MULTI-DIMENSIONAL EVALUATION OF E-LEARNING SYSTEMS IN THE HIGHER EDUCATION CONTEXT: EMPIRICAL INVESTIGATIONS

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Approval of the Graduate School of Informatics

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ABSTRACT

MULTI-DIMENSIONAL EVALUATION OF E-LEARNING SYSTEMS IN THE HIGHER EDUCATION CONTEXT: EMPIRICAL INVESTIGATIONS

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There has been little research on assessment of learning management systems (LMS) within educational organizations as both a web-based learning system for e-learning and as a supportive tool for blended learning environments. This study proposes a conceptual e-learning assessment model, HELAM (Hexagonal e-

Learning Assessment Model) suggesting a multi-dimensional approach for LMS evaluation via six dimensions: (1) system quality, (2) service quality, (3) information (content) quality, (4) learner perspective, (5) instructor quality, and (6) supportive issues. A survey instrument based on HELAM has been developed and applied to 374 learners. This sample consists of students at both undergraduate and graduate levels who are users of a web-based learning management system, U-Link, at Brunel University, UK and NetClass LMS at METU, Turkey. The survey instrument has been tested for content validity, reliability, and criterion-based predictive validity. The explanatory factor analysis shows that each of the six dimensions of the proposed model had a significant effect on the learners' perceived satisfaction. Confirmatory factor analyses used to assess the number of factors and the loadings of variables. The results of confirmatory factor analyses were overlapped with the proposed model. Structural Equation Modeling (SEM) statistical analysis was used to validate the research model. The analytical results strongly support the appropriateness of the proposed model in evaluating LMSs through learners' satisfaction. Additionally, individual case results were presented with descriptive statistics, Pearson's Product Correlations outputs. Findings of this research will be valuable for both academics and practitioners of e-learning systems. The presented statistical results highlighted the importance of supposing a multidimensional analytical approach for e-learning system success evaluation. The proposed model provided several implications for e-learning effectiveness evaluation.

Keywords: *E-learning, Information Systems, Learning Management Systems, E-learning Success Evaluation, E-learning Evaluation Survey.*

ÖZ

YÜKSEK ÖĞRETIM KURUMLARINDA KULLANILAN E-ÖĞRENME YÖNETIM SISTEMLERININ ÖĞRENCI TARAFLI ÇOK BOYUTLU ÖLÇÜLMESI

Köseler, Refika
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Literatürde hem uzaktan eğitim hem de harmanlanmış eğitim ortamlarında kullanılan e-öğrenme yönetim sistemlerinin etkililiğinin ölçülmesi üzerine çok az araştırma bulunmaktadır. Bu sebele bu çalışmada e-öğrenme yönetim sistemlerinin

çok boyutlu bir yaklaşımla ölçülülmesi konusuna yoğunlaşılmıştır, Bu kapsamda, Altıgen E-öğrenme Değerlendirme Modeli (HELAM) sunulmuştur. HELAM modeli 6 temel boyuttan oluşmaktadır. (1) Sistem Kalitesi; (2) Servis Kalitesi; (3) İçerik Kalitesi; (4) Öğrenci Tutumu; (5) Eğitmenin Tutumu; (6) Destek Etmenleri. HELAM modeli temel alınarak 73 soruluk bir anket geliştirilmiştir. Bu anket İngiltere'deki Brunel Üniversitesi'nde U-Link adlı e-öğrenme yönetim sistemini kullanan lisans ve yüksek lisans öğrencilerine ve Türkiye'de Orta Doğu Teknik Universitesi'nde NetClass adlı e-öğrenme yönetim sistemini kullanan lisans ve yüksek lisans öğrencilerine olmak üzere toplamda 374 kişiye uygulanmıştır. Hazırlanan ankete bir çok güvenilirlik ve geçerlilik testi uygulanmıştır. Açıklayıcı ve doğrulayıcı etken çözümlemesi adı verilen istatistiksel metodlar ile modelin çok boyutluluğu değerlendirilmiş ve sonuçlar sunulan HELAM modeli boyutları ile örtüşmüşlerdir. HELAM modelinin doğrulanması için yapısal eşitlik modellemesi adı verilen istatistiksel analizi kullanılmış ve sonuçlar HELAM modelinin uygunluğunu kuvvetli bir şekilde desteklemişlerdir. Bunlara ek olarak, ODTÜ ve Brunel Universiteleri'nde uygulanan anket sonuçları değerlendirilmiş, sonuçlar yorumlanmıştır. Tüm bu sonuçlar e-öğrenme yönetim sistemlerinin çok boyutlu yaklaşımla ölçülmenin önemini vurgulamıştır. Sunulan HELAM modeli gelecek e-öğrenme çalışmalarına ışık tutacak niteliktedir.

Anahtar Kelimeler: *E-öğrenme, Bilişim Sistemleri, E-Öğrenme Yönetim Sistemleri, E-Öğrenme Etkililiğin Ölçülmesi, E-Öğrenme Değerlendirme Anketi.*

To memories of my grandfather, Mehmet KÖSELER

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LIST OF ABBREVIATIONS

CFA	Confirmatory factor analysis
E-Learning	Electronic Learning
IS	Information System
D&M IS Success Model	DeLone &McLean Updated Information System Success Model
HELAM	Hexagonal E-Learning Assessment Model
IT	Information Technology
SEM	Structural Equation Modeling

CHAPTER I

INTRODUCTION

The first chapter has introduced the motivation behind this study and argument for the significance of the assessment and measurement of electronic learning (hereafter e-learning) effectiveness. Additionally, objectives, scope and outline of the study are presented respectively.

1.1. E-LEARNING SYSTEM EFFECTIVENESS ASSESSMENT

Over the past years, humankind has witnessed a fundamental economic transformation. Economists generally acknowledge that a profound shift has occurred in nearly every field of life such as agriculture, industry, service, medical, and education sectors with the trigger of the technological improvements. All these profound changes are transforming the society into "information society" in other words "knowledge society" and economy also is transformed into "Knowledge-Based Economy" where knowledge is the fundamental economic resources and **learning is the most important economic process** (Lundvall & Johnson, 1994), and nowadays, e-work, e-trade, e-commerce are becoming increasingly common (Gürbüz, 2008). Like other field, the nature of learning and teaching functioning has

also been undergoing a rapid transformation due to the impact of technological changes that enabled delivery of the learning services over the Internet. As a result of all these rapid changes, teaching and learning are no longer restricted to traditional classrooms (Wang, Wang & Shee, 2007). The rapid expansion of the internet as a delivery platform, combined with the trends towards location-independent education and individualization, it is poised to become an integral component of information dissemination, and emerges as the new paradigm of modern education. Number of faculty members start to develop their own online courses increased around the world (Lundvall & Johnson, 1994). Not only traditional institutions of higher education but also for-profit organizations have developed web-based courses with an increasing rate (Global Industry Analysts, Inc. 2008). E-learning has become one of the most significant developments in the information systems (hereafter IS) industry (Wang, Liaw, & Wang, 2003). Backed by several favorable trends, the world e-learning market is projected to exceed US$52.6 billion by 2010 (Global Industry Analysts, Inc. 2008). The role of e-learning and information technologies (hereafter IT) in education continues to expand in scope and complexity. However, the development, management and continuous improvement of e-learning systems are quite challenging both for the educational institutions and for the industry. Both IS researchers and education professionals face numerous difficulties in theoretical and methodological concepts. Little is known about why many users stop their online learning after their initial experience (Sun, Tsai, Finger, Chen, & Yeh, 2008). For-profit organizations and traditional institutions of higher education have been developing and using web-based courses, but little is known about their effectiveness compared to traditional classroom education (Piccoli, Ahmad, & Ives, 2001). As a consequence, the need to develop theories and criteria for judging e-learning success becomes essential to achieve efficient systems. Increasing effectiveness of the e-learning systems has become one of the most practically and theoretically important research areas in both educational engineering and IS fields nowadays (Lee & Lee, 2008). Additionally, the importance of measuring IS success in e-learning applications increases as the investments in e-learning systems increase. Before heading an e-learning system investment, there is an indispensible need for assessing

the success of the e-learning systems to save tremendous amount of money. Moreover, assessment has become an essential requirement of a feedback loop for continuous improvement: 'What gets measured gets attention' (Eccles, 1991).

Although there is an important necessity for such an evaluation of every e-learning system, past studies show that there is a gap in evaluation of e-learning environments' effectiveness in between theoretical level and application level. While a considerable amount of research has been conducted on IS success models (DeLone & McLean, 1992; Rai, Lang, & Welker, 2002; Seddon, 1997), little research has been carried out to address the conceptualization and measurement of e-learning systems success **within educational organizations**. Traditional IS success models extended to assessing e-learning systems success is rarely addressed (Wang, et al., 2007).

For e-learning applications to be used efficiently for educational purposes; there is an important need to measure the success and effectiveness of the e-learning system systematically (Global Industry Analysts, Inc. 2008). Since integration of the Information Communication Technologies (hereafter ICT) into the teaching and learning process has become inevitable especially by the higher education institutions, and assessing the e-learning systems is the only way to ensure that higher education programs delivered via technology are of high quality, this study proposes an e-learning evaluation method mainly focusing on higher education Learning Management Systems (hereafter LMS) success evaluation.

1.2. SCOPE OF THE STUDY

This study argues the e-learning system success evaluations within the growing e-learning sector from both totally distance learning perspective and blended learning perspective. LMSs are widely used not only in for-profit organization but also in higher education institutes. However, this research aims to enhance understanding in defining, evaluating, and promoting LMS success especially in higher education

context. Under the light of this aim, the paper proposes a new e-learning effectiveness evaluation model from user perspective in higher educational context.

Other LMS users such as instructors, managers, system administrators or LMS developers such as computer engineers, software developers, content developers' LMS success evaluation is intentionally left out of the scope of this study.

This study conduct to provide recommendations for researchers and practitioners regarding the learners' perceived effectiveness of such systems.

The fundamental contribution to the e-learning system body of knowledge is a comprehensive e-learning system effectiveness assessment method that can be further tested for usefulness and applicability. Future research is recommended to substantiate and improve on the findings of the current study.

1.3. OBJECTIVES OF THE STUDY

The purpose of this research is to develop a comprehensive e-learning assessment model using existing literature as a base, incorporating concepts from both information systems and education disciplines. This study develops a conceptual model to systematically evaluate the success of LMS with respect to users, who interacting with the system, especially the study focuses on the learners' perceived satisfaction. The main reason to focus on learners is the importance of the end users in information system studies. According to Gable, Sedera and Chan (2003) most important part of an information system is the end user. Based on the aims, this research proposes guidelines for evaluating the success of an e-learning environment from the end users' perspective specifically learners. Different significant e-learning success assessment measures and criteria have been combined in the proposed e-learning effectiveness evaluation tool, which altogether have formed a comprehensive e-learning success assessment method.

The presented model is applicable for all e-learning systems however, in this study, the researcher has been applied the model to specifically higher education e-learning

systems therefore, in this study as an end user, ***learner*** and ***student*** are interchangeably used.

The model presented in this study helps (1) researchers by identifying key measures of the e-learning system success dimensions (2) to support improving e-learning environments and to contribute to ongoing research of online education, (3) to future e-learning systems developers and managers, and (4) to identify e-learning's future direction. Figure 1 will briefly describe the study.

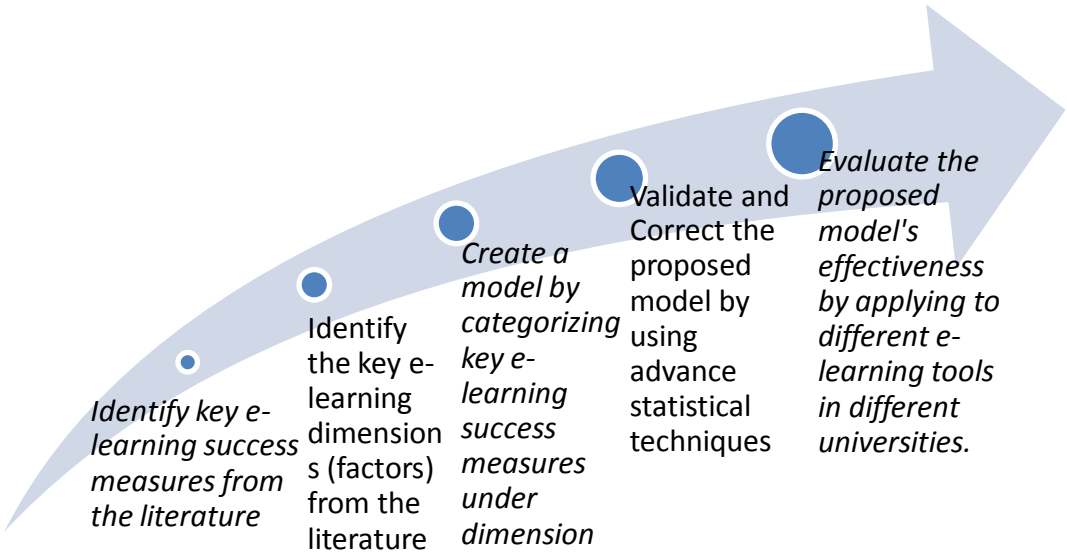

Figure 1 – Study Brief

1.3.1. The Importance of LMS Success Evaluation

LMS have become a popular topic for universities and organizations since 90s. Several organizations spend vast amount of money for LMS infrastructure developing. Sometimes, this money amount holds one of the biggest percentages of these organizations' budgets. Therefore, managements have great expectations from these investments in return. In other words, managements need an approval to make huge investments in LMS as well as managements want to justify their expenditure on LMS. Levy argues that managers need to understand the impacts of LMS investments on organizational performance and evaluation of LMS success provides both a simple managerial feedback and benchmark (2006). The feedback from the

evaluation supports the organizational learning and the benchmark can be used as a measure for the later LMS projects successes. However, since LSM evaluation includes human factor, measuring its success stands as a difficult question.

Additionally, the exploratory phase, including a review of the existing literature and carrying out expert interviews and focus groups, all mentioned below, showed that existing adoption models need extensions to includes all possible factors that affect learners' perceived effectiveness from the used e-learning systems.

These indispensible needs trigger to build the proposed e-learning success evaluation models.

1.4. RESEARCH QUESTIONS

In this section, the study's research questions will be presented. Gaining insight into the answers to these questions is challenging given in the complexity of the phenomena[1]. Nevertheless, these insights are of great value to practitioners in order to increase learners' retention, reduce learners' frustration with e-learning systems, extend the longevity of e-learning programs, and provide a benchmarking tool for e-learning systems.

The research questions are;

RQ1. What are the significant e-learning system success's factors effecting learners' overall satisfaction?

RQ2. What are the key success measures to comprehensively evaluate an e-learning system success?

[1] Human Factor involves, there are several dimensions to affect the e-learning systems.

RQ3. What is the contribution of each LMS evaluation factors on overall e-learning system evaluation?

1.5. OVERALL DESIGN OF THE STUDY

Figure 2 depicts all the research methodology phases. In this study, mainly researchers tried to develop a comprehensive e-learning assessment model using existing theory as a base and incorporating concepts from other disciplines such as information systems and education. The study also examined the factors and key e-learning success measures which affect LMS users' perceived satisfaction. In order to find out the key success measures and factors, the research design was formed to get the opinions of LMS users about the used LMS. Under the light of this aim, the study includes the followings respectively, at very first glance; it is proposed a model which derived from the previous literature, then to make the model more concrete and add them some analytical analyses a survey was build based on the proposed model. To study with survey, some validation analyses and reliability tests were applied on it. After become sure about the correctness of the survey, it is applied to several cases such as NetClass LMS at METU, Turkey and U-Link LMS at Brunel University, England. Then the collected data was verified according to some statistical rules. By using the collected data, statistical proofs of the model's validness were found. And the assessment results of cases were presented. And lastly, the proposed model's effectiveness was discussed.

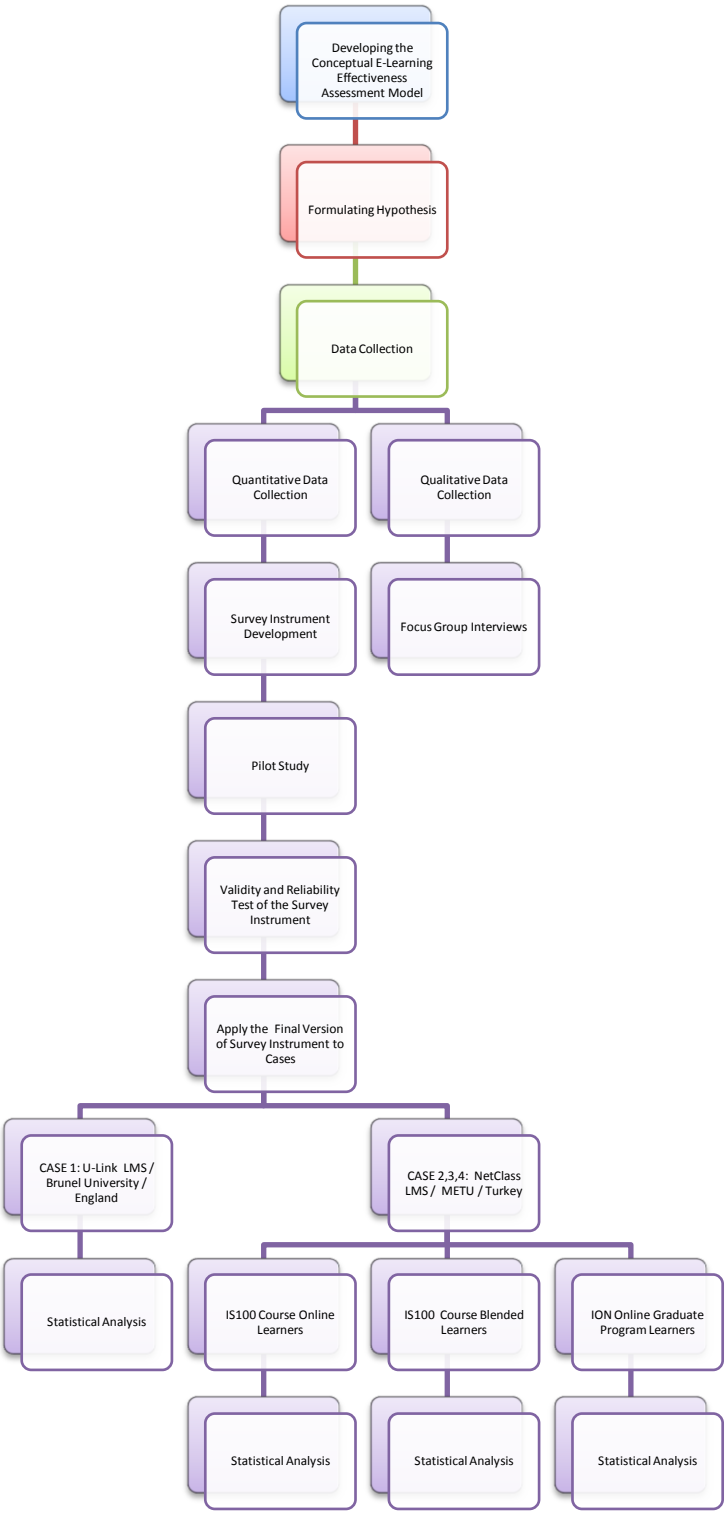

Figure 2- Research Design

CHAPTER II

LITERATURE REVIEW

This chapter provides a review of the pertinent literature regarding to the research questions and is divided into four sections. The first section presents general terminology in the domain field. The second section is a literature review concerning information system success and measurement issues. The third pertains to previous e-learning evaluation models. The forth section investigates e-learning evaluation criteria in a detailed manner.

