DEVELOPMENT OF AN INSTRUMENT TO ASSESS PEDAGOGICAL UTILITY IN E-LEARNING SYSTEMS

by

Sharon Elizabeth Bratt
Master of Education, University of Alberta, 2001
Bachelor of Education, University of Alberta, 1994
Bachelor of Fine Arts, University of Alberta, 1990

DISSERTATION
SUBMITTED IN PARTIAL FULFILLMENT OF
THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY

In the
School of Interactive Arts and Technology
of the
Faculty of Applied Science

SIMON FRASER UNIVERSITY

Fall 2009

Approval

Name: **Sharon Elizabeth Bratt**

Degree: **Doctor of Philosophy**

Title of Thesis: **Development of an Instrument to Assess Pedagogical Utility in e-Learning Systems**

Examining Committee:

Chair: Dr. Marek Hatala
Associate Professor
School of Interactive Arts and Technology

Dr. Tom Calvert
Internal Examiner
Professor Emeritus
School of Interactive Arts and Technology

Dr. Janet McCracken
Senior Supervisor
Assistant Professor
School of Interactive Arts and Technology

Dr. John Nesbit
Co-Supervisor
Associate Professor
Department of Educational Psychology

Dr. Phil Winne
Supervisor
Professor
Department of Educational Psychology

Dr. Thomas Reeves
External Examiner
Professor
The University of Georgia

Date Defended/Approved: November 12, 2009

SFU SIMON FRASER UNIVERSITY
THINKING OF THE WORLD

STATEMENT OF ETHICS APPROVAL

The author, whose name appears on the title page of this work, has obtained, for the research described in this work, either:

(a) Human research ethics approval from the Simon Fraser University Office of Research Ethics,

or

(b) Advance approval of the animal care protocol from the University Animal Care Committee of Simon Fraser University;

or has conducted the research

(c) as a co-investigator, in a research project approved in advance,

or

(d) as a member of a course approved in advance for minimal risk human research, by the Office of Research Ethics.

A copy of the approval letter has been filed at the Theses Office of the University Library at the time of submission of this thesis or project.

The original application for approval and letter of approval are filed with the relevant offices. Inquiries may be directed to those authorities.

Bennett Library
Simon Fraser University
Burnaby, BC, Canada

Abstract

Evidence bearing upon whether and to what extent learning management systems (LMSs) and similar e-Learning technologies achieve the pedagogical goals for which they were designed has not been well-grounded in theory-based evaluation measures and instruments and sound methodological practice. Usability measures applied to this task typically use technical factors when evaluating the user-system interaction. However, interaction design themes and the centrality of the user's experience suggests that conventional usability measures are not designed to evaluate the system's ability to support the goals of the end users in a particular context of use. The purpose of this thesis was to develop the Learning Strategies Support Online (LESSON) questionnaire to assess the utility of e-Learning systems as perceived by the learner along pedagogical rather than technical dimensions. The ability to measure pedagogical support in LMSs provides important opportunities to: (a) improve the system under investigation or similar systems in general, (b) investigate the relationship between intended learning design and actual use of the system and as a result, (c) design online learning environments that optimize the capabilities of LMSs.

Key questions guided this research: (1) How might contemporary learning theories be used to design an instrument to measure learning strategy support? (2) What is the factor structure of the questionnaire developed in this thesis?

The literature on cognitive and metacognitive strategies associated with self-regulated learning provided the theoretical framework for the initial pool of 117 items. A focus group, expert panel review and pilot provided a collection of evidence bearing upon the validity of interpretations of data generated by the instrument. Finally, the questionnaire was administered to a development sample from which an exploratory factor analysis revealed an 11-item factor structure. Subsequent item reduction based on statistical and conceptual considerations concluded with the refinement of the LESSON to its present form as a 34-item multidimensional scale. Other significant outcomes of this research include (1) a new conceptual framework that advances evaluation measures used in interaction design, (2) the introduction of new theory-based measures, (3) evidence of discrepancies between intended system design and actual use.

Keywords: Pedagogical utility; e-Learning systems; self-regulated learning; questionnaire; scale development

Dedication

I dedicate this work to my darling husband Dwayne who agreed to embark on this journey together. Scarce is the page in this thesis that has not been touched by your insight and intellect. Few were the days that I did not lean on you. You have the ability to make the impossible possible. We both know that I share this accomplishment with you. To my beloved Chico, my constant companion who kept me company in Burnaby and lay for hours at me feet while I sat at the computer. Now we will have lots of time to go for walks. I love you both.

Acknowledgements

This experience has been paradoxically both a solitary journey yet one that has benefited from the contribution of others. I would like to acknowledge and thank those who were generous with their time and always supportive and encouraging. To my student and friend Carol Bacon who amidst the tumult of her own life made time to assist me with the analysis of the expert reviewers' data. Your organizational skills, patience and clarity moved my research forward and provided much needed momentum. To my friend and colleague Elizabeth Cudmore who looked after the administration of the pilot study, an undertaking that allowed me to complete this crucial step in the middle of the term when time was scarce. Not only do I thank you for your help but also for the endless laughter and pleasure of your company. How sad I was to see you leave to seek new adventures. Thank you, Jon Coulson for your determination to find me a sample for my empirical test. Where would I be without your diligence? Irene Coulson and Sandy Kostashuk, your permission to visit your classes over three terms to invite your students to participate in my study enabled me to gather sufficient data to finish the research. I thank you for the generosity of your time and support. I would like to thank John Nesbit, my senior supervisor for your constant support and commitment to my success. Thank you Janet McCracken, my other supervisor and mentor for your support, guidance and friendship. I truly value the friendship that grew out of this journey. Thank you, Phil Winne for piquing my interest with gStudy. To Thomas Reeves, whose ideas on e-Learning evaluation are at the heart of my thesis, your presence as an external on my committee was a privilege. Finally, I am greatly indebted to Dr. Todd Rogers for the informal but invaluable supervision. You threw me a lifeline and held on until I was

safely ashore. I doubt that the outcome would have been as successful without the generosity of your time and gift of your knowledge. I hope that I am able to return these gifts to my students.

Table of Contents

Approval ii

Abstract iii

Dedication iv

Acknowledgements v

Table of Contents vii

List of Figures xi

List of Tables xii

CHAPTER ONE 1

Background 1

Purpose of the Study 2

- Research Objectives 3
- Research Questions 4

Scope and Rationale 5

Survey Methodology 8

Conceptualization of the Problem 9

Definition of Key Terms 11

- E-Learning (or eLearning) 11
- e-Learning Systems 11
- Learning management systems (LMS) 12
- Survey research 12
- Scale 12
- Questionnaire 13
- Construct 13
- Construct validity 13
- Content domain 13
- Content validity 14
- Item relevance 14
- Item representativeness 14
- System utility 14
- Pedagogical utility 14
- Pedagogical support 14
- Summary 15

Organization of the Dissertation 16

CHAPTER TWO 19

Literature Review 19

Introduction 19

Usability 21

Background 21

- Limitations of Usability Measures 25

Limitation of Usability Tools in HCI 28
Utility 29
Limitations of Existing Utility Models 32
Conceptual Model – Pedagogical Utility 35
Limitations of Usability Evaluation Measures and Tools - Summary 36
Educational Software Evaluation 37
Overview 37
Educational Software Evaluation – Approaches 37
Evaluation methods 38
Limitations of Educational Software Tools 39
Summary 40
Learning Management Systems 41
Introduction 41
Background 42
LMS Features 43
Learning Management Systems Evaluation 46
Introduction 46
Background 46
Evaluation Approaches 47
Theoretical Framework 54
Background 54
Self-Regulated Learning - Definition 55
Pedagogical support 57
Pedagogical utility 57
Self-Regulated Learning Strategies 58
Research on SRL Strategies 59
Learning Strategies: Definitions and Categories 60
Cognitive Strategies 62
Basic Research on Metacognition 65
Metacognitive Strategies 65
Computer Based Learning Environments and Learning Strategies Support 68
Summary 70

CHAPTER THREE 73
Introduction 73
Research Problem and Objectives 73
Research Questions 75
Study 1 – Construct Definition and Specification of Content Domain 75
Research Design 75

Section One – Focus Group 77
Introduction 77
Research Design - Focus Group 79
Participants 80
Materials 81
Methods 81
Analysis 81
Results 82

Discussion 83

Section Two – Expert Review 83

Introduction 83

Item Development 84

Data Collection 85

Materials 85

Analysis 86

Results 88

Discussion 89

Section Three – Pilot Study 90

Introduction 90

Data Collection 90

Participants 90

Instrumentation 91

Procedure 91

Results 92

Discussion 93

CHAPTER FOUR 95

Empirical Validation of the LESSON Questionnaire 95

Introduction 95

Factor Analysis 96

Empirical Validation Methodology 96

Data Collection 96

Instrumentation 97

Participants 98

Nursing Practice Foundations: Description of Course and Structure 101

Procedure 102

Analysis 102

Between-Group Differences 103

Results 103

Variance-Covariance Matrix Homogeneity 105

Discussion 105

Factor Analyses 107

Results 110

Sampling Adequacy and Exploratory Factor Analysis 110

KMO and Bartlett's Test 110

Internal Consistency 116

Discussion 116

Criteria for Factor Retention 116

Formation of Final Dimensions and Item Retention 117

Summary of Study Results 120

Limitations of Study 122

Conclusion 124

CHAPTER FIVE 125

Discussion and Conclusions 125

Introduction 125
Summary of the Thesis 125
Significant Outcomes 127
    Pedagogical Utility Framework 127
    Usability – Utility Model Development 128
    Human-Computer Interaction and Human Factor Measures 128
    Instrument Development 129
Limitations of this Research 129
    Expert Panel 130
    Characteristics of the Development Sample 130
    Homogeneity of the Sample 130
    Self Report Measures 131
Implications for Practice 132
    Utility Studies 132
    Instructor Training 133
    Program Evaluation 134
Proposed Next Steps 135
Recommendations for Future Research 135
    Further Validation of the LESSON 136
    Emerging Areas of Inquiry 136
Final Thoughts 138

APPENDICES 139

Appendix A 140
Appendix B 148
Appendix C 151
Appendix D 152
Appendix E 174
Appendix F 177
Appendix G 185

References 186

List of Figures

Figure 1. Organization of dissertation 18

Figure 2. Usability- Pedagogical utility matrix 28

Figure 3. Nielsen's system acceptability – with addition of Bratt's Pedagogical Utility (Bratt, 2007) 31

Figure 4. Nielsen's original system acceptability framework 32

Figure 5. Tervakari and Silius's categories of utility: pedagogical usability and valued added attributes 34

Figure 6. Framework for Pedagogical Utility (Bratt, 2007) 35

Figure 7. Student's learning environment categories and description (Arh & Blazic, 2007) 49

Figure 8. Criteria for evaluation effectiveness and efficiency in a pedagogical context from (Ardito et al., 2004) 50

Figure 9. Research Flow 73

Figure 10. Flow chart for questionnaire development and validation (adapted from Benson, 1982). 76

Figure 11. Sample of revised item stem and response format 92

Figure 12. Items grouped under common declarative statement 93

List of Tables

Table 1 *Research Goals and Methods* 9
Table 2 *Comparison of Usability Dimensions* 23
Table 3 *Usability Questionnaires* 24
Table 4 *Hornbaek's 3 Measures of Usability* 26
Table 5 *Comparison of usability dimensions of popular user satisfaction questionnaires* 30
Table 6 *Pedagogical tools and learning strategies* 45
Table 7 *Comparison of LMS evaluation approaches* 47
Table 8 *Conceptual framework of SRL strategies (from LaRue, 2008)* 62
Table 9 *Zimmerman and Martinez-Pons categories of learning strategies* 64
Table 10 *Metacognitive Components adapted from (Schraw & Graham, 1997)* 66
Table 11 *Regulation of Cognition and corresponding LESSON strategies* 67
Table 12 *Sample of reviewers' rating* 87
Table 13 *Results of the content representativeness analysis* 88
Table 14 *KMO and Bartlett's Test* 110
Table 15 *Total Variance Explained* 112
Table 16 *Exploratory factor analysis of the Learning Strategies Support Online (LESSON) with principle axis factoring (PAF) extraction and Promax rotation* 113
Table 17 *LESSON Dimensions and related items* 118
Table 18 *Comparison of learning strategies and dimensions identified in LESSON questionnaire* 121

CHAPTER ONE

Background

The use of integrated web based technologies to deliver online learning, also known as e-Learning, has transformed education and training in both K-12 and higher education teaching environments. Learning management systems (LMSs), the enterprise systems which support online learning have emerged as core technologies crucial to the successful delivery of online learning environments (Syllabus, 2004). The LMS market includes over 100 key and niche players such as Blackboard Inc., eCollege, FirstClass, Moodle, and Sakai (Global Industry Analysts, 2007).

Despite the pervasiveness of LMS (also known as e-Learning systems) on an international scale, very limited research has been done to assess the utility of these systems to support the goals of the various end-users (learners, instructors, and designers of instruction). Evaluation of such systems has been limited to technical and functional criteria rather than pedagogical considerations. This limitation presents an opportunity to develop a new theory-based scale (questionnaire) to assess e-Learning technologies which will enable researchers to investigate the following:

- Do these systems support learning strategies associated with academic success?
- How can theory-based learning design practices optimize the pedagogical utility of these systems?
- Do the capabilities of these systems introduce new learning strategies not previously identified in specific models of self-regulated learning?

