2005)	TAM	544 students	Perceived usefulness, perceived enjoyment and attitude determine intention.
Lee (2008)	TAM	1107 students	Intra-organizational factors and extra-organizational factors affect intention through the mediation of perceived usefulness and perceived ease of use.
Lee et al. (2011)	TAM	357 employees	Perceived ease of use and perceived usefulness mediate the effects of organization support, management support, computer self-efficacy, and task interdependence on intention
Liu et al. (2009)	TAM, flow	102 students	Students felt more flow experience when text, audio and video were used
Liu et al. (2010)	TAM	436 students	Perceived usefulness, perceived ease of use, and perceived interaction affect use intention

Ngai et al. (2007)	TAM	836 students	Attitude mediates the effect of technical support, perceived ease of use, and perceived usefulness on usage
Ong et al. (2004)	TAM	140 engineers	Intention is predicted by perceived usefulness, perceived ease of use, and perceived credibility
Pynoo et al. (2011)	UTAUT	Longitudinal surveys (64 educators in first survey, 41 educators in second survey)	Self-reported usage predicts actual usage
Raaij & Schepers (2008)	TAM	40 managers in MBA class	Use is solely predicted by perceived usefulness
Saade & Bahli (2005)	TAM, cognitive absorption	102 students	Perceived ease of use and perceived usefulness mediate the effect of cognitive absorption on intention
Sanchez-Franco (2010)	TAM, Flow	431 students	Behavioral intention is predicted by flow, perceived ease of use, perceived usefulness, and perceived affect quality.
Sanchez & Hueros (2010)	TAM	226 students	Attitude mediates the effect of perceived ease of use, perceived usefulness, and technical support on usage
Teo et al. (2009)	TAM	250 educators from Singapore, 245 educators from Malaysia	TAM was consistent in both samples
Teo (2009)	TAM	475 educators	Intention is predicted by attitude, self-efficacy, and perceived usefulness
Yi & Hwang (2003)	TAM	109 students	Use is predicted by intention and self-efficacy. Intention is predicted by perceived usefulness and perceived ease of use

Paper 1:   Islam, A. K. M. N. – Mäntymäki, M. (2011) Culture and student samples as moderators of continued IT usage: A meta-analysis of IS continuance literature. *Paper presented at the 15th Pacific Asia Conference on Information Systems (PACIS)*, Brisbane, Australia, July 7–11, 2011, Paper 84

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9 July 2011

Culture And Student Samples As Moderators Of Continued IT Usage: A Meta-Analysis Of IS Continuance Literature

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CULTURE AND STUDENT SAMPLES AS MODERATORS OF CONTINUED IT USAGE: A META-ANALYSIS OF IS CONTINUANCE LITERATURE

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Abstract

The benefits from ICT investments materialize through sustained usage rather than initial acceptance. Hence, the amount of research on continued IT usage (IS continuance) employing the Expectation-Confirmation Model (ECM) has been increasing steadily in recent years. In this body of literature, empirical results regarding the correlations between the key constructs of ECM have not been entirely consistent. Thus, we conduct a meta-analysis of prior IS continuance literature to examine whether the flux in the results can be explained by the presence of moderating effects. First, we investigate whether the cultural context of the empirical study or the use of student samples has influenced the results. Second, we examine whether including perceived ease of use in the ECM has received consistent empirical support. The results demonstrate that both cultural context and student samples potentially act as moderators, and thus have caused the flux in the empirical results. Furthermore, the results show that perceived ease of use is a viable extension to ECM.

Keywords: IS continuance, expectation-conformation theory, meta-analysis, technology acceptance

1 INTRODUCTION

The fact that benefits from investment in ICT only materialize for companies through sustained usage, rather than initial acceptance, has been widely addressed in literature on individual-level technology adoption (Bhattacherjee 2001a; Kim & Son 2009). The focus of this stream of research has gradually been shifting from initial acceptance (e.g., Davis 1989) toward understanding of the drivers of continued use (e.g., Bhattacherjee 2001a; Kim & Son 2009; de Guinea & Markus 2009). According to Bhattacherjee (2001a), the long-term viability of an IS and its eventual success depend on its continued use rather than first-time use.

Compared to the amount of literature based on initial technology acceptance, continued use has not, thus far, enjoyed a comparable level of attention (Larsen et al. 2009). However, the number of publications within this stream has been increasing (e.g., Hayashi et al. 2004; Limayem & Cheung 2008; Thong et al. 2006; Kim & Son 2009; Guinea & Markus 2009). One of the key contributions to the literature on continued use is the Expectation-Confirmation Model (ECM) developed to assess Information System (IS) continuance by Bhattacherjee (2001a), which has had several subsequent studies built upon it (e.g., Thong et al. 2006; Limayem & Cheung 2008; Larsen et al. 2009).

Given that the stream of research examining continued IS use using the ECM is expanding, it has become viable for the further development of the research to scrutinize the consistency of the key assertions of the theoretical perspective it is constituted on. In particular, we address two areas where the prior literature offers mixed or inconclusive empirical evidence. First, there is flux regarding the correlations between the key constructs of ECM. Some studies have reported high correlations (e.g., Limayem & Cheung 2008; Lin et al. 2005; Sorebo et al. 2009), while others have found the correlations to be either low or even negative (e.g., Recker 2010; Hong et al. 2006; Lee 2010). Second, Bhattacherjee (2001a) did not include perceived ease of use (PEOU) in his original model, whilst subsequent studies (e.g., Thong et al. 2006; Tao et al. 2009; Lee 2010) have found significant relationships between PEOU and the constructs of the original ECM. As a result, research examining the extent to which the central tenets of ECM have been proven to be empirically consistent, and whether incorporating PEOU is a meaningful addition to ECM, is appropriate.

We believe that a potential reason for the somewhat mixed results obtained in prior literature may relate to the moderating effects caused by the sample characteristics. In practice, we conduct a meta-analysis of the prior ECM-based IS continuance literature and examine the effect of one contingent factor (the geographical area where the data were collected), and one individual related factor (students vs. non-students).

First, as ECM-based studies have been conducted in several geographical areas such as Hong Kong, Norway, South Korea Taiwan, the Ukraine, and the USA, we investigate whether the results vary across different geographical areas. Second, the use of student samples in empirical studies has been much debated in the literature (Oakes 1972; Schultz 1969). Prior literature has found stronger relationships between Technology Acceptance Model (TAM) constructs in studies using student samples (Schepers & Wetzels 2007). Thus, we test whether the ECM results vary across student and non-student samples. To the best of our knowledge, this is the first meta-analysis of ECM-based studies.

2 EXPECTATION-CONFIRMATION MODEL OF IS CONTINUANCE

Bhattacherjee (2001a) developed the ECM based on the Expectation-Confirmation Theory (ECT) (Oliver 1980) and empirically tested it among online banking customers. ECT is widely used in consumer behavior literature to study consumer satisfaction, post-purchase behavior (e.g.

repurchasing, complaining), and services marketing in general (Bhattacherjee 2001a; Oliver 1980). ECM is built on the assumption that the users – after first time acceptance and a period of initial use – will form an opinion on which their pre-acceptance expectations are confirmed, which is measured with the *Confirmation* (CON) construct. After confirmation, the user forms a perception about the benefits of using the IS, which is captured with *Perceived usefulness* (PU). Thus, *perceived usefulness* can be viewed as the post expectation belief (Bhattacherjee 2001a). After a period of time, both *confirmation* and *perceived usefulness* form the basis of user *satisfaction* (SAT) with the IS in question. Finally, *perceived usefulness* and *satisfaction* impact on the willingness of users to continue the usage of an IS, which is measured with *IS continuance intention* (INT). The original ECM is presented in Figure 1 and shown with solid lines.
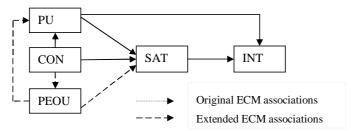
Figure 1.   *The ECM model.*

After the original ECM, a number of extensions have emerged in the literature (e.g., Thong et al. 2006; Hong et al. 2006). One of the most frequent extensions is to add *perceived ease of use* (PEOU) (e.g., Tao et al. 2009; Lee 2010). PEOU was not included in the original ECM framework since, according to Bhattacherjee (2001a), the evidence from TAM-based studies demonstrates that PU alone is adequate in the IS continuance context. Bhattacherjee (2001a) stated that PU is the only belief that can be demonstrated to consistently influence user intention across the temporal stages of IS use.

Thereafter, a number of studies have included PEOU in the original ECM framework (e.g., Thong et al. 2006; Tao et al. 2009; Hong et al. 2006; Lee 2010). Specifically, Hong et al. (2006) compared ECM with and without PEOU and found adding PEOU to the framework increases its explanatory power by 17% within the mobile internet context. There are at least two main arguments for including it in ECM. First, there is strong evidence from TAM-based studies that PEOU is a significant antecedent of technology use (Venkatesh & Bala 2008; Davis 1989). Second, the inclusion of PEOU can help to better understand the role of the complex nature of an IT in explaining user behavior in the continued IT use context. This is particularly salient if the IT being studied is continuously being altered by new services/functionalities (e.g. mobile services) that are introduced on a regular basis, or if it contains a vast number of functionalities, making the system very complex. The new relationships in the extended ECM are shown in Figure 1 with dotted lines. The conceptualizations of the constructs of the extended ECM are shown in Table 1.

Construct	Definition
Confirmation	The degree to which the users' original expectation is confirmed
Perceived usefulness	The salient beliefs that using the IS will enhance his or her job performance
Perceived ease of use	The degree to which an individual perceives using the IS is free of effort
Satisfaction	Individual's feelings of pleasure or disappointment resulting from comparing their perceptions of IS to their expectation level
Intention to use	The intention to participate and continue using the IS

Table 1.   *IS continuance constructs.*

3   RESEARCH METHODOLOGY

3.1   Hypotheses development

To investigate the consistency of results obtained in the ECM-based studies, we examine the relationships between the constructs that are included in the extended ECM. These relationships are not formally hypothesized in this paper. However, these relationships lay the foundation for the subsequent stage of the research process, i.e. the investigation of the moderating effects of the cultural context and student vs. non-student sample.

Numerous studies have examined the influence of culture on the adoption and diffusion of new IT (e.g., Straub et al. 1997; Al-Gahtani et al. 2007; Sun & Zhang 2006). Based on the findings of this body of literature, it is plausible to assume culture also influences continued IT use.

Several approaches have been proposed for studying cultural effects in relation to technology use (Al-Gahtani et al. 2007). Among those, Hofstede's cultural dimensions (Hofstede 2001) have been widely used in IS research (Straub et al. 1997). These dimensions facilitate national-level analyses and allow multiple country comparisons. Hofstede (2001) describes four dimensions that can be used to distinguish different cultures: Power Distance Index (PDI), Uncertainty Avoidance Index (UAI), Individualism (IND) and Masculinity (MAS). Table 2 lists the four dimensions along with a brief description of each. The possible relationships between these dimensions with regard to IS use are discussed in the following.

Dimension	Description
Power Distance	Degree of inequality among people which the population of a culture considers normal
Uncertainty Avoidance	Degree to which people in a culture feel uncomfortable with uncertainty and ambiguity
Individualism	Degree to which people in a culture prefer to act as individuals rather than as members of groups
Masculinity	Degree to which values like assertiveness, performance, success, and competition prevail among people of a culture over gentler values like quality of life, maintaining warm personal relationships, service, care for the weak, etc.

Table 2.   Hofstede's four cultural dimensions.

First, it has to be stated that a computer based system is less capable of delivering information with rich social cues. This filtering out of social cues is known as the leveling effect (Straub et al. 1997). For societies in which the distance between managers and workers is seen to be high with regard to power, the leveling effect of computer-based system is not seen or felt to be a desirable feature (Straub et al. 1997). Thus, in high PDI cultures, we expect that the correlations between the ECM constructs will be lower than in low PDI cultures. Second, according to the social presence theory, people in societies that exhibit low levels of individualism may be against certain technologies, such as communication technology, since they mute the group effect (Sun & Zhang 2006). Thus, in low IND cultures, we expect the correlations between the ECM constructs will be lower than in high IND cultures. Third, according to the information richness theory, individuals choose systems by matching the information requirements of the task to the information richness of the system (Straub et al. 1997; Al-Gahtani et al. 2007). In societies with high UAI, individuals have higher needs for the richness of technology. Thus, in high UAI cultures, we expect that the correlations between the ECM constructs will be lower than in low UAI cultures. Finally, it can be predicted that a system that does not convey the social presence of the communicator will not be favored in cultures in which masculinity is a strong cultural value (Straub et al. 1997). Thus, from the above discussion, we can expect that in societies with high PDI, low IND, high UAI and high MAS, individuals will not be positive towards

IT, meaning that the correlations between the extended ECM constructs will be low.

Most of the ECM-related studies have been conducted in Hong Kong, Norway, Taiwan, the Ukraine, and the USA. Hofstede's indices values for these countries are retrieved from Hofstede (2001) and Bradley (1997) and given in Table 3. Following the procedure suggested by Straub et al. (1997), we have combined Hofstede's indices to create a 'Combined Index' (CI) for these cultures. To calculate this index, UAI, PDI and MAS were added to the 100-IND, which is in keeping with the argument that IND moves in the opposite direction to other scales in its effect on the perceptions and use of an IT. The purpose of calculating CI is to mathematically express the simultaneous effect of all four Hofstede's dimensions as a single number. However, it should be viewed as a useful approximation.

Country	PDI	IND	MAS	UAI	CI
South Korea	60	18	39	85	266
Hong Kong	68	25	57	29	229
Taiwan	58	17	45	69	255
Norway	31	69	8	50	120
USA	40	91	62	46	154
Ukraine	23	51	13	57	142

Table 3.   Country specific Hofstede's indices values.

From the calculated CI value, we observe that South Korea, Hong Kong and Taiwan can be grouped together (average CI = 250) as their CI values are very close to each other. We may call this group a representative of non-western culture. On the other hand, Norway, the Ukraine, and the USA can be grouped together (average CI = 138). Similarly, we may call this group a representative of western culture. This type of grouping was done due to the limited sample size for each country (discussed in the Moderator Analysis section). This kind of grouping is supported by the extant literature (Schepers & Wetzels 2007). The hypotheses related to the cultural effect on IS use are given in Table 4.

Hypothesis #	Hypothesis
H1a	The correlation, CON-PU is significantly stronger for Western than Non-western cultures
H2a	The correlation, CON-SAT is significantly stronger for Western than Non-western cultures
H3a	The correlation, PU-SAT is significantly stronger for Western than Non-western cultures
H4a	The correlation, PU-INT is significantly stronger for Western than Non-western cultures
H5a	The correlation, SAT-INT is significantly stronger for Western than Non-western cultures

Table 4.   Culture related hypotheses.

Using student samples for empirical studies has been a much debated issue for many decades (Oakes 1972; Schultz 1969), and IS is not an exception. Researchers have found stronger relationships between TAM constructs for student samples (Schepers & Wetzels 2007). On the other hand, it is well established that age is a potential moderator of IS initial use. For example, Venkatesh et al. (2003) found that younger users placed more importance on PU. Analogous with this line of reasoning, we expect that the correlations in the extended ECM are stronger for the student sample than the non-student sample. The related hypotheses are given in Table 5.

Hypothesis #	Hypothesis
H1b	The correlation, CON-PU is significantly stronger for students than non-students
H2b	The correlation, CON-SAT is significantly stronger for students than non-students
H3b	The correlation, PU-SAT is significantly stronger for students than non-students
H4b	The correlation, PU-INT is significantly stronger for students than non-students
H5b	The correlation, SAT-INT is significantly stronger for students than non-students

Table 5.   Type of respondent related hypotheses.

3.2 The literature search

A review of the relevant literature published over the period from 2001 to 2010 was conducted. Firstly, we searched in databases such as ABI/INFORM, Business Source Complete, Electronic Journals Service, ScienceDirect, and Wiley InterScience. The search was conducted by using keywords like Expectation-Confirmation, Expectation-Disconfirmation, information systems continuance, and post-adoption use. Webster and Watson (2002) suggest going through a journal's table of contents with a keyword-based search. Thus, to ensure that the relevant articles were included, we performed a manual search of each issue (from 2001 to 2010) of the six highest ranked journals from the senior scholar's basket of IS journals: MIS Quarterly, Information Systems Research, Information System Journal, Journal of the Association of Information Systems, Journal of Management Information Systems and European Journal of Information Systems.

Thereafter, we went backward by reviewing the citations for the articles identified to find more articles. Each article was examined to ascertain that the following criteria applied: 1. The study has to be supported by quantitative data. 2. The study has included the three factors of the basic ECM framework to explain continuance intention (*confirmation, perceived usefulness, and satisfaction*).

Certain articles passed the above criteria but were excluded from the meta-analysis if e.g. the correlation matrix was not reported (Bhattacherjee 2001b). Finally, after the systematic literature review (Webster & Watson 2002; Okoli & Schabram 2010) a total of 21 articles were retained for the meta-analysis.

3.3 The meta-analysis

We found a total of 22 studies from the 21 articles. In Bhattacherjee and Premkumar (2004), the authors reported three studies (two for the Computer Based Tutorials, and one for the Rapid Action Development Tool). We included two studies (one for each system) from these in the analysis. To avoid a potential bias in the results caused by using the same research settings, we did not include all three studies. Table 6 summarizes the research settings of all the studies included in the meta-analysis.

Article	Target technology and sample characteristics	Type of respondents	Country
Bhattacherjee 2001a	Users of online banking. Mean age of the respondents was 33.7 years.	122 mixed users**	USA
Hsu et al. 2004	College student users of WWW.	235 students	Taiwan
Bhattacherjee and Premkumar 2004	Undergraduate student users of computer based tutorial.	54 students	USA
	Graduate student users of the rapid action development tool.	77 students	USA
Lin et al. 2005	Undergraduate student users of WWW.	254 students	Taiwan
Thong et al. 2006	The mobile internet users of e-government services. The age of the respondents ranged from 16 to 60 years. The average age was 30 years. Most of the respondents were in their 20s (48.0%), 30s (35.0%).	811 mixed users**	Hong Kong
Hong et al. 2006	The mobile internet users of e-government services. The age of the respondents ranged from 13 to 76 years. The average age was 25.4 years. Most of the respondents were in their 20s (53.1%), 30s (18.0%) and teens (23.6%).	1826 mixed users**	Hong Kong
Roca et al. 2006	Users of e-learning. People who attended UN staff college training. Average age: 33.7 years. 45% of the respondents had completed a college/university degree and 19% had completed postgraduate degree.	172 mixed users**	Mixed*
Liao et al. 2007	Users of e-learning. Most of the respondents were in	400 mixed	Taiwan

	their 20s (46.27%), 30s (30.92%). Precisely, 34.97% of the respondents were students.	users**	
Hsieh and Wang 2007	Organization users of an ERP system.	200 non-students	Hong Kong
Limayem and Cheung 2008	Undergraduate student users of e-learning.	505 students	Hong Kong
Sorebo and Eikebrokk 2008	Organization users in a mandated context.	161 non-students	Norway
Bhattacherjee et al. 2008	Organization users of a document management system.	81 non-students	Ukraine
Liao et al. 2009	Users of e-learning. A total of 33.1% of respondents reported student as their profession. A total of 95% of the students who were registered in the e-learning system were adults.	626 mixed users**	Taiwan
Kang et al. 2009	Undergraduate student users of online services.	349 students	South Korea
Larsen et al. 2009	Teachers who use e-learning for teaching.	135 non-students	Norway
Sorebo et al. 2009	Teachers who use e-learning for teaching.	124 non-students	Norway
Tao et al. 2009	Student users of business simulation games.	185 students	Taiwan
Recker 2010	Organization users of modeling grammars.	529 non-students	Mixed*
Kim 2010	Graduate student users of mobile data services.	214 students	South Korea
Deng et al. 2010	Graduate and undergraduate student users of mobile internet services.	289 students	USA
Lee 2010	Students of a continuing education program using e-learning. Most of the respondents were between 18 and 24 years old (55.4%) and had school diplomas or Bachelor's degrees (51%).	363 mixed users**	Taiwan

*: *Studies not taken in the type of culture moderator analysis.*

**: *Studies not included in the type of respondents moderator analysis.*

Table 6.   Summary of the research settings.

From each study, we obtained the following information: sample size, the reliability of the constructs, correlations for each hypothesis. We followed the guidelines of Hunter and Schmidt (2004) to analyse data. First, the reported correlations were corrected for measurement error using the following formula.

$$r = \frac{r_{xy}}{\sqrt{r_{xx}} \sqrt{r_{yy}}}$$, where r_{xy} is the observed correlation in the specific study, r_{xx} and r_{yy} are the reliability

of the estimates of the two variables in the correlation.

Then, we calculated the average correlation in which each correlation is weighted by the number of observations in that study using the following formula.

$$\bar{r} = \frac{\sum N_i r_i}{\sum N_i}$$, where $\bar{r}$ is the meta-analysis effect size corrected for reliability and measurement error,

r_i is the correlation value after correcting measurement error, and N_i is the sample size of the particular study.

Thereafter, we calculated the 95% confidence intervals of the corrected effect sizes using standard error to determine the significance of each relationship. As suggested by Hwang (1996), confidence intervals that do not include zero ensure that the relationship is significant.

A final test was performed to determine the robustness of the findings. We calculated the fail-safe statistic for each of the relationships. The fail-safe value provides the number of non-significant correlations (studies) that would have to be included in the sample to reverse the conclusion that a significant relationship existed. The fail-safe value can be calculated using the following formula as specified by Hunter and Schmidt (2004):

$$FSN = k\left(\frac{\bar{r}}{r_c} - 1\right), \text{ where } r_c \text{ is the pre-specified value of a correlation.}$$

Table 7 shows the meta-analysis results. Cohen and Cohen (1983) established a general heuristics to judge the magnitude of the effect sizes as strong (0.50), moderate (0.30), or weak (0.10). As can be seen from the corrected average correlations, the relationships are moderate to strong. From the values of the 95% confidence interval, we see that there is no interval containing zero. It suggests that all the relationships were significant. The fail-safe value ensures the robustness of the findings. A rule of thumb is that the fail-safe value should be at least twice the number of studies (k) in the meta-analysis. All of the correlations of the ECM had the ratio of the fail-safe value to the number of studies greater than 2.0. Thus, all the correlations of the extended ECM were significant.

Correlation	Total N	k	Mean	S.D	95% confidence interval		Fail-safe value to reduce the mean effect size to 0.1	Decision
					Lower limit	Upper limit		
CON-PU	7712	22	0.48	0.20	0.40	0.56	84	significant
CON-SAT	7712	22	0.57	0.30	0.44	0.70	103	significant
PU-SAT	7712	22	0.45	0.29	0.33	0.57	77	significant
PU-INT	7351	20	0.67	0.12	0.62	0.72	114	significant
SAT-INT	7351	20	0.57	0.12	0.52	0.62	94	significant
CON-PEOU	5273	10	0.48	0.21	0.35	0.61	38	significant
PEOU-PU	5273	10	0.49	0.33	0.29	0.69	39	significant
PEOU-SAT	5273	10	0.50	0.24	0.35	0.65	40	significant

Table 7.   Meta-analysis results.

3.4   Moderator analysis

A heterogeneity (or homogeneity) test can be used as an aid in deciding whether observed effect sizes are more variable than would be expected based on sampling error alone (Hedges 1982). If they are, then there is a strong basis for searching for moderators (Hunter & Schmidt 2004).

We performed a moderator analysis only for the relationships of the original ECM because we had only a limited number of studies (only 10) with the *perceived ease of use* extension. As a result, we did not have a sufficient sample size to categorize these studies using the moderator variables.

In order to investigate the existence of moderators, the Q statistic for each relationship was calculated (Cooper & Hedges 1994). The calculated Q value was compared to a critical value, which is the chi-square value with k-1 degrees of freedom, where k is the number of studies. If the Q value exceeds the critical value, a moderating effect may exist. Table 8 illustrates the results of the moderator analysis. From this table, we see that the calculated Q value exceeds the critical value for each relationship indicating the presence of moderators in the relationships.

Correlation	Q value	Critical value	Decision
CON-PU	449.58	32.67	Yes
CON-SAT	1422.15	32.67	Yes
PU-SAT	1018.10	32.67	Yes
PU-INT	393.11	30.14	Yes
SAT-INT	907.09	30.14	Yes

Table 8.   Moderator analysis (Homogeneity test).

To examine the moderating effects, clusters of studies were formed based on the data in Table 6.

First, we distinguished between non-western cultures (China, South Korea and Taiwan; k=12, N=5968) and western cultures (Norway, Ukraine and USA; k=8, N=1043). We excluded studies (Recker 2010; Roca et al. 2006) that had mixed respondents to avoid potential biases in the results.

Thereafter, we distinguished between students (k=9, N=2162) and non-students (k=6, N=1230). Again, because samples that included students and non-students may have biased the results, we did not include certain studies (Bhattacherjee 2001a; Thong et al. 2006; Liao et al. 2009; Liao et al. 2007; Roca et al. 2006; Hong et al. 2006; Lee 2010) in the analysis.

Finally, a Fisher Z-test was conducted to investigate the significance (at 0.05 level) of the difference between the correlations of the two groups. As can be seen from Table 9, when we distinguished between the two cultures, the difference was significant for CON-PU, CON-SAT, PU-SAT and SAT-INT which means H1a, H2a, H3a and H5a are supported. The only relationship that was not moderated by culture was PU-INT, which may be due to the limited number of studies in the meta-analysis. Again, distinguishing between students and non-students demonstrates the difference was significant for CON-PU, CON-SAT, PU-INT and SAT-INT, which means H1b, H2b, H4b and H5b are supported. Overall, in most of the cases, the correlation coefficients of the student samples were greater than the ones using non-student samples. This finding is consistent with prior research conducted with TAM-based studies (Schepers & Wetzels 2007). The only relationship that was not supported was PU-SAT.