2.1. DEFINITION OF E-LEARNING TERMINOLOGY

E-learning refers to the use of electronic devices for learning, including the delivery of content via electronic media such as Internet/Intranet/Extranet, audio or video tape, satellite broadcast, interactive TV, CD-ROM, and so on (Kaplan-Leiserson, 2000).

Asynchronous learning refers to learn in which interaction between instructors and students occurs intermittently with a time delay. Examples are self-paced courses taken via the Internet or CD-ROM, Q&A mentoring, online discussion groups, and email (Kaplan-Leiserson, 2000).

Synchronous learning refers to a real-time, instructor-led online learning event in which all participants are logged on at the same time and communicate directly with

each other. In this virtual classroom setting, the instructor maintains control of the class, with the ability to "call on" participants. In most platforms, students and teachers can use a whiteboard to see work in progress and share knowledge. Interaction may also occur via audio- or videoconferencing, Internet telephony, or two-way live broadcasts (Kaplan-Leiserson, 2000)

Blended Learning refers to learn events that combine aspects of online and face-to-face instruction. (Kaplan-Leiserson, 2000).

Distance Education is define as “planned learning that normally occurs in a different place from teaching and as a result requires special techniques of course design, special instructional techniques, special methods of communication by electronic and other technology, as well as special organizational and administrative arrangements” (Moore & Kearsley, 1996)

Educational Engineering refers to full educational services with strategic consulting, curriculum and coursework design, and custom courseware development.

Learning Management System (LMS) is a broad term used for a wide range of systems that organize and provide access to online learning services for students, teachers, and administrators (MIT-OKI Open, Knowledge, 2003).

Virtual Learning Environments (VLEs) are defined as "computer-based environments that are relatively open systems, allowing interactions and encounters with other participants and providing access to a wide range of resources" (Wilson, 1996).

Today many writers use the terms "LMS", "e-learning", "online learning", "distance education", "distance learning" and "web-based learning (WBL)" interchangeably (Hayen, Cappel, & Roger, 2004), and the same approach will also be taken in this study.

2.2. IS SUCCESS MODELS

Learning management system (LMS) is a special type of IS (Wang, et. al., 2007). Levy suggested that, a closer look will be given to the literature stream from the IS discipline as well as the distance learning literature from the education to evaluate LMS effectively (2006). Before dealing with distance learning literature, in this section a review of the IS success and IS measurement literature has been presented.

2.2.1. DeLone and McLean IS Success Models

In regards to IS Success, the DeLone and McLean IS Success Models are the most cited IS success models (Gable, et.al., 2003; Myers, Kappelman, & Prybutok, 1998; Heo & Han, 2003). In 1992, DeLone and McLean presented an Information Systems (IS) Success Model (Figure 3) as a framework and model for measuring the complex dependent variable in IS research. After nearly ten years (2003), they published a paper and discussed many of the important IS success research contribution, they propose enhancements to their original 1992 IS Success model.

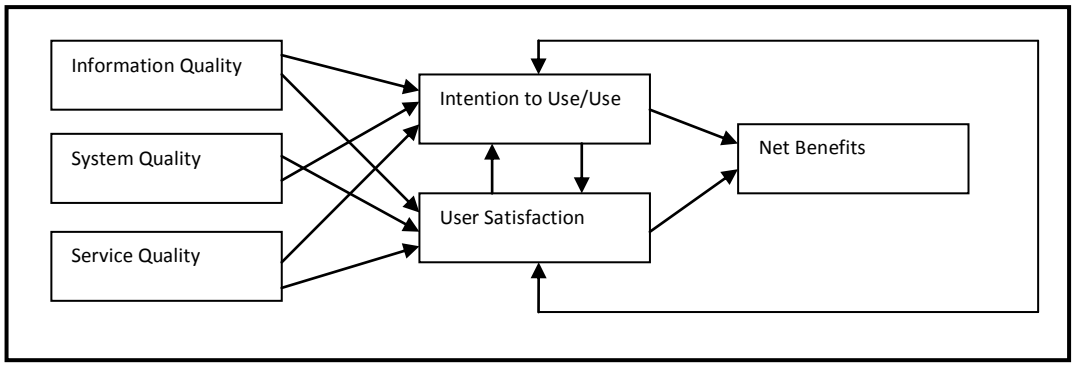

Figure 3 - DeLone and McLean's Information Systems Success Model (DeLone & McLean, 2003)

They made a series of recommendations regarding current and future measurement of IS success (Figure 3 - DeLone and McLean's Information Systems Success Model). Their IS success model become very effective and it is used not only in the IS success but also other related fields like e-learning assessment models.

2.3. PRIOR STUDIES OF E-LEARNING ASSESSMENT

2.3.1. Holsapple and Lee-Post, 2006 - E-Learning Success Models

Holsapple and Lee-Post's E-Learning Success Model (2006) is adapted from DeLone and McLean's (2003) updated information systems success model which, in turn, is an extension of their original model (DeLone & McLean, 1992). DeLone and McLean identified six dimensions of success factors: system quality, information quality, use, user satisfaction, individual impact, and organizational impact (1992). These were incorporated into their original overall success model shown in Figure 4.

The e-learning Success Model proposed by Holsapple and Lee-Post makes the process approach explicit to measure and assess success (2006). Their model also includes success metrics developed specifically for the e-learning context being investigated. They use the process approach to posit that the overall success of e-learning initiatives depends on the attainment of success at each of the three stages of e-learning systems development: design, delivery, and outcome analysis. Success of the design stage is evaluated along three success factor dimensions: system quality, information quality, and service quality. Success of the delivery stage is evaluated along two success factor dimensions: use and user satisfaction. Finally, success of the outcome stage is evaluated along the net benefits dimension. The arrows shown in the Figure 4 depict the interdependences within the three stages of success assessment. Success of system design is essential to the success of system delivery, which, in turn, affects the success of system outcome. The success of system outcome, however, has an impact on the success of subsequent system delivery, as indicated by the double arrow linking system delivery and outcome stages (Holsapple & Lee-Post, 2006).

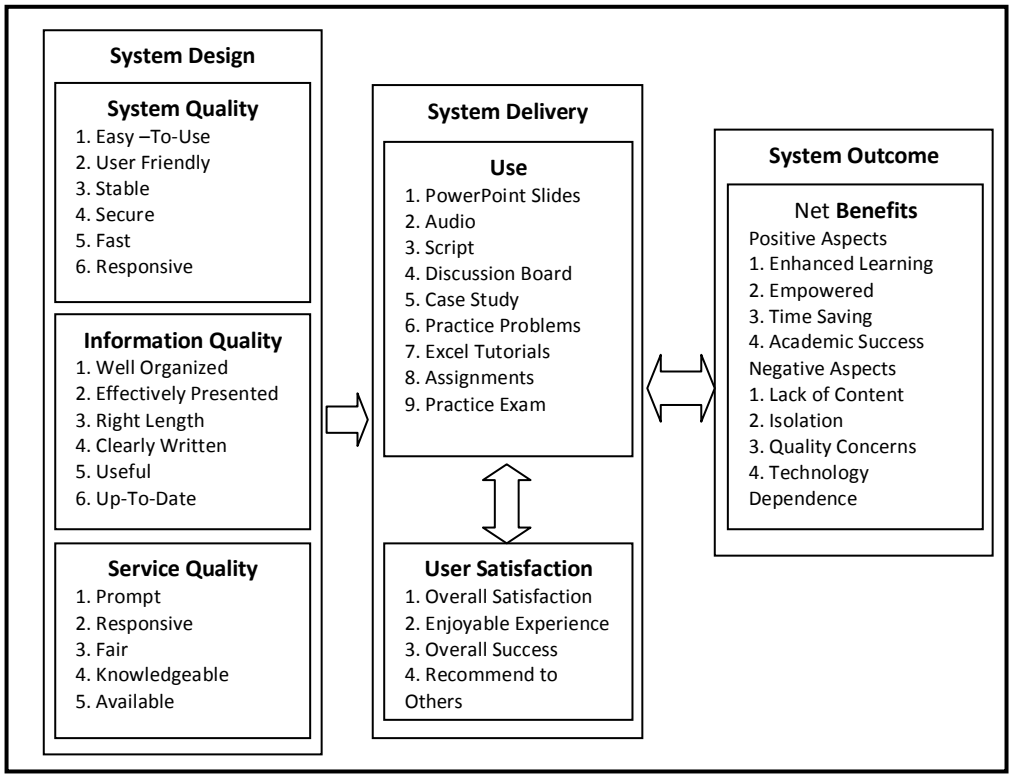

Figure 4 - The E-Learning Success Model and Sample Metrics of Holsapple and Lee-Post (2006)

2.3.2. Piccoli, Ahmad, & Ives 2001 - Dimensions and Antecedents of VLE Effectiveness Model

Piccoli, Ahmad, and Ives classified Learning Environments Effectiveness criteria under three main dimensions which are (1) Human Dimension, (2) Design Dimension, and (3) Effectiveness (2001). Each dimension has sub dimensions. Picoli et. al., (20019 defines these dimensions as follows:

(1) Human Dimension has two sub dimensions which are (1) Students, and (2) Instructors; they state students as a primary participants and instructors as a principal actor in a learning environment.

Students who are using a virtual learning environment (VLE) should be comfortable with technology and have positive attitudes toward it. Mature and motivated students will much more satisfy. Less motivated and mature students tend to suffer from VLE.

Previous experience with a VLE may also be an antecedent of success. Computer anxiety and Epistemic Beliefs are also important success factors for students' satisfaction from VLE.

Instructor's positive attitude toward technology, interactive teaching style, and control over the technology, availability are the key factors to determine a VLE's effectiveness from the perspective of instructors.

(2) Design Dimension has five sub dimensions which are (1) Learning Models, (2) Technology, (3) Content, (4) Interaction, and (5) Learner Control.

Learning Models which can be either objectivist or constructivist influence the design of a learning environment and ultimately its effectiveness. It is important to reiterate that research on the effectiveness of instruction must explicitly acknowledge the role of the learning model.

Technology quality and reliability, as well as easy access to appropriate hardware and software equipment, are important determinants of learning effectiveness, particularly students' affective reaction to the learning experience

Learner Control is also another important factor for an effective VLE which can be define as the degree of discretion that students can exert over the pace, sequence, and content of instruction in a learning environment.

Content which refers to the instructional material presented to the learner is also important sub dimension.

Interaction refers to communication media enable interactivity, but the degree to which a course is interactive depends largely on participants' behavior. Timely contribution and high participation frequency are necessary prerequisites for an effective VLE.

(3) Effectiveness, which is last dimension, has two sub dimensions (1) Self - Efficiency, and (2) Satisfaction.

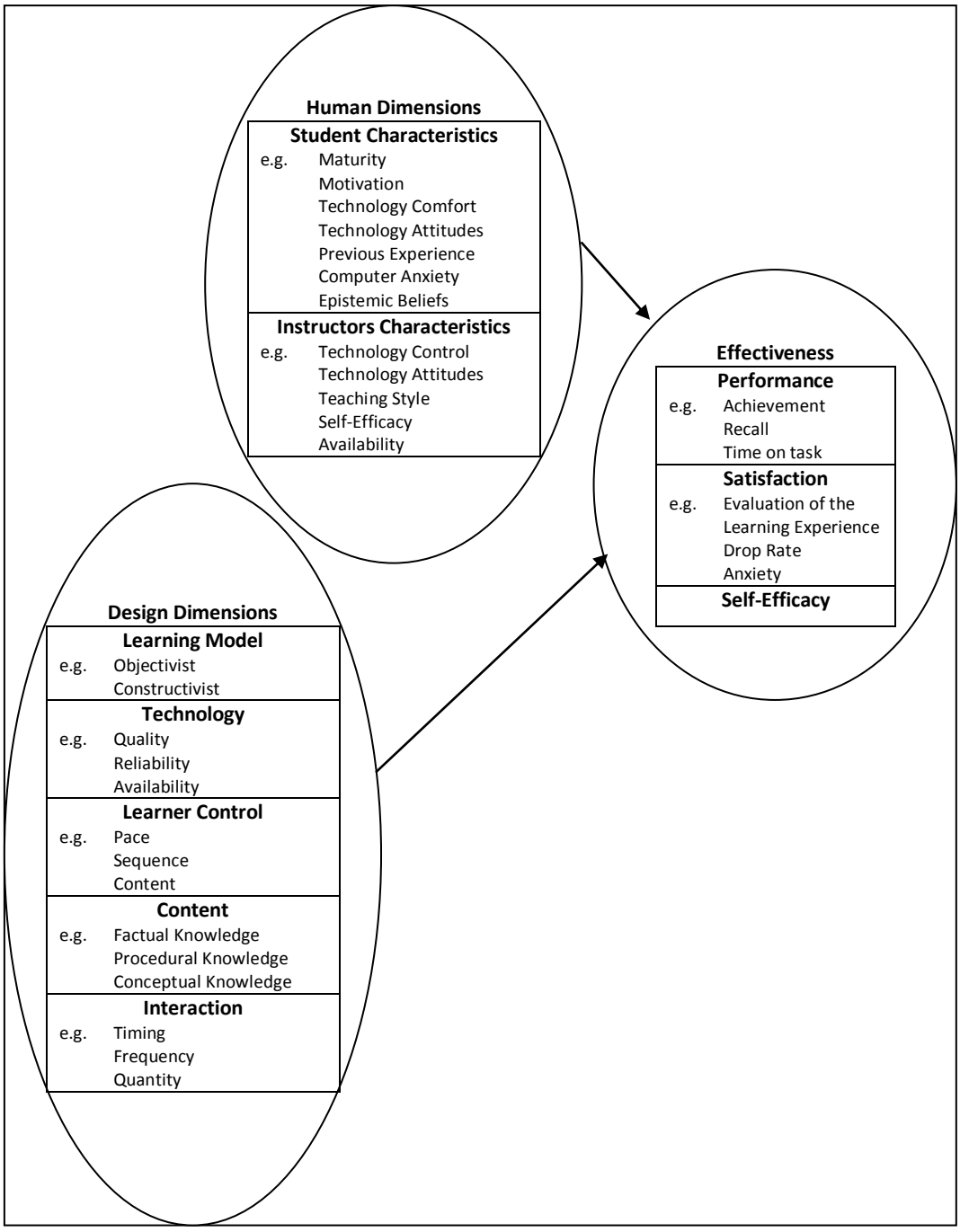

Figure 5 - Dimensions and Antecedents of VLE Effectiveness Model of Piccoli, Ahmad, and Ives (2001)

2.3.3. Selim, 2007 - E-Learning Critical Success Factors: an Exploratory Investigation of Student Perceptions of

According to Selim (2007), e-learning can be evaluated from users' (students') perspective. There are several factors that need to be considered to identify and measure e-learning applications' Critical Success Factors (CSFs) from students' perceptions. Four CSFs were identified and measured, namely, instructor characteristics, student characteristics, technology infrastructure and university support. They tested student's attitude towards using e-learning. A sample of 37 class sections with 538 responses was used to validate the proposed e-learning CSFs. The results revealed that students perceived instructor characteristics as the most critical factor in e-learning success, followed by IT infrastructure and university support. The student characteristics were perceived as the least critical factor to the success of e-learning.

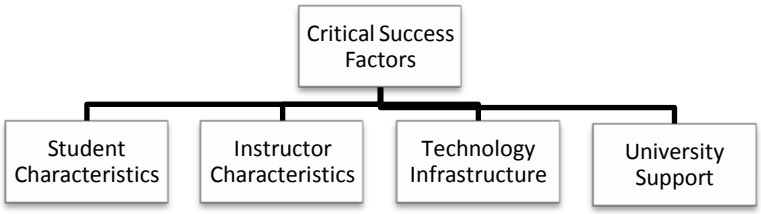

Figure 6 - Critical Success Factors, E-learning critical success factors: an exploratory investigation of student perceptions of Selim, 2007

2.3.4. Islas, Pérez, Rodriguez, Paredes, Ávila, & Mendoza, 2007 – Three-Dimensional Model to Evaluate Training Systems

Islas, Pérez, Rodriguez, Paredes, Ávila, & Mendoza, suggested three-dimensional model based on 40 criterions to evaluate different technologies applied in modern training systems (2007). 40 criterions are grouped in an e-learning evaluation model in accordance with their use and application in training processes. The proposed model includes Management (M), Technological (T), Instructional (I), Management-Technological (MT), Technological-Instructional (TI), Management-Instructional (MI) and lastly Management-Technological-Instructional (MTI) dimensions. Each

dimension has several sub criterions at the end total 40 criterions. For instance TI dimension has (1) Instructor Helpdesk, (2) Course templates, (3) Instructional standards compliance, (4) Searching within course, (5) Online grading tools, (6) Discussion Forums, (7) Bookmarks, and (8) Self- assessment. Applying this methodology, they evaluate different training and learning technologies.