The recent launch of the IEEE Transactions on Learning Technologies peer reviewed journal whose scope includes tools for formative and summative assessment for

learning systems demonstrates the relevance of research in this area. This thesis presents the development of a new instrument that will assess e-Learning systems (learning management systems and similar learning technologies) in order to improve their design and implementation in higher education. This will add to the emerging body of research on these learning technologies.

Purpose of the Study

At the start of this thesis few studies existed that explored on whether and to what extent learning management systems and similar learning technologies achieve the pedagogical goals for which they were designed. This gap may be due to both the inadequacy of evaluation methods and the lack of tools appropriate for the specific context of use under investigation that is e-Learning. Current evaluation methods typically do not include the learner as part of the evaluation team. Evaluation tools, such as heuristics and questionnaires are generic in nature and thus do not account for the context of use (Users, Tasks, and their working Environments) unique to e-Learning (Usability Net, 2006). The recent emergence of other doctoral theses that focuses on end-users' perspectives on the efficacy of e-Learning systems along pedagogical dimensions is indicative of a growing interest in utility of these systems for both learners and instructors(Britto, 2002; Chang, 2008; Petheridge, 2007; Lopes, 2009; Thomas, 2006). Thus, the purpose of this thesis was to develop and provide validity evidence for a scale designed to assess the pedagogical utility of the software system as perceived by the learner. This type of assessment would be useful to several stakeholders including the developers of these systems, instructors and designers of instruction as a method of improving their practice, and to administrators, responsible for the selection of software

intended to support the delivery of instruction. This research involved the development of a multidimensional scale which is designed to assess pedagogical utility in LMS. Pedagogical utility is defined here as "the capability of the system to enable teaching and learning by facilitating or supporting key facets of the entire instructional system, from learner through instructor through instructional design and tools" (Bratt, 2007). The scale will determine the efficacy of these systems based on criteria that extend beyond traditional usability into theories of self regulated learning (SRL), and it will enable institutions to optimize the capabilities of these systems to support academic success. Such research is highly relevant to post-secondary institutions that have become increasingly reliant on such systems to deliver instruction to students.

Research Objectives

The goal of this thesis was to develop and provide evidence that bears on the validity of interpretations of the data generated by an instrument which evaluates LMS and similar e-Learning systems. The methodology employed in this research is sequential in nature and each phase of the research generated its own set of general and specific objectives. These objectives are outlined below:

- To select an appropriate theoretical model as the conceptual basis for the construct measured by the scale developed here, the Learning Strategies Support - Online or LESSON questionnaire.
- Confirm selected self-regulated learning strategy theories as a suitable framework for this content domain.
- Conduct a focus group study to generate data that enhances valid coverage of content.

- Conduct an expert panel review to confirm item relevance and representativeness.
- To determine the factor structure of LESSON questionnaire.
- Conduct a pilot study with a small development sample.
- Administer LESSON to a large development sample.
- Conduct an exploratory factor analysis to determine the number of latent factors measured by LESSON.

These research objectives were developed based on several questions presented below. These questions guided each research phase and will be revisited in the final chapter of this thesis.

Research Questions

- Do select learning management systems support learning strategies associated with academic success? (Chapter 4)
- How can the pedagogical utility of learning management systems and similar learning technologies be observed and measured? (Chapter 3)
- How might contemporary learning theories be used to design and evaluate an instrument designed to measure learning strategy support? (Chapter 2)
- What factors should be considered when assessing the pedagogical utility of learning management systems and similar learning technologies? (Chapter 2)
- What is the factor structure of the questionnaire developed in this thesis? (Chapter 4)
- Do the capabilities of the sampled learning management system introduce learning strategies not previously identified in specific models of self-regulated learning? (Chapter 4)

Scope and Rationale

My ultimate goal is to evaluate learning management systems and similar learning technologies to determine the extent that they (1) support learning strategies and (2) support intended learning design(s). The scope of the current research is limited to the development of a multidimensional scale that measures pedagogical support in learning management systems according to social cognitive theory – in particular *selected* learning strategies associated with SRL which emphasizes the role of cognitive processes and the importance of social interactions in learning. The theoretical model which provided the content domain for the scale was created by Zimmerman and Martinez-Pons (Zimmerman & Martinez-Pons, 1988; Zimmerman, 1986). Their model identifies 14 self-regulated learning strategies used during studying and learning. These strategies are explained in detail in Chapter 2. The ability to measure pedagogical support in LMS provides important opportunities to (a) improve the system under investigation or similar systems in general, (b) investigate relationships between intended learning design and actual uses of the system and as a result, (c) design online learning environments which optimize the capabilities of LMS, (d) investigate relations between learner-system interactions and other variables such as self-efficacy and motivation which are associated with academic success. The development of the questionnaire provides nascent research in three important areas in the evaluation and design of e-Learning environments: (1) the evaluation of e-Learning environments, (2) the development of e-Learning environments in the field of software engineering, and (3) instructional research relevant to e-Learning environments (Chen, 1995). It is anticipated that this instrument can be used in future studies both by the researcher as well as the larger research community working in the areas of learning theory, learning design, learning space design, and human-computer

interaction. Therefore, it is critical to the credibility of any research that uses this instrument that its development provides both theoretical rationale and empirical evidence that support the adequacy and appropriateness of interpretations based on data generated by instrument.

Scale development methodology requires various types of validity evidence throughout the process in an effort to optimize the validity of the meaning or interpretations of the data generated through interactions with the instrument. Construct validity is comprised of all other types of validity (e.g. content, face validity, and nomological validity) and is the optimal goal of scale development (Netemeyer, Bearden, & Sharma, 2003). The Standards for Educational Testing and Measurement considers validity as a unitary concept and defines it as "the degree to which all the accumulated evidence supports the intended interpretation of the tests scores for the proposed purpose" (American Educational Research Association, American Psychological Association, & The National Council on Measurement in Education, 1999). As such, evidence which bears upon the validity of the interpretation as informed by data generated through interactions with the instrument is a critical attribute of a scale due to the potential impact of how the interpretation of scores will be used –be it for descriptive, predictive, or decision-making (Wainer & Braun, 1988). Evaluators who claim a scale measures a particular construct are justifiably scrutinized and criticized if they fail to provide acceptable sources of validity evidence in support of the interpretation of their measures (Cronbach, 1988). Many evaluation studies of learning management systems succumb to this failing; most use scales that have been developed ad hoc, without a theoretical framework, and either without adequate explication of the validation process or with a

flawed methodology. (A more detailed review of such studies appears in a later chapter.) These inconsistencies may undermine the foundations for valid interpretations of the data generated by this instrument. Therefore it is essential that the scale undergo established validation procedures. This research presents these validation procedures for the Learning Strategies Support (Online) questionnaire so that future research which employs this scale has a sound validation argument.

Embedded in this broader scope are research questions concerning the self-regulated learning strategies originally identified by Zimmerman and Martinez-Pons which provide the theoretical model for the LESSON scale (Zimmerman, 1986). Therefore, concomitant with the scale's development will be an analysis of the scale's dimensions to determine if Zimmerman and Pons' original model, which is based on traditional classroom environments, is valid in an e-Learning context at the post-secondary level or if a revised model needs to be introduced that is contextualized for the online learning situation. Given this two-tiered scope, the primary goal of this research is to:

- Develop and validate a multidimensional scale.
- Present evidence of its measurement properties.

And secondary, to use the scale to assess learner-system interactions to:

- Identify the factor structure of the scale and, if necessary,
- Modify the Zimmerman and Martinez-Pons model to reflect e-Learning environments.

Survey Methodology

Questionnaire development and validation is a specific type of survey methodology that involves multiple phases. While steps and procedures may vary from author to author as determined by the scale's purpose (Netemeyer et al., 2003) there are several generally agreed upon steps which are presented briefly here with further elaboration in subsequent chapters (DeVillis, 2003; Haynes, Richard, & Kubany, 1995; Netemeyer et al., 2003; Spector, 1992). Each step and set of procedures used to guide the development of the questionnaire is designed to provide a particular type of information that can affect the validity of interpretations made about data generated when people respond to the scale's items. Each phase represents a separate study that collectively provides several types of information important to synthesizing valid inferences. These inferences include: (a) presenting the conceptual framework for pedagogical utility, (b) specifying the theoretical framework and domain of pedagogical support in the context of learning theory, (c) methods for development of the item pool, (d) expert review of the item pool, and, therefore, the domain to which the items are referenced, and (e) procedures for collecting and analyzing data that bear on psychometric properties of the scale. Each of these steps and procedures is presented as a separate study in a later chapter. Table 1 illustrates the goal and method for each of these separate studies.

Table 1

Research Goals and Methods

Phase	Objective	Method
1	Define construct and content domain	Conduct focus group to inform the initial identification and specification of key constructs associated with the domain.
2	Generate and judge initial item pool	Create or select items which primarily reflect the construct of interest. Subject items to expert review panel
3	Refine item pool	Pilot scale as item-trimming procedure.
4	Test psychometric properties	Administer items to a development sample and conduct factor analysis

Conceptualization of the Problem

The centrality of learning management systems to the effective delivery of e-Learning at the post-secondary level is evident in the pervasiveness of such systems. The learning management system MOODLE reported nearly 40,000 sites supporting nearly 2.6 million courses (Moodle, n.d.). Blackboard, the leading proprietary learning management system is implemented in over 3400 colleges and universities in over 80 countries (Blackboard, 2007). Sakai is currently implemented as either a pilot or production system in 142 institutions worldwide. While it is common practice to evaluate the usability of such mission-critical systems during the system acquisition process, it is less common to evaluate the utility of these systems with respect to achieving pedagogical objectives (Chen, 1995; Schooley, 2007). Evaluation of a system's support for instructional strategies used by faculty and learning strategies used by students is atypical, and there are no extant assessment tools which assess system support for specific learning strategies. That is, there is no way to tell whether such a system is even capable of achieving the fundamental pedagogical goals for which it is being acquired (Chen, 1995). While resources such as EduTools' CMS: Feature List (EduTools, n.d.) do

provide tools to compare LMS feature sets from the course developer and administrator perspectives, existing resources do not evaluate LMSs from the learner's perspective; i.e. they do not provide an evaluation of the LMSs ability to support learning strategies. The presence of a particular feature does not indicate de facto support for a learning strategy. This misconception is revealed later in this thesis. This oversight may be due to a lack of suitable methods and tools for evaluating learning management systems within a pedagogical context.

Human-computer interaction (HCI) research provides a variety of methods and tools to evaluate system usability in general. However, traditional usability evaluation methods and instruments are too generic to be applied to specific use contexts (Bevan & Macleod, 1994). This limits their explanatory power since they fail to account for contexts of use. Context of use refers to the actual conditions in which the system is used in a normal day-to-day working situation. Examples of such conditions include the users, tasks, equipment and the physical, social, and organizational environments in which the system is normally used.

Recent studies suggest new methods and instruments could be designed to include context, thereby extending the explanatory power of the results of usability studies (Pinelle & Gutwin, 2002). One such context is e-Learning and the systems that support computer-based learning environments. However, most existing instruments focus on the technical rather than pedagogical goals of the system. As such usability of e-Learning applications has been identified as a significant challenge for designers since traditional heuristic approaches are too general to be effectively applied to a wide range of systems (Ardito et al., 2004) – including e-Learning systems. This thesis addresses that

challenge. It is the absence of instruments in both HCI and educational research specifically designed to evaluate the utility of learning management systems led to formulation of this thesis.

Definition of Key Terms

It is helpful to provide the definition of key terms used in various sections of this thesis as well as preview where they will be encountered in this thesis. Terms such as e-Learning and learning management systems situate and clarify the scope of the research. Measurement and evaluation research typically uses terms associated with validity that is a reoccurring theme in this thesis and is featured predominantly in Chapter 3. Pedagogical support and pedagogical utility, which originate in this current research, are central to the conceptual underpinning of this thesis.

E-Learning (or eLearning)

The following terms describe open, flexible and distributed contexts for learning activities which are increasingly referred to using a variety of synonymous terms such as e-Learning, Web-Based Learning (WBL), Web-Based Instruction (WBI), Web-Based Training (WBT), Virtual Learning, Distance Learning, Distance Education, Open Learning and Online Learning. E-Learning is defined as 'any form of telecommunications and computer-based learning" (Bates & Picard, 2005). I adopted this broader definition afforded by e-Learning which subsumes the other terms for the purposes of this research.

e-Learning Systems

See Learning Management Systems.

Learning management systems (LMS)

LMS (also known as course management systems) are integrated enterprise software systems that use a variety of information and communication technology to support the pedagogical goals of the organization. Features of such systems include content organization and presentation, student record/grade management, communication tools (e.g. mail, chat, asynchronous discussion boards), evaluation tools, and calendars. Popular LMS include Moodle, TopClass, and Blackboard (Newby, Stepich, Lehman, & Russell, 2006).

Survey research

Survey research encompasses any measurement procedures that involve asking questions of participants. Surveys may take the form of simple paper-and-pencil questionnaires or in-depth one-on-one interviews (Research Methods Knowledge Base, n.d.).