Overall, we may conclude that the *type of respondent* and the *type of culture* are two potential moderators for the ECM.

Correlation	Type of culture				Type of respondent			
	Hypot-hesis #	Non-western	Western	Result	Hypot-hesis #	Student	Non-student	Result
CON-PU	H1a	0.52*	0.61*	supported	H1b	0.62*	0.31*	supported
CON-SAT	H2a	0.62*	0.71*	supported	H2b	0.63*	0.38*	supported
PU-SAT	H3a	0.39*	0.60*	supported	H3b	0.55*	0.68*	not supported
PU-INT	H4a	0.69	0.65	not supported	H4b	0.65*	0.50*	supported
SAT-INT	H5a	0.56*	0.72*	supported	H5b	0.63*	0.38*	supported

*: difference is significant at 0.05 level.

Table 9.   Analysis of the moderating effects with two moderators.

4   IMPLICATIONS

Given that the amount of research on IS continuance has been increasing, it is ever more important to recognize the potential influence of the empirical research setting. Thus, our meta-analysis has four key implications for IS continuance research.

First, analyzing the moderating effects demonstrated that the type of respondent is a potential moderator of ECM theory. It suggests the use of student samples appears to reinforce the correlations between the ECM constructs, except for the relationship between perceived usefulness and

satisfaction. A possible interpretation for this is that students perceive satisfaction as being determined also by other factors such as perceived enjoyment. Furthermore, an interesting area for further investigation would be to examine to what extent affective factors influence satisfaction and whether this could explain the difference between student and non-student samples. Taken together, the use of student samples may provide an overly optimistic view of the users' intention to continue using IT.

Second, with regard to the effect of culture, all correlations except the correlation between perceived usefulness and use intention are higher in studies with samples from western cultures. This leads us to ponder whether the items used in measuring the constructs of ECM stem from a western way of comprehending meaning and should they thus be culturally adapted in order to be more applicable to other cultural contexts.

Third, the meta-analysis provided clear support for all the key relationships of ECM. This indicates that ECM is fundamentally a robust theoretical tool.

Fourth, based on the meta-analysis, perceived ease of use is a meaningful extension to ECM. We suggest the complexity of the target technology and the users' interaction with it should be more carefully scrutinized and, based on this, researchers should determine whether to include perceived ease of use in the research model.

Altogether, the potential existence of moderating effects can explain the somewhat mixed empirical results between the key constructs of ECM. To sum up the main findings, the meta-analysis demonstrated that the key ECM relationships are consistent in the prior literature. Furthermore, cultural context and the use of student samples are viable explanations for explaining flux in the empirical results.

5   LIMITATIONS AND FUTURE RESEARCH

There are several limitations to this study and these provide ideas for future research. First, a potential limitation to be acknowledged is that the measures used in the analyzed studies vary. As argued by Petter and McLean (2009), the potential downside of including studies that use different measures in the meta-analysis is that the measurement is a moderator of the relationships between the constructs.

Second, only two potential moderators were included in the analysis of this study. In addition to the two moderators examined here, other moderating effects may exist. Previous studies have found differences in user acceptance between voluntary and mandatory systems (Wu & Lederer 2009; Venkatesh & Bala 2008), which suggest *voluntariness* is a potential moderator. Unfortunately, the number of studies was not sufficient to include *voluntariness* in the meta-analysis. Secondly, *type of technology* might be another potential moderator. For example, PEOU has been found to be the strongest belief affecting technology continuance regarding mobile internet services which frequently add new services (Thong et al. 2006). Again, due to the limited number of studies, we were not able to classify the studies according to this criterion. For further research, we propose that two additional moderators: *voluntariness* and *type of technology* be included in the analysis.

Third, in this research, we examined the correlation coefficients. As a second concrete path for further research, a meta-analysis investigating the causal paths would be highly appropriate. For this purpose, an individual meta-analysis for all possible relationships among the variables is required to develop a correlation matrix.

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*: *these papers were used in the meta-analysis*

Paper 2:   Islam, A. K. M. N. (2011) The determinants of the post-adoption satisfaction of educators with an e-learning system. *Journal of Information Systems Education (JISE)*, Vol. 22 (4), 319–332

This paper originally published in the Journal of Information Systems Education (JISE), Vol. 22, No. 4. Reprinted with permission from the JISE.

The Determinants of the Post-Adoption Satisfaction of Educators with an E-Learning System

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ABSTRACT

This paper examines factors that influence the post-adoption satisfaction of educators with e-learning systems. Based on the expectation-confirmation framework, we propose a research model that demonstrates how post-adoption beliefs affect post-adoption satisfaction. The model was tested at a university by educators (n = 175) who use an e-learning platform to conduct their teaching. The results suggest that post-adoption satisfaction is driven by confirmation, perceived system quality, perceived usefulness, perceived work compatibility and perceived support. These core determinants of satisfaction explained around 83% of the total variance of satisfaction in this study.

Keywords: Faculty attitudes, Learning Management System (LMS), System use, User satisfaction.

1. INTRODUCTION

The traditional context of learning is being altered by e-learning systems within educational institutions and corporations. The extension of the Internet as a delivery platform and the increasing use of location-independent education and training programs have resulted in an increase in educational and business organizations adopting and using e-learning systems. Furthermore, the increase in investment in e-learning systems by educational and business organization has meant they have become increasingly aware of the importance of seeking a return on their investment.

The evaluation of user satisfaction is regarded as one of the most important methods for evaluating e-learning systems (Wang, Wang, and Shee, 2007). Bailey and Pearson (1983, p. 531) define user satisfaction as "the sum of one's positive and negative reactions to a set of factors." Doll and Torkzadeh (1988, p. 261) describe it as "the affective attitude toward a specific computer application by someone who interacts with the application directly." Eagly and Chaiken (1998, p. 296) regard user satisfaction as "a psychological tendency expressed by evaluating a particular entity with some degree of favor and disfavor."

User satisfaction with Information Systems (IS) has been seen as one of the most important issues in IS research and it has often been linked to two important outcomes: IS success (DeLone and McLean, 2003) and the continued use of IS (Bhattachejee, 2001a). User satisfaction is an important measure of IS success and is often regarded as the easiest and the most useful way to evaluate it (DeLone and McLean, 2003). Additionally, the expectation-confirmation based IS continuance model views it as one of the most important

predictors of IS continuance intention (Bhattacherjee, 2001a). Due to its importance, organizations often invest significant amounts of financial and human resources in the measurement and analysis of user satisfaction while simultaneously trying to improve the level of satisfaction.

A significant amount of research has been conducted on user satisfaction over the last two decades (Bailey and Pearson, 1983; Benson, 1983; Doll and Torkzadeh, 1988; Muylle, Moenaert, and Despontin, 2004). Although satisfaction has been studied extensively in IS research, the scope has primarily been limited to the study of system characteristics and the quality of service available to end-users (DeLone and McLean, 2003; Doll and Torkzadeh, 1988; Seddon, 1997). Such studies have often ignored the adoption process and selected only a small number of system or service attributes for measuring user satisfaction, despite the fact that IS continuance research has pointed out that the psychological motivations behind initial acceptance and continuance are different (Bhattacherjee, 2001a). The expectation-confirmation based IS continuance model examines user satisfaction from a solid theoretical base and explains it in terms of the adoption process and a single post-adoption belief, perceived usefulness (Bhattacherjee, 2001a). However, this ignores many important variables, such as system characteristics and the availability of support. Subsequent studies built upon the expectation-confirmation based IS continuance framework consider 'the use of a single belief (perceived usefulness) as the basis of satisfaction and continuance intention' to be a major limitation of the model (Hong, Thong, and Tam, 2006; Lin, Wu, and Tsai, 2005; McKinney, Yoon, and Zahedi, 2002; Thong, Hong, and Tam, 2006). To address this limitation later studies added more post-adoption beliefs: perceived ease of use (Recker,

2010; Sorebo and Eikebrokk, 2008); perceived playfulness (Lin, Wu, and Tsai, 2005; Tao, Cheng, and Sun, 2009); perceived enjoyment (Kang, Hong, and Lee, 2009; Thong, Hong, and Tam, 2006). However, the determinants of satisfaction cannot be restricted to just those factors because the IS continuance model provides only limited guidance on how to influence satisfaction through design and support. In fact, designers receive feedback regarding usefulness – but only in a general sense because they do not receive actionable feedback about the important aspects of system characteristics. Furthermore, support teams do not receive feedback on their support. Overall, the IS continuance model does not provide enough feedback on how to continuously improve systems or services, which is something that is important for e-learning service providers, especially as distance courses using e-learning systems are still evolving.

Although many studies have been conducted on user satisfaction, we are not in a position to pinpoint the most important factors that shape post-adoption user satisfaction, particularly in the context of how educators utilize e-learning platforms. The willingness of educators to utilize e-learning systems is very important because they can boost their utilization by students (Sorebo et al., 2009). A lack of willingness by educators to utilize e-learning systems may thus lead to students underutilizing them, resulting in reduced learning outcomes. However, despite the importance of knowing the reasons why educators continue to use an e-learning system or adopt another, very few studies have addressed the factors that shape the post-adoption satisfaction and the continuance intention of educators with regard to e-learning systems.

This paper addresses the following research question: what are the determinants of the post-adoption satisfaction of educators with e-learning systems? To answer this question we have integrated the research streams of IS continuance and user satisfaction. In particular, we have drawn upon different factors from the literature on IS adoption and user satisfaction. Furthermore, we have used the expectation-confirmation based IS continuance model (Bhattacherjee, 2001a) as the foundation for our research model. The research model we propose was tested by collecting survey data from university educators who use the popular e-learning platform, Moodle.

The paper is structured in the following way: in section 2 we present the theoretical background and literature reviews, section 3 presents our research model and section 4 is dedicated to the research method. Section 5 presents the data analysis results and discussion, section 6 describes the theoretical and practical implications of our findings and section 7 concludes the paper.

2. THEORETICAL BACKGROUND

2.1 Expectation-Confirmation Theory

Research into the post-purchase behavioral process of consumers has been a dominant theme in consumer behavior literature since the 1970s (Churchill and Surprenant, 1982). Many research frameworks have been used for this theme, of which the expectation-confirmation paradigm has been extensively used to explain the satisfaction and repurchase decisions of consumers in a variety of post-purchase contexts (Bhattachejee, 2001a; Churchill and Surprenant, 1982; Oliver, 1980).

According to the expectation-confirmation theory (ECT), a consumer's repurchase intention is determined by his/her level of satisfaction with a product. In turn, consumer satisfaction is determined by two major constructs: initial expectations (pre-purchase expectations) about a product, and the gap between those expectations and the product's performance (confirmation). According to this theory, buyers first develop expectations about a product before purchase and then their experience of it builds perceptions about its performance. This leads to the buyer either confirming or disconfirming the pre-purchase expectations when they assess perceived performance against their pre-purchase expectations, in other words, their earlier frame of reference. A buyer's expectations are confirmed when the product performs as expected, positively confirmed when it performs better than expected and disconfirmed when it performs worse than expected (Churchill and Surprenant, 1982).

ECT was first introduced to explain IS continuance by Bhattacherjee (2001a). He argued that a decision to continue IS usage is similar to a repurchase decision because both decisions: i) follow an initial (acceptance or purchase) decision, ii) are influenced by the initial use and experience of the IS or product, and iii) can potentially lead to the ex post reversal of the initial decision. In order to draw attention to the substantial difference between initial adoption and continued usage, he developed and empirically tested the information systems continuance model in a voluntary environment by adapting the expectation-confirmation theory. According to the IS continuance model, users, after their initial acceptance and use of a system, form opinions about which of their pre-acceptance expectations are confirmed, which is termed confirmation in the model. Based on this confirmation, the users form an opinion about their benefits i.e. their perceived usefulness, which can be viewed as post-adoption expectation (Bhattacherjee, 2001a). After a period of time, both confirmation and perceived usefulness become the basis for determining their satisfaction with the IS, which is termed satisfaction. Finally, perceived usefulness and satisfaction influence the willingness of users to continue using the IS, which leads to

Figure 1. IS continuance model (Bhattacherjee, 2001a)

the creation of the continuance intention. The IS continuance model is shown in Figure 1.

Despite the structural adaptation from the expectation-confirmation paradigm, Bhattacherjee's information system continuance model contains a few differences. Firstly, it focuses on post-adoption expectations rather than pre-adoption expectations. It takes into account the fact that a user will continue to update their expectations of a system as he/she gains more experience of it. Once the user's experiences of the system have been processed it may be that his/her expectations of it will be different to his/her initial expectations prior to using the system (Bhattacherjee, 2001a). From this perspective, the IS continuance model asserts that post-adoption expectations, rather than pre-adoption expectations, are the relevant determinants of satisfaction. Secondly, the information systems continuance model selects perceived usefulness as the surrogate for post-adoption expectations, while the expectation-confirmation paradigm defines expectation as an individual's belief or the sum of his/her beliefs about the level of attributes possessed by a product or a service (Churchill and Surprenant, 1982). Therefore, Bhattacherjee (2001a) adopts perceived usefulness as the measure of expectation for the reason that it has demonstrated itself to be the most consistent and most salient in determining user intention over time (Davis, 1989; Venkatesh and Davis, 2000). Thirdly, perceived performance is not included in IS continuance theory on the grounds that the effect of perceived performance is captured by the confirmation construct.

2.2 Determinants of Post-adoption Satisfaction with E-learning Systems in Prior Studies
Prior studies have found a number of determinants of post-

adoption user satisfaction with e-learning systems. The majority of prior studies have used data from students who were participating in online courses that had little or almost no face-to-face interaction, and a few studies were based on faculty educators who utilized e-learning systems to support their face-to-face teaching. Table 1 summarizes the studies.
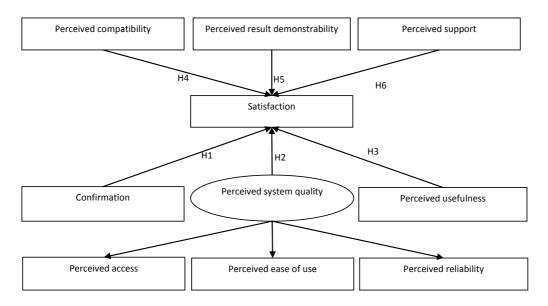
According to the findings of these studies, the different post-adoption beliefs of users are predictors of post-adoption satisfaction. These beliefs can be categorized into two types: behavioral beliefs and object-based beliefs (Hong, Kim, and Lee, 2008; Wixom and Todd, 2005). Behavioral beliefs are concerned with the consequences of using a particular e-learning system, while object-based beliefs are concerned with the characteristics of the e-learning system. There are some behavioral beliefs that have been used as the determinants of post-adoption satisfaction with e-learning systems, such as perceived usefulness, perceived enjoyment and perceived playfulness. The object-based beliefs that have been studied in explaining post-adoption satisfaction with e-learning systems include information quality and system quality.

3. RESEARCH MODEL DEVELOPMENT

The expectation-confirmation based IS continuance model puts forward the hypothesis that confirmation and post-adoption beliefs are the primary determinants of satisfaction. However, this model uses perceived usefulness as the post-adoption expectation belief, although expectations may be a theoretically broader construct that encompass many additional beliefs. In particular, we argue that users may form expectations about various dimensions such as system quality, support quality, result demonstrability, and

Article	Target population	Determinants	Base theory
Chiu et al., (2005)	Students participating in online courses	Usability, usability confirmation, quality, and value.	Expectation-confirmation
Roca, Chiu, and Martinez (2006)	Students participating in online courses	Information quality, system quality, service quality, confirmation, perceived usefulness, cognitive absorption, and perceived ease of use.	Expectation-confirmation
Chiu, Chiu, and Chang (2007)	Students participating in online courses	Distributive fairness, interactional fairness, intrinsic value, attainment value, and utility value.	Fairness theory (Lind et al., 1993)
Liao, Chen, and Yen (2007)	Students participating in online courses	Confirmation and perceived ease of use.	Expectation-confirmation
Liao, Palvia, and Chen (2009)	Students participating in online courses	Confirmation and perceived usefulness (only for short-term users).	Expectation-confirmation
Larsen, Sorebo, and Sorebo (2009)	University faculty teachers	Confirmation.	Expectation-confirmation
Limayem and Cheung, (2009)	University students attending a mixed (face-to-face lectures and e-learning tool) course.	Confirmation and perceived usefulness.	Expectation-confirmation
Sorebo et al., (2009)	University faculty teachers	Confirmation, perceived usefulness and perceived playfulness.	Expectation-confirmation
Lee (2010)	Students participating in online courses	Confirmation and perceived usefulness	Expectation-confirmation
Chen (2010)	Organization employees	Information quality and system quality	IS success
Freeze et al., (2010)	Students participating in online courses	Information quality and system quality	IS success

Table 1. Determinants of e-learning systems post-adoption satisfaction according to prior studies

Note: Perceived system quality is a second order construct
Figure 2. Research model

compatibility after their initial use of a system. The addition of other beliefs to the expectation-confirmation based IS continuance theory is supported by Kwon and Zmud's (1987) call for research on IS adoption research to take into account the influence of context. It is also supported by Wixom and Todd's (2005) view that a system's characteristics should be taken into account in IS adoption research. Most importantly, subsequent studies that have built upon the expectation-confirmation based IS continuance model have pointed that using only one belief for post-adoption expectations limits the model (Hong, Thong, and Tam, 2006).

Prior e-learning continuance research studies mostly investigated behavioral beliefs as the determinants of the post-adoption satisfaction and continuance intention of users in relation to e-learning systems, but have ignored object-based beliefs. However, object-based beliefs are important if one wishes to continuously improve a system or a service's design and development. Thus, in order to determine the post-adoption satisfaction of educators with an e-learning system we add four object-based beliefs to our model: perceived system quality, perceived compatibility, perceived result demonstrability and perceived support. We assert that users, after gaining experience of a particular e-learning platform, will develop these post-adoption expectation beliefs, which will determine satisfaction. The research model is shown in Figure 2.

In the following, we describe these beliefs and build our hypotheses.

3.1 Confirmation of Expectations
Confirmation is a cognitive belief defined as: the extent to which a user's expectation of the performance of an IS is

realized during actual IS use (Bhattachejee, 2001a). The expectation-confirmation based IS continuance model posits that the confirmation of expectations has an effect on satisfaction. In other words, if the perceived performance exceeds the initial expectation, the expectation will be confirmed and create satisfaction with the IS. On the other hand, if the initial expectation is not met by the IS, disconfirmation will occur, which can lead to dissatisfaction. Many studies have validated the association between confirmation and user satisfaction in different contexts including e-learning systems (Bhattacherjee, 2001b; Deng et al., 2010; Hong, Thong, and Tam, 2006; Hsu, Chiu, and Ju, 2004; Liao, Chen, and Yen, 2007; Lin, Wu, and Tsai, 2005). Thus, we make the following hypothesis:

H1. The perceived confirmation of the expectations of educators using an e-learning system positively affects their satisfaction with the e-learning system.

3.2 Perceived Usefulness
Perceived usefulness is defined as the degree to which a user believes that using a particular system would enhance his or her job performance (Davis, 1989). Perceived usefulness captures the instrumentality of system use. Bhattachejee (2001a) uses the Technology Acceptance Model (TAM) to show that perceived usefulness is one of the primary motivators of IS acceptance and that it can also influence subsequent continuance decisions. Therefore, the expectation-confirmation based IS continuance model proposes that perceived usefulness has a direct impact on satisfaction. Many subsequent studies have confirmed this association in different contexts (Bhattachejee and Premkumar, 2004; Hong, Thong, and Tam, 2006; Hsieh and

Wang, 2007; Recker, 2010). Thus, it is reasonable to make the following hypothesis:

H2. The perceived usefulness of an e-learning system affects educators' satisfaction with the e-learning system.

3.3 Perceived System Quality

System quality is the general perception of a system in terms of its performance and this is reflected by various system features (Lee, Shin, and Lee, 2009). The role of system quality in IS success literature has been extensively investigated (DeLone and McLean, 2003; Seddon, 1997). There are many system quality related factors, such as flexibility, integration, response time, sophistication, reliability, accessibility, stability, system speed, usability, ease of use, etc. (Lee, Shin, and Lee 2009). The most frequently used system quality related factors for web-based systems are access, ease of use and reliability (McKinney, Yoon, and Zahedi, 2002; Lee, Shin, and Lee, 2009). Hence, in this paper we have used perceived access, perceived ease of use and perceived reliability as the system quality related dimensions. Their operational definitions are given in Table 2.

Factor	Definition
Perceived access	"refers to the degree of accessibility, responsiveness, and availability of the e-learning systems" (Lee, Shin, and Lee, 2009)
Perceived ease of use	"The degree to which an individual perceives using the e-learning system is free of effort" (Davis, 1989)
Perceived reliability	"refers to the dependability of the e-learning system operation" (Wixom and Todd, 2005)

Table 2. The conceptualization of perceived system quality variables

As perceived system quality can be modeled as a second order factor (Lee, Shin, and Lee, 2009) we decided to model perceived system quality as a second-order construct with three reflective factors: perceived access, perceived ease of use and perceived reliability. DeLone and McLean (2003) state that system quality has a direct effect on user satisfaction and IS use, which has been confirmed by numerous subsequent studies in different contexts (Freeze et al., 2010; Halawi, McCarthy, and Aronson, 2008; Negash, Ryan, and Igbaria, 2003). Thus, we hypothesize the following:

H3. The perceived system quality of an e-learning system affects educators' satisfaction with the e-learning system.

3.3 Perceived Compatibility

Moore and Benbasat (1991) define perceived compatibility as the degree to which an IS is perceived as being consistent with the existing values, needs and experiences of its users. Perceived compatibility has been often used in IS adoption literature as a determinant of intention (Karahanna, Straub, and Chervany, 1999; Venkatesh et al., 2003) and perceived usefulness (Sun, Bhattacherjee, and Ma, 2009). Moore and

Benbasat (1996) examined the effect of compatibility on continued usage intention and found a significant positive relation. Empirically, user adoption has been linked to other research that uses variables similar to perceived compatibility, for example, job-relevance (Venkatesh and Davis, 2000), cognitive fit (Vessey, 1991), task-technology fit (Goodhue and Thompson, 1995), etc.

In this study, we theorize that perceived compatibility is a post-adoption belief and has a direct impact on satisfaction. It is clear that educators carry distinct knowledge about their teaching and training situations, which they use as the basis for determining which tasks can be performed with a given e-learning system. If the e-learning platform is compatible with the teaching tasks, it is most likely that the educators will remain satisfied with the system. Conversely, if the e-learning platform provides important functionalities with a user-friendly interface, but does not provide the functionalities that are needed for the completion of their teaching tasks, they are unlikely to remain satisfied with the system. Thus, we propose the following hypothesis:

H4. The perceived compatibility of an e-learning system positively affects educators' satisfaction with the e-learning system.

3.3 Perceived Result Demonstrability

Perceived result demonstrability is defined as the degree to which the results of using the IS are observable and communicable to others (Karahanna, Straub, and Chervany, 1999). Agarwal and Prasad (1997) examined the effect of result demonstrability in the context of current and continued usage of the Internet. They found result demonstrability to be significant in determining continued usage but non-significant in determining current usage. We argue that educators, after gaining experience of using an e-learning system, develop beliefs about result demonstrability that directly influence their satisfaction with the e-learning system. This suggests that educators will be satisfied if the co-variation between usage and positive results are readily observable and communicable. Conversely, if the e-learning system produces the results desired by the educators, but does so in manner that is complicated and difficult to explain, educators are unlikely to remain satisfied with the system. Thus, we make the following hypothesis:

H5. The perceived results demonstrability of an e-learning system positively affects educators' satisfaction with the e-learning system.

3.3 Perceived Support

Perceived support is defined as the degree to which assistance is available when educators face difficulties with an e-learning system. In our study, we posit that perceived support has a direct influence on the satisfaction of educators with a system. It implies that if the educators get help from manuals and the e-learning system's support team when they face problems in completing a task, they will be satisfied. The use of perceived support in IS adoption research can be traced from the very first article to use TAM (Davis, 1989), in which it was regarded as an external variable affecting perceived usefulness and perceived ease of use. Support is also seen as part of the facilitating conditions that affect intention (Venkatesh et al., 2003). In IS success literature,

satisfaction is determined by service quality, which is a similar variable to perceived support (DeLone and McLean, 2003). Thus, we hypothesize the following:

H6. Perceived support positively affects educators' satisfaction with the e-learning system.

4. STUDY DESIGN AND METHOD

4.1 Research Context

In order to understand the research context of this study, the e-learning platform and the research environment is presented.

The target e-learning system in this study is the Moodle learning management system. Moodle is an open source course management system or a virtual learning environment. It has become very popular among educators for creating dynamic online course websites for students. Moodle can be used to conduct online courses and also to augment face-to-face courses. Moodle provides tools such as forums, databases and wikis for building collaborative learning communities. It also provides ways to deliver content to students and assess learning. To work, it needs to be installed on a web server.

This study has been conducted in an internationally acknowledged, multidisciplinary university located on the southwest coast of Finland. With 21,000 students and 3,000 employees, it is one of the most important universities in Finland. It has seven faculties but research activities and learning also take place in special units. Such units offer adult education, and promote personal, organizational and regional development. Different university support activities are also taken care of at these facilities. The special units enable the construction of multi-disciplinary and international research environments. Educators at the university (both the faculties and the special units) began using Moodle as the main platform for creating online course pages that support face-to-face teaching in 2007. Additionally, personnel from the special units have used Moodle for project management purposes. The faculty educators are free to choose other methods of creating course pages within the university domain. In some faculties, in-house developed course management systems are also available. Thus, using Moodle is not seen as mandatory for educators.