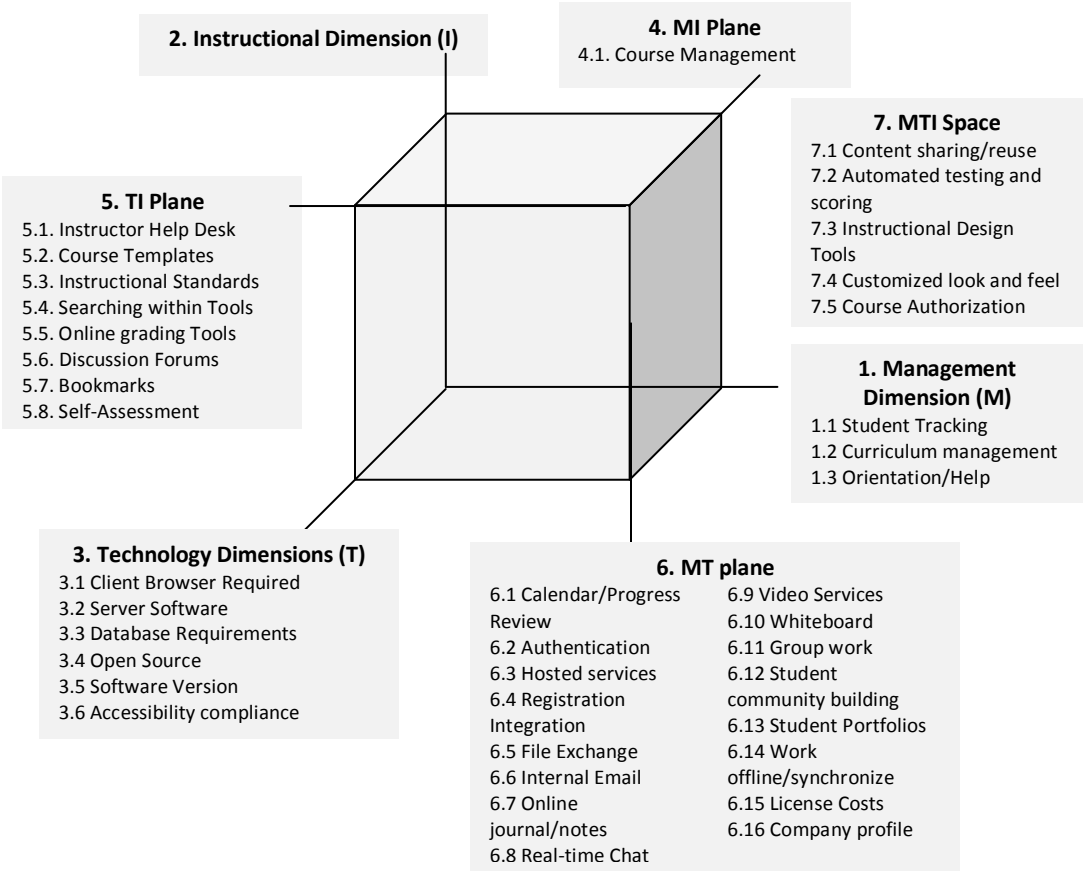

Figure 7 - Three-Dimensional Model to Evaluate Training Systems of Islas, Pérez, Rodriguez, Paredes, Ávila, & Mendoza, 2007; Kim & Lee, 2007 – Evaluation Model for LMS

2.3.5. Kim & Lee, 2007 – Validation of an Evaluation Model for LMS

Kim and Lee suggested a model for evaluating LMS (2007). As seen in the figure 8, seven aspects of the criteria that constitute the model are as follows: (1)

organizational demand, (2) interaction, (3) evaluation, (4) information guidance, (5) screen design, (6) technology and (7) instructional management. According to Kim et. al. the first four aspects are directly related to instruction which are organizational demand, interaction, evaluation, information guidance (2007). Screen design, technology, and organizational demand support instructional activities specific to e-learning. Instructional management controls all aspects of e-learning administration, from class registration to completion. It includes management safety, user accessibility and easiness of course management. Interaction represents communication among users. LMSs should be designed to accommodate a variety of communication types, such as learner-to-learner, Evaluation incorporates a set of criteria, such as the easiness of test management, a variety of test types and the reusability of items. And lastly, Information Guidance includes three subcategories: easiness of furnishing information, searchability of information and accessibility of information.

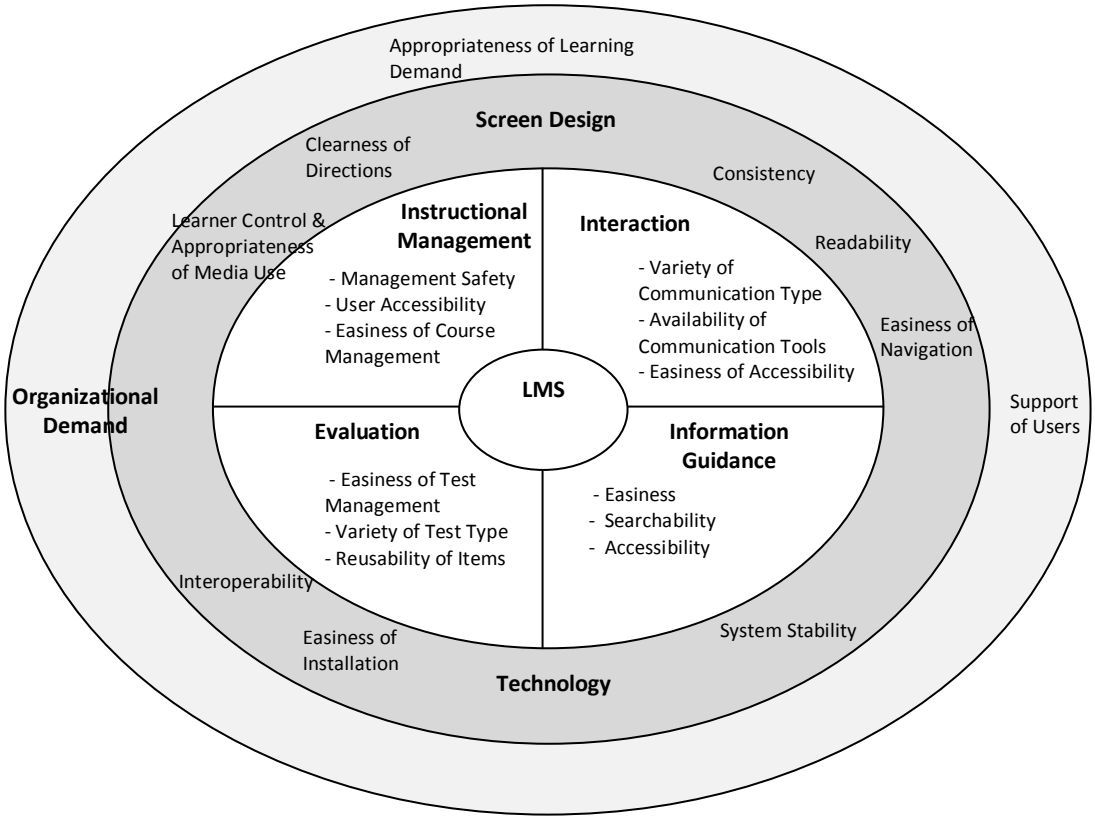

Figure 8 - Potential Criteria Model for Evaluating LMS of Kim & Lee, 2007

2.3.6. Sun, Tsai, Finger, Chen, & Yeh, 2008 - Critical Factors Influencing Learner Satisfaction (CFCs)

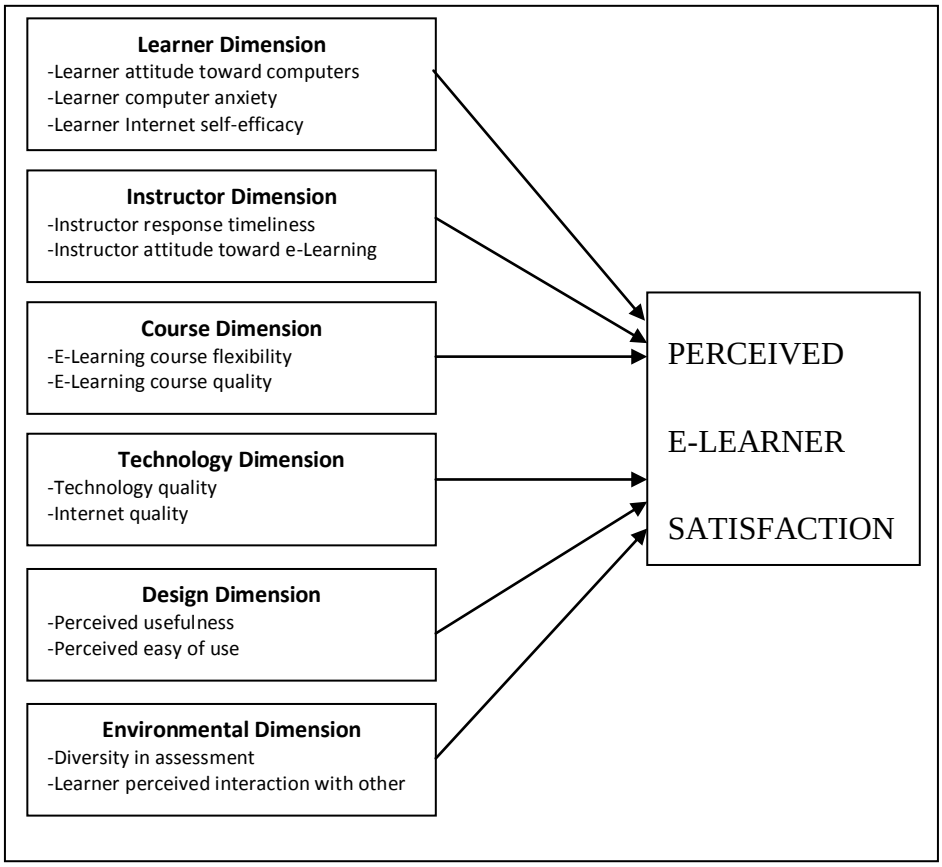

Figure 9 - Dimensions and antecedents of perceived e-Learner satisfaction of Sun, Tsai, Finger, Chen, & Yeh, 2008

Thirteen variables within six dimensions are discussed in their study.

2.4. E-LEARNING EVALUATION MEASURES

As mentioned in introduction part, while the social and economic systems change, the educational approaches and the "world of learning" (Rosenberg, 2006) changes as well. E-learning proliferates in the business and academic communities; there is an

ongoing need to evaluate its effectiveness. There have been previous research studies comparing learners' perceived satisfaction of online learning with using e-learning system success dimensions and critical success factors. This part aims to give a review of the literature which identifies the key e-learning success measures influencing the effectiveness of online delivery.

Volery and Lord defined e-learning as a combination of learner, faculty, instructor, technical staff, administrative, learner support, and use of the Internet and other technologies (200). In parallel, the success of an e-learning system may be considered as an emerging concept of 'social issues' and 'technical issues' and depends on numerous circumstances, rather than a black-and-white formula. These systems are open systems so they are affected by the environment, and influenced by the people who use them. However, these systems are also goal-driven, so an e-learning system can be evaluated by focusing on whether the system contributes to the achievement of its goals. E-learning systems are socio-technical entities therefore the e-learning key success measures have been reviewed under two sections, (1) social issues and (2) technical issues, as presented in the following paragraphs.

2.4.1. E-Learning system as a social entity

2.4.1.1. Learners' Attitudes Effect on E-Learning Success

Learners' perceived effectiveness is considered as one of the most important factor for creating an effective LMS by several researchers (Piccoli et.al., 2001; Webster & Hackley, 1997; Dillon & Gunawardena, 1995; Leidner & Jarvenpaa, 1993; Islas, et al., 2007; Kim & Lee, 2007; Liaw, Huang, & Chen, 2007; Volery & Lord, 2000; Holsapple & Lee-Post, 2006; Selim, 2007; Sun, et al., 2008). Many researchers agree that interactive instructional design is an essential factor for learning satisfaction and success (Jiang & Ting, 1998; Berge, 2000; Khan B. , 2005). Arbaugh & Duray, 2002 also suggested that the more learners interaction with others, the higher the e-learning satisfaction. In a virtual learning environment, interactions between learners and others or course materials can help solve problems and improve progress.

Interacting electronically could improve learning effects (Piccoli et al., 2001). Liaw, et al. (2007) also suggested that e-learning environments offer group interaction, such as learners to learners, or learners to instructors. Group interaction is a kind of cooperative learning that helps learners to make progress through their zone of proximal development by the activities in which they engage (Vygotsky, 1978). When learners increase their interaction with instructors and learners, they in turn raise their chances of building their own knowledge because much of learning inevitably takes place within a social context, and the process includes the mutual construction of understanding (Bruner, 1971). Another important criteria affects learners' satisfaction is learner Attitudes toward LMS. Liaw, et al. (2007), stated that in order to design effective e-learning environments, learner characteristics have to be provided. It is necessary to understand target group. To understand target group, learner characteristics, such as attitudes, motivation, belief, and confidence need to be identified (Passerini & Granger, 2000). Another important factor affect LMS satisfaction is Learner's Computer Anxiety. During the design period of an LMS, experts should consider the emotions such as fear, anxiety, apprehension, enthusiasm, excitement, pride and embarrassment (Konradt & Sulz, 2001). These can provide significant input to and shed light in explaining learners' attitudes (Csikszentmihalyi, 1975). When learners exhibit more positive attitudes toward e-learning, then they have more behavioral intentions to use it (Liaw et. al, 2007). Moreover perceived enjoyment and perceived usefulness are positively related to individual behavioral intention to use LMS. Thus, as individuals' attitudes on e-learning become more positive, they will have greater behavioral intention to use it. The concept of attitude towards computers has gained recognition as a critical determinant in the use and acceptance of computer technology (Smith, Caputi, & Rawstorne, 2000). E-learning effects through measuring learner satisfaction and investigate the preceding factors' influences on satisfaction (Arbaugh, 2002). Perceived e-Learner satisfaction is, therefore, defined as the degree of perceived learner satisfaction towards e-Learning environments as a whole.

2.4.1.2. Instructors' Effect on E-Learning Success

Liaw, et. al., (2007) stated that, instructors are major aspect of e-learning as a teaching assisted tool. An online course demands more time and effort from the instructor. To provide the best, most meaningful learning environments, instructors should have enough time to interact with students in their learning process (Khan, 2005); (Collis, 1995) concluded that, "It is not the technology but the instructional implementation of the technology that determines its effects on learning". Webster & Hackley (1997) proposed that, instructors' attitudes toward a technology, teaching styles, and control over the technology will affect learning outcomes. Additionally, Dillon & Gunawarden (1995) proposed that, instructors' attitudes toward technology-mediated distance learning systems be included in evaluations of these systems.

What is critical to the quality of e-learning is the existence of qualified and highly motivated faculty. What is meant by qualified faculty is (1) Responsiveness, (2) enjoyment, (3) availability, (4) self-efficiency, (5) promptness, (6) usefulness, (7) fairness, (8) communication ability, (9) encouraging interaction between students and lastly (10) control over technology (Hiltz, 1993; Islas et.al., 2007; Khan, 2005; Selim, 2007; Tielemans & Collis, 1999; Wang, et.al., 2007; Liaw, Huang, et.al., 2007; Webster et.al., 1997). Higher education institutions are highly dependent on these attributes of their faculty which affect their learners' satisfaction and encourages learning. It is clear that faculty will play a critical role in higher education institutions' during creating effective LMS. Moreover, teaching style of an instructor-specifically, encouraging student interactions-should also affect learning outcomes because, interaction is key to all learning. The instructor's control of the technology also should relate to learning outcomes (Dillon et.al., 1995; Leidner et.al., 1993; Webster et.al., 1997).

2.4.1.3. Supportive Issues Effect on E-Learning Success

Like any other innovative initiatives, e-learning projects can be subject to both social and political influence. "As we look at the distance learners, we must remember that

these learners exist in a broad social context – a social context which can profoundly affect the success of the distance teaching-learning transaction" (Khan B. , 2005). Khan also emphasized ethical and legal issues (2005). He stated that, institutions should developed e-learning policies and guidelines for legal matters such as privacy, plagiarism, and copyright issues at the very beginning of their e-learning initiatives which are very important indicators to create an effective LMS. Secondly, personalization of the e-learning portals according to learners has been improving the learners' motivation. Trends also one of the most important indicators of

According to the reinforcement theory developed by Scott (1959), Kohlberg (1966), an attitude may be regarded, like a habit, as an implicit anticipatory response which mediates overt behaviours, and arises out of them through response reinforcement. So reinforcement is positively and highly related with attitude. In distance learning, the most valuable reinforcement component will be a valid certificate or diploma. METU is one of the most prestigious universities in Turkey. Therefore, its diploma is very effective and valid, which affects learner's attitudes to distance learning program positively.

2.4.2. E-Learning system as a technical entity

2.4.2.1. System Quality Effect on E-Learning Success

Nearly all of the researchers dealing with LMS success, indicates that technology quality and Internet quality significantly affect satisfaction in e-Learning (Piccoli et. al., 2001; Webster et. al., 1997; Dillon et.al., 1995; Leidner et.al., 1993; Islas et al., 2007; Kim et.al., 2007; Liaw et al., 2007; Volery et.al., 2000; Holsapple et.al., 2006; Selim, 2007; Sun et al., 2008). The definition of technology quality is the learners' perceived quality of IT applied in e-Learning (such as microphones, earphones, electronic blackboards, Electronic mail, online threaded discussion boards, synchronous chat, and desktop videoconferencing are some examples). The definition for Internet quality is network quality as perceived by learners (Sun et. al. 2008). A software tool which is stable, secure, fast and responsive with easy to use

system, user-friendly characteristics, well-organized demands little effort from its users. Learners will be willing to use such a tool and satisfaction will be improved. Therefore, the higher the quality and reliability in Information Technology (IT), the higher the learning effects will be (Hiltz, 1993; Piccoli et. al., 2001; Webster et. al., 1997; Sun et. al., 2008). E-Learning technology may not only involve the software of the LMS but also involve other multimedia technologies such as video conferencing, communication tools, real time media, streaming audio and video, computer animations, participants, simulations, embedded tests, and dynamic content internet infrastructure and etc. Therefore, both technology quality and internet quality are important factors in e-learning. The perceived richness of multimedia technology should also influence learning outcomes (Daft & Lengel, 1986). In medium richness theory rich medium is one that conveys multiple verbal and nonverbal cues, allows for immediate feedback, uses natural language, and allows personal focus. (Tielemans & Collis, 1999; WBLArchitectureTeam, 1999; Roberts, 2005). Studies show us, quality and reliability of technology, as well as network transmission speed, were defined to impact learning effects (Piccoli et al., 2001; Webster et.al., 1997). 'Technology' also incorporates interoperability, ease of installation and system stability. E-learning platforms should be interoperable with other platforms, so that learning materials, created previously, are reusable and all data are synchronously updated when integrating materials with other systems. System installation should be easy, and system stability should ensure no errors (Volery et.al., 2000).

In recent years, several innovative internet technologies such as Web 2.0 applications have been applied in the development of e-learning systems. One of the most popular outcomes of Web 2.0 technologies are Personalized Learning Environments (PLEs) (Weller, 2006). When Web 2.0 principles were analyzed from a learning perspective, (Ullrich, Borau, Luo, Tan, Shen, & Shen, 2008) highlighted stimulation of active participation, i.e. interactivity; and interactive content as distinguished features.

2.4.2.2. Information (Content) Quality Effect on E-Learning Success

Content refers to the subject matter within a domain of knowledge to which a lesson or course is devoted (Khan, 2005). Content quality in e-learning is completely dependent on how well the learning environment is designed and managed, and how dedicated and involved are the instructional and support staff. A dedicated instructional and support staff can help to create meaningful learning environment for learners. Learners place great value on content (Shee & Wang, 2008). Shee at. al. emphasized that a high level of participation from other content developer experts, such as teachers, teaching material editors, and pedagogy professionals in the construction phase as well as in the subsequent operation and maintenance phase is critical for creating an well-organized, effectively presented, clearly written, in the right length, useful, flexible contents (2008). Up-to-date and useful content are the major criterions of effective e-learning environment (Holsapple et.al., 2006). Additionally, Rami, Piccoli, & Ives, 1997; Leidner et. al., 1993 stated that at the heart of the learning process is a learning model such as constructivism or behaviorism. Moreover, conduct an effective course management allows learners to feel more comfortable with the course content. Such an approach should result in higher retention and satisfaction rates. Enter grading in time, make necessary announcements on time; pre-defined structured evaluation criteria can be examples for course management. Essentially, e-learning signifies autonomous learning environments. In other words, users have more opportunities for self-directed learning in e learning environments. Multimedia instruction enables learners to develop complex cognitive skills, such as understanding important elements of conceptual complexity, ability to use acquired concepts for reasoning and inference, and competence to apply conceptual knowledge to novel situations with flexibility (Spiro, Feltovich, Jacobson, & Coulson, 1991).