Scale

A scale is an instrument used to measure social-psychological constructs such as intelligence or aggression (Netemeyer et al., 2003). Constructs are abstract in nature, meaning their attributes are not directly observable or quantifiable. Scales are comprised of items that are theoretically associated with the construct. A scale provides a composite score based on the observable responses to items and is intended to reveal theoretical constructs not readily observable by direct means (DeVillis, 2003).This numerical representation potentially provides the researcher with detailed, quantifiable data about the construct used to investigate the construct of interest and its relations to other variables.

Questionnaire

A questionnaire is a set of questions or items presented as a pencil-and-paper or web-based instrument which the participant completes. The difference between a questionnaire and an interview is that the former is completed by the participant while the latter is completed by an interviewer based on the participant's responses (Research Methods Knowledge Base, n.d.).

Construct

The term construct refers to the concept, attribute, or variable that is the target of measurement (Haynes et al., 1995).

Construct validity

Construct validity is the overarching term for validity. It concerns features of an instrument and data generated using the instrument that influence the validity of interpretations made about people. Messick describes construct validity as a unified concept of validity that "integrates criterion and content considerations into a common framework for testing rational hypotheses about theoretical relationships" (Messick, 1980).

Content domain

A definition (conceptual and/or operational) and careful delineation of the construct of interest which specifies content and boundaries of the phenomenon to be measured (DeVillis, 2003). The content domain is usually situated within a theoretical framework.

Content validity

Content validity is a facet of construct validity which concerns item relevance and item representativeness (these terms are defined below). Specifically, content validity represents "the degree to which elements of an assessment instrument are relevant to and representative of the targeted construct for a particular assessment purpose" (Haynes et al., 1995).

Item relevance

Item relevance is an attribute of content validity that refers to the inclusion of items on a scale which are judged to be characteristic of, appropriate, and significant to the domain of the construct to be measured (Wainer & Braun, 1988).

Item representativeness

Item representativeness is an attribute of content validity that refers to "the degree that the entire domain of the targeted construct can be reproduced" (Haynes et al., 1995).

System utility

The provision of functionality that corresponds with the needs and wants of the user.

Pedagogical utility

The capability of the system to enable teaching and learning by facilitating or supporting key facets of the entire instructional system, from learner through instructor through instructional design and tools (Bratt, 2007).

Pedagogical support

The capability of the software product to enable learning by facilitating or supporting:

- The learner's use of cognitive processes.
- Representations of the learner's knowledge.
- The educator's ability to implement cognitive and socio-constructivist teaching strategies.
- Peer and learner-instructor collaboration.

The term system utility, as it is used in this thesis, is an extension of Nielsen's categories of system acceptability which will be explained Chapter 2. The distinction between utility and usability is central to the conceptualization and operationalization of pedagogical utility and pedagogical support. The conceptual framework presented in Chapter 2 is founded on these two concepts.

Summary

The emergence of Internet-based technologies to enable online learning – commonly referred to as "e-Learning" – resulted in the development of learning managements systems (LMSs) to facilitate the delivery and management of traditional, on-line, and hybrid approaches to post-secondary education. These systems, such Blackboard, TopClass and MOODLE, provide a suite of tools for faculty to manage the many aspects of their classes through a course web site. The collection of administrative and instructional tools indicates an emphasis on faculty requirements with considerably less functionality designed to support the learner's requirements.

However, my interest is in how to design and evaluate environments that have pedagogical utility for the learner, specifically how learning management systems support the embedding of learning strategies that support the development of self-regulated learning skills. The first step in this process is to evaluate existing learning

management systems. Unfortunately, the lack of evaluation tools to measure pedagogical support necessitated the development of a multidimensional scale to measure support for learning strategies associated with self-regulated learning in an online environment. This thesis presents the design and validation evidence for the LESSON beginning with the construct definition and content domain, generating and judging measurement items through studies that led to developing and refining the scale, and exploration of the final scale through exploratory factor analysis.

Organization of the Dissertation

The dissertation is divided into 5 chapters as illustrated in Figure 1. Chapter 2 provides a review of several important components which form the conceptual and theoretical basis for the design of the questionnaire. The chapter begins with a review of usability and the limitations of measures and tools to evaluate LMSs, followed by a discussion of "utility" as conceptually distinct from "usability" and the need to extend and adapt extant utility frameworks to accommodate pedagogical contexts of use. A review of educational software evaluation illustrates the limitations of both methods and tools to evaluate the pedagogical utility of LMSs followed by a description of LMSs including features that afford the scaffolding of learning strategies associated with self-regulated learning. Next, the limitations of more recent efforts at LMS evaluation further illustrate the need for this current research. Chapter 2 concludes with the theoretical framework of the LESSON that situates the construct *pedagogical utility* in both the domain of usability (methods) and self-regulated learning (theory). This framework illustrates the convergence of human-computer interaction and pedagogy. The constructs pedagogical support and pedagogical utility are operationalized and followed by a

description of self-regulated learning that includes several of the more prominent models of SRL developed by Boekaerts; Borkowski; Pintrich; Winne and Zimmerman. A more detailed explanation of Zimmerman's model is provided which includes an explication of the learning strategies that are central to that model. This is followed by a discussion of cognitive and metacognitive learning strategies identified by those prominent SRL models; as well as the encouraging theoretical and empirical studies which suggest that LMSs and similar e-learning applications are capable of supporting these learning strategies. These strategies precisely delineate the boundaries and content domain of the scale.

Chapter 3 reflects the nature of scale development and validity evidence that involves a series of phases or studies to enhance validity evidence in its various forms, such as face validity, content validity, and nomological validity. As previously mentioned, each phase is presented in a separate section as a discrete study consisting of a research objective, method, and results. The first study describes a focus group that served to determine the face validity of the construct (i.e. definition of construct and content domain). This is followed by the creation and expert review of the initial item pool to provide evidence in support of content validity (item relevance and representativeness). The third section describes a pilot study to refine the scale. Chapter 4 describes the administration of the questionnaire to a development sample and the results of exploratory factor analysis to determine the psychometric properties of the scale. Collectively these studies form the "strands within a cable of validity argument." (Cronbach, 1988). The purpose of Chapter 5 is to discuss the results of the factor analysis, limitations of this study, the significance and impact of this research, and to

suggest practical implications, future directions, and recommendations for the further studies in support of a collection of validity evidence for the LESSON.

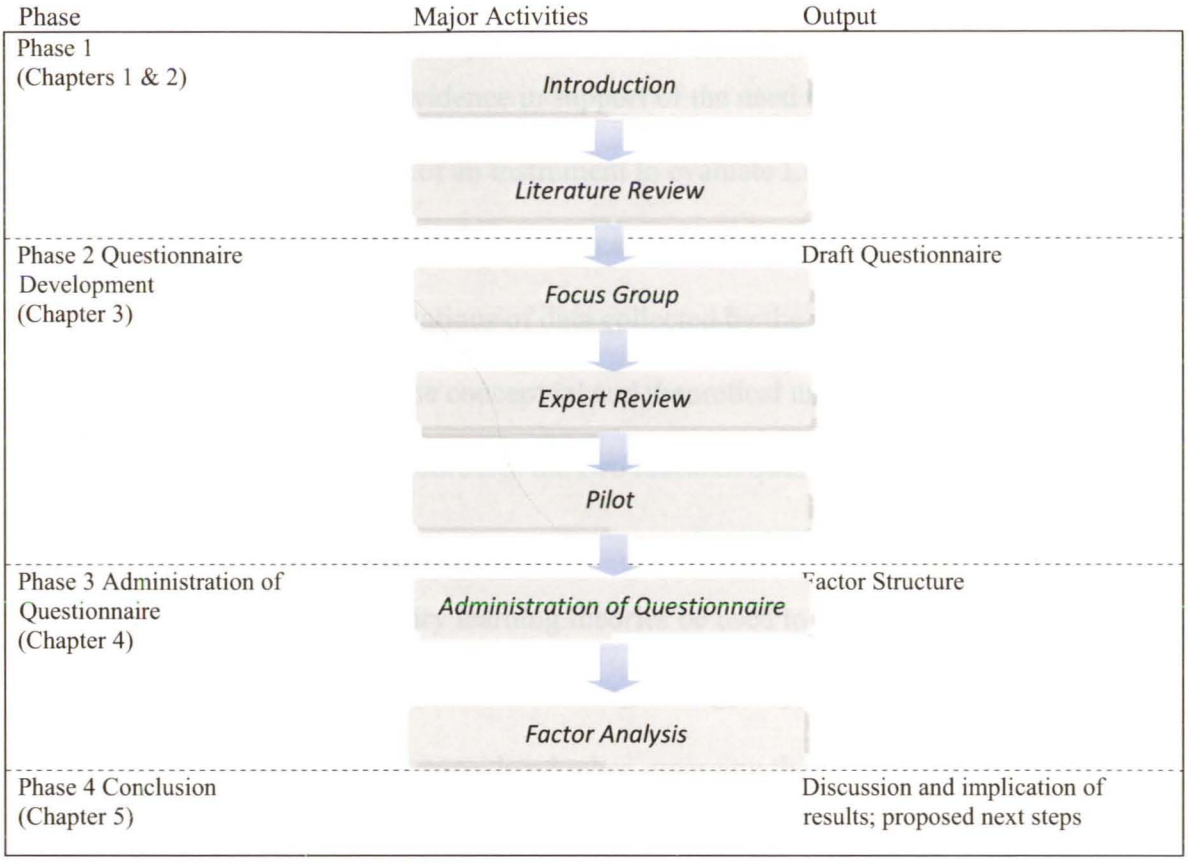

Figure 1. Organization of dissertation

CHAPTER TWO

Literature Review

Introduction

This chapter presents evidence in support of the need to develop and provide a collection of validity evidence of an instrument to evaluate LMS and similar e-Learning systems along pedagogical rather than technical dimensions. Such evidence would support the validity of interpretations of data collected by the instrument. The chapter also provides the reader with the conceptual and theoretical underpinnings for the design of such an instrument. It also addresses the two research questions identified in Chapter 1:

- How might contemporary learning theories be used to design and evaluate an instrument designed to measure learning strategy support?
- What factors should be considered when assessing the pedagogical utility of learning management systems and similar learning technologies?

The development of such an instrument is multidisciplinary in nature as is reflected in the scope of the review of the literature in the present chapter which is organized into sections on: (a) usability (b) utility (c) educational software evaluation (d) LMS (e) self-regulated learning and (f) learning strategies. The purpose of the first section is to familiarize the reader with the concept of usability in its broadest sense and to distinguish usability from utility –a related but conceptually distinct construct. This section will introduce the reader to standard definitions of usability used in the HCI community and the usability dimensions derived from those definitions. These dimensions, which form the basis of many of the measures used in usability studies, limit

their suitability for the design of tools to assess utility in general and certainly utility in the context of the pedagogical goals of the user. The limitations that these definitions and dimensions present to the development of tools to measure pedagogical utility are discussed and a review of the most common usability questionnaires is provided. This first section begins with the definitions and dimensions of usability that are contrasted with the definition of utility, which is a concept that originates in economic theory. The second section introduces the conceptual foundations of utility in the context of human computer interaction that includes two extant models of utility; the first is a component of Nielsen's system acceptability model, (Nielsen, 1993) and the second is an extension of his model by others to include pedagogical criteria. The inadequacies of these models as the basis for assessing pedagogical utility are discussed followed by the conceptual and theoretical model for the design of the questionnaire developed in this thesis. I propose a new model which illustrates the convergence of software *utility* and *pedagogy* to improve the design and evaluation of LMSs. The model is the basis for the questionnaire designed to address the question "can cognitive support in LMS and similar e-Learning systems be observed and measured based on usability evaluation methods and contemporary learning theory?" This section concludes with a discussion of the limitations of usability evaluation methods and tools to assess LMS.

The next section examines the efforts made by educational researchers to provide evaluation measures specifically for educational software. This includes more recent learning management systems evaluation research. A discussion of the most common evaluation approaches and tools and their subsequent limitations for assessing LMS are also presented in this section. An examination of LMS including typical features shared

by the most common systems in use follows that discussion. Many of these features are capable of supporting SRL strategies. A review of these strategies is provided. Finally the limitations of both the HCI and education communities in developing a tool to assess pedagogical utility are summarized. This leads to a general overview of self-regulated learning with a specific focus on the framework by Zimmerman and Pons. The rationale for selecting this framework from among the other SRL models is provided followed by an overview of learning strategies in general and descriptions of those strategies used in the design of the LESSON.

Usability

Background

Usability has been shaped by a variety of perspectives of researchers in Human-Computer Interaction (HCI) and usability experts and is reflected in the evolution of current definitions and dimensions of usability. The most well-known and commonly referenced definitions are provided by the International Standards Organization (ISO). These definitions coalesced into a set of usability dimensions which function as evaluation criteria generally accepted by the HCI community. One of the earliest definitions of usability was, "the quality of interaction which takes place" (Bennett, 1979). Standardization bodies such as the ISO (International Standards Organization) and the Institute of Electrical and Electronics Engineers (IEEE) have developed three different definitions of usability for use with their international standards which emphasize a distinct characteristic or interpretation of usability

(Abran, Khelifi, Suryn, & Seffah, 2003):

1. "The capability of the software product to be understood, learned, used and attractive to the user, when used under specified conditions" (International Organization for Standardization/International Electrotechnical Commission, 2001).
2. "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (International Organization for Standardization/International Electrotechnical Commission, 1998).
3. "The ease with which a user can learn to operate, prepare inputs for, and interpret outputs of a system or component" (IEEE, 1990).