4.2 Questionnaire Development

Each item corresponding to the constructs has been measured using the seven-point Likert scale, with answer choices ranging from "Strongly disagree (1)" to "Strongly agree (7)". Most of these items are adapted from the literature with only minor changes in the wording to reflect the target technology. After the questionnaire was drafted it was sent to two academic researchers to be reviewed and revised according to their comments and suggestions to make the wording of the items more precise. Then it was sent to 30 educators at the university for review. Overall, the educators indicated that the questionnaire was relatively clear and easy to complete. A number of suggestions were made concerning the wording of several items and the overall structure of the questionnaire. The questionnaire was revised according to the given suggestions. The

questionnaire is shown in the Appendix. To avoid the common method bias problem, at least to some extent, we decided to randomize the questions in the questionnaire during data collection (Straub, Boudreau, and Gefen, 2004).

4.3 Data Collection

Data was collected via a web-based survey from the educators who use Moodle for their teaching purposes. A total of 1012 users were registered with Moodle as instructors during August, 2010. Two important points are important to note. Firstly, it should be noted that many of the registered Moodle users were from special units of the university. As explained in section 4.1, such users use Moodle for project management purposes. It was not possible to distinguish between educators and personnel from the special units in the registered Moodle user database. Secondly, many faculty educators are registered as Moodle users but do not use it. This is because such educators are busy with other tasks and use assistants to do their Moodle related tasks. It was also difficult to filter out such users. Thus, a total of 1012 email invitations were sent to all registered Moodle users but only faculty members who had recently used Moodle for conducting their courses were asked to respond. Two reminders were sent to increase the response rate after gaps of two weeks. The survey ran for approximately one and half months. After filtering invalid and incomplete responses a total of 207 survey responses were received. For this particular study, we were interested in those users who had conducted at least one course using Moodle during the academic year. After filtering the survey responses we ended up with 175 usable responses. Table 3 shows the detailed demographic information of the participants. The response rate is low in the study. However, the presence of many users who do not actually use Moodle in the way required for the survey explains the low response rate.

		Frequency	Percent
Gender	Male	74	42.3
	Female	101	57.7
Age	21-40 years	90	51.4
	>40 years	85	48.6
Experience with the target technology	0 – 18 months	54	30.9
	>18 – 36 months	83	47.4
	>36 months	38	21.7
Faculty	Humanities	37	21.1
	Mathematics and Natural Science	38	21.7
	Medicine	18	10.3
	Law	15	8.6
	Social Sciences	16	9.1
	Education	16	9.1
	Turku School of Economics	35	20

Table 3. Demographic information

Construct	Item	Mean	std	Loading	t-statistic
Satisfaction (Composite Reliability = 0.94; AVE = 0.81)	SAT-1	4.84	1.49	0.89	47.53
	SAT-2	4.74	1.51	0.93	83.17
	SAT-3	4.58	1.37	0.85	25.08
	SAT-4	4.27	1.50	0.91	56.42
Perceived usefulness (Composite Reliability = 0.91; AVE = 0.72)	PU-1	4.59	1.33	0.86	38.79
	PU-2	5.18	1.28	0.87	25.97
	PU-3	5.31	1.23	0.88	29.80
	PU-4	5.65	1.22	0.79	18.18
Perceived Ease of use (Composite Reliability = 0.93; AVE = 0.76)	PEOU-1	4.46	1.52	0.87	41.06
	PEOU-2	4.38	1.52	0.78	18.80
	PEOU-3	4.59	1.52	0.94	133.56
	PEOU-4	4.27	1.61	0.90	50.53
Perceived Access (Composite Reliability = 0.86; AVE = 0.77)	ACCESS-1	3.96	1.79	0.88	31.69
	ACCESS-2	4.81	1.39	0.88	28.19
Perceived Compatibility (Composite Reliability = 0.91; AVE = 0.77)	COMP-1	4.95	1.40	0.92	38.76
	COMP-2	5.17	1.26	0.89	47.43
	COMP-3	4.66	1.36	0.83	27.95
Perceived Reliability (Composite Reliability = 0.95; AVE = 0.91)	REL-1	4.35	1.45	0.95	100.93
	REL-2	4.42	1.52	0.96	161.87
Confirmation (Composite Reliability = 0.91; AVE = 0.76)	CON-1	4.55	1.39	0.90	54.26
	CON-2	4.59	1.25	0.90	46.93
	CON-3	4.75	1.14	0.82	22.96
Perceived Support (Composite Reliability = 0.93; AVE = 0.86)	SUP-1	4.36	1.86	0.91	25.25
	SUP-2	4.40	1.66	0.95	60.80
Perceived Result Demonstrability (Composite Reliability = 0.88; AVE = 0.71)	RD-1	5.00	1.24	0.83	17.80
	RD-2	5.08	1.30	0.85	35.93
	RD-3	5.18	1.23	0.84	18.23

Table 4. Items' means, standard deviations and internal consistencies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Perceived Access (1)	**0.88**								
Perceived Compatibility (2)	0.56	**0.88**							
Perceived Ease of Use (3)	0.60	0.67	**0.87**						
Satisfaction (4)	0.70	0.74	0.74	**0.90**					
Confirmation (5)	0.60	0.63	0.56	0.80	**0.87**				
Perceived Usefulness (6)	0.62	0.79	0.61	0.78	0.73	**0.85**			
Perceived Result Demonstrability (7)	0.43	0.70	0.55	0.55	0.51	0.66	**0.84**		
Perceived Reliability (8)	0.65	0.36	0.50	0.58	0.50	0.42	0.31	**0.95**	
Perceived Support (9)	0.30	0.28	0.38	0.38	0.20	0.34	0.31	0.28	**0.93**

Table 5. Correlation among the variables and the square root of average variance extracted

4.4 Data Analysis
Partial least squares (PLS) is the approach used by our analysis and smartPLS is the tool utilized (Ringle, Wende, and Will, 2005). PLS is a second generation regression method that combines confirmatory factor analysis with linear regression, and this makes it possible to run the measurement and structural models simultaneously. PLS has enjoyed increasing popularity in IS research for its ability to model latent constructs under the condition of non-normality (Chin, 1998). A rule of thumb for the required sample size in PLS is that the sample should be at least ten times the most complicated multiple regression in the model (Barclay, Higgins, and Thompson, 1995). The variables in this study are non-normal. Thus, PLS is the right tool for conducting the analysis in this study. In addition, the sample size of this study meets the minimum sample size requirement.

Table 4 shows item wise averages, standard deviations, loadings and t-statistics values for each construct in the model. For each construct the assessment of convergent validity or internal consistency is also included through the composite reliability and average variance extracted (AVE) coefficients. Convergent validity indicates the extent to which the items of a scale that are theoretically related are also related in reality. Table 4 shows that all items have significant path loadings greater than the threshold of 0.7 recommended by Fornell and Larcker (1981) and that all the constructs have composite reliability values that exceed the threshold recommended by Nunnally (1978).

	PA	PC	CON	PS	EOU	PU	PREL	PRD	SAT
ACCESS-1	**0.88**	0.39	0.47	0.23	0.51	0.47	0.61	0.31	0.55
ACCESS-2	**0.88**	0.57	0.58	0.30	0.55	0.61	0.53	0.45	0.69
COMP-1	0.53	**0.92**	0.55	0.29	0.61	0.75	0.28	0.63	0.67
COMP-2	0.54	**0.89**	0.51	0.26	0.53	0.68	0.27	0.60	0.64
COMP-3	0.53	**0.83**	0.58	0.16	0.62	0.65	0.38	0.58	0.63
CON-1	0.66	0.53	**0.90**	0.24	0.50	0.65	0.47	0.39	0.75
CON-2	0.58	0.55	**0.90**	0.12	0.43	0.64	0.35	0.46	0.68
CON-3	0.53	0.56	**0.82**	0.16	0.54	0.60	0.48	0.47	0.65
SUP-1	0.33	0.22	0.18	**0.91**	0.30	0.29	0.25	0.28	0.30
SUP-2	0.39	0.28	0.19	**0.95**	0.39	0.32	0.25	0.29	0.39
PEOU-1	0.55	0.61	0.43	0.35	**0.87**	0.52	0.37	0.52	0.63
PEOU-2	0.49	0.44	0.40	0.26	**0.78**	0.37	0.44	0.32	0.50
PEOU-3	0.67	0.60	0.54	0.36	**0.94**	0.59	0.48	0.51	0.72
PEOU-4	0.63	0.68	0.56	0.34	**0.90**	0.62	0.44	0.54	0.71
PU-1	0.56	0.68	0.64	0.32	0.52	**0.86**	0.36	0.63	0.68
PU-2	0.63	0.73	0.61	0.29	0.57	**0.87**	0.35	0.56	0.68
PU-3	0.61	0.67	0.66	0.24	0.52	**0.88**	0.37	0.51	0.66
PU-4	0.47	0.59	0.55	0.29	0.46	**0.79**	0.33	0.51	0.62
REL-1	0.58	0.31	0.45	0.23	0.44	0.40	**0.95**	0.29	0.51
REL-2	0.65	0.36	0.50	0.29	0.51	0.39	**0.96**	0.30	0.56
RD-1	0.39	0.55	0.42	0.26	0.52	0.52	0.28	**0.83**	0.41
RD-2	0.43	0.63	0.47	0.28	0.43	0.63	0.27	**0.85**	0.56
RD-3	0.31	0.53	0.34	0.22	0.43	0.44	0.20	**0.84**	0.36
SAT-1	0.72	0.67	0.74	0.36	0.64	0.72	0.58	0.45	**0.89**
SAT-2	0.71	0.68	0.73	0.35	0.72	0.70	0.51	0.52	**0.93**
SAT-3	0.61	0.63	0.66	0.35	0.64	0.65	0.40	0.52	**0.85**
SAT-4	0.74	0.66	0.72	0.30	0.64	0.72	0.52	0.48	**0.91**

Table 6. Factor analysis results

Note: Perceived Access (PA), Perceived Compatibility (PC), Perceived Ease of Use (PEOU), Satisfaction (SAT), Confirmation (CON), Perceived Usefulness (PU), Perceived Result Demonstrability (PRD), Perceived Reliability (PREL), Perceived Support (PS).

Testing for discriminant validity involves checking whether the items measure the construct in question or other related constructs. Discriminant validity was verified with both correlation analysis and factor analysis as recommended by Gefen and Straub (2005). Firstly, the inspection of discriminant validity among the variables is based on the correlation between the variables and the square root of their respective average variance extracted (Fornell and Larcker, 1981). As Table 5 shows, the square root of average variance extracted value for the variables is consistently greater than the off-diagonal correlation values, suggesting satisfactory discriminant validity among the variables. Secondly, in Table 6 we see that all items have cross loading coefficients lower than the factor loading on their respective assigned latent variable, suggesting that discriminant validity on the item level is met for all the constructs.
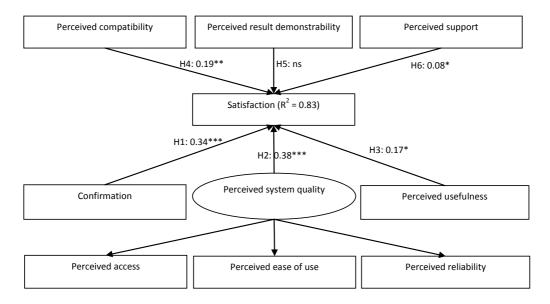
5. RESULTS AND DISCUSSIONS

The test of the structural model includes estimates of the path coefficients, which indicate the strengths of the relationships between the dependent and independent variables, and the R-square values, which represent the amount of variance explained by the independent variables.

Figure 3 shows the results of the test of the hypothesized structural model. Five of our six hypotheses are supported.

As expected, the confirmation of initial expectations ($\beta = 0.34$; $t = 5.49$; $p < 0.001$), perceived system quality ($\beta = 0.38$; $t = 6.34$; $p < 0.001$), perceived compatibility ($\beta = 0.19$; $t = 2.35$; $p < 0.01$), perceived usefulness ($\beta = 0.17$; $t = 2.29$; $p < 0.05$), and perceived support ($\beta = 0.08$; $t = 2.21$; $p < 0.05$) have a significant impact on the post-adoption satisfaction of educators with regard to the target e-learning platform. However, perceived result demonstrability ($\beta = -0.08$; $t = 1.63$; ns) was found to have no significant effect on their post-adoption satisfaction. Taken as a whole, these predictors explained 83% of the total variance in satisfaction. The supported hypotheses are discussed below.

Our study revealed that perceived system quality has the most dominant impact on the post-adoption satisfaction of educators regarding e-learning system utilization. Prior studies that have used the expectation-confirmation based IS continuance model to investigate post-adoption satisfaction have found confirmation to be the most dominant predictor of satisfaction. The interesting finding of our study is the strength of the relationship between perceived system quality and post-adoption satisfaction.

Secondly, our study results show that the confirmation of initial expectations has a strong impact on the post-adoption

Note: *p < 0.05; **P < 0.01; ***p < 0.001; ns: non-significant

Figure 3. PLS analysis results

satisfaction of educators with regard to the utilization of e-learning systems. This finding echoes the finding of many other previous studies (Limayem and Cheung, 2009; Roca, Chiu, and Martinez, 2006).

Thirdly, perceived compatibility was found to significantly influence the post-adoption satisfaction of educators. Although the association between perceived compatibility and satisfaction is not so common and has not been tested empirically in the IS literature, our study revealed that perceived compatibility is important in shaping user satisfaction during the post-adoption stage.

Fourthly, perceived usefulness was found to have a very weak impact on post-adoption satisfaction. Bhattacherjee (2001a) has claimed that perceived usefulness is the only post-adoption belief that affects post-adoption satisfaction and the IS continuance intention. He argues that perceived usefulness is the most consistent belief in predicting an individual's intention to use IS during the various stages of adoption. However, the finding of our study contradicts this. Nevertheless, as Wixom and Todd (2005) have pointed out, behavioral beliefs, such as perceived usefulness, weakly predict satisfaction, while object-based beliefs, such as perceived system quality, are weak in their ability to predict behavioral intention. Our study findings may complement Wixom and Todd's (2005) views in the sense that we found perceived usefulness to be very weak at predicting satisfaction, but we did find that perceived system quality strongly predicted satisfaction. In prior IS continuance literature, a number of studies have found that perceived ease of use, which is a system quality related factor, is more

important than perceived usefulness in predicting user satisfaction (Hong, Thong, and Tam, 2006).

Lastly, we found that perceived support is also important in shaping the satisfaction of educators with an e-learning system during the post-adoption stage. This finding is in line with the IS success model which suggests that service quality influences user satisfaction (DeLone and McLean, 2003).

6. IMPLICATIONS

6.1 Theoretical Implications

Our research findings have theoretical implications. Our study supported the argument that there are other post-adoption beliefs in addition to perceived usefulness that are salient in shaping post-adoption user satisfaction. In fact, our study revealed that behavioral beliefs (perceived usefulness) are very weak in predicting post-adoption satisfaction. We also discovered that object-based beliefs, such as perceived system quality and perceived compatibility, are more important than behavioral beliefs in shaping post-adoption satisfaction. It is clear in prior literature that there are limitations of the IS continuance model. Thus, researchers have tried to overcome those limitations by adding more behavioral beliefs such as perceived enjoyment and perceived playfulness. However, the findings of this study indicate that it is also important to use object-based beliefs to extend the IS continuance model. Furthermore, our study revealed that it is necessary to incorporate more object-based beliefs into the IS continuance model in order to improve the analysis of user satisfaction. Perceived system quality and

perceived compatibility are two potential variables for extending the expectation-confirmation based IS continuance model.

6.2 Practical Implications

Our research findings also have practical implications. Our study revealed a list of factors that are salient in shaping the satisfaction of educators during the post-adoption stage of the utilization of e-learning platforms. Consequently, management and designers should concentrate more effort on the improvement of these dimensions in order to increase user satisfaction. Continuous improvement is particularly important for e-learning systems because the utilization of such systems continues to evolve in both educational and business organizations.

According to our findings, management and development teams may plan for the following actions: Firstly, our study found that perceived system quality is the most important factor for predicting the post-adoption satisfaction of educators with regard to an e-learning system. Thus, in order to maintain user satisfaction, designers should continuously look for opportunities to further improve e-learning platforms that have already been implemented. Designers should concentrate their efforts on making the system easy to use, accessible and reliable. In relation to this, usability tests could be conducted in conjunction with existing users in order to plan for the future improvement of a system. In addition, training for users should be organized by the managers so that they can develop the necessary skills to use an e-learning system, ensuring that users feel the system is easy to use. Additionally, service providers who host e-learning systems should also ensure that it is accessible.

Secondly, we found that the confirmation of initial expectations about an e-learning system also has a very strong influence on the post-adoption satisfaction of educators. Thus, vendors should develop strategies and advertise e-learning systems in ways that build an appropriate level of initial user expectations. This would then allow users to positively confirm their initial expectations and it should also positively affect post-adoption satisfaction during the later stages of their use of the e-learning system.

Thirdly, we found perceived compatibility significantly affects the post-adoption satisfaction of educators. This implies that management and developers should develop e-learning systems that are compatible with the existing values and needs of educators. In essence, designers should understand the teaching tasks that educators have and develop systems that are compatible with those teaching tasks.

Finally, perceived support was found to significantly affect the post-adoption satisfaction of educators. Thus, a support team should improve the support functions of e-learning systems in order to maintain the satisfaction of educators. Prompt, polite and appropriate responses to the problems educators face are the most obvious way to provide support, while the provision of proper instruction manuals would also encourage educators to continue using specific e-learning systems.

7. CONCLUSIONS

In this study, we developed a research model based on the expectation-confirmation framework with the aim of identifying post-adoption beliefs that are salient in shaping the satisfaction of educators during their post-adoption use of an e-learning system. In particular, we hypothesized that confirmation, perceived usefulness, perceived system quality, perceived result demonstrability, perceived support and perceived compatibility would be salient in shaping post-adoption satisfaction. We then collected survey data from 175 university educators who use an e-learning platform for teaching purposes and analyzed the data using PLS analysis. The study's findings revealed that the satisfaction of educators with an e-learning system is mainly determined by the confirmation of their initial expectations, perceived system quality, perceived usefulness, perceived support and perceived compatibility. Perceived result demonstrability was found not to have a significant impact on their satisfaction. Together, these core determinants of satisfaction explained around 83% of the total variance in satisfaction.

This study has several limitations. Firstly, because the study was conducted in a single university and assessed only one e-learning system, caution should be taken before generalizing the results of this study to other contexts, which implies that the replication of this study in other contexts is required. Second, the beliefs of the users regarding a system will change as the users gain experience of a target system but such changes cannot be captured with the type of cross-sectional study undertaken. To do that a longitudinal study is required and this would also provide deeper insights into how changes in the beliefs of users influence user satisfaction. Finally, we did not test how the major demographic variables of the respondents, such as gender, age and computer experience affected their perceptions. Hence, a possible future direction of research would be the testing of the moderating effects that the major demographic variables would have on the associations between the constructs proposed in the research model.

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APPENDEX

Appendix 1: Survey Questionnaire

Construct	Item
Satisfaction (Bhattachejee, 2001a)	SAT-1: My overall experience of using Moodle is very satisfied
	SAT-2: My overall experience of using Moodle is very pleased
	SAT-3: My overall experience of using Moodle is very contented
	SAT-4: My overall experience of using Moodle is absolutely delighted
Perceived usefulness (Bhattachejee, 2001a; Limayem, Hirt, and Cheung, 2007)	PU-1: Using Moodle increases the control with my teaching plan
	PU-2: Using Moodle is of benefit to me
	PU-3: The advantages of Moodle outweigh the disadvantages
	PU-4: Overall, using Moodle is advantageous
Ease of use (Venkatesh and Davis, 2000)	PEOU-1: My interaction with Moodle is clear and understandable
	PEOU-2: Interacting with Moodle does not require a lot of mental effort
	PEOU-3: I find Moodle to be easy to use
	PEOU-4: I find it easy to get Moodle to do what I want to do
Perceived Access (Lee, Shin, and Lee, 2009)	ACCESS-1: Moodle quickly loads all the text and graphics
	ACCESS-2: Moodle provides good access
Perceived Compatibility (Moore and Benbasat, 1991)	COMP-1: Using Moodle fits with the way I like to teach
	COMP-2: Using Moodle fits with my teaching style
	COMP-3: Moodle is compatible with most aspects of my teaching
Perceived Reliability (Wixom and Todd, 2005)	REL-1: Moodle is stable
	REL-2: Moodle operates reliably
Confirmation (Limayem, Hirt, and Cheung, 2007)	CON-1: My experience with using Moodle was better than what I expected
	CON-2: The benefit provided by Moodle was better than what I expected
	CON-3: Overall, most of my expectations from using Moodle were confirmed
Perceived support (Venkatesh et al., 2003)	SUP-1: A specific person (or group) is available for assistance with Moodle difficulties
	SUP-2: Specialized instruction concerning Moodle is available to me
Perceived Result Demonstrability (Moore and Benbasat, 1991)	RD-1: I have no difficulty telling others about the results of using Moodle
	RD-2: The result of using Moodle is apparent to me
	RD-3: I have no difficulty explaining why using Moodle may or may not be beneficial

Paper 3:   Islam, A. K. M. N. (2011) Information systems post-adoption satis-
faction and dissatisfaction: A study in the e-learning context. *Paper presented at
the 15th Pacific Asia Conference on Information Systems (PACIS)*, Brisbane,
Australia, July 7–11, 2011, Paper 83

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9 July 2011

Information Systems Post-Adoption Satisfaction And Dissatisfaction: A Study In The E-Learning Context

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INFORMATION SYSTEMS POST-ADOPTION SATISFACTION AND DISSATISFACTION: A STUDY IN THE E-LEARNING CONTEXT

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Abstract

An information system can be regarded as successful when a significant number of users use the system in a continued basis. Satisfaction is often regarded as the basis of continued usage, while dissatisfaction may cause users to discontinue the system use. While many studies in information system have investigated user satisfaction, user dissatisfaction seems to be ignored. The purpose of this study is to investigate the factors that generate user satisfaction and the factors that generate user dissatisfaction. Drawing the theoretical assumptions from Oliver's expectation-confirmation theory and Herzberg's two-factor theory, we propose a generic theoretical framework that posits environmental factors and job-specific outcome factors may cause satisfaction and dissatisfaction. The framework extends our understanding of user satisfaction and dissatisfaction and helps to underpin and categorize the factors that are salient for causing user satisfaction and dissatisfaction. By collecting text data responses using open ended survey questions and qualitatively analyzing them, we identify a list of factors that generate educators' satisfaction and a list of factors that generate dissatisfaction in the e-learning tool utilization context. Our study reveals that satisfaction is generated by both environmental and job-specific factors, while dissatisfaction is generated by environmental factors only.

Keywords: Continued use, e-learning, Expectation-Confirmation theory, Dissatisfaction, Satisfaction, and Two-factor theory.

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1   INTRODUCTION

User satisfaction has often been linked to at least two important outcomes: information system (IS) success (DeLone & McLean 2003) and IS continued use (Bhattachejee 2001). Organizations often make significant financial and human resource investments into the measurement and analysis of user satisfaction and its subsequent improvement. As a result, significant amount of research has been conducted in the user satisfaction area over the last two decades (Bailey & Pearson 1983; Benson 1983; Doll & Torkzadeh 1988; Muylle et al. 2004; Islam et al. 2010). Most of these studies presuppose that, to find out how a user feels about a particular system or service, it is enough to analyze his/her satisfaction, measured by an ordinal scale (highly dissatisfied-neutral-highly satisfied). This approach may not be enough in at least two senses.

First, users are usually asked only about a limited number of attributes of a system or service. Specifically, attributes that are considered to be positive and which are often associated with the very reason why users use a system are asked in the survey. These lists of attributes generally exclude possible negative features about the system or service that are experienced by the users during their use. After experiencing such negative features, the users may depend on these to build their overall satisfaction and subsequently their future use.

Second, studies of consumer satisfaction indicate that a one-dimensional concept of satisfaction can be insufficient (e.g., Chan & Baun 2007). The one-dimensional construct assumes that a single factor can generate both satisfaction (in case everything goes well) and dissatisfaction (when things do not go well). However, past studies provide evidence that the presence of certain attribute generates satisfaction, yet their absence does not necessarily generate dissatisfaction. The reverse is also true given that certain factors may generate dissatisfaction but their absence does not generate satisfaction (e.g., Herzberg et al. 1959; Chan & Baun 2007). IS researchers have also found that the effect of performance factors of an IS on user satisfaction might be asymmetric (Zhang & von Dran 2000; Cheung & Lee 2005).

As a result, despite the huge research on IS user satisfaction, we are not in a position to pinpoint exactly what attributes of system are necessary to build high level of satisfaction and what factors may generate dissatisfaction. Therefore the purpose of this paper is to explore factors that generate educators' satisfaction and dissatisfaction with an e-learning system. We are interested to explore educators' satisfaction/dissatisfaction because they act as the initiators and facilitators of students' utilization of e-learning system. If the educators become dissatisfied with a particular e-learning system and choose to discontinue its use, the students have no choice but to discontinue their use of the system. In this study, we develop a general taxonomic framework that helps to categorize factors that generate satisfaction and dissatisfaction with a system. The framework also helps to understand the process of developing satisfaction/dissatisfaction with a system. Studying dissatisfaction is particularly important as it is argued in the IS literature that dissatisfaction causes discontinued IS use (Bhattacherjee 2001). Thus, the inclusion of dissatisfaction-based evaluations can give more detailed information to the managers that could be utilized to avoid discontinuance.