2.4.2.3. Service Quality Effect on E-Learning Success

Khan, stated that institutional funding and resources for delivering and maintaining e-learning are critical for an effective e-learning system (2005). Therefore, e-learning

strategies must be aligned with and fully supported by the institutions' mission and strategic plans. The definition of service quality can be explained as the quality of administrative affairs such as, student tracking, course/instruction authorization, providing LMS design tools, course management, knowledgeable, and management including security, and budgeting. E-learning environment includes e-learning delivery and maintenance process (Khan, 2005). Therefore, security and organizational issues become important. It should not be surprising that distance learners demand far more services than traditional campus learners (Berge, 2000; Belanger & Jordan, 2000). Proper institutional feedback mechanisms are important to e-learners (Khan, 2005), so effective administrative mechanisms in e-learning environments should be properly designed to improve frequency, quality, and promptness of interactions between student and institution which could affect learner satisfaction positively. It is a must for institution to be ready for providing high quality education and training with the best learning resources and supporting services.

CHAPTER III

A NEW CONCEPTUAL MODEL FOR LMS EFFECTIVENESS EVALUATION

In previous chapter, a number of approaches of evaluation associated with information system and e-learning effectiveness have been critically reviewed. In the third chapter, the proposed conceptual model is introduced. It has two parts. The first part comprises objectives of a new conceptual model for evaluating LMS effectiveness. Based on the model objectives, the second part of the chapter presents the new conceptual model in a more detailed way.

3.1. MODEL OBJECTIVES

In the literature analyses, a number of previous researches have been reviewed. E-learning systems are multidisciplinary by nature. Therefore, many researchers from different fields such as computer science, information systems, psychology, education, and educational technology, have been trying to evaluate e-learning systems. Some have focused on technology-based components of e-learning systems (Islas, et.al., 2007), where others have studied only the human factor of e-learning systems considering student and instructor satisfaction (Liaw, et.al, 2007). For example Douglas & Van Der Vyver (2004), dealt with the effectiveness of e-learning course materials only; where Arbaugh et.al. (2007) studied the importance of participant interaction in online environments; and (Gilbert, 2007) investigated the

student experience perspective only. These individual assessment frameworks yield convenient solutions in practice. However, they comply with the needs only partially not fulfilling all of the necessities. Hence, there is a need for a systematic and comprehensive model which comprises both social and technical issues of e-learning. In this respect, this model provides guidelines for e-learning systems developers and distance educators to better understand how e-learner's perceived satisfaction can be increased and how the use of learning management systems can be improved. By providing a multidimensional evaluation of e-learning systems from learners' perspective, the findings of this research help to build more effective learning management systems and improve effectiveness in distance education.

The main objective of this model is to develop and validate the LMS success dimensions and key success measures iteratively and propose a model as benchmarking tools which indicates learners' perceived effectiveness of e-learning systems.

The proposed methodology in this paper, not only is helpful to evaluate the applicability of each learning tool from a global point of view, but it is also useful to establish the utilization of each learning tool in every category. This provides different views of the same tool, which allows evaluating each tool from different perspectives. These perspectives help to determine whether or not a tool fulfils the expectation of users.

3.2. MODEL DEFINITION AND COMPONENTS

The proposed system describes a methodology based on 46 measures (criteria) for evaluation. These 46 measures are derived from the pertinent literature. Based on the literature, these 46 e-learning success measures and factors have been summarized in a table presented in Appendix A. (HELAM Dimension with Pertinent Literature Table) which all measures were matched with its pertinent literature. There are many ways to classify these 46 measures available for evaluating an e-learning system. This study categorized the e-learning assessment measures according to pertinent

literature again. Most research suggests an integrated approach to the assessment of e-learning systems. Related literature has been reviewed focusing on e-learning systems both as a 'social' and a 'technical' entity. The proposed model has grouped the measures under two categories first.

1. Technical E-Learning Success Assessment Measures under ***Technical Issues*** part.
2. Social E-Learning Success Assessment Measures under ***Social Issues*** part.

After group the measures under 2 category, the measures are grouped into 6 main categories in accordance with each criterion correlation. The details of 6 categories and 46 criteria of the HELAM are as shown in Figure 10- HELAM (Hexagonal E-Learning Assessment Model).

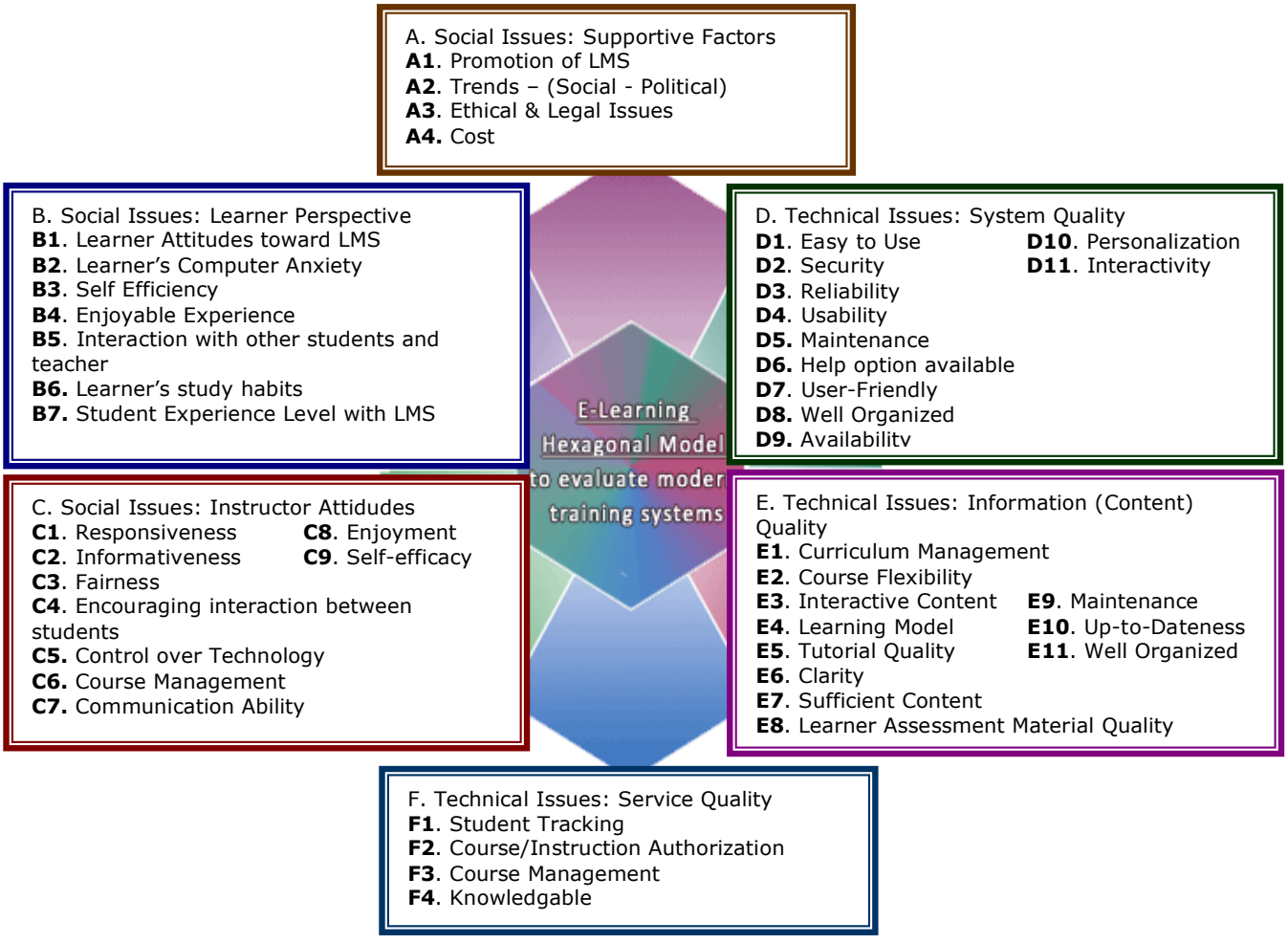

Figure 10 - HELAM (Hexagonal E-Learning Assessment Model)

These six main categories are as follows;

1. Technical Issues: System Quality (8 criteria)
2. Technical Issues: Service Quality (6 criteria)
3. Technical Issues: Content Quality (14 criteria)
4. Social Issues: Learner Perspective (5 criteria)
5. Social Issues: Instructor Attitudes (9 criteria)
6. Supporting Issues (4 criteria)

This Hexagonal E-Learning Success Model proposed here has been adapted from different information systems and e-learning success evaluation systems models. Table 1, presents a list of the models that have been briefly described in this section, which have formed the theoretical basis for HELAM dimension (factors).

Table 1 - References utilized when developing HELAM Dimension (Factors)

References	**Category**
E-Learning Success Model (Holsapple et. al., 2006)	System Quality, Service Quality, Content Quality
An Internet survey for perceptions of computer and World Wide Web: relationship, prediction, and difference (Liaw,et. al., 2007) Surveying instructor and learner attitudes toward e-learning (Liaw, et. al., 2007)	Instructor and learner attitudes toward e-learning
Wang, et. al., (2007)	System Quality
Three-Dimensional model to evaluate modern training systems (Islas, et.al., 2007)	Service Quality, Content Quality and System Quality
Johnson, et. al., (2008)	Factors Contributing to the Creation of Successful E-Learning Environments
E-learning critical success factors (Selim, 2007)	Learner Attitudes
Multi-criteria evaluation of the web-based e-learning system: A methodology based on learner satisfaction and its applications (Wang, et. al., 2007)	System Quality
Measuring e-learning systems success in an organizational context: Scale development and validation (Wang, et. al., 2007)	Service Quality, Content Quality, User Satisfaction, and System Quality
Teaching Effectiveness in Technology-Mediated Distance Learning (Webster et.al., 1997)	System Quality, Learner Attitudes, Information Quality, Instructor Quality

This model is not LMS specific and is applicable to various e-learning information systems and is applicable to various e-learning information systems blended learning supportive system tool. Moreover, the proposed model in this paper, not only is helpful to evaluate the applicability of each learning tool from a global point of view, but it is also useful to establish the utilization of each learning tool in every category. This provides different views of the same tool, which allows evaluating each tool from different perspectives. These perspectives help to determine whether or not a tool fulfils the expectation of users.

3.3. RESEARCH HYPOTHESES

The proposed model has been developed to evaluate e-learning system success from users' perspective. As mentioned earlier, the theoretical grounding for this research derives from existing information system and e-learning system success models such as DeLone & McLean's updated IS success models. Since the proposed model is a new comprehensive model, it becomes essential to test the proposed model whether it will evaluate an e-learning system successfully or not. In this regard, the relations in the proposed research model dimensions lead to the following set of hypothesis:

H1. The quality of e-learning is positively related to learners' attitudes toward LMS.

H2. The quality of e-learning is positively related to learners' perceived satisfaction from instructor.

H3. The quality of e-learning is positively related to learners' perceived satisfaction from system (LMS infrastructure).

H4. The quality of e-learning is positively related to learners' perceived satisfaction from information (content).

H5. The quality of e-learning is positively related to learners' perceived satisfaction from service.

H6. The quality of e-learning is positively related to learners' perceived satisfaction from supportive issues.

DeLone and McLean (2003) emphasize, information systems success is a multidimensional and interdependent construct, and it is therefore necessary to study the interrelationships among those dimensions. Hence future research efforts should explore and test the causal relationships among proposed dimensions within the boundary of e-learning. Also Levy in his "Assessing the Value of E-Learning System" book, (2006) divided e-learning components into seven categories. He stated that none of these components can create meaningful-learning features without proper integration of all of them. He stated that, they are all interrelated with each other. Moreover, (Khan, 2005) underlines the correlations within the LMS factors. In the light of all previous literature given above, this study emphasizes that examining these inter-relations become very crucial to achieve an effective e-learning environment. Therefore, in this study, additional to proposed 6 main dimensions, we will test also whether there is any interrelation among these 6 dimensions or not. If researchers have found any significant relationship between any dimensions, add them as hypotheses.

Hypothesis: There has been a significant interrelation within proposed HELAM dimensions.

CHAPTER IV

RESEARCH METHODOLOGY

Throughout this chapter, the detailed design of the study was covered. Namely, the research methodologies utilized in this study will be summarized. First, the research design and procedure will be explained, then, descriptions of participations are provided. After participations, the proposed data collection instruments were introduced; data collection procedures and the data analysis are explained in a detailed manner respectively. Finally, assumptions and the limitations of the study are presented respectively.

4.1. SAMPLE SELECTION AND PARTICIPANTS

4.1.1. Sample Selection

This study uses the sample selection methodology based upon purposive strategies in particular; random sampling technique was used to select the participants.

Purposive sampling is defined as "A non-probability sample chosen when individuals considered most closely related to the issue being studied are selected for inclusion" (Northern Arizona University). Most qualitative studies use purposive sampling, selecting a sample consciously based on researcher's established particular criteria. Hence, purposeful sampling is considered to be the dominant strategy in qualitative research (Gürbüz, 2008).

4.1.2. Participants

As mentioned in the previous sections, this study's main aim is to propose an e-learning success assessment method by combining different e-learning key assessment factors and measures. In order to achieve a better model, the researcher applied the model as much case as possible. Hence, it is clear that the more case you apply, the more valid model you get.

Under the light of this aim, the proposed model was applied to different e-learning systems which increase the validity and reliability of the model.

The participant section has reviewed under 2 sub sections;

1. Pilot Study Participants
2. Main Study Participants.

4.1.2.1. Pilot Study Participants

A pilot study was conducted before applying the questionnaire to the main participants of the study. Data collection for this pilot study has been built around two different categories of students. These two categories of students use the same LMS (i.e. METU-Online) but with different purposes. One category of students comprises graduate students studying for a graduate degree named as "ION-Informatics Online" program students. Informatics-Online (ION) is a non-thesis Master of Science program at Informatics Institute, METU, in which course participation is exclusively through the Internet. The second category of students comprises undergraduate Level 1 students who are enrolled with the course entitled "IS100 Introduction to Information System Technologies and Applications". This is a core module for all Level 1 students throughout the university. This IS100 module makes use of the LMS as a supporting tool, i.e. the instructor gives an introductory lesson in the classroom, and follow-up materials are provided online via METU-Online.

In the pilot study, 30 students participated from ION graduate program and **20** students participated from IS100 course.

According to the results of this pilot study, both proposed model HELAM and HELAM survey instrument has been modified iteratively to be used on the evaluation of LMSs.

4.1.2.2. Main Study Participants

In the pilot study, some major and several minor changes had been made on the survey instrument; the final version of the instrument was applied at 2 different universities.

1. Brunel University, London, UK
2. METU – Middle East Technical University, Ankara, TURKEY

Table 2 - Summary Table of Participants

University		**Number of Participant**	**Type of Learning**	**Information about Participant**
Brunel University, UK, U-Link		93	Blended Learning	Graduate and Post Graduate Level Students
Middle East Technical University, Turkey, NetClass	IS100 Online Learners	57	Online Learning	Undergraduate Level Junior Class Students
	IS100 Blended Learners	**30***+160	Blended Learning	Undergraduate Level Junior Class Students
	ION Graduate Program Learners	20**+14	Totally Online Learning	Graduate Level Students
Total		**374**		

** 30 participants from IS100 Blended Course were contributed to Pilot Study*
*** 20 participants from ION Program were contributed to Pilot Study*

The survey instrument was distributed via online with a cover letter, which was distributed to subjects from the researchers. All participants were asked to complete the survey and their feedback was guaranteed confidentiality. The use of computer-assisted data collection can greatly improve the reliability of the data as it eliminates

the human data entry step that includes some natural human errors (Fowler, 1993). The detailed information about participants is as follows:

Brunel University, UK; the first study was conducted in England, a total of 265 individuals participated in the study. This sample consists of both graduate and post-graduate students at Brunel University. All respondents are active users of U-Link (www.brunel.ac.uk/intranets/u-link) LMS as a supportive tool to the courses they are enrolled. Out of those who participated in the study, usable data was obtained from 93 students (~35% of the sample size). The following table summarizes the demographic information of survey respondents.

The age of the respondents varied from 19 to 44 years, with an average of 26.88 years. Nearly half of the respondents 46 (49.5%) were male, 47 respondents were female (50.5%). All of those participating in the course indicated that they had previous computer and Internet experience, with over 90% indicating that they had high levels of experience in both. On average, respondents have spent their 24.38 hours on computers per week. These 24.38 hours includes mail checking, chatting, surfing on the internet, etc. Learners stated that they spend approximately 18.13 hours on computers for educational purposes and they spend their 9.8 hours on LMS per week.

Table 3 - U-Link User's Demographic Information - Brunel University

Measure and Item	Frequency	Percentage
Gender		
Male	40	45.5%
Female	44	54.4%
Age		
18-28	69	74.1%
28-38	16	17.2%
38-48	8	8.6%
Computer Usage Habits (per day)		
Spend time on using a computer/Internet (per day)		
Less than 1 hour	2	2,2%
Between 1-3 hour	29	31,2%
Between 3-5 hour	21	22,6%
Between 5-7 hour	24	25,8%
Between 7-9 hour	11	11,8%
More than 9 hour	6	6,5%
Spend time on using a computer/Internet for educational purposes(per day)		
Less than 1 hour	10	10,8%
Between 1-3 hour	42	45,2%
Between 3-5 hour	30	32,3%
Between 5-7 hour	7	7,5%
Between 7-9 hour	4	4,3%
Spend time on using U-Link (per day)		
Less than 1 hour	60	64,5%
Between 1-3 hour	27	29,0%
Between 3-5 hour	5	5,4%
Between 5-7 hour	1	1,1%
Total	**93**	**100**

METU, Ankara; The second study was conducted at Middle East Technical University, Turkey with a sample of 800 students. All respondents are active users of NetClass (http://online.metu.edu.tr) LMS as a supportive tool to the courses they are enrolled. The 800 students were enrolled in a freshman level computer literacy service course, named as "IS100 – Introduction to Information Technologies and Applications". 164 students responded. All missing responses were eliminated and a total of 160 responses were collected. The following table summarizes the demographic information of survey respondents.

The age of the respondents varied from 18 to 38 years, with an average of 20.75 years. 96 students (44.2%) were male, 121 respondents were female (55.7%). All of

those participating in the course indicated that they had previous computer and Internet experience, with over 90% indicating that they had high levels of experience in both. On average, respondents have spent their 14.15 hours on computers per week. These 14.15 hours includes mail checking, chatting, surfing on the internet, etc. Learners stated that they spend approximately 11.45 hours on computers for educational purposes and they spend their 5.3 hours on NetClass LMS per week.