These definitions implicitly provide dimensions to evaluate the usability of a software product but do not provide specific criteria. Evaluation measures (tools or heuristics) are the instantiation of a set of criteria or factors used to quantify usability based on a set of usability criteria. Shackel (1991) provided an initial set of such criteria. These are:

- Effectiveness: level of interaction in terms of speed and errors;
- Learnability: level of learning needed to accomplish a task;
- Flexibility: level of adaptation to various tasks; and
- Attitude: level of user satisfaction with the system.

This initial set of criteria has been adapted and extended by other usability researchers such as Nielsen who updated and extended Shackel's factors to include those which might influence product acceptance. The inclusion of product (or system) acceptability introduced the concept of system *usefulness* which is key to the model of

pedagogical utility developed in this thesis. Nielsen's model will be described in greater detail later in this chapter. Table 2 provides a useful comparison of the dimensions which are common across the definitions of usability compiled by Ryu (2005).

Table 2

Comparison of Usability Dimensions

Usability Dimensions	Shackel (1991)	Nielsen (1993)	ISO 9241 and 9126 (1998; 2001)
Effectiveness	√		√
Learnability	√	√	
Flexibility	√		
Attitude	√		
Memorability		√	
Efficiency		√	√
Satisfaction		√	√
Errors		√	
Understandability			√
Operability			√
Attractiveness			√

These dimensions have been the basis of the measures represented by the most common self-report satisfaction questionnaires used in usability studies that are shown in Table 2. A system may be highly usable based on the above dimensions but may not provide the functionality required by the user to complete a task. This dichotomy illustrates the need for measures that consider *utility*. Such measures might be in the form of a self-report questionnaire designed to evaluate a system's suitability to task based on the user's perception.

As Table 3 illustrates, there are many usability questionnaires that use the quality of the user-system interaction to measure user satisfaction. Questionnaires have been used for decades to assess *usability* (Root & Draper, 1983). The measures used in these tools reflect an emphasis on the quality of the user-system interaction, for example, how

easy a system is to learn; how appealing is the interface; or how fast a user accomplishes tasks.

Table 3

Usability Questionnaires

Acronym	Instrument
QUIS	Questionnaire for User Interface Satisfaction
PUEU	Perceived Usefulness and Ease of Use
NAU	Nielsen's Attributes of Usability
NHE	Nielsen's Heuristic Evaluation
CSUQ	Computer System Usability Questionnaire
ASQ	After Scenario Questionnaire
PHUE	Practical Heuristics for Usability Evaluation
PUTQ	Purdue Usability Testing Questionnaire
USE	USE Questionnaire
SUMI	Software Usability Measurement Inventory
MUMMS	Measurement of Usability of Multi Media Software
WAMMI	Website Analysis and Measurement Inventory

However, this thesis is interested in software system *utility* – a concept which is related to usability but with a distinctly different emphasis. The definitions of utility and the conceptual framework for pedagogical utility, which is an emerging concept derived from this thesis, are presented in greater detail later in this section.

According to Nielsen, a system's acceptability is a combination of social acceptability and practical acceptability. Practical acceptability is composed of factors such as cost, compatibility, reliability and usefulness of a system. Usefulness is further subdivided in to usability and utility. This thesis extends Nielsen's framework to include *pedagogical utility,* which is based on the user's perception of whether the functionality of the system can support what is needed within the context of teaching and learning.

This makes system utility highly *context-dependent.* For example, the context of use for handheld devices might be *mobility*, while the context for groupware might be *collaboration.* Context of use has become a factor in the evaluation of systems and has emerged as a popular research agenda in the HCI community with both the increasing diversity of specialized computer systems and the specification of context of use in usability standards such as ISO/TR 16982:2002, ISO/IEC 9126-1, and ISO/IEC 9126-4. The inclusion of context as an aspect of usability has impacted traditional evaluation methods and tools by limiting their ability to consider the situational demands of the user. Situational demands determine the required functionality – essentially the utility – of the software. For example, if the user requires the system to support statistical functions then one measure of its utility is its capability to provide this function. This limitation of usability measures to consider the situational demands – in particular a pedagogical context of use – is discussed in the next section.

Limitations of Usability Measures

The primary limitation of the most common measures for evaluating the perceived capability of the system to support the pedagogical goals of the end-users is that they do not consider utility. Instead, the most frequently user satisfaction surveys focus on traditional usability criteria as illustrated by Hornbaek (2006).

Hornbaek's review of 180 usability studies classified the measures used in these studies into the three groups: effectiveness, efficiency, and satisfaction, in accordance with the ISO 9241 standard for usability – "[e]xtent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency, and satisfaction" (International Organization for Standardization/International Electrotechnical

Commission, 1998). Horbaek chose this classification because of the wide acceptance of this definition in the HCI community. Each of these three groups is further classified into subgroups as shown in Table 4.

Table 4

Hornbaek's 3 Measures of Usability

Measure		
Effectiveness	Efficiency	Satisfaction
Binary task completion	Time	Standard questionnaires
Accuracy	Task completion time	Preference
Error rates	Time in mode	Rank preferred interface
	Time until event	Rate preference for interfaces
Spatial accuracy	Input rate	Behavior in interaction
Precision	Mental effort	Satisfaction with the interface
Recall	Usage patterns	Ease of use
Completeness	Use frequency	Standard questionnaires
Quality of outcome	Information accessed	Preference
Understanding	Deviation from optimal solution	Rank preferred interface
Experts' assessment	Communication effort	Rate preference for interfaces
Users' assessment	Learning	Behavior in interaction
Other	Other	Satisfaction with the interface
		Ease of use

Adapted from (Hornbaek, 2006)

The measures shown in Table 4 present usability as a qualitative measure of the interaction between user and system. This classification does not include measures of system utility or capability. Nielsen (1993) distinguishes utility as "the question of whether the functionality of the system in principle can do what is needed, and usability is the question of how well users can use that functionality". In other words, system

utility refers to the *provision* of functionality that correspond with the needs and wants of the user whereas usability refers to the *quality of the user's interactions* with that functionality. A further simplification is "what I can do" versus "how easy it is to do it." An example of a utility metric might be the capability of the system to support *help seeking strategies*. The usability of this feature may be measured by how easy it is to remember how to use this tool (Memorability); how pleasurable it is to use (Satisfaction); or how easy it is to learn to use this tool (Learnability). This emphasis on the quality of the interaction based on efficiency, effectiveness, and satisfaction (and other dimensions noted in Table 2) has shaped the criteria used to evaluate software systems. This influence has proven problematic for evaluating the utility of learning management systems along pedagogic dimensions because usability criteria cannot be applied to system capability. For example, *error rate* measures the number of errors made in navigating or using controls to complete a task, not errors made in concept attainment or skill acquisition which in generally goal of the educational software. The unsuitable of usability metrics to evaluate utility is due to their conceptual distinctiveness. The relationship between utility and usability is *orthogonal.*

The two concepts intersect; one can evaluate system utility without evaluating its usability. Similarly, usability can be evaluated without evaluating utility. Ideally, the evaluation of a system would include both its usability and utility as illustrated in *Figure 2*

For example, one might evaluate the system's capability of supporting collaboration (utility) and the quality of that interaction in terms of efficiency (usability).

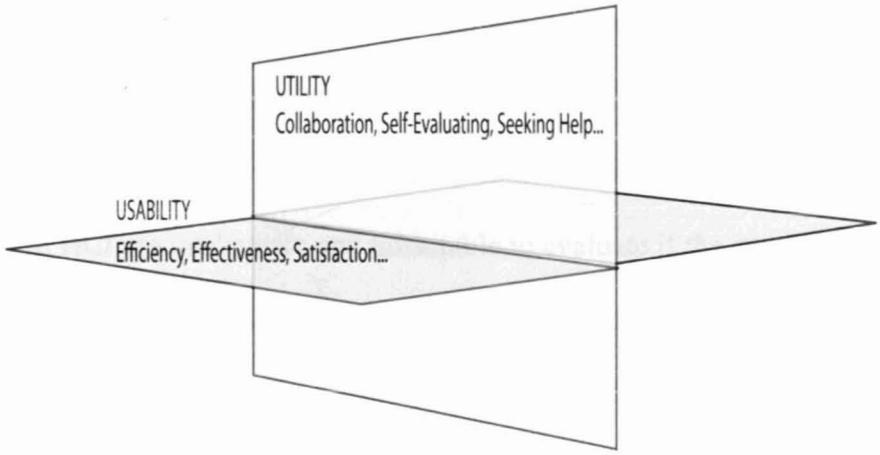

Figure 2. Usability- Pedagogical utility matrix

Another limitation of current usability measures is that they do not account for the pedagogical context of LMS and similar e-Learning systems. These two limitations: 1) absence of utility as a measure, and 2) absence of pedagogical criteria are evident in the most common usability tools that are reviewed in the next section.

Limitation of Usability Tools in HCI

Use of query techniques that involve asking the user directly about their experience with the system under evaluation may involve face-to-face interviews or the completion of a self-report questionnaire. Many questionnaires have been developed over time to evaluate computer systems in general or specific types of systems. (Root & Draper, 1983). General user satisfaction questionnaires include the QUIS, SUMI and USE. Other questionnaires have been developed to evaluate web sites (Human Factors Research Group n.d.); mobile devices (Ryu, 2005), and retail web sites.

These questionnaires use specific technical details about the interface (such as efficiency, learnability, memorability, helpfulness, and control) as measures of user satisfaction or quality of use. These details or dimensions are the basis of the measures

represented by the most common self-report satisfaction questionnaires used in usability studies. A brief overview of three of these questionnaires is presented later in this chapter. It is evident from the illustrative samples shown in Table 2 that current usability instruments in HCI are inadequate and unsuitable to evaluate if the capabilities of learning management systems and similar technologies meet the pedagogical goals of the end users. This limitation was recognized by researchers interested in educational software evaluation. Their efforts to address the issue of context of use has resulted in the development of a variety of frameworks, heuristics and questionnaires to evaluate educational software. An overview of approaches to educational software evaluation over the past two decades is presented in a later section followed by a review of the research on the evaluation of learning management systems. Unfortunately, these efforts also have limitations that compromise their ability to evaluate learning management systems and similar technologies. This thesis suggests that the gap in both usability and educational software evaluation may be bridged by using *utility* as a measure of quality.

Utility

In economic terms, utility is a measure of the perceived *usefulness* of a good or service in satisfying a want or need (Economics A-Z, 2008). In the context of HCI, utility refers to the capability of the system to generally provide functions that correspond with the needs and wants of the users (Nielsen, 1993) –in other words its *usefulness* within a context of use specific to the needs of the user. This is fundamentally different than usability which refers to the technical qualities of the system which contribute to its ease of use and can be measured along various dimensions as illustrated in Table 5.

Table 5

Comparison of usability dimensions of popular user satisfaction questionnaires

Questionnaire	Dimension								
	Efficiency	Effectiveness	Satisfaction	Learnability	Ease of Use	Helpfulness	Attractiveness	Affect	Controllability
USE			√	√	√				
SUMI	√			√		√			√
QUIS			√	√					
Website Analysis and Measurement Inventory (WAMMI)	√			√		√	√		√
Measuring Usability of Multi-Media Systems (MUMMS)				√		√		√	√

Furthermore, usability is only meaningful in the context of utility. First the system has to be able to support the task and subsequently the quality of that support is a measure of its usability. For example, a word processing application such as Microsoft Word may be characterized as both *usable* and *useful* if the user required the application to support tasks such as writing, editing and formatting text. However if the user must perform statistical or financial functions or present quantitative data in a variety of graphical forms then this application, while still maintaining its usability would have limited *utility* since it is not capable of supporting the needs or wants of the user. It is not *useful*. Again, usability is only meaningful in the context of utility. The distinction between usability and utility is evidenced in the work of usability expert Jakob Nielsen. His model of system acceptability, whether the system is good enough to satisfy all the needs and requirements of the users and other potential stakeholders (Nielsen, 1993), includes the concept of usefulness as a subset of a system's practical acceptability. His model of system acceptability is illustrated in

Figure 3.

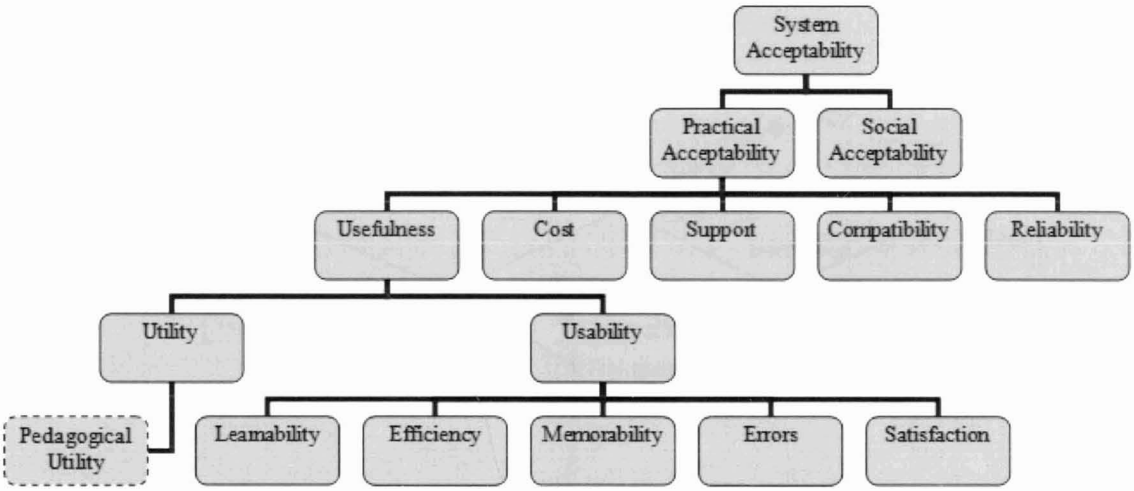

Figure 3. Nielsen's system acceptability – with addition of Bratt's Pedagogical Utility (Bratt, 2007)

As discussed earlier, a system's acceptability is a combination of social acceptability and practical acceptability. Practical acceptability is composed of factors such as cost, compatibility, reliability and usefulness of a system. Usefulness is further subdivided into usability and utility. The present research extends Nielsen's framework to include pedagogical utility, which is based on the user's perception of whether the functionality of the system can do what is needed within the context of teaching and learning (Bratt, 2007). This makes system utility highly context-dependent.