2   THEORETICAL BACKGROUND

The importance of satisfaction has been illustrated in the studies of job satisfaction, consumer behavior and information system success. Job satisfaction causes employees to maximize their self-actualization to achieve high job performance while consumer behavior studies view satisfaction as a pre-requisite to continue purchasing products/services. In information system studies, satisfaction causes a user to use the system.

User satisfaction in IS has received considerable research attention since the 1980s in consumer behavior literature (Bailey & Pearson 1983; Benson 1983; Ives et al. 1983; Harrison & Rainer 1996).

It is an important measure of information systems success, often regarded as the easiest and the most useful way to evaluate an IS. Bailey and Pearson (1983, p. 531) define user satisfaction as the "sum of one's positive and negative reactions to a set of factors." Doll and Torkzadeh (1988, p. 261) describe it as "the affective attitude toward a specific computer application by someone who interacts with the application directly." Eagly and Chaiken (1998, p. 296) regard user satisfaction as a "psychological tendency expressed by evaluating a particular entity with some degree of favor and disfavor".

The commonly adopted methodology for user satisfaction survey consists of first identifying the most important attributes of a system, and second, asking the users to rate them on a symmetrical one-dimensional scale. On this scale, the lowest value indicates the highest dissatisfaction with an attribute, and the highest value represents the greatest satisfaction, while the midpoint indicates neutrality. Following this procedure, many instruments have been developed over the years (e.g., Bailey & Pearson 1983; Doll & Torkzadeh 1988; Palvia 1996; Huang et al. 2004; Muylle et al. 2004; Bargas-Avila et al. 2009; Islam et al. 2010). While these models help us to underpin different factors behind user satisfaction, Oliver (1980) provided the expectation-confirmation theory to understand the process of developing satisfaction with a product/service.

The expectation-confirmation theory hypothesizes that consumers' level of satisfaction with a product/service determines repurchase intention. In turn, consumer satisfaction is determined by two major constructs: initial expectations (pre-purchase expectations) on a product/service, and discrepancies between expectations and product/service performance (disconfirmation). According to this theory, buyers first develop expectations about a product/service before purchase. Second, their consumption experiences with it build perceptions about its performance. This leads to the buyer either confirming or disconfirming the pre-purchase expectations, after assessing perceived performance against the earlier frame of reference (pre-purchase expectations). A buyer's expectations are confirmed when the product/service performs as much as expected; negatively disconfirmed when it performs worse than expected; positively disconfirmed when it performs better than expected (Churchill & Surprenant 1982). The expectation-confirmation model is shown in Figure 1.
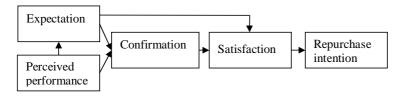

Figure 1.   Expectation-confirmation model (Oliver 1980).

While the user satisfaction instruments do not consider the difference between pre and post adoption, drawing attention to the substantial difference between initial adoption and post-adoption, Bhattacherjee (2001) developed and empirically tested the information system continuance model from the expectation-confirmation theory. Despite the structural adaptation from expectation-confirmation paradigm, Bhattacherjee's information system continuance model possesses a few differences. First, it focuses importance on post-adoption expectations rather than pre-adoption expectations. A user keeps updating expectations towards using a system as he/she gains more experiences by using it. After assimilation of such experiences, the user's expectation can be different from his/her initial expectations prior to use the system (Bhattacherjee 2001). From this perspective, information system continuance model posits that post-adoption expectations (rather than pre-adoption expectations) are the relevant determinants of satisfaction. Second, information system continuance model selected perceived usefulness as the surrogate for post-adoption expectation. The expectation-confirmation paradigm defined expectation as individual beliefs or sum of beliefs about the level of attributes possessed by a product/service (Churchill & Surprenant 1982). Following this definition,

Bhattacherjee (2001) used perceived usefulness as the measure of expectation, since among the cognitive beliefs in IS adoption and usage, perceived usefulness demonstrated itself to be the most consistent and salient one in determining the user intention over time (Davis 1989; Venkatesh 2000). Third, perceived performance is not included in the information system continuance theory. Bhattacherjee (2001) argued that the effect of perceived performance could be captured by the confirmation construct. In sum, the information system continuance model posits that the users after first time acceptance and a period of initial use will form an opinion to which their pre-acceptance expectations are confirmed (Confirmation). From this confirmation, the users form an opinion about the benefits (Perceived usefulness). After a period of time, both confirmation and perceived usefulness are the basis of satisfaction with the IS (Satisfaction). Finally, perceived usefulness and satisfaction impact the users' willingness to continue the IS (intention). The information system continuance model is shown in Figure 2.

Figure 2.   IS continuance model (Bhattacherjee 2001).

As described earlier, according to the expectation-confirmation theory, dissatisfaction occurs when buyers' expectations are not met, and dissatisfaction latter causes buyers to discontinue using the product/service. In IS, dissatisfaction affects IS discontinuance. However, there are only a few studies which assumed that there are particular factors that cause user dissatisfaction (Zhang & von Dran 2000; Cheung & Lee 2005). Most of the IS studies assumed that dissatisfaction is simply opposite of satisfaction. This may not be completely true according to the two-factor theory of job satisfaction (Herzberg et al. 1959).

According to the two-factor theory (motivator-hygiene), satisfaction and dissatisfaction are different constructs, generated by different facets of interaction between a stimulus (job, product) and the individual. The motivator factors generate job satisfaction while the hygiene factors generate job dissatisfaction. The motivators include achievement, recognition, work itself, responsibility, personal growth, advancement etc while the hygiene factors include company policy, supervision, relationship with boss, work condition, salary, relationship with peers etc. The theory is depicted in Figure 3.

Figure 3.   Herzberg's two-factor theory (Herzberg et al. 1959).

In IS literature, a few studies have found different sources of dissatisfaction from that of satisfaction (Zhang & von Dran 2000; Cheung & Lee 2005).

3   A GENERIC SATISFACTION-DISSATISFACTION MODEL

Figure 4 shows a framework we developed for understanding post-adoption satisfaction based on expectation-confirmation assumptions (Oliver 1980) and Herzberg's two-factor theory (Herzberg et al. 1959). The framework should be viewed as a process model.
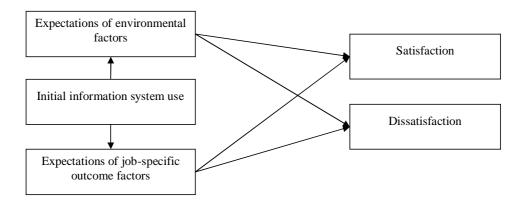

Figure 4.   A generic satisfaction-dissatisfaction model.

According to this framework, the users after first time acceptance and a period of initial use will form an opinion about two generic factors: environmental factors and job specific outcome factors. Environmental factors are the means to a set of ends. These include for example product related factors such as system quality, available support from help-desk, organizational support etc. Job specific outcome factors are considered to be an end themselves. These include for example, perceived usefulness, perceived enjoyment etc. If expectations on these factors are fulfilled, the users remain satisfied. On the other hand, if these expectations are not fulfilled, dissatisfaction is generated among users.

Though, the proposed framework has been developed based on Herzberg's two factor theory, it has substantial difference in underlying assumptions. While two-factor theory posits that motivators generate satisfaction and hygiene factors generate dissatisfaction, we argue that the effect of environmental and job-specific factors on satisfaction and dissatisfaction may vary depending on the context and the level of users' expectations in that particular context. Specifically, we argue the following using the assumptions of expectation-confirmation theory (Oliver 1980).

Depending on the context and users' expectations, a generic factor may have either weak or strong impact on user satisfaction and dissatisfaction. For example, if a user's expectations of environmental factors are fulfilled to some extent, then environmental factors may have weak impact on both satisfaction and dissatisfaction. On the other hand, if the user's expectations of environmental factors are fulfilled well enough, then there might be strong impact on satisfaction but a weak or almost no impact on dissatisfaction. It also implies that depending on the context and users' expectations, the same generic factor may generate both satisfaction and dissatisfaction. For example, a user may remain satisfied with accessibility of a system, but he/she may be dissatisfied with ease of use.

4   RESEARCH CONTEXT

The target system of this study is an e-learning system, Moodle (http://moodle.org/about/). Moodle is an open source course management system, also known as a learning management system or a virtual learning environment. It has become very popular among the educators to create online dynamic course websites for the students. Moodle can be used to conduct fully online courses and also to augment face-to-face courses. Moodle provides tools such as forums, databases and wikis to build collaborative learning communities. It also provides ways to deliver contents to students and assess learning using assignments and quizzes. To work, it needs to be installed on a web server.

This study was conducted in the University of Turku, Finland. The university is internationally acknowledged, multidisciplinary scientific university. The university has seven faculties. The university has been using Moodle since 2007 as the platform to create course pages online. However, educators are mostly free to choose the traditional way to create course pages under the university domain.

5   RESEARCH METHOD

5.1   Data collection

Data was collected using open ended survey questions from the educators of the university who had been using Moodle for teaching purpose. In particular, the educators were asked to report their satisfying and dissatisfying experiences with the system. A total of 1012 email invitations were sent to the educators of the university who had been the registered Moodle users. Out of these, 85 educators reported their satisfying points while 106 educators reported their dissatisfying points about Moodle. Respondents were free to report their satisfying and dissatisfying experiences with Moodle which resulted in thick descriptions for many respondents.

5.2   Data analysis

The reported descriptions of experiences were content analyzed and classified into two broad categories: environmental factors and job-specific outcome factors following the framework presented in Figure 1. Two coders coded and categorized the sample data separately. The coders then met to compare the classifications. The Holsti's (1969) inter-coder agreement was 83%. There were a few disagreements which were resolved by discussion.

6   RESULTS

6.1   Satisfaction: major groups and categories within groups

The sorting of the experiences led to two major groups of factors that appear to be associated with satisfying experiences: environmental factors and job-specific outcome factors. The list of factors and sample quotes from the data are shown in Table 1.

Within environmental factors, two groups emerged from data: system quality factors and available support related factors. Within system quality factors, five categories emerged from the data. These are ease of use (the users felt the system to be easy to use), access (the users felt the system to be quick to respond and available), security (the users felt the system to be capable to share information securely), functionality (the users felt the system had enough functionalities to meet their needs), and mobility (the users felt the system could be usable from any place). Within available support related factors, two categories were identified: support (the users felt that sufficient support were available to solve their problems) and training (users felt that available training was sufficient and useful).

Within the job specific outcome factors, four categories emerged from the data. These are easy knowledge sharing (users felt the system provided an easy way to communicate and share knowledge), improved control (users felt the system provided them improved control on the overall management of teaching), flexible teaching (the users felt the system provided a flexible way to administer the teaching), and students' appreciation (users got feedback from the students that they were happy with the overall management and learning outcome of the course using the system).

Factor		Sample quote from data
Environmental factors	Ease of use	"….At the beginning I found the system to be very complex but I am very happy that I now find the system to be very easy to use…."
	Access	"….I find the system mostly available when I need to check something…."
	Security	"….The good thing is that I can share lecture materials securely…."
	Mobility	"….I can use Moodle through net, thus it is not bound by place…."
	Functionality	"….The wiki is excellent-it saves a lot of emailing and you don't have to remember specific password for everything…."
	Support	"….Moodle support is available…."
	Training	"….Moodle training in the university has been very useful…."
Job-specific outcome factors	Easy knowledge Sharing	"…Being able to upload materials directly to Moodle without having Xerox copies….and the materials are saved in the Moodle server which can be used latter also…."
	Improved Control	"….Now I can control my course easily for example, I can see which participant has spent time on the course page, also I can make grouping easily in Moodle…."
	Students' Appreciation	"….One satisfying incident was the first time I ever used Moodle- at the end of the course a student wrote on the course evaluation, "We 'heart' Moodle"…."
	Flexible teaching	"….It is possible to arrange exam via Moodle which I often use…."

Table 1.   Classification of factors influencing satisfying experience.

6.2   Dissatisfaction: major groups and categories within groups

The sorting of the experiences led to only one major group of factors that appear to be associated with dissatisfying experiences: environmental factors. The list of factors and sample quotes from the data are shown in Table 2.

Within the environmental factors, two categories emerged from the data. These are system quality related factors, and available service related factors. Under system quality related factors, six categories emerged. These are lack of access (the users felt the system to be slow and unresponsive), high complexity (the users felt the system to be very complex to use), lack of reliability (the users felt the system to be unreliable), lack of integration (the users felt the system to be not capable of integrating information from different course pages), lack of functionality (the users felt that the system did not have enough functionalities to meet their needs), and poor usability (the users felt the system to be old-fashioned and not visually appealing).

Within service oriented factors, three categories emerged from the data. These are lack of training (the users felt that the training was not sufficient), lack of support (the users felt that sufficient support was not available when they faced problems with the system) and lack of user rights (the users felt that a sufficient user right is not provided to the students in a course).

Factor		Sample quote from data
Environmental factors	Access	"….The problem has been that often Moodle has been inaccessible or unstable so that I or the students have not been able to access the materials in Moodle…."
	Poor usability	"….In a course with several teachers, all teachers received notifications when any group of students returned their solutions to an exercise project. This was somewhat annoying; It required several clicks with a mouse to find whether I am the instructor of the student group in question…."
	Ease of use	"….Storing and moving files and referring to them is complicated and old-fashioned…."
	Reliability	"….Backing up hasn't been tested well. I accidently lost the list of participants on the course and had to manually add each from the page access log (twice)…."
	Integration	"….Copying the course to a new course is a complicated process and doesn't always succeed…."
	Functionality	"….Text editor is poor, cannot use font size, tabs and the way I wanted to show like…."
	Support	"….Lack of support and answers like look at from the manual…."
	Training	"….I would like more courses on improving my use of Moodle…."
	User rights	"…. Students cannot create materials in the course because the settings make it impossible. I have not been able to do anything about this. If the students could participate in creating the course in Moodle there would be no problem in interaction…."

Table 2.   Classification of factors influencing dissatisfying experience.

Generic Factor	Specific factor	Satisfying		Dissatisfying		Total	Percentage
Environmental expectations	Access	3		31		34	17.2
	Ease of use	6		13		19	9.6
	Reliability	0		10		10	5.1
	Integration	0		4		4	2.0
	Functionality	3		3		6	3.0
	Usability	0	Total 29	17	Total 108	17	8.6
	Security	6		0		6	3.0
	Mobility	4		0		4	2.0
	Training	3		9		12	6.1
	Support	4		15		19	9.6
	User rights	0		6		6	3.0
Job-specific outcome expectations	Easy knowledge sharing	25		0		25	12.6
	Improved control	20	Total 61	0	Total 0	20	10.1
	Flexible teaching	8		0		8	4.0
	Students' appreciation	8		0		8	4.0

Table 3.   The frequency of identified factors.

7   DISCUSSIONS

The frequency of the identified factors is summarized in Table 3. It shows that the educators were satisfied due to both environmental factors and job-specific outcome factors of the e-learning system. However, environmental factors were not as critical as job-specific factors for educators' satisfaction. On the other hand, environmental factors were very critical to lead user dissatisfaction, while job-

specific outcome factors were not. This supports study on consumer behavior literature. For example Swan and Combs (1976) postulated that:

"*Consumers judge products on a limited set of attributes, some of which are relatively important in determining satisfaction, while others are not critical to consumer satisfaction but are related to dissatisfaction when performance on them is unsatisfactory*"

Specifically, Swan and Combs (1976) hypothesized that instrumental (the performance of the physical product) factors, similar to environmental attributes in our context would be more critical for generating user dissatisfaction while expressive (the psychological performance of the product) factors, similar to job-specific outcome factors in our context would be more critical for generating user satisfaction.

The educators were satisfied with the job-specific outcome factors. The educators cited these factors as the source of their satisfaction 61 times. For example, ease of knowledge sharing was cited 25 times, improved control in teaching was mentioned 20 times, flexible teaching was cited 8 times, and students' appreciation as a benefit of using an e-learning system was cited 8 times. The findings that these benefits make the educators satisfied is supported by Bhattacherjee (2001), who reported that perceived usefulness (the degree to which a user believes that using a particular system would enhance his or her job performance) has an influence on user satisfaction. Our findings are also in line with the task-technology fit theory (Goodhue & Thompson 1995), which suggests that an IS will have a positive impact on task performance when the system provides features that fit the task requirement. Our finding implies that this positive impact on the performance of task latter leads to user satisfaction.

The environmental factors also generate satisfaction given that the educators cited these factors as the source of their satisfaction 29 times. For example, ease of use was cited 6 times, access was cited 3 times, functionality was cited 3 times, security was cited 6 times, mobility was cited 4 times, training was cited 3 times, and support was cited 4 times. Ease of use, access, functionality, security, and mobility might be considered as the system quality related factors, while support and training can be considered as service related factors. The IS success model posits that system quality and service quality have an influence on user satisfaction (DeLone & McLean 2003). Our finding implies that the system quality factors: ease of use, access, reliability, security, mobility and offered functionality generate user satisfaction. On the other hand, service factors: available training and support also generate user satisfaction. Thus, our findings are in line with the literature.

The educators were dissatisfied with the environmental factors. The educators mentioned these sources 108 times as the reasons of their dissatisfaction. For example, the educators pointed that the system was not accessible 31 times, complex to use was cited 13 times, poor usability was cited 17 times, reliability problem was cited 10 times, Integration problem was cited 4 times, lack of functionality was cited 3 times, lack of support was cited 15 times, lack of sufficient training was cited 9 times, and lack of sufficient user rights was cited 6 times. In particular, the educators had higher expectations on these factors, but the system did not meet their expectations. Thus, these generated dissatisfaction.

8   IMPLICATIONS

Our study findings have at least three theoretical implications. First, we have proposed a theoretical framework to categorize different factors that may contribute to satisfaction and dissatisfaction. In general, this framework deepens our understanding on how user satisfaction is shaped by different post-adoption expectations. Second, our results show that there are other factors (e.g., environmental factors such as system quality and available support) in addition to perceived usefulness that may contribute to user satisfaction. Thus, it gives an indication that the expectation-confirmation based IS continuance model is incomplete and needs further extensions. Third, we found that sources of satisfaction and dissatisfaction may differ. In particular, some factors are critical to user satisfaction

while others are not. On the other hand, some factors are very critical to user dissatisfaction while others are not. Our study partly supports the Herzberg's two factor theory that some factors may generate satisfaction but in the absence of these does not necessarily generate dissatisfaction. Specifically, we found that job-specific outcomes generated satisfaction but their absence did not generate dissatisfaction. However, this finding could be context dependent. It might be that users' expectations of the job-specific factors were fulfilled in our study context so well that no user pointed their dissatisfaction on this factor. The result can be different if the target system does not meet the users' job-specific expectations well enough. Thus, similar kinds of studies are needed to conduct in different contexts to confirm our finding.

Our study has practical implications too. Knowing the factors that generate user satisfaction and the factors that generate user dissatisfaction provides an awareness to the IS management. The management should develop appropriate strategies to maximize user satisfaction and avoid user dissatisfaction to have continued users, and thus ensuring IS success. Developers may also find ways how to build a system that would make user satisfied. In particular, they may decide to include more features that may help in completing educators' tasks to make the educators satisfied with the e-learning system. They should also consider improving the technical capabilities of the system to increase satisfaction and avoid dissatisfaction. For example, developers should put more effort to improve the system quality related features such as usability, accessibility, ease of use, reliability and so one. The support team should put more effort to improve support and the management should organize more training.

9   CONCLUSIONS

This study identified the factors that generate user satisfaction and the factors that generate user dissatisfaction of information system in the context of educators' utilization of e-learning system. We proposed a theoretical framework that extends our understanding of user satisfaction and dissatisfaction in IS and helps to underpin the factors that are salient for generating user satisfaction and dissatisfaction. Specifically, we proposed that satisfaction and dissatisfaction can be generated from two kinds of generic factors: environmental and job-specific outcomes factors. Our study with an example e-learning system revealed that environmental factors were more salient to generate dissatisfaction while job-specific outcome factors were more salient to generate satisfaction. This implies that the factors that generate dissatisfaction may differ from the factors that generate satisfaction.

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Paper 4:   Islam, A. K. M. N. (2011) Understanding the continued usage intention of educators toward an e-learning system. *International Journal of E-Adoption (IJEA)*, Vol. 3 (2), 54–69

Understanding the Continued Usage Intention of Educators Toward an e-Learning System

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ABSTRACT

The tremendous development of technologies over recent decades has offered many e-learning systems to faculty educators to support teaching. The advantage of using such systems in connection with on-site courses is that it increases flexibility in teaching/learning by making resources available online. However, there is little empirical evidence to suggest which factors shape educators' continuance intention to use such systems. This study builds a model, based on the Unified Theory of Acceptance and Use of Technology to identify the factors. The model was tested among university educators who use the popular e-learning system, Moodle. The results suggest that the continuance intention is driven by perceived usefulness and access. Perceived ease of use, perceived behavioral control, compatibility, and social influence do not have a significant direct impact on continuance intention, although perceived ease of use and compatibility significantly affect perceived usefulness. Taken together, the core determinants of the continuance intention explained around 70% of the total variance in intention in this study.

Keywords: Continued Use, Course Management System, E-Learning, E-Learning System, Unified Theory of Acceptance, Use of Technology

INTRODUCTION

During recent years, e-learning using the Internet has become such a common phenomenon that educational institutions have invested ample resources to build and maintain e-learning environments (Coates et al., 2005). E-learning refers to the use of information and communications technology (ICT) to enhance and/or support teaching/learning. E-learning may provide many benefits, such as reduced education cost, consistency, timely content, flexible

accessibility, and convenience (Cantoni et al., 2004; Lee et al., 2009a).

An e-learning environment may be comprised of student learners, educators, and the ICT. Learning may occur without an educator, particularly in an informal learning situation where learners study through the ICT and with other learners. However, in a formal teaching situation the educators' role is visible and they enable or constrain learning. In both situations, e-learning systems are very attractive to educational institutions. Thus, when evaluating an e-learning system, the educators' perspective must be considered. The success of such system

depends on the willingness of the educators to continue utilizing it. If an educator chooses to discontinue his/her use of a particular e-learning technology, the students generally do not have any other choice than to leave the technology and adapt to the educator's alternative choice.

To do research on the behavior of users in the utilization of e-learning systems, researchers often depend on general Information System (IS) adoption theories (Larsen et al., 2009; Sorebo et al., 2009). IS researchers have been attempting to identify the factors that may explain IS use for decades. Two schools of thoughts have evolved (Larsen et al., 2009). The first addresses the initial use of IS or IS acceptance, while the second addresses the subsequent IS use or IS continuance. Users' initial e-learning system acceptance is an important first step toward gaining success. But the long-term viability of an e-learning system and its eventual success depend on its continued use rather than its initial acceptance (Bhattacherjee, 2001).

The research on IS continuance is mainly dominated by the expectation-confirmation theory (ECT) (Bhattacherjee, 2001). However, studies built upon other frameworks such as the Technology Acceptance Model (TAM), the Theory of Planned Behavior (TPB), etc. are also found in the literature (Hsu & Chiu, 2004; Lin, 2011). The integration of two or more frameworks in order to aid the understanding of the IS continuance intention has also been extensively studied (Lee, 2010; Liao et al., 2007). One of the most popular integrative frameworks developed for IS acceptance and use is the Unified Theory of Acceptance and Use of Technology (UTAUT) (Venkatesh et al., 2003). The UTAUT model was developed after synthesizing the previous adoption models. Thus, in this paper, we use the UTAUT model as the basis for our research model for understanding educators' continuance intention toward utilization of e-learning systems in the university context.

RESEARCH CONTEXT

In order to understand the research context of this study, a brief introduction of the targeted e-learning system and the research environment are presented.

One e-learning system that may support both the traditional teaching and online teaching is a course management system, also known as a learning management system. A course management system is web-based software used for delivery, tracking and managing education/ training. It contains features for distributing courses over the Internet and online collaboration. The educators can track the progress of students using such software. The students may also submit their assignments, download course materials, track their grades, etc. by logging on to the system. Course management systems are very widely used in higher education. For example, in 2005, 95% of all higher education institutions in the UK were using course management systems (Browne et al., 2006).

There are many course management systems, such as aTutor, Blackboard, it's learning, Moodle etc. The target course management system of this study is Moodle. Moodle is an open source course management system or a virtual learning environment. It has become very popular among educators for creating dynamic online course websites for students. Moodle can be used to conduct online courses and also to augment face-to-face courses, the latter is known as blended learning. Moodle provides tools such as forums, databases and wikis to build collaborative learning communities. It also provides ways to deliver content to students and assess learning using assignments and quizzes. To work, it needs to be installed on a web server.

This study has been conducted in an internationally acknowledged, multidisciplinary scientific university located on the southwest coast of Finland. With 21,000 students and 3,000
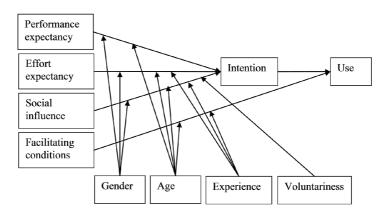
Figure 1. UTAUT model (Venkatesh et al., 2003)

employees, it is one of the major universities in Finland. The university has seven faculties and has been using Moodle since 2007 as the platform for creating course pages online. However, educators are mostly free to choose other methods of creating course pages within the university domain. In some faculties, self-made course management systems are also available. Thus, using Moodle is not seen as mandatory by the faculty educators.