Table 4 - Demographic Characteristics of Respondents (Both Online and Blended Learning NetClass Users) - METU

Measure and Item	**Frequency**	**Percentage**
Gender		
Male	96	% 44.23
Female	121	% 55.76
Age		
Under 21	168	% 77.4
Over 21	49	% 22.6
Computer Usage Habits (per day)		
Spend time on using a computer/Internet (per day)		
Less than 1 hour	31	% 14.3
Between 1-3 hour	105	% 48.4
Between 3-5 hour	58	% 26.7
Between 5-7 hour	15	% 6.9
Between 7-9 hour	3	% 1.4
More than 9 hour	5	% 2.3
Spend time on using a computer/Internet for educational purposes(per day)		
Less than 1 hour	92	% 42.4
Between 1-3 hour	100	% 46.1
Between 3-5 hour	18	% 8.3
Between 5-7 hour	4	% 1.8
More than 9 hour	3	% 1.4
Spend time on using Net-Class (per day)		
Less than 1 hour	189	% 87.1
Between 1-3 hour	17	% 7.8
Between 3-5 hour	9	% 4.1
Between 5-7 hour	2	% 0.9
Total	**217**	**% 100**

4.2. SURVEY INSTRUMENT AND DATA COLLECTION

In this study both quantitative and qualitative methods have been used to test the proposed model, HELAM. To collect data from students about their perceptions of the learners' learning environment and LMS in regards to their benefits and satisfaction level; a survey instrument based on HELAM has been developed.

The researchers referred to a group of experts when discussing the validity of the questions within the survey instrument. The aim was to conduct a ***content validity*** based on the extent to which the measurement reflects the specific intended domain of content (Carmines & Zeller, 1994). A total number of *nine experts* in the field of information systems (IS) and educational technology have been asked to assess whether each dimension in the model is 'essential', 'useful but not essential', or 'not necessary'. Four of the experts are from the Information Systems Evaluation and Integration Group (ISEing), Brunel University, London, UK; three from Learning and Teaching Development Unit, Brunel University, London, UK; and one from the Middle East Technical University, Informatics Institute, Ankara, Turkey, and one from the Computer Education and Instructional Technology Department, Middle East Technical University, Ankara.

A pilot study was conducted where the initial instrument was applied to 30 undergraduate Level 1 students who were enrolled with the course entitled "IS100 Introduction to Information System Technologies and Applications" and 20 graduate students who are attending ION graduate program at Middle East Technical University, Turkey. The LMS evaluated was METU-Online (Ozkan, Koseler, & Baykal, 2009). Together with the findings from this pilot study and the feedback gained from the individual experts, both HELAM and the survey instrument had been revised and developed iteratively.

The final version of the survey consists of 73 questions in two main parts: first part aims to gather generic data about the learners, and the second part about learners' LMS experiences. The first part consists of demographic questions. The second part

is divided into six sections each of which corresponds to one HELAM dimension. In this part, 5 point likert-type scale item is used. These questions are anchored from 1 to 5, where 1 indicates strong disagreement and 5 indicates strong agreement. McMillan & Schumacher suggested that, the Likert-type scale is used when attitude, opinion, and perception are being measures since it is more agreeable to the quantitative approach (2001). Moreover, Gliner & Morgan stated that, Likert-type scale is the most common example of scaled items used in the questionnaires (2000). Carmines et.al. defines that, "A true likert scale is one in which the stem includes a value or direction and the respondent indicates agreement or disagreement with the statement" (1994). Therefore, Likert-type scale items were used in the survey instrument. All responses were guaranteed confidentiality. The survey instrument is presented in Appendix B. For quantitative data collection, the survey instrument has been made available online. It has been anticipated that the use of computer-assisted data collection can greatly improve the reliability of the data as it eliminates the human data entry step that includes some natural human errors (Fowler, 1993).

As mentioned earlier, the survey has two main categories. One of them is gather data about students themselves, and the other one asks about student's METU-Online LMS experiences.

In the first part of the survey, there are 5 questions. The first 2 question is about sex and age of the users, 3rd, 4th and 5th questions are about learners' computer usage habits, which are (3) define total number of hours spend using computer for any purposes weekly, (4) define total number of hours spend using computer for educational purposes weekly, (5) define total number of hours spend using METU-Online LSM weekly.

The second part questions are consists of a five-point Likert-type scale items. Each item anchored from 1 to 5, where 1 indicates strong disagreement and 5 indicates strong agreement. The students could select a rating from strongly disagree, disagree, not sure, agree, and strongly agree. It is divided into 6 categories. These categories are the same categories as HELAM's categories.

- Overall Students Satisfaction: in this field there are 3 questions asking overall students satisfaction.
- Learner Perspective: in this field students answered 10 questions which are related with learner's perspectives to the METU-Online LMS.
- Instructor Attitudes: in this field students answered 12 questions which are related with instructor's perspectives to the METU-Online LMS.
- System Quality: in this field students answered 15 questions which are related with system quality of the METU-Online LMS.
- Content Quality: in this field students answered 15 questions which are related with content quality of the METU-Online LMS
- Service Quality: in this field students answered 8 questions which are related with services quality of the METU-Online LMS.
- Supportive Issues: in this field there are 5 questions related with supportive issues such as ethical and legal issues in e-learning or trends.

In order to capture qualitative data, focus group discussions have been conducted with 20 e-learners. Four different focus groups were formed randomly from volunteers who were enthusiastic to become a part of this study. Each group consisted of 5 e-learners at graduate and undergraduate levels. Approximately 30 minutes were spent with each group. The focus groups created an interactive group setting where participants felt free to talk with other group members and make critiques. Semi-structured interviews were made with learners to seek their general beliefs, perceived satisfaction, attitudes, and comments about the instructor, course, and the LMS itself. Semi-structured interviewing methods was used, because a semi-structured interview is flexible, allowing new questions to be brought up during the interview as a result of what the interviewee says on the other hand structured interviews have formalized, limited set questions which gives limited information about learners thoughts.

4.3. ETHICS CLEARANCE

Our research involves human participants to the interviews in the data collection phase. For this reason, we need to apply for an ethics approval for research involving humans. The ethics clearance of our data collection is approved by Practical Ethics Research Board at the Middle East Technical University (Appendix C).

4.4. DATA ANALYSIS

The mixed methods case study design was used since a qualitative or quantitative research approach alone may not have been sufficient to reach the objectives of the study (Gürbüz, 2008). In this study, the data was gathered from the user via (1) survey instrument and (2) focus group interviews. Since the data collection procedures are different, data analysis is also different from each other.

4.4.1. Qualitative Analysis

In this study, user interview methods were used to gather and record the experiences of the users. "The interviewing methods provide several advantages for case studies because of supplying flexibility and capability to capture a wide range of data" (Gürbüz, 2008). Although quantitative methods are described as more scientific and reliable than qualitative methods by many researchers, qualitative methods are more appropriate to measure human behavior (Kanar, 2003). Patton explained that "The purpose of interviewing is to find out what is in and on someone else's mind.... We interview people to find out from them the things we cannot directly observe" (2005).

Therefore, additional to quantitative methods, we used qualitative data analysis for evaluate to understand students' perceived satisfaction about the effectiveness of the learning management systems.

4.4.2. Quantitative Analysis

In this study, quantitative research presents statistical results represented with numbers. Quantitative data was gathered from 67 five-point Likert-type survey questions. Quantitative study was carried out to understand students' satisfaction from the used LMS.

To conduct a quantitative study, the researcher used several statistical methods which are explained below.

- Validation of the Survey
    - Content Validity
    - Reliability
    - Criterion-Based Predictive Validity
    - Experimental Factorial Analysis
- Building Research Model
    - Confirmatory Factorial Analysis
    - Structural Equation Model (SEM)
- Case Results
    - Descriptive Analysis of the Results
    - Pearson's Product Correlations

CHAPTER V

RESULTS

In the 6th chapter, the results of both qualitative and quantitative analyses are presented and the individual LMS case results were introduced.

To examine the data, statistical data analyses methods have been used. Descriptive statistics, confirmatory and explanatory factorial analyses, correlations, regression analyses and structural equation model analyses were run to analyze the collected data. The responses to the questionnaire were analyzed using the Microsoft Excel 2007, SPSS 11.5 Windows (Statistical Package for the Social Sciences) and LISREL 8.7 software programs. The results of statistical analyses are presented and the individual case study results are interpreted.

The results of this study has been reviewed under three sections,

1. validation of the survey instrument based on pooled data
2. building the research model based on pooled data
3. case results based on individual data sets used

5.1. VALIDATION OF THE SURVEY

During the analyses, different data sets were used to different analysis. The survey instrument was validated by using pooled data.

The 73-item survey instrument was refined through analyzing the pooled data; that is, data from all different programs in 2 different universities was considered together. Because the primary purpose herein was to develop a general instrument capable of reliably and accurately measuring HELAM in various organization sectors, the pooling of sample data was appropriate to find the survey instrument validation.

In order to validate proposed LMS success assessment model's - HELAM (Hexagonal E-learning Assessment Model) - survey instrument, a number of validity and reliability tests applied. First, content validity, expert review, was applied. Second, factor analysis of the survey was identified. Factor analysis is a statistical technique used to determine the number of components in a set of data. These components were then named according to their characteristics. Finally, reliability tests were applied to the survey to check overall consistency.

5.1.1. Content Validity

The content validity in other words expert reviews of the survey was reviewed under Chapter 4, section 4.3, Survey instrument and data collection.

5.1.2. Identifying Factor Structure

Before the Factor Analysis; it is scanned for the significance correlation values and looked for any item for which the majority of the values are greater than the alpha value 0.05. Then the researchers searched for any value among the correlation coefficients that are greater than 0.9 to avoid any possible multicollinearity problem. Checking the determinant of the correlation matrix is another way of detecting multicollinearity problem. In this case the majority of the correlation coefficients are

significant along with values smaller than 0.9 and a determinant greater than the necessary value of 0.00001, therefore all the questions left[2] in this questionnaire correlate reasonably well and none of them is particularly large not leading to multicollinearity or singularity.

Kaiser-Meyer-Olkin (KMO) Measure of Sampling Adequacy and Bartlett's test of Sphericity was conducted and a KMO value of 0.898 was found. A value close to 1 indicates that of correlations are relatively compact and so factor analysis should yield distinct and reliable factors (Kaiser, 1974). Therefore we can make an inference such that there are separate differences between factors' correlations indicating having an adequate sample along with distinct reliable factors. In addition, the researcher have a significant test with Chi Square value of 2567.45 with 76 degrees of freedom and a significance value of 0.000 therefore it can be concluded that there are non-zero correlations between variables hence factors exist.

Explanatory factor analysis was conducted to primarily establish the factor structure of the model. In order to investigate the internal consistency of the subscales of the survey, Cronbach alpha coefficient was examined. Descriptive statistics were used to present central tendency and variability. In order to decide the number of factors we used Screen plot and Eigenvalues greater than 1 criterion (Tabachnick & Fidell, 2007). It was found that items were loaded on expected factors named as: Instructor Quality (Factor 1): Information Content Quality (Factor 2), System Quality (Factor 3), Service Quality (Factor 4), Learner's Attitude (Factor 5) and finally Supportive Issues (Factor 6). Total explained variance by running the data was 69.23%. This percentage is high enough to consider HELAM questionnaire as usable for LMS evaluation.

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[2] All the steps explained through Factor Analysis contains repeated controls for omitting inappropriate items from the factors in according to the Factor Analysis rules explained throughout this part. The process is defined over *the final* version of the factors.

Rotation optimizes the factor structure as a result the relative importance of the six factors is equalized and construction Rotated Component Matrix we have reached more homogenously distributed factor loadings of items among six factors (Table 6).

5.1.3. Reliability

In order to determine the reliabilities of the factors and to assess the internal consistency of the factors, we used Cronbach's alpha. All the factors have high values of Cronbach's alpha that can be seen from Table 6, all of which are around 0.8 being close to 1. Since Cronbach's alpha evaluates how well the items of a factor measure a single unidimensional latent construct; a high value closer to 1 indicates that the items consisting the factor can measure the same underlying structure meaning they form a reliable factor and they are consistent in between the other items in the factor.

Table 5 - HELAM Survey Instrument's Factor Analyses and Reliabilities

Factors	Item		Factor Loadings	Factor Reliability	% Total Variance Explained
Factor 1: Instructor Quality	F1.1	24	.871	.9234	25.069
	F1.2	21	.814		
	F1.3	22	.788		
	F1.4	26	.735		
	F1.5	25	.750		
	F1.6	30	.704		
	F1.7	29	.677		
	F1.8	27	.673		
	F1.9	23	.665		
	F1.10	20	.634		
Factor 2 : Information Content Quality	F2.1	50	.782	.9346	15. 235
	F2.2	51	.690		
	F2.3	53	.680		
	F2.4	55	.658		
	F2.5	52	.645		
	F2.6	54	.621		
	F2.7	46	.587		
Factor 3: System Quality	F3.1	37	.854	.8906	11.898
	F3.2	38	.798		
	F3.3	33	.778		
	F3.4	36	.675		
	F3.5	32	.665		
	F3.6	39	.640		
	F3.7	40	.531		
	F3.8	44	.520		
Factor 4: Service Quality	F4.1	66	.876	.9456	4.576
	F4.2	67	.787		
	F4.3	61	.654		
Factor 5: Learner's Attitude	F5.1	15	.778	.8420	8.894
	F5.2	13	.731		
	F5.3	10	.652		
	F5.4	12	.592		
Factor 6: Supportive Issues	F6.1	73	.776	.7175	3.567
	F6.2	70	.443		
	F6.3	72	.425		
TOTAL					**69.23**

5.1.4. Criterion Based – Predictive Validity

Regarding predictive validity a multiple regression analysis was performed. The main objective was to assess the efficacy and effectiveness of the survey instrument's LMS success parameters in predicting learner's satisfaction. In this research, the proposed usability parameters (i.e. the 6 factors identified in factor

analysis) are the independent variables (IVs) and the composite variable learner satisfaction is the dependent variable (DV). The composite dependent variable was consisted of the tree items used to measure learner satisfaction (Appendix – Overall Questions). All independent variables were entered into the analysis simultaneously in order to assess the predictive strength of the proposed model. When all independent variables entered into the multiple regression model results showed an R square[3] of 0.982 and adjusted R-square of 0.799 (Table 7) at $p<.001$ which is statistically significant. These findings reveal that the six LMS success dimensions (factors extracted from factor analysis) when entered together in the regression model, accounted for 98.2% (R Square .982) of the variance in learner's satisfaction. Such findings delineate good results for the questionnaire and can be considered as preliminary evidence of the validity of the proposed method (Cohen, 1988).

Table 6 - LMS Success Parameters in Predicting Learner's Satisfaction

Model Summary				
Model	R	R Square	Adjusted R Square	Significant (*p*)
	.991(a)	.982	.799	.001

a Predictors: (Constant), Factor 1: Instructor Quality; Factor 2 : Information Content Quality; Factor 3: System Quality; Factor 4: Service Quality; Factor 5: Learner's Attitude; Factor 6: Supportive Issues

5.2. BUILDING THE STRUCTURAL EQUATION MODEL

The Structural Equation Modeling (hereafter SEM) approach was used to validate the proposed model, HELAM. This approach was chosen because SEM is a statistical

[3] In regression, the R^2 coefficient of determination is a statistical measure of how well the regression line approximates the real data points. An R^2 of 1.0 indicates that the regression line perfectly fits the data.

technique for testing and estimating causal relationships using a combination of statistical data and qualitative causal assumptions (Joreskog & Sorbom, 1996). Specifically, "SEM provides a great flexibility in estimating relationship among multiple predictors and criterion variables and allows modeling with unobservable latent variables; it estimates the model uncontaminated with measurement errors" (Martinez-Torres, et.al., 2008). Additionally, Structural equation modeling grows out of and serves purposes similar to multiple regression, but in a more powerful way which takes into account the modeling of interactions, nonlinearities, correlated independents, measurement error, correlated error terms, multiple latent independents each measured by multiple indicators, and one or more latent dependents also each with multiple indicators (Ivancevic, 2007). Therefore, rather than using multiple regression analysis or other analyses, the researcher prefer to use SEM to find out the proposed HELAM model's statistical strengths. Lastly, because of the proposed model, HELAM is pre-defined model derived from pertinent literature, SEM is more appropriate than other analyses since SEM is usually viewed as a confirmatory rather than exploratory procedure. In this regard, the collected data from **(1)** METU and (2) Brunel University pooled in one dataset and applied one of the most valid and popular hypotheses testing methods SEM by LISREL 8.7 to investigate the proposed model usability.

5.2.1. Model Reliability and Validity

Before running the SEM model, each survey instrument was tested for reliability and validity using confirmatory factor analysis (CFA) which is a set of more complex and sophisticated statistical techniques used to test hypotheses, or the model. CFA tests hypotheses that state the number of factors representing data and the items comprising each factor. In CFA, the researcher specifies a certain number of factors, which factors are correlated, and which observed variables measure each factor (Ivancevic, 2007). The model included 29 items categorized under HELAM 6 dimensions. Several items' factor loadings were greater than recommended level which is defined as 0.60 (Chin, Gopal, & Salisbury, 1997). However, all item

loadings are acceptable levels to run a structural equation model (Johnson, Hornik, & Salas, 2008). Factor loading is a prerequisite requirement for SEM which was guaranteed by high item loadings.

Considering the factor structure as indicated in Table 8, latent variables were formed for the path analytic model, In some dimensions all the items were selected, such as "overall", but in others, typical items representing the dimension were selected such as "learners' perspective" factor. In this process two important criteria were used. First the number of observed variables was kept to three as a minimum (Schumacher & Lomax, 1996) second the items with greater factor loadings were primarily preferred.