Limitations of Existing Utility Models

Nielsen's model has a distinct limitation as shown in Figure 4.

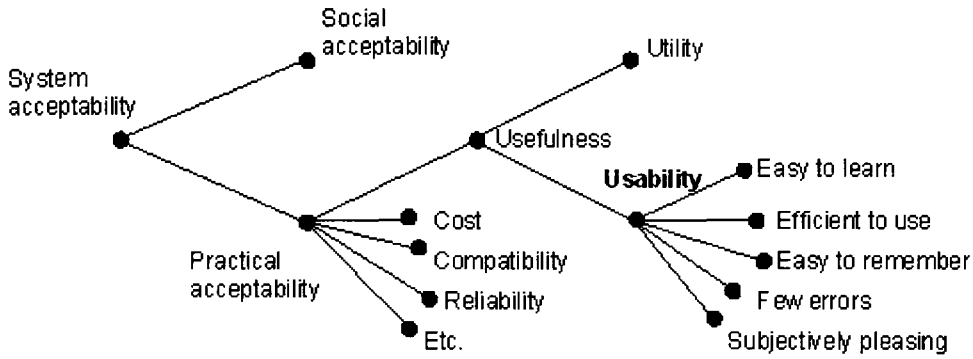

Figure 4. Nielsen's original system acceptability framework

Practical acceptability appears as the super ordinate concept of Usefulness, which is subdivided into Usability and Utility. Usability is characterized by the usual measures however, *Utility* is not characterized by any measures. This deficiency is addressed by this thesis, which contends that a system's perceived usefulness by users and other stakeholders is contingent upon the situational demands. For example, a learning management system may provide a set of synchronous and asynchronous communications tools such as chat, whiteboards, message boards and shared workspaces, which are useful for web-based learning environments. However, these tools have minimal utility for a hybrid course in which the majority of communications occur in person, such as a course that is delivered primarily face-to-face with the additional use of some web-enhanced components. Similarly, a system may provide user statistics which might be useful for researchers or administrators tracking system use; however, this

feature offers minimal utility to an instructor with a primary interest in course delivery and little interest in tracking site statistics.

Nielsen noted that the utility is not domain-specific; courseware might have high utility if it enables users to learn from using it (Nielsen, 1993). However, his model does not provide attributes or dimensions of *utility* as has been done with *usability*. Others have extended his model by adding dimensions of utility in order to evaluate the usefulness of web-based learning environments such as courseware or learning management systems. Tervakari and Silius (2002) developed a multidisciplinary evaluation tool for web-based learning environments as shown in Figure 5.

Their model identifies three categories of pedagogical usability: 1) support of the organization of the teaching and studying; 2) support of the learning and tutoring processes, achievement of learning objectives; and 3) support of the development of learning skills; However, it is not evident how these categories would be operationalized i.e. developed into theory-based assessment criteria. For example, how might one measure "support for growth of learner's autonomy" or "support for organizing of teaching"? I present a modified and extended framework used in the design of the LESSON. This framework is presented in the next section.

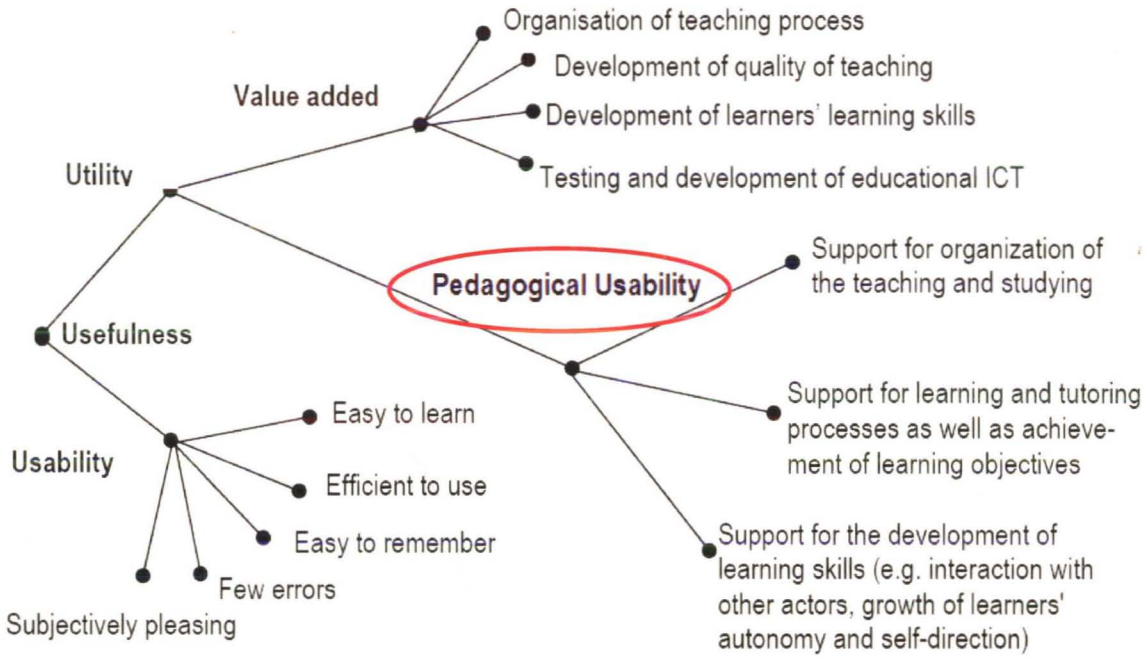

Figure 5. Tervakari and Silius's categories of utility: pedagogical usability and valued added attributes

Their tool is based on an extension of Nielsen's model in which the concept of utility is divided into two categories: valued added and pedagogical usability. However, the term pedagogical usability is not appropriate for the context in which it is presented because it is represented as a branch of *utility* not connected to usability. Furthermore, ISO standards recognize usability as a measure of the perceived ease of use of a system and not the usefulness of a system. Therefore, it would be more appropriate to use the term *pedagogical utility* to accurately denote its relationship to system usefulness. This present research has produced this term and it is used throughout the thesis.

Conceptual Model – Pedagogical Utility

The multidimensional framework of pedagogical utility extends and modifies Nielsen's and Silius and Tervakari's original components. The framework's essential components, which are relevant to this current research, are shown in Figure 6 however, the complete framework is available in (Bratt, 2007).

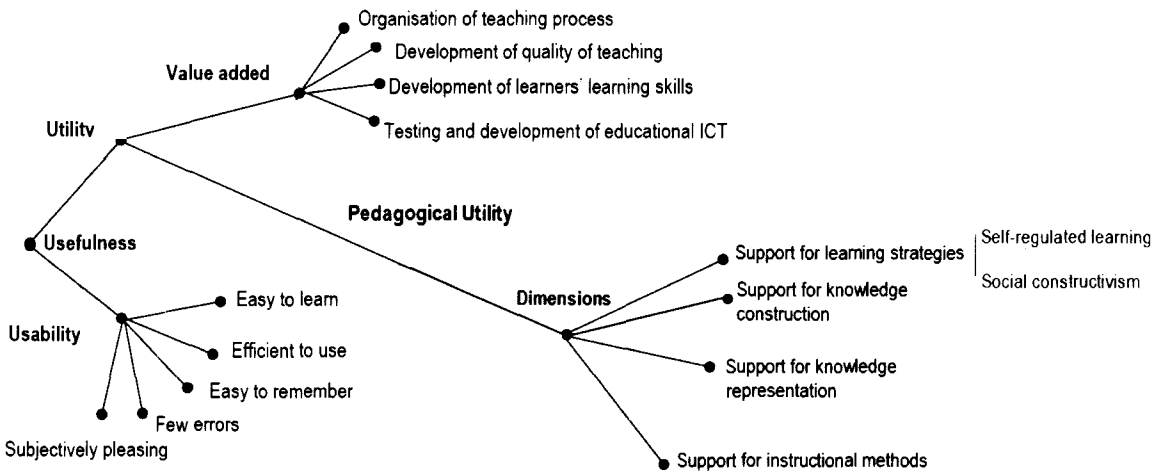

Figure 6. Framework for Pedagogical Utility (Bratt, 2007)

The term "pedagogical usability" is replaced with the more appropriate term "pedagogical utility" to convey that it is a measure of the usefulness of the system within a particular context of use. The four *dimensions* of pedagogical utility replace Silius and Tervakari's three categories of pedagogical usability. The present research is limited to the development and validation of a scale to measure *support for learning strategies*. Future research will develop and validate a separate scale for the remaining three dimensions. When complete, these scales may be integrated into a single questionnaire.

The present research is in the first phase that involves the development of a scale to measure support for cognitive and regulatory learning strategies. These strategies reflect Weinstein and Mayer's use of the term to describe various "cognitive processes and behaviors that students employ to accomplish their self-set goals or the goals implied by the academic task" (Weinstein & Mayer, 1986, p. 315). These processes include both cognitive (declarative and procedural) and metacognitive (knowledge of one's own mental processes.). The belief that an individual has control of these cognitive strategies is foundational to self-regulated learning (SRL) theory. The Zimmerman and Martinez-Pons SRL framework, which is based on several of these self-regulated learning strategies, provides the theoretical framework for the design of the LESSON. This model is presented in a subsequent section.

Limitations of Usability Evaluation Measures and Tools - Summary

As previously discussed in this chapter, traditional usability evaluation methods and tools are too generic to be applied to specific use contexts (Bevan & Macleod, 1994) due to the dimensions used to evaluate system (effectiveness, efficiency and satisfaction) and the instantiation of these dimension as specific measures found in commonly used questionnaires in the field of usability. These constraints limit the explanatory power of such methods and instruments since they fail to account for the specific contexts of use that uniquely define an instantiation of the software's use –for example, the collaborative nature of groupware. However, recent studies suggest new methods and instruments could be designed to include context of use, such as mobile technology, thereby extending the explanatory power of the results of usability studies (Kommers, Jonassen & Mayes). One such context is e-Learning and its associated systems that support

constructivist and collaborative learning environments. The following section discusses the role of educational software evaluation research in providing criteria that considers the pedagogical context of LMSs.

Educational Software Evaluation

Overview

The goal of this section is to present some of the most common methods and tools used in educational software evaluation and propose that they are generally insufficient to effectively evaluate LMS and similar e-Learning systems. This section includes the purpose of educational software evaluation; who is traditionally responsible for this task; and the most common measures considered with evaluating this type of software. This section 1) describes the limitations of current tools –specifically checklists, as they apply to LMS; and 2) illustrates the conceptual link between the criteria used in educational software evaluation and theoretical framework of the LESSON.

Educational Software Evaluation – Approaches

The educational software market has grown rapidly since the advent of instructional software available for use in the classroom beginning in the 1980's. The number and variety of software titles available requires educators and educational administrators responsible for the selection of software used in classrooms and schools to systematically review and assess these products prior to purchase. Clearly the provision of methods and tools would facilitate the ability of these stakeholders to make informed decisions (McDougall & Squires, 1995; Tergan, 1998). Such resources have been available to educators since the emergence of the educational software market. McDougall and Squires (McDougall & Squires, 1995) identified 19 checklists to assist in

the assessment of educational software provided by agencies such as The Educational Products Information Exchange (E.P.I.E.), Minnesota Educational Computing Consortium (M.E.C.C.), the National Council of Teachers of English, and the National Council of Teacher of Mathematics, and numerous independent groups. The use of checklists was a common and effective approach to educational software evaluation prior to the complex enterprise systems which support e-Learning (Squires & Preece, 1996) suitable in some situations. However, checklists have been criticized for various reasons including 1) their emphasis on the technical aspects of the software rather than considering the context of use and the pedagogical goals of the end-users, 2) the inclusion of criteria which may be irrelevant to a particular context of use, 3) lack of theory-based criteria, 4) lack of validity, 5) do not consider different teaching strategies, 6) do not consider different learning strategies 7) cannot be inclusive of innovative uses which new technologies permit (McDougall & Squires, 1995; Tergan, 1998). These criticisms have resulted in the development of criteria to assess educational software along *pedagogical* dimensions rather than technical dimensions. However, despite the improvement in educational software evaluation tools no questionnaire has been developed to date which assesses the pedagogical usefulness of learning management systems. The initial design of the LESSON addresses many of the criticisms identified with checklists; subsequent versions of the questionnaire may address all of the criticisms –specifically support for teaching strategies.