THEORETICAL BACKGROUND

UTAUT Theory

Prior research on technology adoption has employed a number of theoretical models such as the Theory of Reasoned Action, the Technology Acceptance Model, the Motivational Model, the Theory of Planned Behavior, the Model of Personal Computer Utilization, the Innovation Diffusion Theory, and the Social Cognitive Theory to examine individual acceptance of technologies. These models and theories have culminated in the UTAUT theory (Venkatesh et al., 2003). According to UTAUT, there are four core determinants of user acceptance and use: performance expectancy, effort expectancy, social influence, and facilitating conditions. Venkatesh et al. (2003) conceptualizes performance expectancy as the degree to which an individual believes that using the IS will help

him or her to attain gains in job performance, and effort expectancy as the degree of ease associated with the use of the IS. They define social influence as the degree to which an individual perceives that important others believe he or she should use the IS, and facilitating conditions as the degree to which an individual believes that the necessary organizational and technical infrastructure exist to support use of the IS. In the UTAUT model, gender, age, experience and voluntariness have been theorized as being the moderators between the associations of behavioral intention/behavior and the core constructs (performance expectancy, effort expectancy, social influence, and facilitating conditions). The UTAUT model is shown in Figure 1.

E-Learning Continuance Research

Several empirical studies on e-learning continuance are found in the literature. Table 1 summarizes these studies. Most of these are built upon the ECT framework and other complimentary theories such as TAM (Davis, 1989), TPB (Ajzen, 1991), the IS success model (ISM) (DeLone & McLean, 2003), fairness theory (FT) (Lind et al., 1993), self-determination theory (SDT) (Deci & Ryan, 1995), task-technology fit (TTF) (Goodhue & Thompson, 1995), and UTAUT (Venkatesh et al., 2003). The majority of the studies are targeted toward students participating in online courses, with little or almost
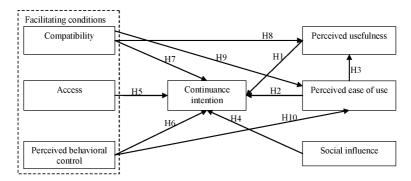
Table 1. Empirical studies on e-learning continuance

Article	Theories used	Target population	Key findings
Chiu et al. (2005)	ECT	Students attending online courses	Satisfaction affects continuance intention.
Roca et al. (2006)	ECT, TAM, and TPB	Students attending online courses	Satisfaction affects continuance intention.
Chiu et al. (2007)	FT	Students attending online courses	Satisfaction, and utility value affect continuance intention.
Liao et al. (2007)	ECT, TPB	Students attending online courses	Satisfaction, subjective norm, and perceived behavioral control affect continuance intention.
Roca & Gagne (2008)	TAM, SDT	Students attending online courses	Perceived usefulness, perceived playfulness, and perceived ease of use affect continuance intention.
Chiu & Wang (2008)	UTAUT	Students attending online courses	Computer self-efficacy, attainment value, utility value, perceived playfulness, performance expectancy, and effort expectancy affect continuance intention.
Sorebo et al. (2009)	ECT, SDT	University faculty educators	Perceived usefulness and perceived playfulness affect continuance intention
Liao et al. (2009)	ECT, TAM	Students attending online courses	Satisfaction, perceived usefulness (only for initial adopter), and attitude affect continuance intention.
Larsen et al. (2009)	ECT, and TTF	University faculty educators	Satisfaction, and utilization affect. continuance intention.
Limayem & Cheung (2009)	ECT	Students attending a mixed (face-to-face lectures and e-learning tool) course.	Satisfaction, and perceived usefulness affect continuance intention.
Cho et al. (2009)	TAM	Students attending online courses	Satisfaction, perceived usefulness, and prior experience affect continuance intention.
Lee (2010)	ECT, TAM, TPB, and FT	Students attending online courses	Satisfaction, perceived usefulness, attitude, concentration, subjective norm, and perceived behavioral control affect continuance. intention.
Lin (2011)	TAM	Students attending online courses	Satisfaction (only for less experienced users), and attitude affect continuance intention.

no face-to-face interaction. A few studies are targeted toward faculty educators who use an e-learning system to support their face-to-face contact teaching.

The majority of studies have concluded that perceived usefulness and satisfaction are the main determinants of e-learning continuance intention (Liao et al., 2009; Sorebo et al., 2009). However, drawing the theory of TAM some studies have concluded that perceived ease of use is important for predicting continuance intention (Roca & Gagne, 2008). A few studies have used TPB theory to understand e-learning continuance and have concluded that subjective norms and perceived behavioral control are also important in predicting e-learning continuance (Liao et al., 2007). Researchers have also found that intrinsic motivation (perceived enjoyment and perceived playfulness) is important in shaping

Figure 2. Research model

e-learning continuance intention (Roca & Gagne, 2008; Sorebo et al., 2009).

RESEARCH MODEL

Based on the literature review on e-learning continuance, we have identified two gaps. First, we observe that very few studies have been conducted to model faculty educators' continuance intention to use e-learning systems. Second, e-learning continuance research is mainly dominated by the expectation-confirmation framework. Thus, researchers have paid only a little attention to the UTAUT model in the e-learning continuance context, although it has been shown to be a very powerful model in explaining user behavior in the context of technology acceptance and use (Sun et al., 2009; Venkatesh et al., 2003). Thus, to fill the research gaps we have built our research model based on the UTAUT theory in order to understand educators' continued usage intention regarding an e-learning system. However, in this study, we are interested only in the associations between the core UTAUT constructs and behavioral intention without moderating effect. The research model is shown in Figure 2.

Performance Expectancy

Depending on the theory, different constructs pertain to performance expectancy (Venkatesh et al., 2003). Among these, perceived usefulness

from technology acceptance and expectation-confirmation frameworks has been studied extensively in the literature (Bhattacherjee, 2001; Davis, 1989). Perceived usefulness is defined as the degree to which a person believes that using a particular system would enhance his or her job performance (Davis, 1989). In most of the prior studies, perceived usefulness has been found to be the strongest predictor of intention. Thus, we hypothesize the following.

H1. Perceived usefulness positively affects educators' continuance intention to use an e-learning system.

Effort Expectancy

Again, depending on the theoretical perspective, different constructs may capture the concept of effort expectancy (Venkatesh et al., 2003). Among these, perceived ease of use has been studied extensively in technology acceptance. Perceived ease of use is defined as the degree to which a person believes that using a system would be free of effort (Davis, 1989). Perceived ease of use has not been included in the original expectation-confirmation based IS continuance theory (Bhattacherjee, 2001). However, many subsequent studies have shown that perceived ease of use can be added to the expectation-confirmation based IS continuance theory (Hong et al., 2006; Recker, 2010). Thus, we make the following hypothesis.

H2. Perceived ease of use positively affects educators' continuance intention to use an e-learning system.

TAM hypothesizes that perceived ease of use affects perceived usefulness in the IS acceptance and use context (Davis, 1989). In the IS continuance context, many studies have found a significant positive relationship between perceived ease of use and perceived usefulness (Hong et al., 2006). Thus, we make the following hypothesis.

H3. Perceived ease of use positively affects the perceived usefulness of an e-learning system from the educators' perspective.

Social Influence

UTAUT model posits that social influence positively affects the continued usage intention. This has been supported by many studies, especially in the IS continuance context where the subjective norm, which pertain to social influence, have been found to affect continuance intention significantly (Kim, 2010; Lee, 2010; Sun et al., 2009). The theory of planned behavior also posits a direct positive relationship between the subjective norm and behavioral intention (Ajzen, 1991). Thus, we hypothesize the following.

H4. Social influence positively affects educators' continuance intention to use an e-learning system.

Facilitating Conditions

One of the major limitations of UTAUT theory is the operationalization of the core constructs. Each of the core-constructs in UTAUT theory has been operationalized by using the highest-loading items from each of the respective scales (Venkatesh et al., 2003). The danger of this approach is that facets of each construct can be eliminated, thus threatening content validity (Venkatesh et al., 2003). To overcome

such limitations and with the argument that facilitating conditions being such a construct that might capture a wide scope, we conceptualize facilitating conditions as having three dimensions: access, perceived behavioral control, and compatibility. Access refers to the degree of accessibility, responsiveness, stability and availability of an e-learning system (Lee et al., 2009b). Perceived behavioral control refers to people's perception of the ease or difficulty of performing the behavior of interest (Ajzen, 1991). Compatibility refers to the degree to which an innovation is perceived as being consistent with the existing values, needs, and experiences of potential adopters (Moore & Benbasat, 1991). In the original UTAUT model, facilitating conditions has been shown to affect behavior directly and has no direct association with behavioral intention (Venkatesh et al., 2003). However, many studies have modeled a direct relationship between perceived behavioral control and behavioral intention (Lee, 2010; Sun et al., 2009) and compatibility and behavioral intention (Karahanna et al., 1999; Sun et al., 2009). Thus, we make the following hypotheses and argue that these are in line with the literature.

H5. Access positively affects educators' continuance intention to use an e-learning system.
H6. Perceived behavioral control positively affects educators' continuance intention to use an e-learning system.
H7. Compatibility positively affects educators' continuance intention to use an e-learning system.

Users carry distinct knowledge about their job situations, which they use as a basis for determining what tasks can be performed with a given system. If the system is compatible with what the users do in their jobs, then it is most likely that the users will feel the system to be useful. Conversely, if the system provides lot of important functionalities with a user-friendly interface but does not provide the functionalities needed to complete the users'

tasks, users may feel the system is not useful. Hence, compatibility has been used in the IT adoption and post-adoption literature as an antecedent of perceived usefulness (Larsen et al., 2009; Sun et al., 2009). Thus, we propose the following hypothesis.

H8. Compatibility positively affects the perceived usefulness of an e-learning system from the educators' perspective.

TAM 3 hypothesizes that facilitating conditions (perceptions of external control) positively affect perceived ease of use (Venkatesh & Bala, 2008). We further argue that if the system is compatible with the job requirements of its users, they may find the system easy to use. On the other hand, an individual's control belief regarding his ability and the availability of organizational resources may positively affect the perceived ease of use. Thus, we propose the following two hypotheses.

H9. Compatibility positively affects the perceived ease of use of an e-learning system from the educators' perspective.
H10. Perceived behavioral control positively affects the perceived ease of use of an e-learning system from the educators' perspective.

RESEARCH METHOD

Questionnaire Development

Each item corresponding to the constructs has been measured using the seven-point Likert scale, with answer choices ranging from "Strongly disagree (1)" to "Strongly agree (7)". Most of these items are adapted from the literature with minor changes in wording reflecting the target system. After the questionnaire was drafted, it was first sent to two academic researchers for their review and revised according to their comments and suggestions to make the wording of the items more precise. Then, the questionnaire was sent to 30 educators at the

university, so that they could review it. Overall, the educators indicated that the questionnaire was relatively clear and easy to complete. A number of suggestions were made concerning the wording of several items and the overall structure of the questionnaire. The questionnaire was revised according to the given suggestions. The questionnaire is shown in the Appendix.

Data Collection

Data was collected via a web-based survey from the educators of a university in Finland who use Moodle for their teaching purposes. A list of the educators' email addresses was collected from the Moodle support team at the university. A total of 1012 email invitations were sent to the educators at the university who were registered Moodle users. Two reminders were sent to increase the response rate after gaps of two weeks. The survey ran for approximately one and half months. After filtering invalid and incomplete responses a total of 207 survey responses were received. For this particular study, we were interested in those users who had conducted at least one course using Moodle during the academic year. After filtering the survey responses according to this criterion, we ended up with 175 usable responses. The demographic information of the respondents is given in Table 2. The response rate is low in the study. However, only faculty members who had used Moodle for conducting their courses were asked to respond. There were many users registered with Moodle who were from the Open University who do not belong to any faculty and never conduct teaching. Instead, they use Moodle for project and course management purposes. Thus, the response rate is judged as being acceptable. To avoid the common method bias problem to some extent, we decided to randomize the questions in the questionnaire during the data collection (Straub et al., 2004).

Data Analysis

Partial least squares (PLS) is used as the approach for our analysis and smartPLS is the tool utilized (Ringle et al., 2005). PLS is a second

Table 2. Demographic information

		Frequency	**Percent**
Gender	Male	74	42.3
	Female	101	57.7
Age	21-40 years	90	51.4
	>41 years	85	48.6
Experience with the target system	0 – 18 months	54	30.9
	>18 – 36 months	83	47.4
	>36 months	38	21.7

generation regression method that combines confirmatory factor analysis with linear regression, and this makes it possible to run the measurement and structural models simultaneously. PLS has enjoyed increasing popularity in IS research for its ability to model latent constructs under the condition of non-normality (Chin, 1998). A rule of thumb for the required sample size in PLS is that the sample should be at least ten times the most complicated multiple regression in the model (Barclay et al., 1995). The variables in this study are non-normal. Thus, PLS is the right tool for conducting the analysis in this study. In addition, the sample size of this study meets the minimum sample size requirement.

Table 3 shows item wise averages, standard deviations, loadings and t-statistics values for each construct in the model. For each construct the assessment of convergent validity or internal consistency is also included through the composite reliability coefficient. Convergent validity indicates the extent to which the items of a scale that are theoretically related are also related in reality. As we can see from Table 3, all items except SI-2 have significant path loadings greater than the threshold 0.7 recommended by Fornell and Larcker (1981). Thus, we decided to remove SI-2 from our instrument. All the constructs have composite reliability values that exceed the threshold recommended by Nunnally (1978).

Testing for discriminant validity involves checking whether the items measure the construct in question or other (related) constructs. Discriminant validity was verified with both correlation analysis and factor analysis as recommended by Gefen and Straub (2005). First, the inspection of discriminant validity among variables is based on the correlation between the variables and the square root of their respective average variance extracted (Fornell & Larcker, 1981). As Table 4 shows, the square root of average variance extracted value for the variables is consistently greater than the off-diagonal correlation values, suggesting satisfactory discriminant validity among the variables. Second, from Table 5 we see that all items have cross loading coefficients lower than the factor loading on their respective assigned latent variable, suggesting that discriminant validity on the item level is met for all the constructs.

RESULTS AND DISCUSSIONS

The test of the structural model includes estimates of the path coefficients, which indicates the strengths of the relationships between the dependent and independent variables, and the R-square values, which represent the amount of variance explained by the independent variables. Figure 3 shows the results of the test of the hypothesized structural model. Six out of our ten hypotheses are supported. As expected, perceived usefulness ($\beta = 0.54$; $p < 0.001$), and access ($\beta = 0.15$; $p < 0.05$) have a significant impact on the continued usage intention. On the other hand, compatibility ($\beta = 0.13$, ns),

Table 3. Construct items, means and internal consistencies

Construct	Item	Mean	std	Loading	t-stat
IS continuance intention (CR = 0.90)	INT-1	6.00	1.20	0.91	39.45
	INT-2	5.23	1.32	0.88	28.16
	INT-3	2.36	1.60	0.81	11.49
Perceived usefulness (CR = 0.92)	PU-1	4.59	1.33	0.84	27.91
	PU-2	5.8	1.33	0.78	11.07
	PU-3	5.18	1.28	0.85	15.41
	PU-4	5.31	1.23	0.87	19.96
	PU-5	5.65	1.22	0.80	12.99
Perceived Ease of use (CR = 0.93)	PEOU-1	4.46	1.52	0.88	30.53
	PEOU-2	4.38	1.52	0.75	13.94
	PEOU-3	4.59	1.52	0.94	105.14
	PEOU-4	4.27	1.61	0.91	44.62
Access (CR = 0.87)	ACCESS-1	4.53	1.35	0.79	12.47
	ACCESS-2	3,96	1.79	0.80	21.11
	ACCESS-3	4.81	1.39	0.82	18.26
	ACCESS-4	4.35	1.45	0.71	12.74
Compatibility (CR = 0.91)	COMP-1	4.95	1.40	0.92	35.21
	COMP-2	5.17	1.26	0.89	38.26
	COMP-3	4.66	1.36	0.82	20.31
Perceived Behavioral Control (CR = 0.90)	PBC-1	5.03	1.42	0.84	22.62
	PBC-2	4.52	1.64	0.84	23.85
	PBC-3	5.24	1.51	0.85	17.93
	PBC-4	5.22	1.44	0.80	13.23
Social Influence (CR = 0.76/0.83**)	SI-1	4.78	1.48	0.83	13.47
	*SI-2**	*3.77*	*1.54*	*0.28*	*1.47*
	SI-3	4.53	1.37	0.84	12.83
	SI-4	4.70	1.40	0.68	5.37

Note: *The item was removed

**Composite reliability (CR) = initial coefficient/coefficient after one item was removed

perceived behavioral control (β = 0.14, ns), perceived ease of use (β = 0.04, ns), and social influence (β = 0.03, ns) do not have significant effect on the continued usage intention. Taken as a whole, these predictors explained 70.2% of the total variance in intention. As expected, perceived ease of use (β = 0.15; $p < 0.05$) and compatibility (β = 0.68; $p < 0.001$) have a significant impact on perceived usefulness explaining 62% of its variance. Finally, compatibility (β = 0.39; $p < 0.001$) and perceived behavioral control (β = 0.45; $p < 0.001$) have a significant impact on perceived ease of use explaining 58% of its variance.

Overall, the associations of UTAUT model are partially supported in explaining educators' continuance intention to use an e-learning system in this study. Perceived ease

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Table 4. Correlation among the variables and the square root of their average variance extracted

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Access (1)	**0.79**						
Compatibility (2)	0.60	**0.88**					
Perceived ease of use (3)	0.68	0.69	**0.87**				
Intention (4)	0.65	0.72	0.60	**0.87**			
Perceived behavioral control (5)	0.48	0.67	0.71	0.62	**0.84**		
Perceived usefulness (6)	0.68	0.78	0.62	0.81	0.62	**0.83**	
Social influence (7)	0.40	0.45	0.39	0.43	0.45	0.44	**0.79**

of use has no significant impact on continuance intention. This is in line with the extant literature which suggests that perceived ease of use does not have significant direct impact on intention during continued usage (Bhattacherjee, 2001; Venkatesh et al., 2003). Social influence also has no significant effect on the continuance intention. The reason is that the target e-learning system is a voluntary system. Thus, this finding is also in line with the original UTAUT model (Venkatesh et al., 2003) where the association between social influence and intention was found significant only for the mandatory usage condition. Perceived usefulness was found to be the most dominant predictor of the continued usage intention. This is also in line with the extant literature. Specifically, many studies have found perceived usefulness to be the most dominant predictor of the intention to use in different usage contexts (Limayem & Cheung, 2008; Roca et al., 2006). We included three factors (access, perceived behavioral control and compatibility) in order to conceptualize facilitating conditions and found that only access significantly affects the continued usage intention. It may be so that the other constructs (perceived behavioral control and compatibility) of facilitating conditions are important during initial use, but then fail to maintain their importance when users become experienced in using the system. However, access is the factor that remains important in all stages of the use of an e-learning system and

it does not depend on user experience. To confirm this we performed a post-hoc analysis dividing the respondents into two groups (short-term users and long-term users). Short-term users were classified as those who had 0-18 months experience with the target system, while the long-term users were those who had more than 18 months experience. Our post-hoc analysis results revealed that perceived behavioral control and access are significant for short-term users, while for long-term users only access retains its significance.

The results of this study also reveal that compatibility and perceived ease of use significantly predict perceived usefulness in the e-learning continuance context. However, perceived ease of use has a weaker impact than compatibility. The weaker effect of perceived ease of use is in line with the argument which states that as users become experienced with using a system, the effect of the perceived ease of use diminishes (Bhattacherjee, 2001; Davis, 1989).

Finally, our results show that compatibility and perceived behavioral control affect perceived ease of use. One interesting point is that TAM 3 did not find a significant relationship between job relevance (similar to compatibility) and perceived ease of use (Venkatesh & Bala, 2008). However, our finding implies that judgments about a system's ease of use are affected by an individual's cognitive matching of their job goals with the consequences of system use.

Table 5. Factor analysis results

	Access	Compatibility	Intention	PBC	PEOU	PU	SI
ACCESS-1	**0.786463**	0.515772	0.593880	0.419606	0.583447	0.568843	0.303539
ACCESS-2	**0.796663**	0.395571	0.410875	0.299866	0.527207	0.488704	0.304013
ACCESS-3	**0.824423**	0.574608	0.594821	0.446229	0.551278	0.610426	0.431421
ACCESS-4	**0.706908**	0.321391	0.317850	0.250392	0.437239	0.404879	0.128569
COMP-1	0.525831	**0.920228**	0.641234	0.658706	0.616833	0.735583	0.460072
COMP-2	0.531361	**0.891297**	0.658304	0.557715	0.546627	0.669185	0.391780
COMP-3	0.539619	**0.822454**	0.594184	0.539408	0.637164	0.643171	0.340420
INT-1	0.613314	0.663457	**0.912857**	0.597102	0.549628	0.766565	0.384090
INT-2	0.617805	0.635904	**0.876759**	0.556211	0.532145	0.728307	0.436037
INT-3	0.430778	0.563661	**0.807900**	0.432989	0.434741	0.608755	0.276200
PBC-1	0.527877	0.700857	0.621303	**0.843748**	0.609300	0.677219	0.405587
PBC-2	0.395710	0.559563	0.513029	**0.841294**	0.570565	0.524240	0.259863
PBC-3	0.347718	0.458914	0.462797	**0.850484**	0.574477	0.447106	0.384167
PBC-4	0.260471	0.454167	0.417345	**0.802890**	0.587595	0.354477	0.462199
PEOU-1	0.555218	0.611709	0.549818	0.672384	**0.880262**	0.511484	0.357237
PEOU-2	0.508778	0.441995	0.340040	0.441714	**0.749328**	0.374476	0.213716
PEOU-3	0.667997	0.607141	0.534810	0.642440	**0.941519**	0.584028	0.387911
PEOU-4	0.639499	0.683849	0.581581	0.658672	**0.910902**	0.611412	0.345103
PU-1	0.571677	0.681398	0.658595	0.536908	0.525993	**0.837328**	0.440403
PU-2	0.508439	0.505124	0.620203	0.433748	0.392752	**0.777794**	0.220751
PU-3	0.633857	0.734896	0.666400	0.582792	0.578769	**0.849824**	0.440328
PU-4	0.611087	0.680287	0.717753	0.496324	0.527966	**0.868801**	0.415281
PU-5	0.490979	0.595950	0.704159	0.507797	0.472526	**0.803882**	0.268306
SI-1	0.243365	0.380831	0.328507	0.322557	0.251313	0.337779	**0.822415**
SI-3	0.280228	0.413147	0.366497	0.381698	0.254599	0.375951	**0.849058**
SI-4	0.430957	0.267630	0.309015	0.353234	0.407744	0.315455	**0.678554**

Note: Perceived Behavioral Control (PBC), Perceived Ease of Use (PEOU), Perceived Usefulness (PU), Social Influence (SI)
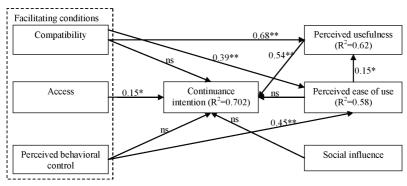
IMPLICATIONS

Our study has two theoretical implications.

First, IS continuance research is mostly dominated by the expectation-confirmation framework. However, from the theoretical perspective, our UTAUT based approach provides a refined view of how continued usage intention is shaped by its determinants. This may open up opportunities for future research on the comparison of different theoretical perspectives with reference to understanding IS continuance.

Second, we have included three factors that help to conceptualize facilitating conditions. We encourage researchers to look for more factors for facilitating conditions as well as for other core constructs of UTAUT. This kind of decomposed UTAUT may provide us with a better understanding of both IS acceptance and

Figure 3. PLS analysis results

Note: *p < 0.05; **p < 0.001; ns: non-significant

continuance. It may also eliminate the content validity related limitation of the UTAUT model.

Our findings have practical implications too.

First, the dominant effect of perceived usefulness on intention provides potential fruitful avenues for system designers regarding how to affect users' continuance intention to use. The research results suggest that good design and developing a useful system helps to deter IS discontinuance in the e-learning context. Educators will discontinue using an e-learning system, if it is not useful for their purpose, even if other conditions are fulfilled. To develop a useful e-learning system, designers should pay attention to designing systems that are easy to use and match the relevant job needs of their users. The designers need to understand user's jobs and tasks to improve a particular system. For understanding users' jobs and tasks, task analysis approach can be followed. In addition, usability tests could be done among the existing users to plan for future improvement of the system. The management should arrange trainings for the users, so that the users could develop their skills in using the e-learning system which would lead the users to feel that the system is easy to use.

Second, we found that access is another important determinant of the continuance intention. Thus, the practitioners should use appropriate actions and strategies to ensure it. The service providers who host the e-learning

services in the Internet also should put enough effort to ensure accessibility.

CONCLUSION

This study has followed the UTAUT based approach to understand the continued usage intention of educators with regard to an e-learning system. We developed a research model according to the UTAUT theory. Then, we conducted a test using survey data from 175 university educators, and analyzed the data using PLS analysis. The findings of the study show that the continuance intention is mainly determined by perceived usefulness and access. Social influence, perceived ease of use, perceived behavioral control and compatibility were found not to be significant in determining the continued usage intention. Overall, UTAUT theory is partially supported in the continued usage of e-learning system.

This study had several limitations which could be usefully addressed in future research. First, the research model did not include the demographic variables and voluntariness which were conceptualized as moderators in the original UTAUT theory. In the future, we plan to test the moderating effect of these variables on different associations of the theory in the continuance context. Second, our research has solely focused on the usage intention of faculty educators in the university context. However, we

might end up with different findings if examine the issue from the perspective of students. In our opinion, the success of an e-learning system depends on the effective utilization of the tool by both educators and students. Thus, it would be interesting to study the continued usage intention of students as well. Third, this research has been conducted in university settings but business organizations are also becoming interested in the use of such e-learning systems. Careful consideration should be made before generalizing the findings of this study to such contexts. Thus, similar studies should be repeated in the context of business organizations.