Table 7 - Items' Confirmatory Factor Loadings and Individual Item Reliabilities

Item	Corresponding Measures	Factor Loading
Overall		
overall1	LMS helps me to manage my learning more systematically.	0.81
overall2	Overall, I am satisfied with LMS.	0.89
overall3	Overall, I find LSM successful.	0.83
Learners' Perspective		
learner1	In my studies, I am self-disciplined and find it easy to set aside reading and homework time.	0.84
learner2	I can manage my "study time" effectively and easily complete assignments on time by using LMS.	0.75
learner3	I enjoy attending to the LMS sessions overall.	0.76
Instructor Quality		
instr1	The instructor returns e-mails/posts within 24 hours via LMS.	0.74
instr2	The instructor is proficient with all the content used in the course.	0.79
instr3	The instructor created an online environment conducive and enjoyable for learning via LMS.	0.78
instr4	The instructor encourages us to interact with other students by using LMS interactive tools.	0.76
instr5	I find it easy to communicate with the instructor via LMS.	0.77
instr6	The instructor follows up student problems and tries to find out solution via LMS.	0.71
System Quality		
sys1	LMS's graphical user interface is suitable for e-learning systems.	0.86
sys2	The program directions and navigations are clear.	0.78
sys3	LMS supports interactivity between learners and system by chat, forums, discussions and etc.	0.77
sys4	I have not faced any system errors on LMS.	0.78
sys5	Navigation is very easy on LMS.	0.76
Information Quality		
info1	Course content and presentation gain attention.	0.83
info2	The course content is covered to an appropriate degree of breadth.	0.82
info3	The content is up-to-date.	0.81
info4	Lecture notes are supported by multimedia tools (Flash animations, simulations, videos, audios, and etc)	0.73
info5	Abstract concepts (principles, formulas, rules, etc.) are illustrated with concrete, specific examples.	0.66
info6	Vocabulary and terminology used are appropriate for me	0.64
Service Quality		
service1	The service supported by the university is good enough.	0.82
service2	I can easily contact with the institution administrative via mail or phone or fax.	0.81

service3	I do not experience any problems during registrations.	0.67
Supportive Issues		
support1	LMS lecture notes are prepared by obeying the ethical and legal issues.	0.78
support2	If it was trendier and more popular, I would prefer to take this module totally online from home without having to come to the face-to-face lectures.	0.69
support3	LMS helps me to cut-down my expenditure such as paper cost, communication cost (i.e. phone), transportation cost, etc.	0.68

According to Joreskog et. al., 1996 χ^2 (the ration between χ^2 and the degrees of freedom) provides direct statistical evidence for the test of model goodness of fit. The observed normed χ^2 for measurement motggthdel was 2.24 (χ^2 = 4093.09, *df* = 1822), which is smaller than 3 recommended by (Bagozzi & Yi, 1988). Other than chi-square various goodness-of-fit indexes were tested and summarized in the Table 2. Other than GFI – Goodness of fit index, all indexes shows good fit for the measurement model. Proposed model's indexes are higher than recommended level, CFI is 0.91, which exceed the recommended cut-off level of 0.9 (Joreskog et.al.,1996). The root mean square error of approximation (RMSEA) is 0.07, which is below the cut-off level of 0.08 recommended by (Browne & Cudeck, 1993). However, GIF index are slightly lower than the recommended level which 0.8 (Joreskog et.al.,1996). Since other goodness of fit indexes are higher than the acceptable levels and the GIF index is slightly lower than the recommended value defined above, the model was accepted as a valid and SEM can be applied on it.

Table 8 - Goodness-of-Fit Measures

Fit Indexes	**χ^2 (Chi Square)**	**χ^2 / *df***	**NFI (Normed Fit Index)**	**GFI (Goodness of Fit Index)**	**CFI (Comparative Fit Index)**	**RMSEA (Root Mean Square Error of Approximation)**	**P**
Recommended Values	-	≤ 3	≥ 0.8	≥ 0.8	≥ 0.9	$\leq 0.05 – 0.08$	0.000
Proposed Model's Values	4093.09	2.24	0.94	0.67	0.91	0.070	$\leq$ 0.05

5.2.2. Structural Equation Model

The results of structural model analysis are displayed in Figure 11(The original block diagram of the figure is given in the Appendix D). According to the SEM results, all six proposed factors are strong determinants of the overall satisfaction, and all proposed hypothesis are accepted.

The SEM model showed that system quality positively affects learners' overall perceived satisfaction from used LMS, whether U-Link or NetClass, (R^2=0.88), providing support for H3. Moreover, information quality significantly affects overall satisfaction (R^2=0.79) supporting H4. From H2 and H6, overall satisfaction is positively affected from instructor quality (R^2=0.87) and supportive issues (R^2=0.63). Additionally, learners' attitudes (R^2=0.89), service quality (R^2=0.70) has positive effect on overall satisfaction, which supports H1, H5, respectively.

The structural model correlates not only the dimension, or in technical wording latent variables, with overall learners' satisfaction, but also it gives all possible interrelations between dimensions. Therefore, additional to proposed six main dimensions, it is tested that, whether there is any interrelation among these 6 dimensions or not. So, SEM calculated three additional interrelations within the proposed dimensions. SEM analyses showed that there are 3 additional relations were found within the dimensions. The hypotheses are as follows;

H7. Instructor quality is highly depending on the Information quality trying to be delivered during the semester.

H8. The quality of the service is strongly correlated with the quality of the system.

H9. Learners' attitudes are highly depending on the quality of the instructor.

According to SEM results for interrelations within dimensions are as follows; (1) Information quality positively affects instructor quality, (R^2=0.69), providing support for H7; (2) system quality positively affects service quality, (R^2=0.48), providing

support for H8; (3) instructor quality has a positive effect on learners' attitudes toward the course, (R^2=0.83), providing support for H9.

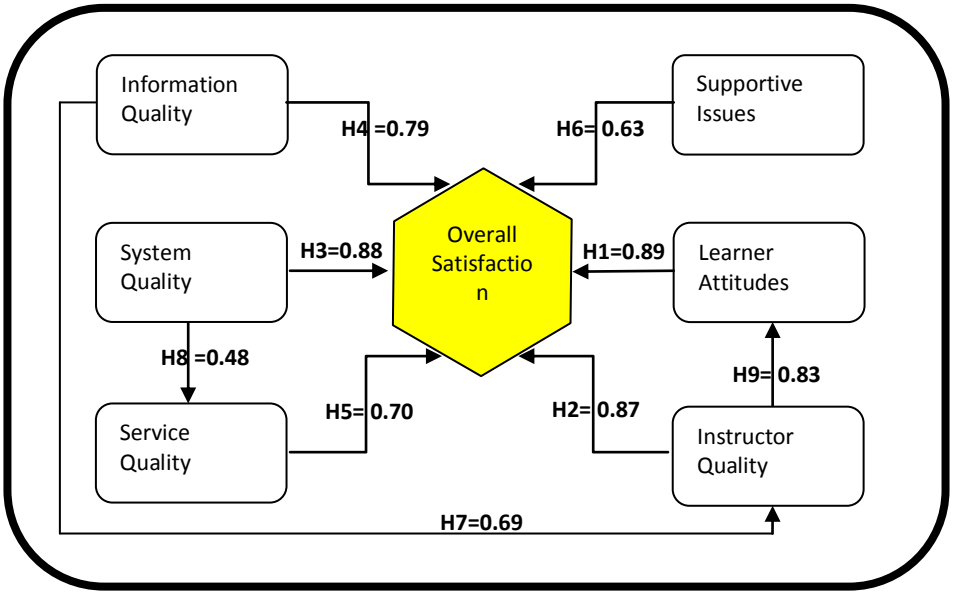

Figure 11 - Structural Equation Model

5.3. INDIVIDUAL CASE RESULTS

The new model and the new assessment method have been evaluated via two cases which are;

1. Brunel University, London, UK
2. METU – Middle East Technical University, Ankara, TURKEY

Empirical evidence is sought through case study research and the proposed HELAM model has been adapted to two universities LMS users. Specific implications have been drawn concerning the relationship between user satisfaction and LMS assessed from each case. Both two cases have provided insight into the LMS usage. In this section, these quantitative results are presented respectively.

5.3.1. First Case - Brunel University, London, UK

Descriptive statistics of each HELAM category are depicted in Table 10 to summarize the data collected from survey results. These include mean, maximum, minimum values and standard deviations. Based on the descriptive statistical data, by considering only total student satisfaction results from blended learning, (mean value 3.72), learner's perceived satisfaction from U-Link is high.

Table 9 - Descriptive Statistics of U-Link LMS Users: Mean, Standard Deviation, Maximum and Minimum Values for HELAM Dimensions

	N	Minimum	Maximum	Mean	Std. Deviation
Learner's Attitudes	84	2.00	5.00	3.66	.666
Instructor Quality	84	1.00	5.00	3.53	.966
System Quality	84	1.29	5.00	3.69	.711
Information (Content) Quality	81	1.83	5.00	3.79	.670
Service Quality	84	1.00	5.00	3.68	.870
Supportive Issues	84	2.00	5.00	3.95	.764
Total Learning Quality	**83**	**1.52**	**5.00**	**3.72**	**.775**

In addition to descriptive statistics, Pearson correlations have been reported for all quantitative measures in order to test the quantitative results. All findings are analyzed with Pearson Correlation Coefficient at the significant level of 0.01. The findings will not be accepted if the significant level (2-tailed) is less than 0.01. The results of testing Pearson Correlation Coefficient values are shown in Table 11. By using Pearson's Product Moment Coefficient values interpretation has been done by looking into correlations of each HELAM dimension with overall student satisfaction.

Pearson's product moment coefficient (r) is a parametric technique which portrays the strength and direction of the relationships between two variables. A correlation coefficient was also perceived as a statistical devise used to measure the strength/degree of supposed linear relationships between two variables. It is said to take the value from -1 to +1. The sign in front denotes the nature of the relationship and the absolute figure provides an indication of the strength of the relationship. The

interpretation of the value between 0 and 1 was according to Cohen, (1988) guidelines as follows, r=.10 to.29 or r=.-10 to -.29 is indicated as small, r=.30 to .49 or r=-.30 to -.49 is indicated as medium and lastly, r=.50 to 1.0 or r=-.50 to -1.0 is in the scope of large. The level of criticality of each dimension is represented by its Pearson Correlation results.

Table 10 - Correlation Results of U-Link Users (Correlations in between HELAM categories)

r	1	2	3	4	5	6	7
Overall Satisfaction (1)	**1**						
Learner's Attitudes (2)	.482(**)	1					
Instructor Quality (3)	.602(**)	.623(**)	1				
Supportive Issues (4)	.630(**)	.473	.718	1			
Information Quality (5)	.623(**)	.592	.983(**)	.692	1		
System Quality (6)	.753(**)	.573	.617	.455(**)	.618	1	
Service Quality (7)	.537(**)	.541	.740	.621(**)	.727	.482(**)	1

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

5.3.2. U-Link LMS Effectiveness Evaluation Findings

The findings of this research have been presented under the 6 subheadings.

5.3.2.1. Learner's Attitudes versus Learner's Perceived Satisfaction from LMS

The first measure indentifies the effect of learner attitudes on perceived learner's satisfaction from LMS. Pearson's correlation output, presented in Table 11, proves that there is a positive statistically significant relationship between learner's attitudes and overall learner satisfaction. According to statistical information, learners have positive attitudes (Table 10, Learner's Attitudes, Mean: 3.66) towards LMS. The value of Pearson Correlation (r) is 0.482 at a significance level of 0.01 (r = 0.482; p=0.01). There is a medium correlation between these variables.

Webster, et. al. (1997) stated that learner's attitudes towards technology and blended learning may have significant effects on the success of the LMS. The statistical results of this study partially support this since Pearson Correlation analyses revealed that there is a medium correlation between learner's attitudes and perceived

usefulness towards an LMS. Therefore in this study, learner's attitudes have not been found to be the most powerful factors on user satisfaction, which is in contrast with some researchers who proposed that user satisfaction is the most appropriate measure for IS success available (Gelderman, 1998; Davis, Bagozzi, & Warshaw, 1989; Zoltan & Chapanis, 1982).

The statistical analyses prove that the most powerful indicator for learner's attitudes is 'learner's perceived enjoyment towards e-learning system' (r=0,782; p=0.01). This is in parallel with qualitative findings: one learner stated that "…U-Link is beneficial for me mainly because I can achieve the whole course material whenever and wherever I want. Besides, the course materials are spread electronically not in paper format via U-Link that I can save important course materials during even after the semester without any loss of information. Additionally, the electronic format of the course materials helps me to achieve these important files more easily and efficiently. I can even save my whole course materials years and years…". It is highly important factor, which changes learner's attitudes positively toward LMS. Most of the survey participants stated that they would still prefer to use U-Link as a supportive tool even if it was optional as they believe that it would help their performance in the module.

Another finding from the focus group interviews – and also supported by the statistical results - is that the attitudes of learners towards U-Link are positively related with the learner's past LMS experience. For instance, one post-graduate learner stated that "…since I am familiar with distance learning from my undergraduate studies, I found it straightforward to use U-Link. It was not difficult for me to find the relevant tools of U-Link…"

5.3.2.2. Instructor Quality versus Learner's Perceived Satisfaction from LMS

The second measure identifies the effect of instructor quality on perceived learner's satisfaction from LMS. According to descriptive statistical information, learners have positive attitudes (Table 10, Instructor Quality, Mean: 3.53) towards instructors.

Collis (1995) remarked that the instructor plays a central role in the effectiveness of online delivery: “It is not the technology but the instructional implementation of the technology that determines the effects on learning". This study statistically supports this since Pearson’s correlation results, r = 0.602 p=0.01, reveal that there is a strong relationship between the instructor’s quality and learner’s perceived satisfaction. In parallel, focus group discussions have strengthened the importance of instructors. One of the learners stated that, “…whenever I send an e-mail to instructor or write something on forum, I more enthusiastically open my U-Link session because I wonder the answer, but if the instructor does not reply to my question, my willingness to login U-link session decrease dramatically…” Another learner states “…the instructor is very friendly and his methods were admired which motivates me to use U-Link…”

In brief, learner’s perceived satisfaction towards e-learning is positively affected, when the instructor responds to learners rapidly, his teaching style is good enough, his explanations are clear, and he has control over technology, which altogether influence the success of the learning overall positively. These results overlap with the literature (Arbaugh, et. al., 2002; Thurmond, Wambach, & Connors, 2002).

5.3.2.3. System Quality versus Learner’s Perceived Satisfaction from LMS

The third measure identifies the effect of system quality on learner’s perceived satisfaction. This dimension is investigating the attitudes of learners towards technology, usefulness of technology, and quality and reliability of the system. According to descriptive statistical information, learners have positive attitudes (Table 10, System Quality, Mean: 3.69) towards used technology for U-Link. This is in parallel with Pearson’s correlation results (r=0.753, p=0,01). This proves that there is a positive and high relationship between System Quality of the LMS and overall learner satisfaction. Considering the criteria under the system dimension, it can be deduced that the stability of the learner interfaces has a significant emphasis on the learner. The focus group discussions explored that the user interface is an area where a high level of interaction takes place; a well-designed, user-friendly learner interface

becomes one of the most critical factors in determining the satisfaction of learners when using the LMS. This is in parallel with many IS-related studies (DeLone & McLean, 2003; Laudon & Laudon, 2000; Arbaugh et. al., 2007; Wang, et. al. 2007).

Another key issue which affects the learner's perceived system quality is personalization. The focus group interviews reflect that one of the most important requirements of the learners is being able to control their learning progress. This is in parallel with the literature (Wang, et al., 2007). The learner's habits have also been found to affect the overall LMS success. 'Easy navigation', 'easy to find the required information', and 'available help option' are important aspects for creating learner's habit.

Additionally, in a distance environment, students often feel isolated since they do not have the classroom environment in which they interact with the instructor. However, in blended learning, students have face-to-face sessions with instructors periodically so instructors do not need to provide various forms of interactive components and methods of contacts for the learners. Because of these reasons, most of the learners replied to questions associated with communication as 'Neutral'. The majority of them (90.6 %) do not use any of the communication tools in blended learning environment as they interact in the classroom.

5.3.2.4. Information (Content) Quality versus Learner's Perceived Satisfaction from LMS

The fourth measure identifies the effect of information (content) quality on learner's perceived satisfaction. In 'information quality' part of the questionnaire, learners were asked about the course content quality such as whether the course content gain attention, is easy to follow, interactive, covering appropriate degree of breadth, includes multimedia tools, contains concrete examples and illustrations. The results depicted in Table 11 prove that there is a strong positive linear correlation between information quality of the LMS and overall learners' perceived satisfaction ($r=0.753$, $p=0.01$). In parallel with correlation results, descriptive statistics verify that U-Link

learners are highly satisfied from the used content in their blended learning environment (mean value=3.79, Table 10). Focus group interviews supports that content quality has significant role on learner's perceived satisfaction from LMS. Learner's mostly define a quality content as whether the presentations or lecture notes are easily understandable, used appropriate degree of breath, up-to-date, and rich content. Additionally, they state that, clear examples, illustrations, given additional resources gain their attentions, and positively influence their satisfaction.

One of the most interesting results of this study is, in contrast to pertinent literature about the importance of interaction in e-learning environment, U-Link blended learning users do not expect a high level of interaction, flexibility, or multimedia tools from the course content. Learners claim that 'interaction' is not a major aspect to increase their learning as the interaction has already been formed in classrooms via instructor.

Since learners use U-Link as a supportive tool, they are not offered to use online exam options; the only assessment material is assignments. Therefore, this study only covers the importance of assignments in regards to the quality of learner assessment materials. Nearly all focus group participants underline the importance of assignment's quality. In parallel with Khan (2005) learners pointed out that, an online assignment should force them to think and create something about the evaluated content rather than "read, paraphrase and write". They additionally stated that an assignment should not be too long, if it is too long they are easily distracted and hence the benefit decreases.

5.3.2.5. Service Quality versus Learner's Perceived Satisfaction from LMS

The fifth measure identifies the effect of service quality on learner's perceived satisfaction. The Pearson Correlation results presented in the Table 11 revealed r = 0.537 at a significance level of 0.01 which proves that a positive but medium relationship between Service Quality of the U-Link and overall satisfaction. According to descriptive statistics, U-Link users' perceived effectiveness of the LMS

services quality is high (Table 10, Service Quality, Mean: 3.68). Learners are highly satisfied by the assistants' attitudes, and the services provided by the administrative staff. Focus group results show that learners in blended learning courses often face a technical problem which influences their overall satisfaction level negatively. It is therefore crucial that every blended learning program has to have a supportive technical staff who has a good control of the technology and who is able to perform basic troubleshooting tasks such as adding a learner at the last minute, modifying learner's passwords, changing the course settings, etc. (Volery et. al., 2000). It can be concluded from both qualitative and quantitative results that learner's perceived satisfaction is positively related to the capability of service provided to follow up student problems and to solve students' problems. In parallel with (Haynes, Pouraghabagher, & Seu, 1997), supportive staffs are essential for overall coordination of a blended learning module. Both faculty and technical resources must be identified and committed to the schedule during the development of a blended module (Volery et. al., 2000).

5.3.2.6. Supportive Issues versus Learner's Perceived Satisfaction from LMS

The sixth measure identifies the effect of supportive issues on learner's perceived satisfaction. Pearson's correlation output, presented in Table 11, proves that there is a positive statistically significant (high) relationship between supportive issues and overall learner satisfaction ($r = 0.630$; $p=0.01$). Descriptive statistics are parallel with Pearson's Correlation results (Table 10, Supportive Issues, Mean: 3.95). Qualitative results demonstrate that, popularity of LMS and trends influence LMS users significantly. For instance, U-Link was developed back in 1999. Since 1999, at the beginning of each term, all the university students and academics have been encouraged to use U-Link in their modules. According to the statistical data provided by the Brunel University, the use of U-link has increased significantly during the last three years. According to one of the U-Link developers (David Sacramento) this is mainly because of the increasing popularity of e-learning portals.