Evaluation methods

Reiser and Kegelmann's review of evaluation methods of instructional software discusses the inconsistencies in evaluation methods and makes three recommendations to

improve existing evaluation procedures, 1) use of students as participants in the evaluation process; 2) collect data on student performance; and 3) collect attitude data from student (Reiser & Kegelmann, 1994). Although their review focuses on the evaluation of domain specific educational software (content) as opposed to course or learning management systems (container) their recommendations support the use of students as participants and the collection of attitude data which is central to the design and application of the LESSON.

Limitations of Educational Software Tools

The identified deficiencies in evaluation practices describe above can be addressed by combining the best practices of each in order to create an evaluation method that is grounded in learning theory and instructional design theory, follows usability evaluation practices and uses an empirically tested scale consisting of theory-based criteria. This is a very timely cross-discipline approach to usability evaluation given the ubiquity of e-Learning and the systems that support this mode of instruction. Collectively these systems can be referred to as e-Learning systems. Many of these systems serve multiple purposes that include course management, student records management, evaluation, collaborative learning, electronic portfolios and personal knowledge management which are distinctly different from traditional instructional systems which are designed to teach a particular subject. The multipurpose nature of LMS is distinctly different from subject-specific software which is designed to develop domain-specific declarative and procedural knowledge in the user. The evaluation methods of web-based instruction and educational software are well-established in the educational literature but to date, little work has been done in the evaluation of LMS.

Therefore, this thesis proposes that such systems be evaluated according to their pedagogical utility. Pedagogical utility in LMS is a new construct which is defined here as the capability of the system to enable teaching and learning by facilitating or supporting key facets of the entire instructional system, from learner through instructor through instructional design and tools (Bratt, 2007). A key characteristic of pedagogical utility is pedagogical support, which has been defined in this research as the capability of the software product to enable learning by facilitating or supporting:

1. the learner's use of cognitive processes
2. representation of the learner's knowledge
3. the educator's ability to implement cognitive and socio-constructivist teaching strategies
4. peer and learner-instructor collaboration

This present research is limited to the development and validation of a scale to measure support for the learner's use of cognitive processes, as well as peer and learner-instructor collaboration.

Summary

As described at the beginning of this chapter, several pioneers in the HCI research community have identified diverse usability dimensions based on usability definitions. Unfortunately these dimensions are generic in nature and fail to consider the pedagogical context of use of LMSs and similar e-learning applications.

The results of parallel efforts from HCI and educational technology to develop effective usability evaluation methods (UEM) for instructional systems reflect different interpretations of usability. HCI efforts reflect a concern for technical qualities while the

educational technology research is characterized by more pedagogical concerns. What is needed is a new construct that accommodates the pedagogical concerns of educational technology as a type of usability that extends beyond technical qualities of the user interface to include context of use.

While HCI has established methods, heuristics and instruments for software evaluation, these focus on the technical rather than pedagogical requirements of the system (Chua & Dyson, 2004; Johnson, Zhang, Tang, Johnson, & Turley, 2004; Tergan & Schenkel, 2003). Current HCI usability evaluation instruments lack the criteria to measure the pedagogical utility of e-Learning systems. This absence of pedagogical criteria prevents the evaluation from measuring the usefulness of the software in an educational context. Nielsen refers to this usefulness as the "utility of the system" which is distinct from the usability – ease of use – of the system. In contrast many educational software evaluation instruments, such as checklists and questionnaires include pedagogical factors based on learning and instructional design theories. However they often lack the methodological rigor of usability practices and many evaluation methods use instruments that were developed ad hoc, which are neither empirically tested nor standardized.

Learning Management Systems

Introduction

The emergence of learning management systems (LMS), also known as course management systems (CMS) has been a relatively recent phenomenon in higher education. Traditional modes of instruction included face-to-face while distance education used media such as live satellite or closed-circuit tv. (Falvo & Johnson, 2007)

The increasing ubiquity of broadband and the technologies it enables has arguable been a direct factor in the proliferation of the educational paradigm known as "e-Learning" previously defined in this research as 'any form of telecommunications and computer-based learning" typically involving open, flexible and distributed learning activities. This term is also synonymous with: Web-Based Learning (WBL), Web-Based Instruction (WBI), Web-Based Training (WBT), Virtual Learning, Distance Learning, Distance Education, Open Learning and Online Learning.

Background

LMSs are a technological evolution of education and training on the World Wide Web, which, until the arrival of these systems, typically used a variety of disparate systems to combine and integrate text, audio and video with learner-learner and learner-instructor interactions to support learning and instruction. These systems organize and provide access to online learning services for students, teachers, and administrators.(Paulsen & Keegan, 2003) However, the advent of LMS enabled institutions to provide a platform independent, enterprise system capable of integrating rich multimedia, synchronous and asynchronous communication, course management and assessment tools to support the growing global trend towards e-Learning in both institutions of higher learning as well as corporate training.

The proliferation of these systems is evident in Paulsen's meta-analysis of six European regions that identified 52 either self-developed or commercial LMS on the market since inception of these systems. (2003) However, in recent years the North American market has largely been dominated by BlackBoard (formerly WebCT) (Falvo & Johnson, 2007) with open source systems such as Moodle and Sakai occupying a

smaller portion of the market. The Observatory on Borderless Higher Education, provider of research and reports on current and emerging issues in transnational higher education, noted:

> Recent years have witnessed remarkable growth in use of learning platforms in higher education around the world... Learning platforms offer enhanced student access to learning materials, straightforward integration of digital content and a range of student interaction and tracking services. Different systems have different emphases, but common features include content authoring tools, calendars, syllabi, discussion boards and assessment mechanisms (Garrett, 2002).

These common features or tools and their potential to support the pedagogical goals of end users within the conceptual and theoretical model of *pedagogical utility* presented earlier in the chapter are explored in the next section.

LMS Features

As noted previously, LMSs share a common set of features or tools to support the core set of functions associated with the delivery of e-Learning. These tools may be broadly categorized according to the functionality (capabilities) they are primarily designed to provide –such as content management, course administration, communication services, instruction, and learning assessment. Within these broad categories is a subset of pedagogical features such as discussion boards, online gradebooks, and group management tools. Recent research suggests that this subset of tools is capable of supporting or scaffolding different self-regulated learning processes (e.g. goal setting, self-monitoring) (Dabbagh & Kitsantas, 2005; Hadwin & Winne, 2001; Narciss, Proske,

& Koerndle, 2007b; Perry & Winne, 2006; Zimmerman & Tsikalas, 2005). Dabbagh and Kitsantas validated that six learning strategies associated with SRL processes are supported by four categories of web-based pedagogical tools, and that support for the strategies varies based on tool category (2005). This result reaffirms the value of the ability to assess SRL support within learning systems. While the authors established their result using a survey methodology, they did not create a generalized tool to assess system support for SRL processes, as their instrument was not independently validated and was specific to the study in question. Additionally, the authors note that the distributed nature of the course in question may have limited the generalizability of their result. Dabbagh and Kitsantas also focused on 4 specific assignments within the course, each of which was specifically directed toward the use of an SRL strategy, rather than assessing the utility of system features to the typical SRL strategies of the learners. Finally, their instrument required the survey participant to have detailed knowledge of SRL, which further limits its applicability. Table 6 shows an illustrative sample of pedagogical tools within these four categories and some of the corresponding self-regulatory strategies that they are capable of supporting as identified by the focus group. The capability of a LMS to provide pedagogical tools which support self-regulatory learning strategies is the basis of pedagogical utility (Bratt, Coulson, & Kostashuk, 2009) proposed in this thesis. This table is the initial reference model for the LESSON. The complete model is found in Appendix C.

Table 6

Pedagogical tools and learning strategies

	Learning Strategies							
Pedagogical tools	Goal Setting and Planning	Organizing	Transforming	Seeking Information	Monitoring comprehension	Seeking Help	Self-evaluating	Reviewing Records
Content Creation & Delivery								
Lecture notes				√				√
Assignments								
Rubrics	√						√	
Web links				√				
Syllabus				√				
Glossary				√				√
RSS feeds				√				
Administrative								
Calendar	√			√				
Collaborative and Communication								
Chat				√		√		
Discussion boards				√		√		
Email				√		√		
Wikis				√		√		
Blogs				√		√		
Announcements				√				
Assessment								
Gradebook	√				√			
Quizzes					√			

Learning Management Systems Evaluation

Introduction

The usability of e-learning application has emerged as a challenge to researchers and practitioners interested in merging theories of usability design and evaluation with developments in e-learning and a number of researchers have approached this task with varying outcomes(Ardito et al., 2004; Inversini, Botturi, & Triacca, 2006a). We will examine the efforts made to evaluate LMSs; discuss the limitations of these approaches and reiterate the suitability of the LESSON to evaluate the pedagogical utility of LMSs and similar e-learning systems based on their ability to provide support for cognitive and metacognitive learning strategies associated with self-regulated learning. The LMS evaluation research has created frameworks, guidelines, models, heuristics, and questionnaires. A brief review of the most recent research follows.

Background

The emphasis on system-oriented parameters such as hardware infrastructure requirements, supported formats, and learning technology standards compliance (Inversini, Botturi, & Triacca, 2006a) was previously identified in this review as a fundamental limitation of current usability criteria in the context of LMSs and similar e-learning systems. Several approaches from both the usability and e-learning communities have contributed to the current research on LMS and similar e-learning applications. These approaches include heuristics, conceptual models, frameworks, checklists, and questionnaires. The cross-disciplinary nature of e-learning systems evaluation is demonstrated in the criteria used in these approaches that vary from the technical to the pedagogical to a combination of both. The following review traces the development of

LMS evaluation from the application of traditional usability heuristics to the design of theory-based questionnaires. Table 7 summarizes the LMS evaluation approaches and outcomes of these studies.

Table 7

Comparison of LMS evaluation approaches

Criteria	Study title, author, year	Research Outputs
Technical		
	(Inversini, Botturi, & Triacca, 2006b)	Tasks Scenarios Heuristics
	(Chua & Dyson, 2004)	usability evaluation framework
	(Arh & Blazic, 2007)	LMS evaluation model
	(Reeves et al., 2002)	Adaptation of Nielsen's heuristics
Pedagogical		
	(Lanzilotti, R., Ardito, C., Costabile, M. F., & De Angeli, A., 2006)	Method
	(Mehlenbacher, Bennett, Bird, Ivey, M. Jan Lucas: Morton, J., & Whitman, 2005)	Five dimensional framework of instructional situations
	(Tergan & Schenkel, 2003)	Checklist
	(Nokelainen, 2006)	PMLQ Questionnaire
	(Trigano, 2006)	The TELESTUDENTS-SRL Questionniare
Technical and Pedagogical	(Rentróia-Bonito, Guerreiro, Martins, Fernandes, & Jorge, 2006)	Framework
	(Silius, Tervakari, & Pohjolainen, 2003)	Framework

The above studies and their associated models are discussed in the context of evaluation approaches.

Evaluation Approaches

Heuristic approaches are typically conducted by an evaluator or small group of evaluators who examine the user interface to identify usability issues based on a set of

general principles known as heuristics. Many usability studies of LMSs continue to focus on system-oriented parameters. For example, a comparative usability study conducted on four different LMS used *Technical Heuristics* and *User Experience Indicators* (UEIs) (Inversini, Botturi & Triacca, 2006). Both tools represent traditional usability factors: "the effectiveness, efficiency, and satisfaction with which specified users achieve specified goals in particular environments" (International Organization for Standardization/International Electrotechnical Commission, 1998).

Several frameworks have been developed in recent years to define the categories that may be used to measure quality in use. These typically use usability criteria as the basis of these categories. For example, Chua and Dyson's framework for evaluating e-learning system quality applies the ISO 9126 model as a basis of comparison when making purchasing decisions for these systems (Chua & Dyson, 2004). The framework was used to evaluate selected Blackboard system tools according to their functionality, reliability, usability, and efficiency. Unfortunately, the factors in the ISO 9126 represent *technical* rather than pedagogical dimensions.

Arh and Blazic's hierarchical framework divides its criteria into three categories: (1) student's learning environment, (2) system, technology and standards and, (3) tutoring and didactics (2007). The criteria used in the category *Student's learning environment* (shown in Figure 7) includes system functionality which considers the needs of the learner such as the ability to search for information or participate in a discussion. However, it also includes technical criteria such as the ability to print without frame pitfall; navigate effectively; and store bookmarks locally. The framework fails to

effectively differentiate between technical features of the user interface and their capability to support the pedagogical goals of the learner.

Applicability of LMS	Assessment of the applicability of Learning Management Systems.
Student's learning environment	Quality of student's learning environment.
Ease of use	The students can use the environment like common web pages: page URLs can be bookmarked, copied and pasted into email messages.
Keyword search	Keyword searching in content, discussion forums,...
Metadata search engine	Metadata Search Engine is available.
Navigation	Effective navigation through the LMS.
Print current page	Printing pages without frame pitfall.
Communication	The LMS focuses on asynchronous and synchronous communications, mainly threaded discussion forums and chatrooms.
Asynchronous communications	Asynchronous communications is mainly by threaded discussion
Internal mailing system	E-mail messages n the learning environment.
Internet messaging	See who is inside and chat with the person.
Discussion forums	Different discussion forums are available to students for knowledge exchange.
Synchronous communication	Synchronous communication; chatrooms, audio and video conferences.
Chatrooms	An online communication between students and students and tutors
Chatroom logfile	You can download all chatroom statistics (logins and discussion).
Audio/video conferencing	Audio/video conferencing
Functional environment	Student's learning environment can be personalized and additional functions can be easily used.
Configurable environment	Students can individualize hide/reveal tools.
Network search	Search a network of nodes connected to Learning Management System.
Collection of tools	Additional useful tools like access to local content (CD/DVD), assignments, calendar, individual document repository, groupware functions.
Browser bookmarks	Store bookmark to content pages and discussion postings on the local machine.
Help	Basic manual/tutorial for students and authors; FAQs.