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APPENDIX

Survey questionnaire

Construct	Source	Item
IS continuance intention	Limayem et al. (2007)	INT-1:I intend to continue using Moodle rather than discontinue its use
		INT-2:My intentions are to continue using Moodle than use any alternative means
		INT-3:If I could, I would like to discontinue my use of Moodle
Perceived usefulness	Limayem et al. (2007)	PU-1:Using Moodle increases the control with my teaching plan
		PU-2:Using Moodle enables me to accomplish teaching information sharing more quickly
		PU-3:Using Moodle is of benefit to me
		PU-4:The advantages of Moodle outweigh the disadvantages
		PU-5:Overall, using Moodle is advantageous
Perceived Ease of use	Venkatesh and Davis (2000)	PEOU-1:My interaction with Moodle is clear and understandable
		PEOU-2:Interacting with Moodle does not require a lot of mental effort
		PEOU-3:I find Moodle to be easy to use
		EOU-4:I find it easy to get Moodle to do what I want to do
Access	Lee et al. (2009b)	ACCESS-1:Moodle is responsive to my request
		ACCESS-2:Moodle quickly loads all the text and graphics
		ACCESS-3:Moodle provides good access
		ACCESS-4:Moodle is stable
Compatibility	Moore and Benbasat (1991)	COMP-1:Using Moodle fits with the way I like to teach
		COMP-2:Using Moodle fits with my teaching style
		COMP-3:Moodle is compatible with most aspects of my teaching
Perceived Behavioral Control	Taylor and Todd (1995)	PBC-1:I am able to use Moodle well for accomplishing my teaching
		PBC-2:Using Moodle is entirely within my control
		PBC-3:I have the resources necessary to use Moodle
		PBC-4:I have the knowledge necessary to use Moodle
Social Influence	Venkatesh et al. (2003)	SI-1:People important to me support my use of Moodle
		SI-2:People who influence my behavior want me to use Moodle instead of any alternative means
		SI-3:People whose opinions I value prefer that I use Moodle for doing my teaching
		SI-4:In general, the school has supported the use of Moodle

Paper 5:   Islam, A. K. M. N. (2011) The role of perceived system quality as the educators' motivation to continue e-learning system use. *AIS Transaction of Human Computer Interaction (THCI)*, Vol. 4 (1), 25–43

Transactions on Human-Computer Interaction

THCI

The Role of Perceived System Quality as Educators' Motivation to Continue E-learning System Use

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Abstract

This study incorporates perceived system quality into the original expectation-confirmation based information system continuance model in order to investigate the role of perceived system quality in users' motivation to continue e-learning system use. Our proposed model was tested among university educators (n = 175) who use the popular open-source e-learning system, Moodle. The results reveal that perceived usefulness, confirmation of initial expectations, and perceived system quality significantly affected educators' satisfaction. In addition, perceived usefulness and satisfaction significantly affected continuance intention. Unexpectedly, no direct association between perceived system quality and continuance intention was found. The determinants of continuance intention explain around 64% of its total variance. The paper finishes with conclusions and implications for future research and practice.

Keywords: Continued use, e-learning, expectation-confirmation theory, satisfaction

INTRODUCTION

With the latest development of Internet technologies, universities are investing considerable resources in e-learning systems to support teaching. These systems facilitate educator-to-student communication, the ability to track students' progress, and the secure sharing of course content online. Because of such useful features, e-learning systems are very attractive for universities. However, when evaluating e-learning systems, the educator's perspective must be considered because the success of such systems depends on their willingness to continue utilizing the systems. Moreover, if an educator chooses to discontinue the use of an e-learning system, students generally do not have any other choice than to leave the system and adapt to the educator's alternative choice. Thus, it is plausible that an educator's unwillingness to utilize e-learning possibilities may lead to underutilization by students and possibly reduced learning outcomes (Sorebo et al., 2009).

When conducting research on individuals' e-learning system usage behavior, researchers often depend on different behavioral theories (Davis, 1989; Larsen et al., 2009; Sorebo et al., 2009). Using Fishein and Ajzen's (1975) Theory of Reasoned Action (TRA), two schools of thought have evolved (Larsen et al., 2009). The first addresses initial information system (IS) use (or IS acceptance), while the second addresses subsequent IS use (IS continuance). Initial IS use is an important first step toward achieving success. However, the long-term viability of an IS and its eventual success depend on its continued use rather than initial use (Bhattacherjee, 2001).

A variety of theoretical perspectives have been advanced in order to understand what motivates individuals to continuously use an IS (e.g., Bhattacherjee, 2001; Hsu et al., 2004; Kang et al., 2009; Karahanna et al., 1999; Lin, 2011). Among these theoretical perspectives, the expectation-confirmation theory (ECT) has been dominant since 2001 (Bhattacherjee, 2001; Hsieh and Wang, 2007; Kim, 2010; Lee, 2010; Liao et al., 2007; Lin et al., 2005; Recker, 2010). The ECT based IS continuance model was developed with the argument that the psychological motivation shaping continuance behavior is different from that of acceptance behavior (Bhattacherjee, 2001). According to the ECT based IS continuance model, continuance intention is determined by perceived usefulness (a post-adoption behavioral belief that represents the consequences of utilizing an IS) and satisfaction (the affective attitude toward a specific IS exhibited by someone who interacts with the IS directly). Despite its popularity, this model provides only limited guidance on how to influence usage via design and implementation from the Human-Computer Interaction (HCI) perspective. Benbasat and Barki (2007) argued that to increase practical relevance for the HCI field, design and implementation attributes must be included in the research models. Following this, Benbasat (2010) recommended that such design attributes should be tested as antecedents of the constructs of interest. He further argued that adoption research reflecting only surrogate variables like perceived usefulness cannot generate any specific design advice for HCI practitioners. For example, HCI practitioners receive feedback regarding usefulness in a general sense, but they do not receive actionable feedback about the important aspects of a system's characteristics. Such feedback would be very important, especially for organizations, as online and distance courses using e-learning systems are still evolving. Thus, an extended IS continuance model using factors related to system characteristics may provide more guidance for e-learning system designers and managers.

The motivation for this study therefore derives from two different streams of research: IS continuance and system quality research. Although a significant amount of research has been conducted in these two fields independently, very few studies have tried to integrate them to understand IS continuance, particularly in the e-learning system utilization context. One important point to be noted at this point is that in prior IS literature, system quality has often been measured by soliciting users' subjective evaluations. Thus, we put the word 'perceived' in front of system quality in the rest of this paper to indicate users' perceptual evaluations of system quality. Perceived system quality has been explored in connection with IS continuance research, but only on a limited scale (Chiu et al., 2007; Kang et al., 2009; Roca et al., 2006). Prior research has primarily focused on exploring relationships between perceived system quality and satisfaction. However, little research has been done to examine the influence of perceived system quality on the IS continuance intention (Saeed and Abdinnour-Helm, 2008). Thus, there is no proof of the value of a good system for promoting the continued usage of IS for IS managers. Hence, this study attempts to integrate perceived system quality into the ECT based IS continuance model to explore IS continuance. In practice, we use the ECT based IS continuance model as the main theoretical framework to understand educators' intention to continue using e-learning systems. To highlight the role of perceived system quality in predicting educators' continuance intention to use e-learning systems, we incorporate perceived system quality as an additional variable within the ECT based IS continuance model. This allows us to study the impact of the technological factors on continued usage behavior in the context of e-learning system utilization. Furthermore, it should demonstrate to managers and developers the value of improving system quality to retain existing users.

The paper proceeds as follows. *Theoretical Background* section presents the theoretical background and literature review. *Research Context* section presents the research context. In *Research Model Development* section we develop our research model. *Study Design* and *Method* section is dedicated to the research method, data analysis, results, and discussion. In Implications section we describe the implications of our findings for theory and practice. Finally, *Conclusions* section concludes the paper.

THEORETICAL BACKGROUND

Expectation-Confirmation theory

Since the 1970s, research into consumers' post-purchase behavioral process has been a dominant theme in consumer behavior literature (Churchill and Surprenant, 1982). Among the research frameworks used in this theme, the expectancy-confirmation paradigm has been extensively used to explain consumers' satisfaction and repurchase decisions in a variety of post-purchase contexts (Bhattacherjee, 2001; Churchill and Surprenant, 1982; Oliver, 1980).

The expectation-confirmation theory hypothesizes that consumers' level of satisfaction with a product/service determines their repurchase intention. In turn, consumer satisfaction is determined by two major constructs: initial expectations (pre-purchase expectations) about a product/service, and the discrepancies between the expectations and the product/service performance (confirmation). According to this theory, buyers first develop expectations about a product/service before purchase. Second, their experiences with the product/service build perceptions about actual performance. This leads to the buyer either confirming or disconfirming the pre-purchase expectations after assessing the perceived performance against the earlier frame of reference (pre-purchase expectations). A buyer's expectations are confirmed when the product/service performs as expected, are negatively confirmed when it performs worse than expected, or are positively confirmed when it performs better than expected (Churchill and Surprenant, 1982).

Drawing attention to the substantial difference between initial adoption and continued usage, Bhattacherjee (2001) developed and empirically tested the information system continuance model in a voluntary environment using expectation-confirmation theory. Despite the structural adaptation from the expectation-confirmation paradigm, Bhattacherjee's information system continuance model possesses a few differences. First, it focuses on post-adoption expectations rather than pre-adoption expectations, because a user keeps updating expectations of a system as he/she gains more experience of it. After the assimilation of such experiences, the user's expectations can be different from his/her initial expectations prior to using the system (Bhattacherjee, 2001). From this perspective, the information system continuance model posits that post-adoption expectations (rather than pre-adoption expectations) are the relevant determinants of satisfaction. Second, the information system continuance model employs perceived usefulness as a surrogate for post-adoption expectation. The expectation-confirmation paradigm defines expectation as individual belief or sum of beliefs about the level of attributes possessed by a product/service (Churchill and Surprenant, 1982). Following this definition, Bhattacherjee (2001) adopted perceived usefulness as the measure of expectation, since among the cognitive beliefs in IS adoption and usage, perceived usefulness has demonstrated itself to be the most consistent and salient factor in determining users' IS usage intention over time (Davis, 1989; Venkatesh and Davis, 2000). Third, perceived performance was not included in the information system continuance theory with the argument that the effect of perceived performance could be captured by the confirmation construct (Bhattacherjee, 2001).

In summary, the information system continuance model postulates that after an initial acceptance and period of use, users form an opinion about which of their pre-acceptance expectations have been confirmed (confirmation). From this confirmation, users form an opinion about the benefits (perceived usefulness). After a period of time, both confirmation and perceived usefulness form the basis of satisfaction with the IS (satisfaction). Finally, perceived usefulness and satisfaction influence users' IS continuance intention (intention). The information system continuance model is shown in Figure 1.
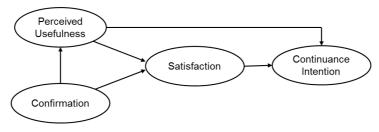

Figure 1: IS Continuance Model (Bhattacherjee, 2001)

Empirical studies on e-learning continuance

To conduct a review of the relevant literature on e-learning continuance, we searched in the following databases: ABI/INFORM, Business Source Complete, Electronic Journals Service, ScienceDirect, and Wiley InterScience. We

selected these databases because they include most IS journals, making it possible to find a significant proportion of the published material on e-learning system continuance. The search was conducted by using keywords: expectation-confirmation, expectation-disconfirmation, information systems continuance, e-learning continuance, and e-learning post-adoption use. Webster and Watson (2002) suggest going through a journal's table of contents with a keyword-based search. Thus, to ensure that the relevant articles were included, we performed a manual search of each issue of the six highest ranked journals from the senior scholar's basket of IS journals: MIS Quarterly; Information Systems Research; Information System Journal; Journal of the Association of Information Systems; Journal of Management Information Systems; and European Journal of Information Systems. In addition, we went through the table of contents of two major IS conferences: International Conference on Information Systems (ICIS) and the European Conference on Information Systems (ECIS). Thereafter, we utilized the references of the articles identified to find additional articles.

Several empirical studies on e-learning continuance exist in the literature; they are summarized in Table 1. These studies were mainly built upon the ECT based IS continuance framework and other complementary theories such as the technology acceptance model (TAM) (Davis, 1989), the unified theory of acceptance and use of technology (UTAUT) (Venkatesh et al., 2003), the theory of planned behavior (TPB) (Ajzen, 1991), the attribution theory (Heider, 1958), the diffusion theory (Rogers, 2003), the IS success model (DeLone and McLean, 2003), the fairness theory (Lind et al., 1993), the self-determination theory (Deci and Ryan, 1995), and the task-technology fit (Goodhue and Thompson, 1995). The majority of studies targeted students participating in online courses, who had little or almost no face-to-face interaction. A few studies targeted faculty educators who used an e-learning system to support their face-to-face contact teaching.

The majority of studies concluded that perceived usefulness and satisfaction are the main determinants of e-learning continuance intention (e.g., Liao et al., 2009; Sorebo et al., 2009). However, drawing on TAM, some studies concluded that perceived ease of use is important in predicting the continuance intention (e.g., Roca and Gagne, 2008). A few studies used TPB theory to understand e-learning continuance and concluded that subjective norms and perceived behavioral control are also important in predicting e-learning continuance (e.g., Liao et al., 2007). Some studies also found that indicators of intrinsic motivation (e.g., perceived enjoyment, perceived playfulness) are important in shaping the e-learning continuance intention (e.g., Roca and Gagne, 2008; Sorebo et al., 2009).

Perceived System Quality

System quality is a measure of an IS from the technical and design perspectives (Gable et al., 2008). Thus, perceived system quality can be defined as the users' evaluation of an IS from the technical and design perspectives. Perceived system quality has been operationalized in many different ways in the IS literature. For example, Bailey and Pearson (1983) used convenience of access, flexibility of the system, integration of the system, and response time. Belardo et al. (1982) used reliability, response time, ease of use, and ease of learning. Franz and Robey (1986) used perceived usefulness of the IS. Seddon (1997) used reliability, user interface consistency, ease of use, documentation quality and maintainability of program code. Depending on the target technologies, the variables related to system quality may vary (DeLone and McLean, 2004). In general, the manifest variables of perceived system quality in terms of a web-based system are access convenience, flexibility, integration, response time, sophistication, reliability, accessibility, stability, system speed, usability, ease of use, navigation and network speed (Lee et al., 2009).

The role of perceived system quality in the IS acceptance and success literature has been investigated extensively (e.g., Adeyinka and Mutula, 2010; DeLone and McLean, 2003; Halawi et al., 2008; Kamla, 2009; Seddon and Keiw, 1996; Wang and Wang, 2009; Wu and Wang, 2006). According to the IS success model, system quality is a critical success factor that influences user satisfaction and the intention to use (DeLone and McLean, 2003). Petter and McLean (2009) performed a meta-analysis of studies that have used the IS success model to investigate the strengths of different relationships in the model. They found both perceived system quality-user satisfaction and perceived system quality-intention to use relationships were strong. System quality has also been studied with regard to individuals' IS acceptance research. According to TAM, system quality can be viewed as an external variable that affects behavioral beliefs (Davis, 1989).

Despite the significant amount of research on system quality, very few studies have examined the role of users' perceived system quality in relation to e-learning system continuance. Roca et al. (2006) used the ECT based IS continuance model to which they added perceived system quality as an antecedent of confirmation and satisfaction in the e-learning context and concluded that perceived system quality is an important predictor of both confirmation and satisfaction. Freeze et al. (2010) utilized the IS success model and found that perceived system quality significantly affects both satisfaction and e-learning system usage. The results of these studies provide empirical evidence that users' perceived system quality can be utilized to extend the ECT based IS continuance model.

Table 1: Prior Empirical Studies on E-Learning Continuance

Article	Theories used	Target population	Key findings
Chiu et al. (2005)	ECT.	Students taking online courses.	Satisfaction affects continuance intention.
Roca et al. (2006)	ECT, TAM, and TPB.	Students taking online courses.	Satisfaction affects continuance intention.
Pituch and Lee (2006)	TAM.	Students taking mixed (face-to-face lectures and e-learning tool) courses.	System functionality, perceived ease of use, and perceived usefulness affect use of supplementary learning. System functionality, system interactivity, perceived usefulness, perceived ease of use, and use of supplementary learning affect use of distance education.
Chiu et al. (2007)	Fairness Theory.	Students taking online courses.	Satisfaction and utility value affect continuance intention.
Liao et al. (2007)	ECT, TPB.	Students taking online courses.	Satisfaction, subjective norm, and perceived behavioral control affect continuance intention.
Roca and Gagne (2008)	TAM, Self Determination Theory.	Students taking online courses.	Perceived usefulness, perceived playfulness, and perceived ease of use affect continuance intention.
Chiu and Wang (2008)	UTAUT.	Students taking online courses.	Computer self-efficacy, attainment value, utility value, perceived playfulness, performance expectancy, and effort expectancy affect continuance intention.
Liao and Lu (2008)	Diffusion Theory.	Students taking online course.	Compatibility and result demonstrability affect continuance intention.
Liaw (2008)	Self-developed model.	University students taking a mixed (face-to-face lectures and e-learning tool) course.	Satisfaction and usefulness affect continuance behavioral intention.
Limayem and Cheung (2008)	ECT.	University students taking a mixed (face-to-face lectures and e-learning tool) course.	Perceived usefulness and satisfaction affect continuance intention.
Mahdizadeh et al. (2008)	Self-developed model.	University faculty teachers	Perceived added value, opinion about computer-assisted learning, and opinion about web-based activities affect e-learning use.
Cho et al. (2009)	TAM.	Students taking online courses.	Perceived usefulness, satisfaction, and prior experience affect continuance intention.
Liao et al. (2009)	ECT, TAM.	Students taking online courses.	Satisfaction, perceived usefulness (only for initial adopter), and attitude affect continuance intention.
Larsen et al. (2009)	ECT and Task-Technology Fit.	University faculty teachers.	Satisfaction and utilization affect continuance intention.
Sorebo et al. (2009)	ECT and Self Determination Theory.	University faculty teachers	Perceived usefulness and perceived playfulness affect continuance intention.
McGill and Klobas (2009)	Task-Technology Fit.	University students taking a mixed (face-to-face lectures and e-learning tool) course.	Attitude, instructor norm, and expected consequences affect e-learning use.
Lee (2010)	ECT, TAM, TPB, and Fairness Theory.	Students taking online courses.	Satisfaction, perceived usefulness, attitude, concentration, subjective norm, and perceived behavioral control affect continuance intention.
Freeze et al. (2010)	IS Success Model.	University students taking a mixed (face-to-face lectures and e-learning tool) course.	Information quality and system quality affect e-learning system use.
Liu et al. (2010)	TAM.	High school students taking online courses.	Perceived usefulness, perceived ease of use, and perceived interaction affect continuance intention.
Ho (2010)	ECT, TAM, and Self Determination Theory.	Mixed users.	Confirmation, and perceived usefulness affect satisfaction. In turn, satisfaction, attitude, and perceived usefulness affect continuance intention.
Lin (2011)	TAM.	Students taking online courses.	Satisfaction (only for less experienced users), and attitude affect continuance intention.
Karaali et al. (2011)	TAM.	Workers in the automotive industry.	Social influence, perceived usefulness, and attitude affect continuance intention.
Hung et al. (2011)	ECT and Attribution Theory.	School teachers.	Satisfaction, causal attributions, and perceived usefulness affect continuance intention.

RESEARCH CONTEXT

In order to understand the research context of this study, a brief introduction of the target e-learning system and the research environment are presented.

One type of e-learning system that may support the traditional teaching method is a course management system, also known as a learning management system. A course management system is web-based software used for the delivery, tracking and management of education/training. It contains features for distributing courses over the Internet and online collaboration. Educators can also track the progress of students using such software. Furthermore, the students may submit their assignments, download course material, track their grades, etc. by logging into the system. Course management systems are very widely used in higher education. For example, 95% of all higher education institutions in the UK used course management systems in 2005 (Browne et al., 2006).

The course management system used by the educators in this study is Moodle, which has become very popular among educators for creating dynamic online course websites for students (http://moodle.org/about/). Moodle is an open source course management system, or a virtual learning environment, that can be used to conduct online courses and also to augment face-to-face courses. Moodle provides tools such as forums, databases and wikis to build collaborative learning communities. It also provides ways to deliver content to students and assess learning by using assignments and quizzes. To function, it needs to be installed on a web server.

This study has been conducted in an internationally acknowledged, multidisciplinary university located on the southwest coast of Finland. With 21,000 students and 3,000 employees, it is one of the major universities in Finland. The university has seven faculties. Outside of the seven faculties, research activities and learning take place in different special units. Such units offer adult education and promote personal, organizational and regional development. Different university support activities occur at these facilities as well. Special units enable the construction of multi-disciplinary international research environments. The university (both faculties and special units) has been using Moodle since 2007. The faculty educators use Moodle as the platform for creating online course pages that support face-to-face teaching. On the other hand, personnel from special units use Moodle for project management purposes. The educators are free to choose other methods of creating course pages within the university domain. In some faculties, in-house developed course management systems are also available. Thus, using Moodle is not seen as mandatory for educators.

RESEARCH MODEL DEVELOPMENT

We have identified two research gaps in the literature. First, very few studies have extended the ECT based IS continuance model by using perceived system quality in an e-learning context. Second, one limitation of the ECT based IS continuance model, which is often noted in the literature, is that it uses only one post-adoption belief (perceived usefulness) as the surrogate for post-adoption expectation (Hong et al., 2006; Thong et al. 2006). To fill these research gaps, we decided to extend the IS continuance framework by using perceived system quality. Extending the IS continuance model using perceived system quality not only helps to fill the research gaps but also can provide actionable guidance to HCI practitioners. We conceptualize and model perceived system quality, in addition to perceived usefulness, as another post-adoption belief which might address the limitations of the information system continuance model. Following Wixom and Todd (2005), we view perceived usefulness as a behavioral belief and perceived system quality as an object-based belief. The research model is shown in Figure 2.

An exploratory study to probe perceived system quality factors

As explained earlier, there are many system quality-related features for a web-based system. However, not all variables are equally important in relation to an educators' usage of an e-learning system. To explore this, we conducted an exploratory study to probe the system quality-related factors that affect e-learning technology use during the post-adoption stage. Using open-ended questions, we interviewed seven educators from different departments of the university about their Moodle usage. The list of questions is shown in the Appendix A. The participating users had different levels of experience with the target system. Each interview lasted around 30 minutes. Short notes were taken during the interviews, and the interviews were also recorded for future analysis. Based on the exploratory study and existing literature review, we deemed access, ease of use, integration, and reliability to be the salient traits that help to encourage an educator's continued usage of an e-learning technology. Their operational definitions along with evidence from the interview data are given in Table 2.

Table 2: Perceived System Quality Factors

Factor	Definition	Sample evidence
Access	"refers to the degree of accessibility, responsiveness, and availability of the e-learning system" (Lee et al., 2009)	"I find Moodle often inaccessible and slow to respond, but when it works, it is a good tool to conduct courses "
Ease of use	"refers to the degree to which an individual perceives using the e-learning system is free of effort" (Davis, 1989)	"When I started to use Moodle, I felt it is impossible to use, however when I got into it, I found it is not that complex. But still I would say things could be much more easier with more careful layout design"
Integration	"refers to the way the e-learning system allows data to be integrated from various existing course pages" (Wixom and Todd, 2005)	"I can use my old course pages to be integrated in the new course pages and it makes easy to develop the new pages"
Reliability	"refers to the dependability of the e-learning system operation" (Wixom and Todd, 2005)	"Last year, all of the student enrollments were deleted due to some reasons, probably server update, and we had a lots of trouble because of that"

By considering these system quality-related factors carefully, HCI designers should be able to facilitate the building or improving of an e-learning system in the following ways.

First, designers should keep in mind that an e-learning system is hosted on a web-server and that many students and educators use that system. Hence, they need to ensure that the e-learning system is hosted on a web-server that can meet the demands of the users connecting to the service. The response time of the server during its busiest time period needs to be analyzed in order to select the most appropriate web-server.

Second, usability is considered to be one of the major concerns of HCI designers. Usability is considered to be part of system acceptability and relates to how well users are able to use the system (Nielsen, 1993). Ease of use can be regarded as a measure of usability (Zhang et al., 2005). Prior research has also highlighted the importance of ease of use in technology acceptance (Davis, 1989) and technology continuance (Hong et al., 2006). When designing an e-learning system, HCI designers need to remember that perceptions of ease of use vary according to the user group as stated in prior adoption studies (Venkatesh et al., 2003).

Third, integration is also an important issue for e-learning systems. Educators usually have a limited amount of time to spend on building new course pages from scratch, so they look for ways to use their old course pages to build new ones. Hence, it would be beneficial for educators if e-learning systems could provide features that would enable the integration of older material.

Finally, reliability is another concern that needs to be discussed. Course registration, the delivery of learning materials, and communication amongst the participants are all implemented online in the e-learning system. Consequently, the e-learning system must be viewed as a repository of large amounts of information and should therefore be reliable and be backed up.

The development of hypotheses

As the relationships of the IS continuance theory have been verified extensively in the literature in different contexts including e-learning system continuance (e.g., Hong et al., 2006; Larsen et al., 2009; Liao et al., 2009; Limayem and Cheung, 2008; Roca et al., 2006), we argue that these hypotheses are valid for our context also. Thus, we propose the following expectation-confirmation theory related hypotheses without further argument:

- H1. Educators' satisfaction with an e-learning technology positively affects their continued e-learning technology usage intention.

- H2. Educators' confirmation of expectations positively affects their satisfaction with e-learning technology.

- H3. Educators' perceived usefulness of an e-learning technology positively affects their satisfaction with e-learning technology.