Another important indicator for LMS effectiveness can be named as “friend effect”. One of the learners underlines that, most of LMS users begin to use LMS after seeing other colleagues using U-Link. Another learner emphasizes that marketing the product to create customers (in this case learner) is essential for LMS to increase its usage. Therefore “advertisement” of LMS in between learners becomes essential. Since, we are living in the age of communication; it has become a necessity to spread produced values to others to increase the usage of it via different media such as TV, Radio, Print Media or Internet (Shimp, 1981).

The ‘supportive issues’ dimension additionally covers ethical and legal issues together with privacy, plagiarism and copyright concepts. Khan (2005), in his book, emphasized the importance of ethical and legal issues to create an effective LMS. In a typical e-learning module, there are numerous text dialogs generated from LMS communication tools (e-mail, forum). These communication tools contain participants’ personal views and biases which they may not want the outside world to know. Considering the openness of the web, search engines can find this information. Therefore, institutions should clearly indicate to the learners whether or not their personal information will be shared. E-learning module should provide clear information regarding institution’s plagiarism policy. Important e-learning portals impose serious penalties if a case of plagiarism is substantiated (Athabasca University in Canada, Phoenix University in USA, Open University in UK). The last ethical-legal issue is copyright. Content authors, instructors, tutors, facilitators and other learning material developers should consider the others intellectual property rights during the preparing e-learning materials and institutes should check the copyright infringements (Papp, 2000).

5.3.3. METU – Middle East Technical University, Ankara, TURKEY

Descriptive statistics of each HELAM category are depicted in Table 12 to summarize the data collected from survey results. Based on the descriptive statistical data, learner’s perceived satisfaction from NetClass LMS is medium (mean value 3.45).

Table 11 - Descriptive Statistics of NetClass LMS Users: Mean, Standard Deviation, Maximum and Minimum Values for HELAM Dimensions

	Minimum	Maximum	Mean	Std. Dev.
Learner's Attitudes	1.50	5.00	3.41	.568
Instructor Quality	1.00	5.00	3.52	.623
System Quality	1.00	5.00	3.23	.574
Information Quality	1.00	5.00	3.47	.822
Service Quality	1.86	5.00	3.63	.584
Supportive Issues	2.00	5.00	3.53	.541
Total Learning Quality	**1.36**	**5.00**	**3.45**	**.605**

In addition to descriptive statistics, Pearson correlations have been reported for all quantitative measures in order to test the quantitative results. All findings have been analyzed with Pearson Correlation Coefficient at the significant level of 0.01. The findings were not accepted if the significant level (2-tailed) was less than 0.01. The results of testing Pearson Correlation Coefficient values are shown in Table 13, the results shows us there is a significant relationship between each HELAM dimension and students' perceived overall satisfaction.

Table 12 - Correlation Results of NetClass LMS Users (Correlations in between HELAM categories)

r	**1**	**2**	**3**	**4**	**5**	**6**	**7**
Overall Satisfaction (1)	**1**						
Learner's Attitudes (2)	.624(**)	1					
Instructor Quality (3)	.579(**)	.352	1				
Supportive Issues (4)	.638(**)	.355	.456	1			
Information Quality (5)	.665(**)	.456(**)	.765	.564	1		
System Quality (6)	.453(**)	.743	.357	.334(**)	.753	1	
Service Quality (7)	.626(**)	.343	.576	.875	.546	.434	.445

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

5.3.4. NetClass LMS Effectiveness Evaluation Findings

The findings of the NetClass LMS evaluation results have been presented under the 6 subheadings. The survey instrument was applied to 224 learners including both online learners and blended learners. So, NetClass LMS was used not only supportive tool for a course, but also an online course delivery system. Therefore, sometimes found results are presented case by case.

5.3.4.1. Learner's Attitudes versus Learner's Perceived Satisfaction from LMS

The first measure indentifies the effect of learners' attitudes on perceived overall satisfaction from LMS. Pearson's correlation output, presented in Table 13, proves that there is a positive statistically significant relationship between learner's attitudes and overall learner satisfaction. According to statistical information, learners have positive attitudes (Table 12, Learner's Attitudes, Mean: 3.41) towards LMS. The value of Pearson Correlation (r) is 0.624 at a significance level of 0.01 (r = 0.624; p=0.01). There is a medium correlation between these variables. According to the statistical results, nearly all of the students who attend ION online graduate program define themselves as self-disciplined and self-motivated learner. One of the main essential requirements to be an online learner is being a self-discipline student. Therefore, it can be concluded that self-disciplined learner's prefer distance education. As a conclusion, learner's study habits are positively related with learner's perceived effectiveness from an LMS. As mentioned above IS100 students are first level computer literacy course students, in this regard their most important indicator under learners' attitudes dimensions are, perceived enjoyment and student-student, instructor-student interaction. If they enjoyed from the used LMS or taught course, then they could satisfied from them. Perceived enjoyment is the most important indicator for IS100 students' learner attitudes.

5.3.4.2. Instructor Quality versus Learner's Perceived Satisfaction from LMS

The second measure identifies the effect of instructor quality on perceived learner's satisfaction from LMS. The results depicted in Table 13 prove that *there is a strong positive linear correlation* between instructor quality of the LMS and overall learners' perceived satisfaction (r=0.579, *p*=0.01). In parallel with correlation results, descriptive statistics verify that NetClass learners, specifically IS100 students are highly satisfied from the used content in their blended learning environment (mean value=3.42, Table 12). Focus group interviews supports that, instructors respond to them rapidly, teaching style is good enough, explanations are clear and etc.

Additionally, nearly all of the e-learners (95.7%) satisfied from instructors' self-efficiency and attitudes. This affects the overall success of the LMS positively. Moreover, according to the focus group interviews, students stated that "…..their satisfaction is high dependent on the instructors' communication abilities and self-efficiency ….." additionally one of the students added that "….. if an instructor or assistant has not respondent to my question in a couple of days via e-mail, then I would not prefer to get an answer, even I did not want to study to that course anymore, I assumed that, the responsible person was not focus on the course, then Why did I spend too much time to try to learn the topic?....."

5.3.4.3. System Quality versus Learner's Perceived Satisfaction from LMS

The third measure identifies the effect of system quality on learner's perceived satisfaction. According to descriptive statistical information, NetClass users have a positive but low attitudes (Table 12, System Quality, Mean: 3.23) towards used technology for NetClass. This is in parallel with Pearson's correlation results (r=0.453, p=0,01).

Regarding the criteria of system dimension, the stability of the learner interfaces has a great emphasis on the learner. One of the key issues for the learners is to be able to easily access shared data. When it comes to system content, learners care most about whether they find it useful. When we look at all the criteria with respect to the success of the system, e-learners' habits become important. 'Easy navigation', 'easy to find the required information', and 'available help option' are important aspects of a system. According to this study's survey results, ION and IS100 learners' perceived effectiveness from METU-Online LMS's system quality is average. Most of the learners have found the required information easily, nearly the half of them stated that they were able to navigate easily, but all students complained about "no help option available" in the system. In addition, METU-Online system accessibility has not been found to be efficient. Although it is a web-based application, due to some technical errors, the system occasionally can become disconnected. This is an important reliability problem, which has a negative impact on the learners'

satisfaction. The negative effects of system reliability decrease the results of system quality.

5.3.4.4. Information (Content) Quality versus Learner's Perceived Satisfaction from LMS

The fourth measure identifies the effect of information (content) quality on learner's perceived satisfaction. Interactive course infrastructure and content quality are both proven to be significant in this research. The results show that, interactivity is an important indicator for an effective e-learning system. According to the descriptive statistics and , the Pearson Correlation results NetClass users perceived satisfaction from METU-Online LMS's content quality has a mean value of 3.47 (Table 12) and Pearson Correlation result is r=0.665 (Table 13) which shows learners are satisfied from METU-Online content. As seen from the statistical results users are not really satisfied from instructor. The answer is hidden in ION students. They were not satisfied from the content derived. According to them, ION program content is highly static, no interaction and no animation is added. Besides, abstract concepts are not illustrated or explained deeply. One of the ION students said that "……the only thing is done with the content in ION program is, writing the whole book electronically….." On the other hand, IS100 learners are satisfied from the content delivered. The main reason for this is IS100 content is updated newly and added interactive components. All the complex subjects are explained or illustrated in a detailed manner. Therefore, not only IS100 online learners but also IS100 blended learners are highly satisfied from the content quality of the IS100 course.

5.3.4.5. Service Quality versus Learner's Perceived Satisfaction from LMS

The fifth measure identifies the effect of service quality on learner's perceived satisfaction. The Pearson Correlation results presented in the Table 13 revealed r = 0.626 at a significance level of 0.01 which proves that a positive but medium relationship between Service Quality of the NetClass and overall satisfaction.

According to descriptive statistics, NetClass users' perceived effectiveness of the LMS services quality is high (Table 12, Service Quality, Mean: 3.63). Learners in distance learning courses often face technical problems. It is therefore crucial that each online program has to have a supportive technical staff who has a good control of the technology and is able to perform basic troubleshooting tasks (e.g. adding a learner at the last minute, modifying learners' passwords, changing the course settings) (Volery et. al., 2000). According to descriptive statistics, both ION and IS100 learners' have satisfied from these services which will positively influence perceived e-Learner satisfaction.

5.3.4.6. Supportive Issues versus Learner's Perceived Satisfaction from LMS

The sixth measure identifies the effect of supportive issues on learner's perceived satisfaction. Pearson's correlation output, presented in Table 13, proves that there is a positive statistically significant relationship between supportive issues and overall learner satisfaction ($r = 0.638$; $p=0.01$). Descriptive statistics are parallel with Pearson's Correlation results (Table 12, Supportive Issue, Mean: 3.53). Qualitative results demonstrate that, supportive issues have an influence on overall satisfaction.

One of the other findings related with supportive issues is user is positively influenced by the popularity (trend) of LMS and distance learning application in the environments. In the interviews with ION program students, one of the questions was: "if e-learning applications were much more popular than today's popularity, would you prefer continue your undergraduate education with distance education?" More than half of the responded positively express that popularity was an important factor to preferences of an online learning program. Popularity is an important effect for creating an efficient learning environment.

CHAPTER VI

DISCUSSION

This study assesses the applicability of the proposed e-learning effectiveness evaluation model, HELAM, and examines its dimensions of quality (e.g. system quality, information quality and service quality) influenced learners' overall satisfaction within the higher education environment. The analytical results of this study are discussed and interpreted according to previously defined research purposes below. In this chapter, the proposed model, HELAM, in-depth investigations and interpretations are presenting with respect to the both literature, quantitative and qualitative data analyses.

In the Introduction Section - Chapter I - , three research questions were proposed, which are; (1) what are the significant e-learning system success factors, effecting learners' overall satisfaction?; (2) what are the key success measures to comprehensively evaluate an e-learning system success?; (3) what is the contribution of each LMS evaluation factors on overall e-learning system evaluation? The study results were discussed with respect to the proposed 3 research question.

Statistical results showed that, the most significant factor is "learners' attitudes toward LMS". The most important survey items to increase learners' attitudes toward LMS are "In my studies, I am self-disciplined and find it easy to set aside reading and homework time."; "I can manage my "study time" effectively and easily

complete assignments on time by using LMS."; "I enjoy attending to the LMS sessions overall.". According to (Vygotsky, 1978) behavior is evoked from the feeling of pleasure, joy and fun. Perceived enjoyment is defined as 'the extent to which the activity of using the computer is perceived to be enjoyable in its own right, apart from any performance consequences that may be anticipated' (Martinez-Torres, et.al., 2008). Therefore, if a learner perceives the use of the e-learning tool as enjoyable, he or she is more likely to have a favorable feeling towards the e-learning tool and a higher degree of intention to use it. Results of this study show that the most important attitudes which trigger learners' e-learning satisfaction are their learning habits. If a learner is self-disciplined and is able to manage his study-time, then that learner will be more satisfied from the LMS. Thus, most important measures under learners' attitude dimension are Self Efficiency, Enjoyable Experience, and Learner's study habits. Unlike the literature, interaction has not been found to be the most important indicator to effect learners' perspective to LMS. Although interaction is essential for purely online learners, interaction is not that much significant for blended learners since blended learners come together with classmates and instructors periodically. Because the data set used in this research includes not only online learners but also blended learners, interaction has not been found as significant as self efficiency, enjoyable experience, and learner's study habits.

Statistical results showed that, the second most significant factor is "system quality". System quality is a significant predictor of user satisfaction to use LMS. Consequently, enhancing the system quality increases members' satisfaction and behavioral intention to use LMS. The most important survey items to increase learners' attitudes toward LMS are "LMS's graphical user interface is suitable for e-learning systems."; "The program directions and navigations are clear."; "LMS supports interactivity between learners and system by chat, forums, discussions and etc."; "I have not faced any system errors on LMS."; "Navigation is very easy on LMS." Therefore, LMS's website reliability, usability, access convenience, security, ease of use, available help option, well organized website, personalization and

website flexibility comprised system quality criteria. Thus, positive results for these factors resulted in a positive influence on user satisfaction. Effective graphical user interface, clear program directions and navigations, includes interactive tools, errorless system infrastructure were important considerations for all LMS users. One of the most important technical developments in education industry is interactive environments. Before Web 2.0, students often felt isolated in a distance environment since they were not able to interact with the instructor and other learners. By using the new technological infrastructure, learners may interact with each other which increase learning outcomes favorably.

Statistical results showed that, the third most significant factor is “instructor quality”. It is clear that faculty will play a critical role in higher education institutions’ during creating effective LMS. Collis (1995) remarked that the instructor plays a central role in the effectiveness of online delivery: `It is not the technology but the instructional implementation of the technology that determines the effects on learning". Webster et. al. (1997) suggested 3 instructor characteristics, (1) attitude towards technology; (2) teaching style; and (3) control of the technology. Those influence the learning objectives of distance education program. In this study, the most important survey items to increase instructor quality are "The instructor returns e-mails/posts within 24 hours via LMS."; "The instructor is proficient with all the content used and LMS in the course."; "The instructor created an online environment conducive and enjoyable for learning via LMS."; "The instructor encourages us to interact with other students by using LMS interactive tools."; "I find it easy to communicate with the instructor via LMS."; "The instructor follows up student problems and tries to find out solution via LMS." Therefore, most important instructor category measures are, responsiveness, enjoyment of the instructor, teaching style of an instructor, specifically encouraging student interactions should affect learning outcomes because, and interaction is key to all learning. The instructor's control over technology also should relate to learning outcomes.

Statistical results showed that, the fourth most significant factor is “information quality”. Information quality had significant influence on user satisfaction. Consequently, high-quality information increases member satisfaction and behavioral intention to use the LMS. The most important survey items to increase information quality are "Course content and presentation gain attention."; "The course content is covered to an appropriate degree of breadth."; "The content is up-to-date."; "Lecture notes are supported by multimedia tools (Flash animations, simulations, videos, audios, and etc)"; "Abstract concepts (principles, formulas, rules, etc.) are illustrated with concrete, specific examples."; "Vocabulary and terminology used are appropriate for me". Therefore, most important information category measures are up-to-dateness, clear, sufficient, interactive, quality content, and lastly effective curriculum management. Thus, the LMS should provide Up-to-date, clear, sufficient, interactive, quality information in the website systems, subsequently increasing user satisfaction to use LMS. This is in parallel with the literature where Web 2.0 technologies provide interactive online content (Safran, Helic, & Gütl, 2007).

Statistical results showed that, the fifth most significant factor is “service quality”. Service quality significantly affects user satisfactions to use LMS. As such, a high level of service quality leads to high levels of member satisfaction to use the LMS. The most important survey items to increase service quality are "The service supported by the university is good enough."; "I can easily contact with the institution administrative via mail or phone or fax."; "I do not experience any problems during registrations." Thus, a high score for service quality (e.g. effective student tracking, knowledgeable responsive service provides) will have a positive influence on behavioral intention to use LMS. LMS managers must provide well-organized service related issues and prompt service to attract more members’ participation.

Statistical results showed that, the sixth and least significant factor is “supportive issues”. Supportive Issues are important indicators of the perceived LMS

satisfaction. This indicates that the combination of the predictors "LMS lecture notes are prepared by obeying the ethical and legal issues."; "If it was trendier and more popular, I would prefer to take this module totally online from home without having to come to the face-to-face lectures."; "LMS helps me to cut-down my expenditure such as paper cost, communication cost (i.e. phone), transportation cost, etc." are the most loaded factor which predicts the supportive issues effect on overall learner satisfaction. According to results, essential factors are ethical and legal issues, and trends. The quality of e-learning is positively related to learners' perceived satisfaction from supportive issues.

The model factors has not only significant effect on overall learners' perceived satisfaction, but also they have effects on other dimensions such as information quality has positive impact on instructor which is highly meaningful in the real life applications. Therefore, additional to the proposed HELAM factors' measures, statistical results shows there are three more interrelations was existed within the HELAM dimension.

(1) Information quality positively affects instructor quality; this value indicates that the relation between two variables is high. According to the significance of this result, we can say that an increase in Information quality causes a change in Instructor Attitude in the same manner. We can illustrate this relationship in the following way; the more efficient the tools (Information) an Instructor uses, the higher the ability of the Instructor to deliver the content to the learners (therefore an increase in Instructor Attitude).

(2) The second hypothesis that Technical Quality affects Service Quality in a positive way, hence the relation is not as strong as information and instructor quality interrelation. In detailed, when the technical quality improves for example by increasing the stability of the system or by an enhancement of human computer interaction this change will result in an increase in the Service Quality. For instance as an innovation when the technical quality is supported with a new announcement system, this will help the students to be aware of developments regarding service

offered, therefore the service quality increases by the enlargement of the target audience.

(3) Lastly, instructor quality positively affects learner attitudes, Instructor Quality has an effect on Learner's Perspective is proved with the statistical analyses. Therefore we can conclude that an upgrading of the instructor quality causes a higher learners perspective. Webster et. al. (1997) also suggests that instructor has a direct relation with learners' learning process. The learners' learning has directly and positively affected from instructor ability to teach or enthusiasm to the content being developed.

To sum up, the results confirm the structure of the HELAM which contributes to the e-learning literature with an instrument providing a roadmap for practitioners and researchers to better understand how e-learner's perceived satisfaction can be increased and how the use of learning management systems can be improved.

CHAPTER VII

CONCLUSIONS

This chapter commences with an overview of the research. Following, theoretical and practical contributions of the research are presented. Lastly, limitations of the study and further research recommendations are given.

This study attempted to propose an e-learning evaluation model comprising a collective set of measures associated with an e-learning system. The research in this paper sought to empirically test the constructs of this proposed conceptual model via a survey instrument and to demonstrate which were critical for e-learning systems effectiveness. The instrument was validated and it has been proved that all six dimensions of the proposed e-learning evaluation model were important for e-learning effectiveness. In the previous sections, the researchers have tried to,

1. propose a model according to literature
2. build a survey based on the proposed model
3. validate the survey
4. apply the survey to cases
5. collect and verify the data
6. statistically prove the model's validness
7. assess two different LMS (NetClass and U-Link LMSs) with using the proposed model

8. give these LMSs effectiveness results respectively
9. discuss the findings of the research.