Figure 7. Student's learning environment categories and description (Arh & Blazic, 2007)

Some frameworks have been developed which consider the pedagogical needs of learners and instructors. Figure 8 illustrates a set of guidelines to evaluate e-learning

systems that reflects a pedagogical context of use however, they are still framed within the traditional usability dimensions of effectiveness and efficiency (Ardito et al., 2004).

User's Activity	**Effectiveness**	Supportiveness for Learning/Authoring Supportiveness for communication, personalization and access	Easy to use authoring tools provided Assessment tests to check one' progress at any time provided It is possible to use learning domain tools even when not scheduled It is possible to eliminate scaffolding or to personalize its attenuation I t is possible to communicate with both students and lecturers It is possible to make annotations It is possible to integrate provided material
	Efficiency	Structure adequacy Facilities and technology adequacy	Mechanisms are provided for search by key or natural language Authoring tools allow to create standard-compliant documents and tests (AICC, IMS, SCORM) Authoring tools facilitate documents update and assessment tests editing

Figure 8. Criteria for evaluation effectiveness and efficiency in a pedagogical context from (Ardito et al., 2004)

Mehlenbacher et al. developed a five dimensional framework for the design and evaluation of usable e-learning. The five dimensions of all instructional situations are:

- Learner Background and Knowledge
- Learner Tasks and Activities
- Social Dynamics
- Instructor Activities
- Learning Environment and Tools

These represent a set of heuristics developed by the authors. Heuristics evaluation is a methodology for examining the usability of software –not the usefulness. Therefore the dimensions developed by Mehlenbacher still use traditional usability criteria, for example, learner background knowledge is subdivided into (1) accessibility, (2)

customizability, (3) error support and feedback (4) navigability and user movement and (5) user control, error tolerance, and flexibility. Again, these measure the quality of user-system interaction. (Mehlenbacher et al., 2005). Furthermore, heuristic evaluations are designed to be completed by an expert rather than the end user and it does not directly measure the system's suitability to a task from the learner's perspective. The practice of developing usability heuristics to evaluate e-learning systems continued with the work of Reeves who extended and adapted Nielsen's original usability heuristics (Nielsen, 1993) to create 15 e-learning heuristics (Reeves et al., 2002). Although the descriptions of each heuristic refer to a pedagogical context, the heuristics are directed toward the usability of the user interface – not the system's capability to support a desired task. For example, one of the metrics for *Visibility of system status* is whether the user is informed if modules or other components of e-learning (e.g. streaming video) are downloading properly. Some researchers have shifted from technical to pedagogical criteria. For example, Silus, Tervakari, and Pohjolainen developed a framework to evaluate the pedagogical usability of web-based learning. (Silius et al., 2003) Their framework extends Nielsen's systems acceptability model by defining two categories of utility: pedagogical usability and added value of web-based learning and teaching. Of significance in this study in the inclusion of criteria which consider the capability of the system's "tools, content, interface and the tasks of the web-based learning environments support various learners to learn in various learning contexts according to selected pedagogical objectives." The approaches developed by researchers to evaluate LMS and similar e-learning systems demonstrates the limitations of using traditional usability criteria and the shift to more pedagogical considerations based on the capability of the

system to support the learning and instructional goals of the users. Heuristics provide general guidelines; frameworks delineate and classify the scope of the criteria. However, neither approach provides an instrument that measures the user's perception of the system's suitability to a task from the learner's perspective. This limitation has been partially addressed by Tergen and Schenkel's learner-centred checklist which is part of an inventory of instruments for evaluating the quality of e-learning applications (2003). The criteria are based on several instructional design models and cognitive learning theories including strategies associated with self-regulated learning such as metacognition, self-evaluation, help-seeking and task and time management. The checklist uses a split-evaluation approach which divides the criteria into system-oriented features and task and learner-centred features for "fostering and maintaining effective learning activities and cognitive processes" (p. 607). As with heuristic evaluations, the checklist is designed to be completed by an expert evaluator rather than the learner and it does not directly measure the system's suitability to task from the learner's perspective. The Pedagogically Meaningful Learning Questionnaire (PMLQ) is a self-evaluation questionnaire that measures user satisfaction with both the *technical* usability of the LMS and the types of learning materials the system enables the user to produce --which the author refers to as *pedagogical usability*. (Nokelainen, 2006) The 10 pedagogical usability dimensions include: (1) learner control (2) learner activity (3) cooperative/collaborative learning (4) goal orientation (5) applicability (6) added value (7) motivation (8) evaluation of previous knowledge (9) flexibility, and (10) feedback.

Although the PMLQ addresses a learning context the purpose of the questionnaire is to evaluate the system in terms of a) the kind of learning material it enables the users to

produce; and b) the learning material. Furthermore, the study is methodologically limited by a small sample size (n=56) of the participants who completed the evaluation of the LMS. Conceptually the sample from which the population of interest was drawn was limited to students ranging from 10 – 13 years old. Finally, the authors state that their "main focus of interest is in the contents (i.e., learning material)" therefore most of the items measure the usability of material that learners interact with using the system not how the system supports the learner. The final two studies reviewed in the section are the most theoretically and methodologically similar to the development and validation of the LESSON. Both are designed to measure SRL in online environments. The Online Self-regulated Learning Questionnaire (OSLQ) is an instrument designed to measure self-regulated learning in an online environment (Lan, Bremer, Stevens, & Mullen, 2004). However, the instrument is designed to determine if students engage in SRL in an online environment *not if the environment (system) supports SRL*. Finally, this review of LMS evaluation approaches concludes with the work of the European TELEPEERS Project and their development of the TELESTUDENTS-SRL, a self-report questionnaire to evaluate if the technology enhanced learning environment (TELE) can be used by the learner to support their self-regulated learning activities (Trigano, 2006). TELEs differ from traditional environments in their use of computers to direct and enhance learning (Sharma & Hannafin, 2007). The TELEPEERS Project researchers define a TELE as "a specific and complex learning environment which included teachers/instructors, peers, and any material used for learning and instruction, including technology" (Steffens, 2006). The theory-based criteria are derived from the 1998 Zimmerman and Martinez-Pons model and include (1) cognitive, (2) emotional, (3) motivational and (4) social

components of SRL. The questionnaire also assesses learner's perception of the value of their (1) tutor/instructor (2) peers (3) ability (4) (5) effort (6) prior knowledge. Unlike the LESSON, which is designed specifically to evaluate the LMS, the TELESTUDENTS-SRL is designed to evaluate a broad range of technology enhanced learning environments such as weblogs, an ESL CD ROM program, web-based portfolios, and online computer programming tutorial. The most salient difference between the TELESTUDENTS-SRL and the LESSON is that the former's assumes a more holistic perspective on the learning environment; the TELE is an aggregate of the technology, learning materials, tutor/instructor, peers, and learner characteristics. In contrast, the scope of the learning environment is limited to the LMS capabilities. The development and validation of the LESSON is presented in Chapter 4.

Theoretical Framework

Background

The Standards for Educational and Psychological Testing recommends the use of a sound theoretical model as the basis for the construct to be measured (American Educational Research Association, American Psychological Association, & The National Council on Measurement in Education, 1999). Self-regulated learning (SRL) was chosen as the theoretical model for measuring support for learning strategies for several reasons described below.

A significant body of knowledge concerning the relationships between learning, motivation and instruction has evolved within the last thirty years. Three decades ago, learning theorists such as Bandura began to articulate an integrated theory of learning, motivation, and instruction. Corno referred to this integrated theory as self-regulated

learning (SRL) (Corno & Mandinach, 1983). Over the years, several prominent researchers have articulated their own theories of SRL. Following their developmental stages, these theories have undergone empirical investigation, and in many instances, classroom application (Butler, 2002; Dabbagh & Kitsantas, 2004). The development of SRL into a comprehensive body of research comprised of different theoretical models with significant empirical research, and a wide breadth of application provides us with a substantive theoretical basis from which to select facets relevant to the operationalization of the construct *support for learning strategies*.

Self-Regulated Learning - Definition

Definitions of SRL vary according to theoretical perspectives. Zimmerman describes several of the most prominent theoretical perspectives: operant, phenomenological, information processing, social cognitive, volitional, Vygotskian, and cognitive constructivist approaches (Zimmerman, & Schunk, 2001). However, all perspectives share three common features: (1) learners engage in goal-oriented, self-directed processes or strategies to improve their academic achievement, (2) these processes involve an iterative feedback loop designed to provide the learner with feedback on the efficacy of their strategies which may be subsequently modified as required, and (3) a description of the rationale for the selection of a particular strategy, process or response (Zimmerman & Schunk, 1989). These commonalities across theoretical perspectives enable an over-arching definition of SRL as "the degree that students are metacognitively, motivationally, and behaviorally active participants in their own learning process" (Zimmerman, 1986). Contemporary models of self-regulation emphasize cognitive, metacognitive, and motivational factors as well as individual

differences associated with productive self-regulation (Hadwin & Winne, 2001). Indeed, as Puustinen and Pulkkinen observe, the discriminating feature amongst the models is the relative weight which is given to each factor (Puustinen & Pulkkinen, 2007).

Specific cognitive and metacognitive learning strategies associated with SRL were selected as the basis of the LESSON by reviewing the literature on SRL. The review examined several models that include the use of cognitive strategies by learners to regulate their learning (see Puustinen & Pulkkinen, 2007 for a review of the models). Zimmerman and Pons' model was ultimately chosen due to its conceptual framework and construct validation that includes 14 key cognitive and metacognitive strategies (Zimmerman & Pons, 1986; Zimmerman, 1986). Although cognitive and metacognitive strategies occupy an important role in several SRL models (Winne, 1998; Zimmerman, & Pons, 1986; Zimmerman, 1986) more emphasis is evident in the Zimmerman and Martinez-Pons model. These strategies are not unique to the Zimmerman and Martinez-Pons model; many of these strategies appear in the literature as general "learning strategies". However, their model integrates many of these strategies into a single, unified framework. The model's strategies and their definitions are found in

Table 9. The questionnaire items were developed around these strategies. Second, compelling research has recently emerged which focuses on the relationship between e-Learning systems and SRL (Dabbagh & Kitsantas, 2004; Dabbagh & Kitsantas, 2005; Lan et al., 2004; Narciss, Proske, & Koerndle, 2007a; Schober, Wagner, Reimann, & Spiel, 2008; Steffens, 2006; Trigano, 2006; F. Winters, Greene, & Costich, 2008). SRL is being used as a framework for both the technical design of such systems (Hadwin & Winne, 2001; Hadwin, Winne, & Nesbit, 2005; Winne et al., 2006) as well as the

instructional design of learning environments that use these systems (Dabbagh & Kitsantas, 2004; Dabbagh & Kitsantas, 2005; Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007). Others have identified a need to develop SRL competencies in online learning environments in order to support academic success (Schober et al., 2008) . Clearly the centrality of SRL theory in both the technical and pedagogical designs of e-Learning environments, make it a reasonable choice as the theoretical basis for the two key constructs central to the design of the LESSON:

Pedagogical support

The capability of the software product to enable learning by facilitating or supporting:

1. the learner's use of cognitive processes
2. representation of the learner's knowledge
3. the educator's ability to implement cognitive and socio-constructivist teaching strategies
4. peer and learner-instructor collaboration

Pedagogical utility

Previously we have defined pedagogical utility as the capability of the system to enable teaching and learning by facilitating or supporting key facets of the entire instructional system, from learner through instructor through instructional design and tools (Bratt, 2007). The e-Learning research community has begun to recognize the value of linking contemporary learning theory with e-Learning and the use of systems designed to support the instructional models which support e-Learning.

According to Watson, "advancements in e-Learning designs will not grow automatically as technology improves, but from a better understanding of the learning process" (Anderson, 2008). Therefore, contemporary learning theory should occupy a central role in the design of LMSs and similar e-Learning technologies. Others acknowledge that "Effective practitioners of online instruction should strive to develop the links between learning theory and various learning systems through pedagogical schema", (Conole, Dyke, Oliver, & Seale, 2004). However, it is not common practice to use contemporary learning theories as the foundation for the design and implementation of systems. This has resulted in the development of e-Learning systems that lack sufficient consideration of the pedagogical requirements for which they were designed (Hadjerrouit, 2007) limiting their efficacy from both a learning and instructional perspective.

This thesis aims to rectify this issue by providing the ability to evaluate such systems based on their pedagogical utility in order to aid in their design and implementation. Designers of these systems can include utility evaluations as part of the software development process. Administrators, teachers and designers of instruction can extend traditional course evaluation to include the efficacy of technology integration as a dimension of instructional quality. The following sections provide a detailed background on SRL to ground the discussion.