- H4. Educators' perceived usefulness with an e-learning technology positively affects their continued e-learning technology usage intention.

- H5. Educators' confirmation of expectations positively affects their perceived usefulness of e-learning technology.

Lee et al. (2009) argued that perceived system quality can be modeled as a second-order factor. Thus, we modeled perceived system quality as a second-order construct with the four reflective factors identified in our exploratory

study: access, ease of use, integration and reliability. DeLone and McLean (2003) describe system quality as having a direct effect on user satisfaction and IS use. This has been confirmed by many studies in different contexts (e.g., Chen, 2010; McKinney et al., 2002; Nagash et al., 2003; Seddon and Kiew, 1996). Roca et al. (2006) tested the impact of perceived system quality on satisfaction in the e-learning context and found it to be significant. Recently, Freeze et al. (2010) found a significant relationship between perceived system quality and e-learning system use. Thus, we hypothesize the following:

- H6. Educators' perceived system quality of an e-learning technology positively affects their satisfaction with the e-learning technology.

- H7. Educators' perceived system quality of an e-learning technology positively affects their continued e-learning technology usage intention.

Roca et al. (2006) proposed a causal relation from system quality to confirmation. However, we propose a causal relation from confirmation to perceived system quality in this paper and put forward the following argument in support of our hypothesis. Oliver (1980) did not use any determinant of confirmation in testing the proposed expectation-confirmation model. According to expectation-confirmation theory, confirmation is the difference between perceived performance (p) and pre-expectations (e). Hence, Oliver (2009) noted that researchers can use either (p-e) as a measure of confirmation or simply the subjective evaluation of confirmation. In either case, confirmation captures an abstraction of both pre-expectations and perceived performance. Following this, Bhattacherjee (2001) did not include perceived performance in his adaptation of expectation-confirmation theory in the IS continuance model he developed. He further argued that post-adoption expectations, rather than pre-adoption expectations, are important in predicting users' satisfaction and continuance intention. Although the original expectation-confirmation theory contains variables related to both pre- and post-adoption, the IS continuance model contains only post-adoption variables. This makes the IS continuance model a pure post-adoption model. At the post-adoption stage, actual interaction with the IS shapes users' mental representations of its characteristics. We argue that the users of a system, during the post-adoption stage, may change expectations about system quality. This argument is supported by both the expectation-confirmation theory and the theory of reasoned action paradigms. Specifically, these paradigms have defined expectation as individual beliefs or the sum of beliefs about the levels of attributes possessed by a system (Churchill and Surprenant, 1982; Davis, 1989). Repeated interaction with the IS could possibly help the users to identify the gaps between their expectations and the capabilities of the IS (Saeed and Abdinnour-Helm, 2008). This helps the users to build more concrete expectations about the capabilities of the IS even after confirming pre-adoption expectations. It suggests a causal flow from confirmation to perceived system quality during post-adoption stage instead of from perceived system quality to confirmation. Bhattacherjee and Premkumar (2004) also argued that pre-adoption beliefs are antecedents of confirmation while post-adoption beliefs are the consequences of confirmation. Thus, we propose the following hypothesis:

- H8. Educators' confirmation of expectations positively affects their perceived system quality of an e-learning technology.

We argue that experience with using the IS to conduct various tasks can produce a better understanding of its characteristics, which can assist the user in forming cognitions about its overall usefulness. We argue that if the users of a system develop cognitions about its perceived system quality, it would, in turn, affect their cognitions about its perceived usefulness. Seddon (1997) proposed an association between system quality and perceived usefulness in his modified IS success model. Lee and Lee (2008) found a significant causal relationship between e-learning environment quality and perceived usefulness. Thus, we propose the following hypothesis:

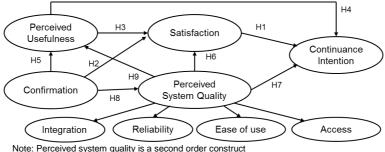- H9. Educators' perceived system quality positively affects their perceived usefulness of an e-learning technology.

Note: Perceived system quality is a second order construct

Figure 2: Research Model

STUDY DESIGN AND METHOD

Questionnaire development

Each item corresponding to the constructs was measured using the seven-point Likert scale, with answer choices ranging from "Strongly disagree (1)" to "Strongly agree (7)." Most of these items were adapted from the literature with minor changes in wording reflecting the target technology. The measures of confirmation, perceived usefulness, satisfaction, and continuance intention were adapted from Limayem et al. (2007) and Bhattacherjee (2001). The measures of reliability and integration were adapted from Wixom and Todd (2005) while the measures of access and ease of use were adapted from Lee et al. (2009) and Hong et al. (2006) respectively. After the questionnaire was drafted, it was first sent to two academic researchers for their review, and then it was revised according to their comments and suggestions to make the wording of the items more precise. Then, the questionnaire was sent to 30 educators in the university for further review. Overall, the educators indicated that the questionnaire was relatively clear and easy to complete. A number of suggestions were made concerning the wording of several items and the overall structure of the questionnaire. The questionnaire was revised according to the given suggestions. The final questionnaire is presented in Appendix B. To avoid the common method bias problem to some extent, we decided to randomize the questions in the questionnaire during data collection (Straub et al., 2004).

Data collection

Data was collected via a web-based survey from the educators who use Moodle for their teaching purposes. A total of 1012 users were registered with Moodle as instructors during August, 2010. Two important points need to be noted. First, many of the registered Moodle users were from special units of the university. As explained in section 3, such users use Moodle for project management purposes. It was not possible to distinguish between faculty educators and special units' personnel from the registered Moodle user database. Second, many faculty educators registered in Moodle do not use the service because they are busy with other tasks and have assistants perform Moodle-related tasks. It was also difficult to filter out such users. Thus, a total of 1012 registered Moodle users received email invitations. Nevertheless, only faculty members who had used Moodle recently for conducting their courses were asked to respond. Two reminders were sent to increase the response rate after gaps of two weeks. The survey ran for approximately one and half months. After filtering invalid and incomplete responses, a total of 207 survey responses were received. For this particular study, we were interested in those users who had conducted at least one course using Moodle during the academic year. After filtering the survey responses according to this criterion, 175 usable responses remained. Table 3 shows the detailed demographic information of the participants. A total of 42.3% of the respondents were male. About half of the respondents (51.4%) were between 21 and 40 years old, while the rest (48.6%) were over 40 years of age. A total of 30.9% of the respondents had between 0 and 18 months of experience with Moodle, while 47.4% respondents had more than 18 months but less than 36 months of experience with Moodle. The rest of the respondents (21.7%) had more than 36 months of experience with Moodle. The low response rate in this study can be explained by the presence of many special units' users and educators who do not actually use Moodle in the survey invitation list. However, to increase reliability, we assessed the non-response bias by following the procedure developed by Armstrong and Overton (1977). This procedure is widely used in research studies from different disciplines including Information Systems (Karahanna et al., 1999). We treated responses received after the first deadline (two weeks after the questionnaire was sent to the respondents) as being representative of non-respondents. T-tests on the demographics and key constructs of the study showed no significant differences between the respondents and non-respondents. Although it is a commonly used method to test non-response bias, the possibility of bias is not entirely eliminated (Karahanna et al., 1999), thus results should be interpreted accordingly.

Table 3: Demographic Information

		Frequency	Percent
Gender	Male Female	74 101	42.29 57.71
Age	21-40 years >40 years	90 85	51.43 48.57
Experience with the target technology	0 – 18 months >18 – 36 months >36 months	54 83 38	30.86 47.43 21.71

Data analysis

We employed partial least squares (PLS) as the approach for our analysis and utilized the tool smartPLS (Ringle et al., 2005). PLS is a second generation regression method that combines confirmatory factor analysis with linear regression, and this makes it possible to run the measurement and structural models simultaneously. PLS has enjoyed increasing popularity in IS research for its ability to model latent constructs under the condition of non-normality (Chin, 1998). The variables in this study are non-normal. Thus, PLS is an appropriate tool for conducting the analysis in this study. A rule of thumb for the required sample size in PLS is that the sample should be at least ten times the number of independent variables in the most complicated multiple regression in the model (Barclay et al., 1995). The sample size in this study meets the minimum sample size requirement.

Table 4 shows the means and standard deviations of construct items. For each construct, the assessment of convergent validity or internal consistency is also included. Convergent validity indicates the extent to which the items of a scale that are theoretically related are also related in reality. As shown in Table 4, all items have significant ($p <$ 0.001) path loadings exceeding the threshold value of 0.7 recommended by Fornell and Larcker (1981). All of the constructs have composite reliability values between 0.81 and 0.94, fulfilling the recommended value proposed by Nunnally (1978). Finally, the average variance extracted (AVE) values exceed the threshold of 0.5 as recommended by Fornell and Larcker (1981).

Testing for discriminant validity involves determining whether the items measure the construct in question or other (related) constructs. Discriminant validity was verified with both a correlation analysis and a factor analysis as recommended by Gefen and Straub (2005). The inspection of discriminant validity among the variables is based on the correlation between the variables and the square root of their respective average variance extracted (Fornell and Larcker, 1981). As Table 5 shows, there are some high correlations among some variables. However, the square root of average variance extracted values for the variables is consistently greater than the off-diagonal correlations, suggesting satisfactory discriminant validity among the variables (Gefen and Straub, 2005). Furthermore, prior studies also found such high correlations among the IS continuance model's constructs in the e-learning context (e.g., Liao et al., 2007). Finally, Table 6 shows that all items have cross loading coefficients lower (at least 0.1) than the factor loading on their respective assigned latent variable, suggesting that discriminant validity on the item level is met for all constructs (Gefen and Straub, 2005).

Table 4: Item Means, Standard Deviation and Internal Consistencies

Construct	Item	Mean	std	Loading	t-stat
Continuance intention (Composite Reliability = 0.92; AVE = 0.76)	INT-1 INT-2	6.00 5.23	1.20 1.32	0.91 0.87	71.67 54.04
Satisfaction (Composite Reliability = 0.95; AVE = 0.81)	SAT-1 SAT-2 SAT-3	4.84 4.74 4.27	1.49 1.51 1.50	0.91 0.93 0.93	61.66 76.99 72.18
Perceived usefulness (Composite Reliability = 0.92; AVE = 0.69)	PU-1 PU-2 PU-3	5.18 5.31 5.65	1.28 1.23 1.22	0.87 0.90 0.82	24.99 40.10 21.58
Confirmation (Composite Reliability = 0.94; AVE = 0.76)	CON-1 CON-2	4.55 4.59	1.39 1.25	0.94 0.93	102.74 54.98
Integration (Composite Reliability = 0.90; AVE = 0.81)	INTGR-1 INTGR-2	4.15 3.93	1.19 1.22	0.90 0.90	36.06 29.49
Reliability (Composite Reliability = 0.95; AVE = 0.67)	REL-1 REL-2	4.35 4.42	1.45 1.52	0.95 0.96	106.69 169.38
Ease of use (Composite Reliability = 0.94; AVE = 0.76)	PEOU-1 PEOU-2 PEOU-3	4.46 4.59 4.27	1.52 1.52 1.61	0.89 0.94 0.93	47.25 128.09 73.96
Access (Composite Reliability = 0.88; AVE = 0.77)	ACCESS-1 ACCESS-2	3.96 4.81	1.79 1.39	0.83 0.83	30.42 29.30

Table 5: Correlation among Variables and Square Root of Average Variance Extracted

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Access (1)	**0.88**							
Confirmation (2)	0.60	**0.94**						
Ease of Use (3)	0.60	0.50	**0.92**					
Integration (4)	0.27	0.24	0.30	**0.90**				
Intention (5)	0.58	0.65	0.60	0.20	**0.93**			
Perceived usefulness (6)	0.62	0.69	0.62	0.25	0.76	**0.89**		
Reliability (7)	0.65	0.44	0.47	0.22	0.33	0.41	**0.95**	
Satisfaction (8)	0.71	0.76	0.74	0.44	0.73	0.75	0.58	**0.92**

Note: The bold elements on the diagonal represent the square roots of the average variance extracted, and off-diagonal elements are the correlation estimates.

Table 6: Factor Analysis Results

	Access	CON	Integration	Intention	PEOU	PU	Reliability	SAT
ACCESS-1	**0.88**	0.47	0.22	0.43	0.51	0.47	0.61	0.57
ACCESS-2	**0.88**	0.58	0.24	0.59	0.55	0.62	0.53	0.68
CON-1	0.59	**0.94**	0.25	0.64	0.50	0.65	0.47	0.64
CON-2	0.52	**0.93**	0.21	0.57	0.44	0.64	0.35	0.68
INTGR-1	0.23	0.25	**0.91**	0.20	0.28	0.28	0.18	0.19
INTGR-2	0.24	0.19	**0.90**	0.16	0.24	0.16	0.20	0.17
INT-1	0.54	0.63	0.16	**0.92**	0.56	0.69	0.31	0.68
INT-2	0.53	0.57	0.21	**0.93**	0.54	0.61	0.29	0.66
PEOU-1	0.48	0.37	0.25	0.52	**0.89**	0.49	0.37	0.61
PEOU-2	0.61	0.49	0.23	0.54	**0.94**	0.59	0.48	0.61
PEOU-3	0.56	0.51	0.33	0.59	**0.93**	0.62	0.44	0.60
PU-1	0.49	0.62	0.27	0.65	0.54	**0.88**	0.36	0.67
PU-2	0.58	0.59	0.20	0.65	0.58	**0.90**	0.35	0.67
PU-3	0.57	0.62	0.18	0.61	0.53	**0.89**	0.37	0.65
REL-1	0.58	0.40	0.20	0.30	0.41	0.38	**0.95**	0.53
REL-2	0.65	0.44	0.20	0.33	0.48	0.39	**0.96**	0.58
SAT-1	0.67	0.70	0.21	0.68	0.64	0.69	0.58	**0.91**
SAT-2	0.65	0.69	0.16	0.66	0.73	0.68	0.51	**0.93**
SAT-3	0.65	0.71	0.19	0.67	0.66	0.70	0.52	**0.93**

Note: Confirmation (CON), Ease of Use (EOU), and Perceived Usefulness (PU).

Overall, these tests of validity and reliability provide us with a high degree of confidence about the scale items used in testing our research model.

Results and discussion

The test of the structural model using PLS includes estimates of the path coefficients, which indicate the strengths of the relationships between the dependent and independent variables, and the R-square values, which represent the amount of variance explained by the independent variables. Figure 3 shows the results of the hypothesized structural model. As expected, confirmation ($\beta=0.45$, t = 5.84, p < 0.001) and perceived system quality ($\beta=0.39$, t = 6.78, p < 0.001) had a significant effect on perceived usefulness, accounting for 57% of the variance in that measure. Confirmation ($\beta=0.61$, t = 13.53, p < 0.001) had a significant influence on perceived system quality, explaining 37% of its variance. Confirmation ($\beta=0.34$, t = 6.22, p < 0.001), perceived usefulness ($\beta=0.22$, t = 4.22, p < 0.001) and perceived system quality ($\beta=0.45$, t = 8.87, p < 0.001) significantly influenced satisfaction, accounting for 78% of its variance. Perceived usefulness ($\beta=0.48$, t = 7.86, p < 0.001) and satisfaction ($\beta=0.38$, t = 5.85, p < 0.001) had a significant influence on intention. Interestingly, perceived system quality ($\beta=0.07$, t = 1.06, ns) had no significant influence on intention. Perceived usefulness, satisfaction and perceived system quality together accounted for around 64% of the variance in intention. The explained variances in this study are high. However, prior studies employing the IS continuance model in different contexts explained similar amount of variances. For example, Larsen et al. (2009) explained 68% of the variance of intention in e-learning context. Liao et al. (2007) explained 79% of the variance of satisfaction and 70% of the variance of intention in e-learning context. Furthermore, Bhattacherjee et al. (2008) explained 74% of the variance of intention in the context of document management system utilization. Thus, the amount of variances explained of the dependent variables in our study is in line with prior literature.
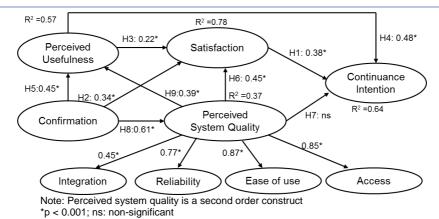
Figure 3: PLS Analysis Results

We found support for three out of the four added hypotheses in our extended information system continuance model. All of the hypotheses of the original continuance model were also supported. The proposed model expands our understanding of the phenomenon of IS continuance at the individual level by virtue of the inclusion of perceived system quality in the research model.

We found perceived usefulness and satisfaction to be the significant determinants of educators' e-learning system continuance intention. Unexpectedly, perceived system quality had no direct impact on continuance intention. The lack of a significant relationship between perceived system quality and continuance intention is somewhat surprising as there should be a significant relationship according to the IS success model (DeLone and McLean, 2003). However, our finding is in line with the IS acceptance research (Davis, 1989) and the modified IS success model proposed by Seddon (1997). In both research streams, system quality is viewed to have an indirect impact on behavioral intention via behavioral beliefs such as perceived usefulness and perceived ease of use. Our finding is also in line with Wixom and Todd (2005) who argued that object-based beliefs (e.g., perceived system quality) are not good predictors of behavioral intention. According to our study's findings, the educators placed most importance on perceived usefulness when deciding to continue the use of the e-learning system. Many studies found perceived usefulness to be the most dominant predictor of intention to use (e.g., Hong et al., 2006; Limayem and Cheung, 2008). In support of this conclusion, we also found that perceived usefulness strongly predicts continuance intention. In fact, the interviews revealed that, in general, educators reported that they had been using Moodle for its usefulness. For example, an educator commented, "I use Moodle because I do not need to send individual emails to the students attaching lecture materials." Another educator commented, "I use Moodle because it has lots of possibilities to make my teaching tasks easier."

We found that confirmation, perceived usefulness and perceived system quality all had significant positive effects on user satisfaction in the e-learning usage context. Perceived system quality was the most dominant factor in shaping user satisfaction, although, in many prior studies, confirmation had been found to be the most dominant factor influencing user satisfaction (e.g., Bhattacherjee, 2001). Our study found confirmation to be the second most dominant predictor of satisfaction after perceived system quality. This finding shows the importance of perceived system quality in relation to the IS post-adoption. According to the IS continuance model, perceived usefulness is supposed to represent post-adoption expectation, because perceived usefulness has been the most salient cognitive belief that forms expectation (Bhattachejee, 2001). However, the scope of the expectation can be much broader, encompassing many different cognitive beliefs (Hong et al., 2006). This line of reasoning supports the findings of our study. Our study shows that only one post-adoption belief (perceived usefulness) is not adequate to shape satisfaction in the e-learning context. Perceived usefulness only provides a little contribution in developing educators' satisfaction with an e-learning system.

We also observed that confirmation had an effect on perceived system quality. This suggests that perceived system quality is a post-adoption belief that is determined by the confirmation of initial expectations.

Furthermore, we found that perceived usefulness can be predicted by confirmation and perceived system quality. These findings are also in line with prior findings. First, prior studies on IS continuance have supported the associations between confirmation and perceived usefulness (Bhattacherjee, 2001). Second, our finding regarding the association between perceived system quality and perceived usefulness is supported by both IS success (e.g., Seddon, 1997) and IS acceptance (e.g., Davis, 1989) studies.

Finally, all of the second-order factors were found to be important features of perceived system quality. These second-order factors include: access, ease of use, reliability and integration. Specifically, our results suggest that access, reliability, and ease of use are the three most important perceived system quality features in the e-learning context.

IMPLICATIONS

Theoretical implications

Our study has three main theoretical implications. First, this study is an extension of the ECT based IS continuance theory with the IT artifact's system characteristics. We encourage researchers to investigate the effects of the IT artifact itself as an antecedent to perceived usefulness, satisfaction, and continuance intention. If one is interested in understanding how system design and implementation attributes might influence continued use, then variables related to the design and implementation of the artifact should be measured. Researchers should investigate the effect of these variables on behavioral beliefs, satisfaction, and continuance intention. Such studies would also provide useful guidance to HCI designers. This recommendation is supported by the work of Wixom and Todd (2005) who encourage similar research within the IT acceptance context.

Second, we identified four perceived system quality related factors that are salient for e-learning system continuance based on an exploratory study. It would be useful for researchers to investigate whether there is a core set of perceived system quality features that apply broadly across a wide range of systems. Future studies should systematically investigate various technologies that differ in relation to important features, such as systems with high analytical capabilities vs. systems with high information richness. It may allow us to compare how information system continuance might differ between such systems.

Third, our results provide support for the idea that confirmation and perceived usefulness do not solely shape users' satisfaction in the post-adoption stage, as has been previously indicated in IS continuance theory. In fact, our study suggests that perceived system quality is the most critical factor in shaping user satisfaction.

Implications for practice

In a broad sense, the extended IS continuance model can help managers assess system characteristics and then investigate their impacts on continuance intention by use of the proposed causal chain. This should then help with management activities, such as task prioritization and resource allocation, especially in cases where management discovers that users have become extremely dissatisfied with a system. The findings of this study may help management focus on the most important system characteristics to be examined when aiming to improve user satisfaction.

The results highlight the importance of perceived usefulness in predicting continuance intention with regard to using e-learning systems to support teaching. The dominant effect of perceived usefulness on intention provides potential fruitful avenues to HCI designers for affecting users' continuance intention to use e-learning technologies. The research results suggest that designing and developing a useful system helps to prevent IS discontinuance in the e-learning context. Educators will discontinue using an e-learning technology if it is not useful for their purpose, even if they are satisfied with the technology. Thus, organization managers should take appropriate action to advertise the technology among educators in order to develop an appropriate level of expectation about the particular e-learning technology. In addition, managers should note that educators' expectations about e-learning technology use will be adjusted during their use of the technology. Furthermore, their expectations will become concrete and clear through frequent use of the e-learning technology, helping educators to set their post-consumption expectations (perceived usefulness and perceived system quality) to an appropriate level.

In accordance with prior literature, we also found that user satisfaction is another important determinant of continuance intention. Thus, HCI practitioners should devise strategies that will help increase user satisfaction with e-learning technology, and help to retain existing users and increase the usage of the technology. Our results suggest that perceived system quality strongly affects user satisfaction. The evaluation of the proposed extended IS continuance model highlights reliability, integration, ease of use, and access as important perceived system quality-related features that should be designed to the highest standards possible by practitioners. The extended model provides a mechanism for understanding and assessing the relative influence of system characteristics for HCI designers. For example, it can facilitate the understanding of which characteristics (ease of use, reliability, integration, and access) are of most importance within the context of interest. Based on this understanding, HCI designers can look at the mean scores for these characteristics and determine the changes that should help improve a system. For example, if the educators face significant problems with the accessibility of the e-learning system, the problems can be addressed by hosting the e-learning service on a faster web-server, increasing Internet speed, and using

lightweight content in the e-learning system's home pages. Overall, the mean scores of perceived system quality-related variables in this study suggest that there is a need to have set strategies in order to improve such features and influence satisfaction and perceived usefulness.

The relative influences of system characteristics may provide an additional practical implication for HCI practitioners. If the proposed IS continuance model is tested in different contexts, the HCI designers can pool their accumulated knowledge about the relative influences of factors from across the different contexts. Such accumulated knowledge might provide the basis for important design guidelines and standards for building effective systems.

Furthermore, the extended IS continuance model has a diagnostic value at all stages of the system implementation and usage process. An e-learning system like Moodle evolves over time; new functionalities are added and architectural changes occur. In addition, as Moodle is an open source system, local designers also have the option to customize it according to organizational needs. Therefore, it is important to diagnose design-related issues and their effects on continued usage at any point within the system lifecycle.

CONCLUSIONS

This study extended the expectation-confirmation based IS continuance theory by using perceived system quality. Based on an exploratory study, we identified the factors of perceived system quality. We developed an integrated research model using IS continuance theory and perceived system quality. Then, we conducted a survey and received usable answers from 175 university educators and analyzed the data using PLS analysis. The findings reveal that IS continuance was mainly determined by perceived usefulness and satisfaction. Perceived system quality was also found to affect IS continuance intention indirectly via perceived usefulness and satisfaction. The lack of a direct association between perceived system quality and IS continuance intention was unexpected and requires further research to confirm this finding. However, the results were largely consistent with the hypotheses contained in the model, and they demonstrate the potential to integrate the concept of perceived system quality and IS continuance theory into a single unified model. The combined model explained around 64% of the total variance of continuance intention.

This study has some limitations that need to be acknowledged. First, this study was cross-sectional. However, usage behavior is dynamic and changes over time due to changes in cognition as the users become experienced with the target system, and such changes in cognition and attitude cannot be captured with a cross-sectional study. A longitudinal design would capture such changes and provide deeper insights into how changes in user cognition influence usage behavior. Second, this study was conducted in a university setting and caution should be taken when generalizing the findings of this study to business organization settings. It would therefore be useful to replicate this study in different contexts to further validate the extended IS continuance model proposed in this paper.

ACKNOWLEDGEMENTS

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APPENDIX A: INTERVIEW QUESTIONS

How did you feel about Moodle when you used it as a teacher for the first time?
How do you feel about your ability about the general computer/Internet user?
Tell me about your use of Moodle in teaching.
Tell me about your general feelings on Moodle.
Tell me a positive and a negative experience with Moodle.