7.1. CONTRIBUTION OF THE STUDY

Even though the statistical analyses and pertinent literature allowed the researchers to propose a comprehensive LMS evaluation model, it is important to note that this instrument focuses on assessing the effect of each HELAM dimension on overall e-learning perceived satisfaction based on student perceptions only. However, there are other stakeholders of e-learning systems such as system developers, technicians, administrators, instructors, instructional designers, multimedia designers, online facilitators, independent evaluators, etc. whose perceptions are also important indicators for a complete e-learning systems evaluation. In this study, a survey instrument based on HELAM with respect to student perceptions has been developed, verified and validated. For future work, HELAM could be taken as a basis forming a starting point when developing other instruments for e-learning systems evaluation with respect to other stakeholders' perceptions.

The proposed model (HELAM) is not exhaustive and is open to continuous development. It is not a fixed and unchanged model. In that regard, future studies may extend this model through adding other dimensions or criteria in parallel with changes in the e-learning field and with the latest advances in e-learning technologies. Another future expansion would be to check the validity of the causal research model on different learning management systems. In this regard, HELAM is composed of fundamental issues which should be perceived as very basics for effective e-learning.

7.2. LIMITATIONS AND FUTURE RESEARCH

This study is limited to a sample size of 374 students with 2 different LMS at 3 different programs and the interviews are limited with experimental group students. The qualitative results of this study are limited with the perceptions of the students

using LMS. In addition, the validity of the responses to the instruments used in the study was limited to the honesty of the subjects.

Most importantly, the evaluation of different LMS users (other than learner such as instructor, manager, etc.) or LMS creators' (such as programmer, content developer, software engineer, and etc.) perspective is intentionally left out of the scope of this study. Future studies may evaluate an LMS from the other stakeholders' perspective.

Other future research may focus on the development of other instruments based on HELAM specific to various types of organizations that reflects the characteristics of education and training practices taking place in different institutional settings, including primary and secondary schools, universities and companies. Moreover, the researchers may extend this model through adding other dimensions in parallel with changes in the e-learning field. Another future expansion would be to check the validity of the causal research model on different learning management systems.

In conclusion, 46 measures grouped under six dimensions for evaluating e-learning systems can greatly benefit those engaged in e-learning as they seek guidance to better understand how e-learner's perceived satisfaction can be increased and how the use of learning management systems can be improved.

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APPENDICES

APPENDIX-A – HELAM MEASURES WITH PERTINENT LITERATURE

HELAM Dimensions	Measures	Pertinent Literature	Survey Instrument Question Number
A. Supportive Issues	**A1.** Promotion	Sethy, 2008; Agarwal & Venkatesh, 2002	Focus Group
	A2. Trends (Social-Political)	Khan, 2005	71, 72
	A3. Ethical Issues	Khan, 2005	69, 70
	A4. Cost	Agarwal & Venkatesh, 2002	73
B. Learner 's Attitudes	**B1.** Learner Attitudes toward LMS	Torkzadeha & Van Dykeb, 2002; García, Schiaffino, & Amandi, 2008; Levy, 2007; Selim, 2007; Piccoli, Ahmad, & Ives, 2001	12, 16, 17
	B2. Learner's Computer Anxiety	Bowdish, Chauvin, & Vigh, 1998; Piccoli, et al., 2001; Zaharias & Poulymenakou, 2003; Hayashi, Chen, Ryan, & Wu, 2004; Webster & Hackley, 1997; Sun, Tsai, Finger, Chen, & Yeh, 2008	Demographic Questions
	B3. Self Efficiency	Picolli, et al., 2001; Zaharias & Poulymenakou, 2003; Granic, 2008; Hiltz & Johnson, 1990; Sun, et. al.,2008	10, 12, 13, 15
	B4. Enjoyable Experience	Holsapple & Lee-Post, 2006; Hiltz R. S., 1993	11
	B5. Interaction with Other Students and Teacher	Johnson, Hornik, & Salas, 2008; Kim & Lee, 2007; Sun, et. al.,2008; Islas, Pérez, Rodriguez, Paredes, Ávila, & Mendoza, 2007	14, 65
	B6. Learners' study habits	Detwiler, 2008; Lim, Lee, & Nam, 2007	9, 15
	B7. Student Experience Level with LMS	Rosenberg, 2006	18
C. Instructor's Attitudes	**C1.** Responsiveness	Sun, et. al., 2008	20
	C2. Informativeness	Shumarova & Swatman, 2007; Sun, et al., 2008	19, 23
	C3. Fairness	Levy Y. , 2007	19, 29
	C4. Encouraging Interaction between Students	Liu & Cheng, 2008; Wu, Tennyson, & Hsia, 2008; Ssemugabi & Villiers, 2007	27, 30
	C5. Control Over Technology	Volery & Lord, 2000 Webster et al., 1997	21, 22, 26
	C6. Course Management	Dillon & Gunawardena, 1995	22
	C7. Communication Ability	Picolli, et al., 2001; Levy, 2007	26, 28
	C8. Enjoyment	Picolli, et al., 2001; Webster et al., 1997; Dillon et al., 1995; Islas, et al., 2007; Levy, 2007	25
	C9. Self- efficacy	Sun, et al., 2008	24
Demo	**D1.** Easy to Use	Sun, et al., 2008; Shee & Wang, 2008; Holsapple et al.,	36, 37

		2006;	
	D2. Security	Holsapple et al., 2006	34
	D3. Reliability	Shee, et al., 2008; Holsapple et al., 2006	34
	D4. Usability	Picolli, et al., 2001; Dillon et al., 1995	40, 44, 38
	D5. Maintenance	Martinez-Torres, Toral Marı´n, Garcia, Vaizquez, Oliva, & Torres, 2008; Wu, et al., 2008; Shee, et al., 2008	35
	D6. Help option available		41
	D7. User Friendly	Shee & Wang, 2008; Holsapple et al., 2006	31
	D8. Well Organized	Volery, et al., 2000	32, 37
	D9. Availability	Holsapple, et al., 2006	39, 42
	D10. Personalization	Ssemugabi, et al., 2007, Piccoli, et al., 2001; Shee, et al., 2008	45
	D11. Interactivity	Islas, et al., 2007; Khan, 2005; Webster et al., 1997	33
E. Information Content Quality	**E1.** Curriculum Management	Papp, 2000; Pawlowski, 2002	46, 47
	E2. Course Flexibility	Sun, et al., 2008	52
	E3. Interactive Content	Picolli, et al., 2001	52, 53
	E4. Learning Model	Picolli, et al., 2001	51
	E5. Tutorial Quality	Littlejohn, Falconer, & Mcgill, 2008; Webster et al., 1997	59, 57, 60
	E6. Clarity	Holsapple et al., 2006	55, 57, 60
	E7. Sufficient Content	Holsapple et al., 2006	49, 50
	E8. Learner Assessment Material Quality	Khan, 2005	57
	E9. Maintenance	Littlejohn, et al., 2008	58
	E10. Up-to-Datedness	Shee & Wang, 2008; Holsapple et al., 2006	50
	E11. Well Organized	Holsapple et al., 2006	51
F. Service Quality	**F1.** Student Tracking	Volery & Lord, 2000; Islas, et al., 2007	61, 62, 65
	F2. Course/Instruction Authorization	Islas, et al., 2007	64
	F3. Course Management	Khan, 2005	61, 62, 66
	F4. Knowledgeable	Liu & Cheng, 2008; Holsapple et al., 2006; Clouse & Evans, 2003	63
	F5. Maintenance	Martinez-Torres, et al., 2008; Namc, Leeb, & Lima, 2007	67, 68

APPENDIX B – HELAM SURVEY INSTRUMENT

DEMOGRAPHIC QUESTIONS

1. Please enter your age.
2. Please Enter Your Sex
3. Average time I spend on using a computer/Internet per day
4. Average time I spend on using a computer/Internet for educational purposes per day
5. Average time I spend on using LMS[4] per day is;

OVERALL

6. LMS helps me to manage my learning more systematically.
7. Overall, I am satisfied with LMS.
8. Overall, I find LMS successful.

LEARNER'S PERSPECTIVE

9. Face-to-face education is better than distance education in learning process.
10. I can manage my "study time" effectively and easily complete assignments on time by using LMS.
11. I enjoy attending to the LMS sessions overall.
12. LMS improves my success in the module.
13. I find all my educational need from LMS.
14. LMS makes the communication easier with instructor and other class mates for me.
15. In my studies, I am self-disciplined and find it easy to set aside reading and homework time.
16. I believe that LMS is a very efficient educational tool.
17. LMS helped me to become more familiar with the module.
18. I have previous experience with LMS.

INSTRUCTOR ATTITUDES

19. Instructor clearly informs the students about grading policy via LMS.
20. The instructor returns e-mails/posts within 24 hours via LMS.
21. The instructor follows up student problems and tries to find out solution via LMS.
22. Instructor frequently updates lecture notes and fixes all the errors and mistakes in the documents on the LMS.

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[4] LMS refers to actively using Learning Management System. LMS was changed as "**Net-Class"** in METU participants survey, "**U-Link"** in Brunel University participants survey.

23. The instructor responds promptly to questions and concerns via LMS.
24. The instructor is proficient with all the content used in the course.
25. The instructor created an online environment conducive and enjoyable for learning via LMS.
26. The instructor is good at communication with students via LMS.
27. I think communicating with the instructor via LMS is important and valuable.
28. I find it easy to communicate with the instructor via LMS.
29. Exam and assignment results are announced on time via LMS.
30. The instructor encourages us to interact with other students by using LMS interactive tools.

SYSTEM QUALITY

31. LMS's graphical user interface is suitable for e-learning systems.
32. The program directions and navigations are clear.
33. LMS supports interactivity between learners and system by chat, forums, discussions and etc.
34. I have not faced any system errors on LMS.
35. When I counter an error in the system, I can get immediate feedback by e-mail and telephone.
36. Navigation is very easy on LMS.
37. I can find required information easily on LMS.
38. In the LMS system I can easily navigate where I want.
39. LMS is easily accessible via internet.
40. LMS is a good educational portal and improves my learning.
41. Help option is available on the system.
42. LMS is accessible 7 days 24 hours.
43. I am informed about all the course announcements LMS by using 'announcements' tool.
44. Fonts (style, color, saturation) are easy to read in both on-screen and in printed versions.
45. When I log in, I prefer LMS to provide me a personalized entry page (i.e. showing my progress, showing which chapters I have to revise, etc)

INFORMATION (CONTENT) QUALITY

46. Lecture notes are the core learning materials on LMS.
47. Course content and presentation gain attention.
48. Course content and presentation are long enough to cover all content.
49. The course content is covered to an appropriate degree of breadth.
50. The content is up-to-date.
51. I find it easy to understand and follow the content in lecture notes.
52. Lecture notes are supported by multimedia tools (Flash animations, simulations, videos, audios, and etc)
53. The lecture notes are interactive.
54. Course content on the LMS is integral.
55. Abstract concepts (principles, formulas, rules, etc.) are illustrated with concrete, specific examples.
56. Lecture notes provided to me via LMS are very enjoyable.
57. Exam questions and assignments are clearly explained.

58. Supporting materials, web-links and given examples are up-to-date, real-life examples, they improve my learning.
59. Vocabulary and terminology used are appropriate for the learners.
60. The learning objectives of the module are stated clearly on LMS.

SERVICE QUALITY

61. Instructor's attitudes are good to learners.
62. Instructor's attitudes are friendly to learners.
63. Instructor is knowledgeable enough about content.
64. The service supported by the university is good enough.
65. I can contact with the instructor via mail or phone or fax.
66. I do not encounter any problems during communicating with university administration and help desk.
67. I do not experience any problems during registrations.
68. I can easily solve when I encounter a problem during admission to a module in registrations.

SUPPORTIVE ISSUES

69. LMS lecture notes are prepared by obeying the ethical and legal issues.
70. The LMS supported module provides any ethics policies that outline rules, regulations, guidelines, and prohibitions.
71. If the use of LMS was optional, I would still prefer to use LMS as a supportive tool as it helps my performance in the module.
72. If it was trendier and more popular, I would prefer to take this module totally online from home without having to come to the face-to-face lectures.
73. LMS helps me to cut-down my expenditure such as paper cost, communication cost (i.e. phone), transportation cost, etc.

APPENDIX C – ETHICS CLEARANCE

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B.30.2.ODT.0.70.72.00/400 3478 - 260 9.5.2008

ENFORMATİK ENSTİTÜSÜ MÜDÜRLÜĞÜ'NE

İLGİ: 2.5.2008 tarih ve E.E.M.:323-5044 sayılı yazınız.

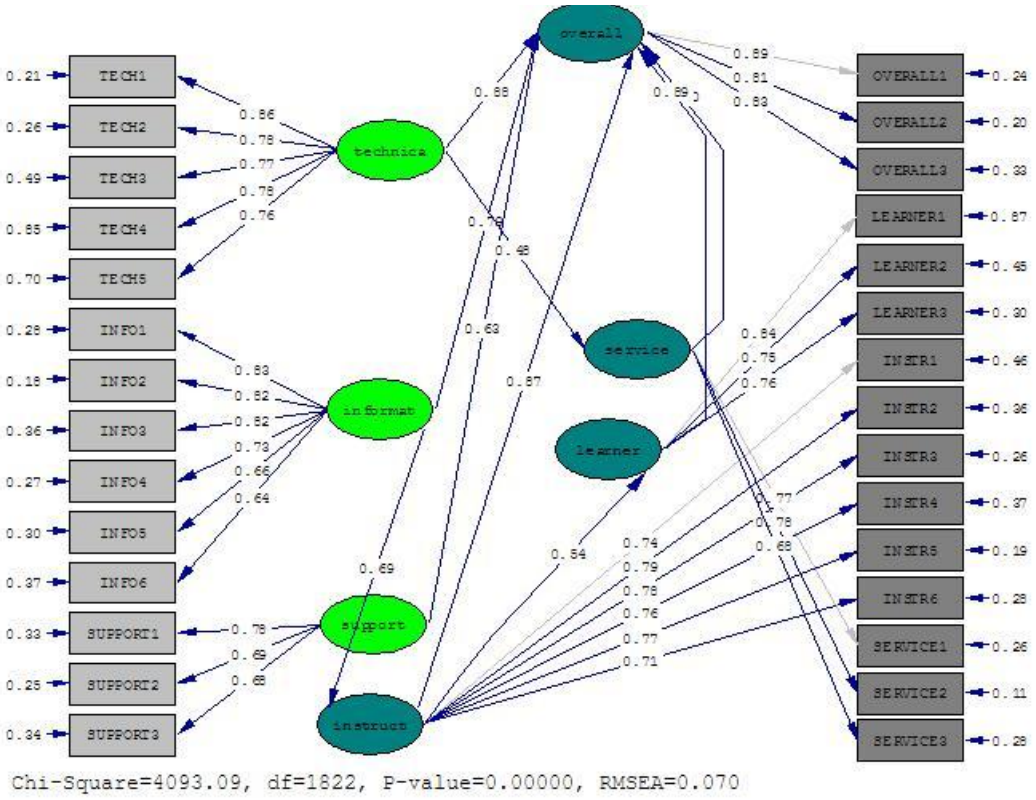
İlgi yazınız ile Bilişim Sistemleri Anabilim Dalı yüksek lisans öğrencisi Refika KÖSELER'in, 2007-2008 ders yılı 2.döneminde tezi ile ilgili "Information Systems Evaluation in e-Learning" başlıklı araştırma çalışmasına ilişkin ODTÜ Enformatik Enstitüsü İnternet Üzerinden Bilişim Yüksek Lisans Programı öğrencileri ve Enformatik Enstitüsü sistem yöneticilerine uygulama yapma isteği Rektörlük Makamınca uygun görülmüştür.

Gereğini bilgilerinize arz ederim.

Saygılarımla.

Nesrin ÜNSAL
Öğrenci İşleri
Dairesi Başkanı

APPENDIX D-BLOCK DIAGRAM OF THE STRUCTURAL EQUATION MODEL TAKEN FORM LISREL 8.7



APPENDIX E – QUALITATIVE DATA QUESTIONS

- METU-Online sisteminde en çok hangi araçları kullandınız, işaretleyiniz. (Ders Notları; Ödevler, Dosya yükleme; Not Defteri; Duyurular; Online Sınavlar; Forum; Chat; Sınıf Üyleri; Ders izlencesi, Ders Çizelgesi)
- While you are using U-Link system, which of the followings did you use mostly? (Lecture Notes; Assigments, File Upload; Grading; Announcements; Online Exam; Forum; Chat; Class Lists; Syllabus)
- Kullandığınız e-öğrenme aracından memnun musunuz? Beğenmediğiniz özellikleri var mi? METU-Online e-öğrenme aracı ile ilgili algılanan yararlılık, kullanım kolaylığı ve bu e-öğrenme aracına ilişkin tutumlarınız (görüşleriniz) nelerdir?
- Do you satified from the used LMS – U-Link –? Which component do you like?
- IS100 eğitimi boyunca sizinle ilgilenen tüm eğitmenlerinizin ya da asistanlarınızın tutumlarınız nelerdir?
- Do you satisfied from your instructors and assistant?
- IS100 eğitimi boyunca kullanılan METU- Online sisteminin değerlendirilmesi ile ilgili sorulara cevap veriniz.
- Do you satisfied from the used LMS U-Link's system quality?
- IS100 eğitimi boyunca kullanılan içeriklerin değerlendirilmesi için aşağıdaki sorulara cevap veriniz.
- Do you satisfied from the content that used in the U-Link?
- Please give your general ideas and bliefs about LMS?

APPENDIX F - PUBLICATIONS RELATED WITH THESIS

Sevgi Ozkan, **Refika Koseler**, Nazife Baykal, "*Evaluating Learning Management Systems: Hexagonal E-Learning Assessment Model (HELAM)*", European and Mediterranean Conference on Information Systems 2008 (EMCIS2008), May 25-26 2008, Al Bustan Rotana Hotel, Dubai

Sevgi Ozkan, **Refika Koseler**, Nazife Baykal, "*Evaluating Learning Management Systems: Adoption of Hexagonal E-Learning Assessment Model in Higher Education*" Journal of Transforming Government: People, Process and Policy, Vol.3, No.2 ,2009

Sevgi Ozkan, **Refika Koseler**, "*Multi-Dimensional Evaluation of E-Learning Systems in the Higher Education Context: An Empirical Investigation of a Computer Literacy Course"* (abstract is approved full paper is also approved to Frontiers in Education Conference (FIE))

Refika Koseler, Sevgi Ozkan, "*Multi-Faceted Approach to Assessing the Quality of Courses Delivered Through Learning Management System: An Empirical Investigation of a Computer Literacy Course*" (abstract is approved full paper is also approved to e-Challenged 2009)

Sevgi Ozkan, **Refika Koseler,** "*Multi-Dimensional Evaluation of E-Learning System Success in Higher Education Context: An Empirical Investigation*", Computers and Education, DOI Number: 10.1016/j.compedu.2009.06.011