APPENDIX B: SURVEY QUESTIONNAIRE

Construct	Item
Satisfaction (Bhattachejee, 2001)	SAT-1:My overall experience of using Moodle is very satisfied
	SAT-2:My overall experience of using Moodle is very pleased
	SAT-3:My overall experience of using Moodle is absolutely delighted
Perceived usefulness (Limayem et al. 2007)	PU-1: Using Moodle is of benefit to me
	PU-2: The advantages of Moodle outweigh the disadvantages
	PU-3: Overall, using Moodle is advantageous
Ease of use (Venkatesh and Davis, 2000)	PEOU-1: My interaction with Moodle is clear and understandable
	PEOU-2: I find Moodle to be easy to use
	PEOU-3: I find it easy to get Moodle to do what I want to do
Access (Lee et al. 2009)	ACCESS-1: Moodle quickly loads all the text and graphics
	ACCESS-2: Moodle provides good access
Reliability (Wixom and Todd, 2005)	REL-1:Moodle is stable
	REL-2:Moodle operates reliably
Confirmation (Limayem et al. 2007)	CON-1:My experience with using Moodle was better than what I expected
	CON-2:The benefit provided by Moodle was better than what I expected
Integration (Wixom and Todd, 2005)	INTGR-1:Moodle effectively integrates data from existing course pages to a new course page
	INTGR-2:Moodle pulls together information from different existing course pages to a new course page
IS continuance intention (Limayem et al. 2007)	INT-1:I intend to continue using Moodle rather than discontinue its use
	INT-2:My intentions are to continue using Moodle than use any alternative means

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Paper 6: Islam, A. K. M. N. (2012) Understanding e-learning systems usage outcomes in hybrid courses. *Paper presented at the 45th Hawaii International Conference on System Sciences (HICSS)*, Hawaii, USA, January 4–7, 2012, 118–127

Understanding e-learning system usage outcomes in hybrid courses

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Abstract

E-learning systems are widely used in higher education. However, much of the research on e-learning systems focuses on the technology and is limited to the adoption and utilization e-learning systems. In order to develop the potential advantages of e-learning systems, research that addresses the outcomes of the adoption and use of e-learning system is needed. This paper proposes a research model for assessing the possible outcomes of e-learning systems adoption and use. It was tested by university students (n = 249) participating in hybrid courses using partial least squares (PLS) analysis. Its findings suggest that beliefs about perceived usefulness and perceived ease of use, and how an e-learning system is used cause students' perceived learning assistance. In turn, perceived learning assistance predicts students' perceived academic performance.

1. Introduction

One of the most significant developments in the use of information technology in universities in the last decade has been the adoption and use of e-learning systems to support the processes of teaching and learning. The learning management system (LMS), also known as course management system (CMS) or the virtual learning environment (VLE) is an e-learning system that has been widely adopted by universities. The LMS is web-based software that is used for the delivery, tracking and managing of education and training online. It contains features for distributing courses over the Internet and online collaboration. Since the late 1990s, the utilization of LMSs for online education has steadily increased in higher education. Nowadays, LMSs have become indispensable tools for online education. Whether focusing on distance education or class-room based education, most universities use LMSs to support and improve learning and teaching processes [1]. For example, in 2005, 95% of all higher education institutions in the UK used course management systems [2]. LMSs are usually implemented across an entire university, faculty, or school, and then adopted by educators who use them in

a variety of ways to support course management and student learning [3]. The use of the LMSs in university education has made it easy to augment online education with traditional face-to-face classroom instruction. Such a hybrid or mixed delivery approach allows educators to combine the advantages of online learning with the benefits of face-to-face instruction [4]. A mix of face-to-face (somewhere between 90% and 10%) and online instruction (somewhere between 10% and 90%) has been argued to be superior to either 100% face-to-face or 100% online courses [31].

However, in order to understand the impact of e-learning systems on students' learning outcomes and take advantage of the potential of e-learning systems, research that addresses the outcomes of e-learning systems adoption and their use is needed. In addition, research investigating the factors that influence the adoption and use of e-learning systems is required – if we are to further develop e-learning systems. There has been much prior research focusing on the adoption and use of e-learning systems [5; 6]. These studies identified the e-learning system usage intention as the dependent variable and investigated its antecedents or determinants. However, these studies overlooked the outcomes of e-learning system usage. Knowing the outcomes of e-learning system usage is particularly important if we are to evaluate the success of such systems, plan for their future development and achieve better learning outcomes. Thus, this paper investigates the outcomes of e-learning system usage for hybrid courses from the perspective of university students.

The paper proceeds as follows. In section 2 we present the literature review and research model. Section 3 is dedicated to the research method and section 4 presents the data analysis results and discussion. Finally, section 5 discusses the implications and conclusions.

2. Literature review and research model

One of the major focuses of prior e-learning research has been the adoption and continued use of e-learning systems [5; 6]. This research stream has mainly used two theoretical frameworks: the

technology acceptance model (TAM) [7] and the expectation-confirmation model (ECM) [8] to investigate individuals' e-learning system adoption and continued use. These studies mainly investigated the factors that affect the adoption and use of e-learning systems, but they do not consider how these factors, or the use of the e-learning system itself is associated with learning outcomes. Indeed, few studies have gone beyond use to explore the factors associated with learning. McGill and Klobas [3] found that e-learning system utilization influences perceived impact on learning. Lee and Lee [9] revealed that a number of e-learning environment quality related variables affect satisfaction with e-learning. In turn, satisfaction was found to influence academic achievement. Liaw [10] found high correlation between intention to use e-learning and e-learning effectiveness. These studies provide some empirical support about the possible relationships between e-learning system use and e-learning outcomes. However, these studies have been conducted with a variety of outcome variables that use different explanatory variables and this has led to models that offer only weak theoretical support. Thus, these studies fall short in explaining the relationship between the antecedents of adoption and use of e-learning systems and their use outcomes, and the relationship between e-learning system use and use outcomes. Hence, a conceptual framework with strong theoretical support is necessary.

Figure 1 illustrates the conceptual framework of the e-learning system use outcomes.

The framework is conceptually supported by both the IS adoption model, TAM [7] and the IS success model [11]. TAM presents two behavioral beliefs, perceived usefulness and perceived ease of use as the determinants of IS usage intention and use. Perceived usefulness is the degree to which an individual believes that the system will enhance his or her job performance and perceived ease of use is defined as the degree to which a person believes that using a system would be free of effort [7]. Following TAM, we posit that these two behavioral beliefs result in e-learning system use. On the other hand, according to the IS success model, IS use brings benefits to both individuals and organizations [11]. Similarly, according to our framework, e-learning system use will positively affect the learning process of individuals. In particular, we argue that one variable regarding individuals' learning processes, perceived learning assistance, is important. Perceived learning assistance refers to the extent to which the e-learning system assists an individual's learning. Such assistance provided by the e-learning systems will impact students' perceived academic performance positively.

In summary, according to this framework, beliefs may impact on e-learning use outcomes in two ways. First, the beliefs can have a direct impact on e-learning use outcome variables. For example, a useful and/or easy to use e-learning system may assist students by helping them to learn more effectively. Such benefits may help students improve their academic performance. The direct relationship between the beliefs and e-learning use outcome is supported by a number of prior studies [3; 9]. Second, these beliefs can have an indirect effect on e-learning use outcome through the mediation of e-learning system use. As described earlier, this indirect effect is supported by the IS success model.

Based on the conceptual framework, we have developed a research model for evaluating how the use of an e-learning system affects e-learning outcomes. The research model is shown in Figure 2.

TAM postulates that perceived usefulness has an impact on IS use. If individuals believe that the e-learning system they use provides them with better information or increased learning control, they are more likely to use the system in the courses for downloading or reading learning materials and interacting with other participants (participating in the discussions, chatting, sending emails, etc.). The association between perceived usefulness and e-learning system use is supported by many prior studies [5; 6]. Thus, we make the following hypothesis.

H1. Perceived usefulness positively affects students' e-learning system use.

A particular e-learning system can provide value in several ways [12]. First, the system can be more useful when it expands either the quality or quantity of information which the students are able to access. Second, the e-learning system can be useful because it helps the students manage and control their learning process. Prior studies have argued that greater learning control by students leads to better learning outcomes [13; 14], which suggests that a useful e-learning system may increase students' control of the learning process and eventually affect learning effectiveness. In addition, the e-learning system can be useful because it contains many features that help the participants collaborate with each other to maintain working relationships [37] as well as assist students to learn [25]. Studies suggest that an effectively designed and administered online course environment can assist in the creation of a social environment [18; 33]. We further argue that such social interaction will create a social network. For example, face-to-face meetings among educators and students should help to build a supportive social network. Additionally, online activities should provide students with the opportunity to become better acquainted and share their common interests about a particular topic more deeply. It may even be that many students become more active in the online social medium of instruction in comparison with

face-to-face situations. In fact, some students may prefer to participate more in online discussions rather than face-to-face. In brief, active online discussions conducted by students may assist them in learning. Thus, we propose the following hypothesis.

H2. Perceived usefulness positively affects students' perceived learning assistance.

TAM further postulates that perceived ease of use affects IS use. It has been confirmed by many studies in different contexts including e-learning system utilization [5; 32]. Thus, we propose the following hypothesis.

H3. Perceived ease of use positively affects students' e-learning system use.

We further argue that an easy to use e-learning system may also assist students' learning. The technical design and format will impact on how effectively the participants can share learning materials and collaborate with each other [36]. In addition, when the students perceive an e-learning system as easy to use, they are better able to concentrate on their learning instead of putting effort into learning the system itself. The system provides them an easy way to collaborate with others, which eases the group work. Currin [20] argued that the group work can help students clarify similar confusions on a particular topic, resulting in higher course grades. Following this, we propose the following hypothesis.

H4. Perceived ease of use positively affects students' perceived learning assistance.

Although, students and educators are physically separated in an e-learning environment, it has been argued that students' engagement is greatly increased in such a learning environment [15]. Increased student engagement can improve learning outcomes, such as problem solving and critical thinking skills [16]. Individuals are assumed to learn better when they discover things by themselves and when they control the pace of learning [17]. This implies that the use of e-learning systems in the courses provides some sort of self-directed learning opportunities which lead to the improvement of learning effectiveness among the

students. Many studies also argue that students interact more effectively when a system enables them to access a larger base of contacts and makes the exchange of information faster [33; 34]. Fast receipt of information may assist learning. For example, educators can upload learning materials in advance so that the students can read them before going to class. This may allow them to learn effectively in classroom situations. In addition, both educators and students can instantly share other course related information by utilizing the database of contacts. They may also use chat or discussion facilities for immediate and fast communication. Thus, it is plausible to assume that the utilization of an e-learning system provides the opportunity to share information faster. It assists to develop a social community too. Research on the learning processes in face-to-face groups indicates that the development of social community is important for making students feel like insiders in the learning environment, thus contributing to students' motivation, involvement, and contentment [19]. Following these arguments, we propose the following hypothesis.

H5. Use of an e-learning system in a course positively affects students' perceived learning assistance.

Traditionally in the IS field, it has been assumed that IS effectiveness obtain higher individual performance. For instance, according to Gatian [21], there is a strong relationship among user satisfaction, decision making performance, and efficiency. It is thus inferred that learning assistantship offered due to e-learning use will be positively related to the academic performance. If the e-learning system provides learning contents and an effective way of interacting among the participants, the students may learn well which can improve their academic performance. Thus, we propose the following hypothesis.

H6. Perceived learning assistance positively affects students' perceived academic performance.
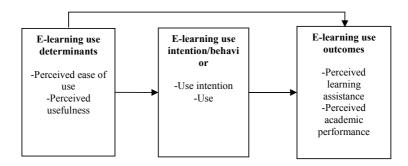
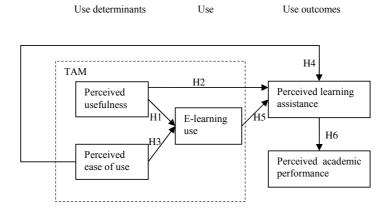**Figure 1. Conceptual framework for e-learning system use outcome**

Figure 2. Research model

3. Research method

3.1. Questionnaire development

The questionnaire had three parts: demographic questions, questions related to the constructs of the research model, and open ended questions asking to report the students' satisfaction and dissatisfaction with the target system. Each item corresponding to the constructs has been measured using the seven-point Likert scale, the answer choices range from "Strongly disagree (1)" to "Strongly agree (7)". Most of these items are adapted from the literature with minor changes in wording reflecting the target system. The measures of perceived usefulness and e-learning

system use were adapted from Limayem et al. [22] and Ma et al. [23] respectively. The measures of perceived ease of use were adapted from Hong et al. [24]. The measures of perceived learning assistance were developed from Liaw [10]. Finally, the measures of perceived academic performance were adapted from Lee and Lee [9]. After the questionnaire was drafted, it was first sent to two academic researchers for their review and revised according to their comments and suggestions to make the wording of the items more precise. Then, the questionnaire was sent to 10 students for their review. Overall, the students indicated that the questionnaire was relatively clear and easy to complete. A number of suggestions were made concerning the wording of several items and the overall structure of the questionnaire. The questionnaire was revised according to the given

suggestions. In order to avoid the common method bias problem as much as possible, we decided to randomize the questions in the questionnaire during data collection [26].

3.2. Participants

The target system of this study is the learning management system, Moodle (http://moodle.org/about/). Moodle is an open source course management system and has become very popular among educators for creating dynamic online course websites for students. Moodle can be used to conduct online courses or to augment face-to-face courses (hybrid courses).

This study was conducted in an internationally acknowledged, multidisciplinary scientific university in Finland. The university has seven faculties. The university has been using Moodle since 2007 as its platform for creating course pages online. Data was collected via a web-based survey from the students of the university who use Moodle in hybrid courses. A list of students' email addresses was collected from the Moodle support team in the university. A total of 1100 email invitations were sent to randomly selected students of the university who had been registered in Moodle as student users. One reminder was sent to increase the response rate after a gap of one week. The survey ran for approximately two weeks. After filtering invalid and incomplete responses, we had a total of 249 survey responses that could be used in this study. The

demographic information of the respondents is given in Table 1.

3.3. Data analysis

To analyze the quantitative data, we employed partial least squares (PLS) as our analysis approach and utilized the tool smartPLS [27]. PLS is a second generation regression method that combines confirmatory factor analysis with linear regression, and this makes it possible to run the measurement and structural models simultaneously. The qualitative data was content analyzed and used to support the findings of the PLS model.

Table 2 shows item wise averages and the loadings of each construct in the model. For each construct the assessment of convergent validity or internal consistency is also included through the composite reliability coefficient [28]. Convergent validity indicates the extent to which the items of a scale that are theoretically related are also related in reality. As we can see from Table 2, all items have significant path loadings greater than the threshold 0.7 recommended Fornell and Larcker [28]. All the constructs have composite reliability values that exceed the threshold recommended by Nunnally [29].

Table 1. Demographic information

		Frequency	Percentage
Gender	Male	101	40.56
	Female	148	59.44
Age	less than 21 years	31	12.45
	21-30 years	166	66.67
	31-40 years	25	10.04
	>41 years	27	10.84
Experience with the target system	0 – 6 months	15	6.02
	>6 months – 1 year	63	25.30
	>1 year – 1 year 6 months	10	4.02
	>1 year 6 months – 2 years	47	18.88
	>2 years – 2 years 6 months	9	3.61
	>2 years 6 months – 3 years	27	10.84
	>3 years	78	31.33

Table 2. Construct items, means and internal consistencies

Construct	Item	Mean	std	Loading
Perceived usefulness (CR = 0.91; AVE = 0.76)	PU-1: Using Moodle is of benefit to me	5.33	1.46	0.87*
	PU-2: The advantages of Moodle outweigh the disadvantages	5.37	1.38	0.91*
	PU-3: Overall, using Moodle is advantageous	5.32	1.71	0.84*
Perceived ease of use (CR = 0.93; AVE = 0.77)	PEOU-1: My interaction with Moodle is clear and understandable	4.90	1.39	0.86*
	PEOU-2: Interacting with Moodle does not require a lot of mental effort	5.15	1.51	0.87*
	PEOU-3: I find Moodle to be easy to use	5.16	1.54	0.90*
	PEOU-4: I find it easy to get Moodle to do what I want to do	4.76	1.51	0.88*
Perceived learning assistance (CR = 0.93; AVE = 0.76)	LA-1: Moodle provides flexibility of learning with regard to time and place	5.67	1.38	0.81*
	LA-2: Moodle assists learning performance	4.84	1.37	0.93*
	LA-3: Moodle assists learning efficiency	4.76	1.46	0.92*
	LA-4: Moodle assists learning motivation	4.31	1.54	0.83*
Perceived academic performance (CR = 0.91; AVE = 0.83)	AP-1: I anticipate good grades in such courses where Moodle is used heavily	3.98	1.35	0.91*
	AP-2: I anticipate better grades in such courses where some of the in-class activities are replaced by Moodle (online) activities	3.83	1.49	0.91*
E-learning system use (CR = 0.96; AVE = 0.92)	USE-1: I use Moodle frequently in this academic period	4.82	1.65	0.96*
	USE-2: I use Moodle heavily during my study	4.20	1.58	0.96*

Note: Composite reliability (CR), Average Variance Extracted (AVE), *p < 0.001

Table 3. Correlation among variables and squared root of average variance extracted

	(1)	(2)	(3)	(4)	(5)
Perceived academic performance (1)	0.91				
Perceived learning assistance (2)	0.68	0.87			
Perceived ease of use (3)	0.45	0.57	0.88		
Perceived usefulness (4)	0.53	0.68	0.65	0.87	
e-learning system use (5)	0.49	0.60	0.60	0.70	0.96

Table 4. Factor analysis results
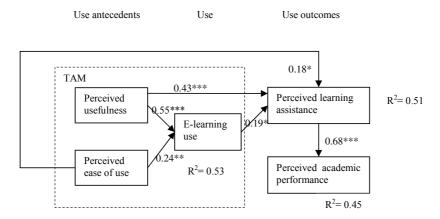
	Perceived academic performance	Perceived learning assistance	Perceived ease of use	Perceived usefulness	e-learning system use
AP-1	0.912770	0.624931	0.446025	0.546658	0.516976
AP-2	0.907730	0.608428	0.373496	0.419792	0.380810
LA-1	0.506225	0.811703	0.558073	0.648265	0.537861
LA-2	0.602032	0.929225	0.521947	0.594350	0.529865
LA-3	0.604235	0.920721	0.501885	0.615953	0.521858
LA-4	0.646899	0.827863	0.427086	0.520408	0.509509
PEOU-1	0.406143	0.526706	0.860389	0.619708	0.567165
PEOU-2	0.309029	0.420433	0.867054	0.503426	0.446315
PEOU-3	0.405754	0.501233	0.896624	0.582400	0.543351
PEOU-4	0.443497	0.546963	0.876356	0.569808	0.518067
PU-1	0.485582	0.629898	0.577446	0.869696	0.624178
PU-2	0.483359	0.591721	0.602227	0.910331	0.645901
PU-3	0.421122	0.556769	0.531375	0.838663	0.570731
USE-1	0.503266	0.577935	0.563957	0.672974	0.956699
USE-2	0.442622	0.571949	0.578858	0.673771	0.957184

Testing for discriminant validity involves checking whether the items measure the construct in question or other (related) constructs. Discriminant validity was verified with both correlation analysis and factor analysis as recommended by Gefen and Straub [30]. First, the inspection of discriminant validity among variables is based on the correlation between variables and the square root of their respective average variance extracted [28]. As Table 3 shows, the square root of the average variance extracted value for the variables is consistently greater than the off-diagonal correlation values, suggesting satisfactory discriminant validity between the variables. Second, from Table 4 we see that all items have cross loadings coefficients lower than the factor loading on their respective assigned latent variable, suggesting that discriminant validity on the item level is met for all the constructs.

4. Results and discussions

The test of the structural model includes estimates of the path coefficients, which indicates the strengths of the relationships between the dependent and independent variables, and the R-square values, which represent the amount of variance explained by the independent variables. Figure 3 shows the results of the test of the hypothesized model.

As hypothesized, perceived usefulness ($\beta = 0.55$; $p < 0.001$) and perceived ease of use ($\beta = 0.24$; $p < 0.01$) have a significant impact on e-learning use explaining its 53% variance. On the other hand, perceived usefulness ($\beta = 0.43$; $p < 0.001$), e-learning use ($\beta = 0.19$; $p < 0.05$), and perceived ease of use ($\beta = 0.18$; $p < 0.05$) have significant effects on perceived learning assistance explaining its 51% variance. Finally, perceived learning assistance ($\beta = 0.68$; $p < 0.001$) was found to have significant impact on perceived academic performance explaining its 45% variance.

*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$; ns: non-significant

Figure 3. PLS Model results

The relationships of the TAM model were supported in our study. As expected, perceived usefulness affects e-learning use significantly. This finding is in line with the findings of [8]. The qualitative data also supported this finding. For example, one student wrote the following:

"....*Finding all course materials in one place is great*...."

In addition, we found that perceived ease of use also predicts e-learning use significantly. However, its predictive strength is weaker than perceived usefulness. This finding is in line with those of IS adoption studies [7].

The other hypotheses are discussed below. First, our study results revealed that perceived usefulness strongly impacts perceived learning assistance. This relationship was not tested empirically in the prior

studies. However, the findings of prior studies provide indirect empirical support for our finding. Johnson et al. [12] conceptualized course performance, course satisfaction and course instrumentality as the measures of e-learning effectiveness. They concluded that perceived usefulness has a significant impact on both course performance and course satisfaction. This finding implies that a useful e-learning system assists students' learning process and thus students achieve better grades as well as remain satisfied with the course. Our finding is also indirectly supported by media synchronicity theory [35]. Media synchronicity theory emphasizes three key features of a media that enable effective communication: parallelism, reprocessibility and rehearsability [35]. Parallelism refers to the medium's capability to support multiple and simultaneous conversations. Reprocessibility refers to the medium's capability to support the reexamining and revisiting of a message. Finally, rehearsability refers to the medium's capability of supporting reediting and refining a message before sending it out. The target LMS provides such facilities, of which the group discussions facility is an excellent example. Additional examples include the ability to have multiple conversations, documenting conversation history for future reference, and editing a message before sending it. Thus, our finding about the association between perceived usefulness and perceived learning assistance is in line with the prior literature. The qualitative data also provides support for our findings. For example, one student wrote the following:

"....*For one course, we had good group discussion on Moodle. The topic was good, and all the students participated and Moodle worked well which made me inspired by the course and assignment in general....*"

Second, we found that perceived ease of use was also significant – although very weak – in predicting perceived learning assistance. We argue that the weak impact can be explained based on prior findings. In particular, adoption studies argue that perceived ease of use is weak at predicting the usage intention for experienced users [7]. In our study, the respondents were experienced with the target system (see Table 1). In practice, when users become experienced with an e-learning system they become more comfortable in using the system to perform their predefined tasks. At such stages, students put low importance on perceived ease of use when they evaluate e-learning system's outcomes. Thus, perceived ease of use did not contribute strongly to predicting perceived learning assistance.

Third, we found that e-learning system use also has a significant direct impact (although very weak) on perceived learning assistance. This causal relationship has not been tested empirically in prior literature, although there is ample evidence of support for this finding. For example, it is often argued that replacing some of the in-class activities with e-learning resulted in higher learning outcomes when compared to traditional face-to-face learning. Empirically, Liaw [10] found a high correlation between e-learning utilization intention and e-learning effectiveness. In addition, McGill and Klobas [3] found LMS use positively affects students' perceived learning impact. Thus, we conclude that our findings are supported by prior findings. However, the interesting point is that we found e-learning use is very weak at predicting perceived learning assistance. The interpretation of this finding is that the extensive use of e-learning system does not necessarily bring benefits to students. Hence e-learning systems should be used in such a way that can help to learn and increase collaboration. Such effective utilization largely depends on an educator's capabilities to build an effective learning environment with the students. The qualitative data provides further support to this. For example, one student wrote the following:

"....*All teachers do not know how to use Moodle, some teachers know but they don't take the full advantage of Moodle....*"

Another student wrote the following:

"....*Moodle sites work best when the teachers put timely and valuable information there....*"

Another student wrote the following:

"....*I have the feeling that teachers do not really want us to take full advantage of Moodle. For example, the teachers do not really encourage us to use discussion forums. In addition they do not allow us to put external links to the Moodle page which could be important for learning....*"

Finally, we found that perceived learning assistance has a significant strong impact on students' perceived academic performance. It implies that the students felt the e-learning system was contributing to their learning process positively, and it was reflected in their academic performance.

5. Implications and conclusions

Our study findings have a major theoretical implication. Our study has found how TAM variables affect e-learning usage outcomes. While prior studies only investigated the adoption and use of e-learning systems, our study went beyond e-learning use and provided insights into the outcomes of e-learning system adoption and use. Overall, the study's findings suggest that an e-learning system may assist students in

learning and achieve better academic performance, if it is used to augment face-to-face education.

Our study findings have practical implications for e-learning system designers, educators, and school management. The study found that behavioral beliefs (perceived usefulness and perceived ease of use) have significant impacts on perceived learning assistance, which implies that designers need to develop e-learning systems that are useful and easy to use in order to affect students' learning outcomes. Developing easy to use and useful systems also leads to more usage of such systems by students. However, educators need to remember that the increased usage of e-learning systems may not lead to more effective learning. Educators are required to put effort into designing courses utilizing e-learning systems so that the students are able to learn effectively. They should add different functionalities to the course pages and encourage the students to use them. For example, educators may encourage the students to participate in the discussion forums. They may announce some incentive, such as the possibility to earn some bonus points for active participation.

Finally, an education institute's management needs to know how to ensure users' effective usage of e-learning systems. Improving students' and educators' knowledge about the e-learning systems should lead to the effective usage of such systems. If they do not have much knowledge of these systems, they are less likely to use them or they may not be able to gain the full benefits of such systems, which may result in ineffective online collaboration. In turn, ineffective collaboration may negatively impact on student learning. Therefore, schools and universities should provide training for both students and educators on how to use their particular e-learning systems most effectively.

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