Self-Regulated Learning Strategies

The goal of this section is to connect the dots between the importance of cognitive and metacognitive strategies in learning; the ability of the pedagogical tools available in many LMS to support these strategies; and the subsequent need to evaluate these systems

along pedagogical dimensions such as support for self-regulatory processes –specifically cognitive and metacognitive strategies.

Cognitive and metacognitive strategies are two categories of strategies associated with the SRL literature. We begin with a definition of a "learning strategy" and continue with a discussion of cognitive and metacognitive strategies to show the important role that research suggests these categories of self-regulatory strategies play in classroom learning. LaRue's framework of the most common types of cognitive and metacognitive strategies from the literature delineates the scope of this thesis whereby the capability of systems to support these strategies is the basis of the design of the LESSON. An exhaustive review of the prominent SRL models and empirical research is beyond the scope of this review as is the motivational, emotional and social component of some SRL models. Rather, this review is limited to selected learning strategies associated with SRL.

Research on SRL Strategies

The SRL research spans the last three decades and includes numerous theoretical perspectives (Zimmerman, & Schunk, 2001). A number of different models of self-regulation have been proposed (Boekaerts, Pintrich, & Zeider, 2000; Puustinen & Pulkkinen, 2007) which have been the basis of studies seeking to understand the phenomenon in order to improve learning outcomes and environments. Contemporary models of self-regulation emphasize cognitive, metacognitive, and motivational factors as well as individual differences associated with productive self-regulation (Butler & Winne, 1995; Hadwin & Winne, 2001; Winne, 2001).

Research suggests that SRL strategies may be effective in educational settings to facilitate attention (Flavell, Green, & Flavell, 1995; Miller, 1985), motivation (McMillan

& Hearn, 2008; Pintrich & Schunk, 1996; Zimmerman, 2008), learning, memory (Kelemen, 2000), comprehension, and problem solving (Harmon, 1993); (Wittrock, 1986) and that successful learners possess more effective metacognitive knowledge and regulation than their less successful peers (Schneider & Sodian, 1997). LMSs and similar e-Learning systems, combined with instructional designs may be the mechanisms that explicitly require learners to engage in self-regulatory behaviours and support those behaviours.

Learning Strategies: Definitions and Categories

Learning strategies are described as mental activities and behaviors that are engaged by the learner to facilitate encoding during knowledge acquisition, which, according to cognitive theory, is central to the learning process (Ertmer & Newby, 1993). Learning strategies are believed to influence the acquisition, organization and integration and later recall of new knowledge (Weinstein & Mayer, 1986). There has been some debate over whether the definition of strategy must include *intentionality* as a criterion or if strategy selection may reach a level of automaticity such that much less or no conscious attention and reflection is required by the learner. The present research adopts the definition of strategy proposed by Pressley, Forrest-Pressley, Elliot-Faust, and Miller: "A strategy is composed of cognitive operations over and above the processes that are natural consequences of carrying out the task, ranging from one such operation to a sequence of interdependent operations. Strategies achieve cognitive purposes (e.g., comprehending, memorizing) and are potentially conscious and controllable activities." (1985, p. 4). Learning strategies are specific, goal-oriented methods of attaining a

performance standard. An example of a strategy might be *rehearsal* (specifically, maintenance rehearsal, repeating items) to memorize information.

Educational research associated with self-regulated learning typically distinguishes three major types of strategies: cognitive, metacognitive, and affective (Winne, 1996) which are further subdivided into: (1) rehearsal (2) elaboration (3) organizational (4) comprehension and (5) affective strategies (Weinstein & Mayer, 1986). LaRue's framework provides a synthesis of the work on learning strategies (Table 8). As this thesis is founded on Zimmerman's framework, it will exclusively examine cognitive and metacognitive learning. The fourteen SRL strategies contained within the framework are summarized in Table 8 and are elaborated over the remainder of the chapter.

Table 8

Conceptual framework of SRL strategies (from LaRue, 2008)

Category	SRL Strategies	Examples of student activities
Cognitive Statement of student action taken to directly process information.	Repetition or memorization	memorizing repeating reviewing
	Elaboration	using previous knowledge & experience to establish logical relations between keywords using examples formulating questions
	Organization	organizing & structuring content grouping classifying categorizing establishing a hierarchy mapping
	Generalization	identifying an example finding similarities
	Discrimination	identifying a counterexample finding differences
Metacognitive Statement of student reflection on learning methods in relation to a task or perception of self as a learner.	Self-evaluation	appraising one's methods of learning
	Regulating	changing or maintaining strategies
	Self-monitoring	checking the effectiveness of a change
Affective Statement of negative or positive student affect associated with a task and control of the affect.	Maintaining interest & motivation	consciously dealing with negative feelings & procrastination
	Support for attention & concentration	reducing distractions creating a healthy work environment
	Management of emotions	controlling thoughts to act on emotions lightening up, relaxing
Resource-management Statement of how student manages time, material, and human resources.	Time management Organization of material resources Identification of human resources	planning & managing time making a work schedule
		using the necessary material putting oneself in an environment conducive to learning
		seeking peer support when facing difficulties consulting teachers

Cognitive Strategies

"Cognition refers to thinking and the mental processes humans use to solve problems, make decisions, understand new information or experiences and learn new things" (Salkind & Rasmussen, 2008, p. 164). Of the various areas of cognitive

psychology, the most pertinent to self regulated learning strategies are cognitive strategies. Cognitive strategies are mental operations enacted by the learner to achieve intended learning or performance outcomes by facilitating various forms of information processing. The educational and psychological literature relating to cognitive strategy research began in the 1970's with the pioneering work of Gagne (problem solving) and Weinstein (studying strategies) and extended into numerous areas such as reading comprehension, mathematical problem solving, writing, second language, special needs and study skills. The theory of cognitive processes or strategies is rooted in the information processing model which emerged in the 1950's. This theory proposes that human perception, acquisition, encoding, storage and retrieval of information is highly similar to computer information processing and memory (Alexander & Winne, 2006). Cognitive learning theories emphasize the acquisition of knowledge and the development of mental structures of information during the learning process. Research suggests that the use of cognitive strategies contributes significantly to learning (Hofer, Yu, & Pintrich, 1998; Pressley & Levin, 1983a; Pressley & Levin, 1983b; Weinstein, 1987; Winne, 1998; Zimmerman, & Schunk, 2001; Zimmerman & Schunk, 1989). Of the various types of cognitive strategies, (1) self-evaluation (2) organizing and transforming (3) goal-setting and planning (4) seeking information (5) keeping records and monitoring (6) environmental structuring (7) self-consequences (8) rehearsing and memorizing (9) seeking assistance, and (10) reviewing records, are the most salient to this thesis as they are derived from the Zimmerman and Martinez-Pons framework (as shown in

Table 9) which provides the theoretical framework for the design of the LESSON:

Table 9

Zimmerman and Martinez-Pons categories of learning strategies

Categories of strategies	Definitions
Self-evaluation	Statements indicating student-initiated evaluations of the quality or progress of their work, e.g., "I check over my work to make sure I did it right."
Organizing and transforming	Statements indicating student-initiated overt or covert rearrangement of instructional materials to improve learning, e.g., "I make an outline before I write my paper."
Goal-setting and planning	Statements indicating student setting of educational goals or subgoals and planning for sequencing, timing, and completing activities related to those goals, e.g., "First, I start studying two weeks before exams, and I pace myself."
Seeking information	Statements indicating student-initiated efforts to secure further task information from non-social sources when undertaking an assignment, e.g., "Before beginning to write the paper, I go to the library to get as much information as possible concerning the topic."
Keeping records and monitoring	Statements indicating student-initiated efforts to record events or results, e.g., "I took notes of the class discussion." "I kept a list of the words I got wrong."
Environmental structuring	Statements indicating student-initiated efforts to select or arrange the physical setting to make learning easier, e.g., "I isolate myself from anything that distracts me." "I turned off the radio so I can concentrate on what I am doing."
Self-consequences	Statements indicating student arrangement or imagination of rewards or punishment for success or failure, e.g., "If I do well on a test, I treat myself to a movie."
Rehearsing and memorizing	Statements indicating student-initiated efforts to memorize material by overt or covert practice, e.g., "In preparing for a math test, I keep writing the formula down until I remember it."
9-11. Seeking social assistance	Statements indicating student-initiated efforts to solicit help from peers (9), teachers (10), and adults (11), e.g., "If I have problems with math assignments, I ask a friend to help."
12-14. Reviewing records	Statements indicating student-initiated efforts to reread tests (12) notes (13), or textbooks (14) to prepare for class or further testing, e.g., "When preparing for a test, I review my notes."
15. Other	Statements indicating learning behavior that is initiated by other persons such as teachers or parents, and all unclear verbal responses, e.g., "I just do what the teacher says."

Basic Research on Metacognition

Metacognitive research began as metamemory research in the field of developmental psychology in the early 1970's (McCormick, 2003) primarily led by the work of John Flavell (Flavell, 1976; Flavell & Wellman; 1975; Flavell, 1979). Since then, it has engendered a significant body of theory and research from general metacognitive development to metacognitive strategies specific to content areas and tasks spanning early childhood to early adulthood (Hacker, Dunlosky, & Graesser, 1998; Resnick, 1976; Weinert & Kluwe, 1987). Surveys of this metacognitive research include Brown, Bransford, Ferrara, and Campione (1983), Flavell, Miller, and Miller (2002), Kuhn (1999), Moshman (1998), and Schneider and Bjorklund (1998).

The majority of developmental studies classified as metacognitive have investigated children's metamemory, which is their knowledge about variables affecting memory performance and, especially, their knowledge and use of memory strategies (Flavell, 2004). However, the present research concerns the use of LMS tools to support metacognitive strategies in higher education across all disciplines. As such, the discussion will briefly address metacognitive strategies in general. For further discussion of the development of metacognitive processes see Flavell (1979).

Metacognitive Strategies

Whereas cognitive strategies refer to rehearsal, elaboration, and organization (Hofer et al., 1998; Weinstein & Mayer, 1986) metacognition refers to *knowledge* and control or *regulation* of those strategies. An early and generally accepted definition of metacognition is "knowledge concerning one's own cognitive processes and products or anything related to them" (Flavell, 1976) or more simply, "knowledge about

knowledge." This knowledge is used to monitor and regulate one's cognitive strategies; therefore metacognition consists of two essential components: metacognitive knowledge and metacognitive regulation (Flavell, 1979). There are three types of metacognitive knowledge: (a) declarative (b) procedural, (c) conditional, as illustrated in (Schraw & Graham, 1997; Woolfolk, Winne, & Perry, 2003). Declarative knowledge includes knowledge about oneself as a learner and about what factors, such as memory, skills; strategies and resources, may influence one's performance. Procedural knowledge refers to knowing *how* to utilize these factors. Conditional knowledge refers to knowing *when* and *why* to use declarative and procedural knowledge. Hence, metacognition is the strategic application of these three types of metacognitive knowledge to accomplish the learning task or goal. There are three components of metacognitive knowledge that enable regulation of thinking and learning: *planning, monitoring*, and *evaluation*. Table 10 shows the framework for both components of metacognition.

Table 10

Metacognitive Components adapted from (Schraw & Graham, 1997)

Component	Description
Knowledge of Cognition	*(What one knows about cognition)*
Declarative	Individual knowledge of one's own learning processes (skills, strategies, resources and abilities as a learner)
Procedural	Knowledge of how to implement learning procedures (e.g., strategies)
Conditional	Knowledge about when and where it is appropriate to use such strategies
Regulation of Cognition	*(What one does to regulate cognition)*
Planning	Planning, goal setting; strategy selection and allocation of resources prior to learning
Monitoring	Monitoring comprehension; assessment of one's learning or strategy use.
Evaluation	(B. J. Zimmerman, 1986)(Zimmerman, 1986;Zimmerman, 1986;Zimmerman, 1986;Zimmerman, 1986;Zimmerman, 1986)Judgments about performance and strategy effectiveness after a learning episode.

Although metacognition includes both knowledge and regulation components the LESSON addresses the metacognitive strategies associated with *regulation* of cognition components as opposed to the *knowledge* of cognition components. *Table 11* shows the three components of metacognitive regulation and corresponding strategies measured by the LESSON.

Table 11

Regulation of Cognition and corresponding LESSON strategies

Metacognitive Process	Description	Corresponding SRL Strategy (from (Zimmerman, B. J., & Pons, M. M., 1986)
Regulation of Cognition		
Planning	Planning, goal setting; strategy selection and allocation of resources prior to learning	Goal-setting and planning Organizing and transforming Seeking information Keeping records Environmental structuring Self-consequating Rehearsing and memorizing Seeking help Reviewing records
Monitoring	Monitoring comprehension; assessment of one's learning or strategy use.	Monitoring
Evaluation	Judgments about performance and strategy effectiveness after a learning episode.	Self-evaluation

The SRL strategies in *Table 11* are the proposed dimensions or factors represented in the LESSON. In addition, this thesis proposes that the following strategies, grouped together as a single category in the Zimmerman and Martinez-Pons model are actual discrete categories: (1) organizing, (2) transforming, (3) goal-setting, (4) planning, (5) keeping records and (6) monitoring comprehension. An exploratory factor analysis will identify the actual factor structure. The results of the factor analysis are discussed in Chapter 4.

Computer Based Learning Environments and Learning Strategies Support

Learning management systems and similar e-Learning systems include both computer-based learning environments (CBLE), and Web-based learning environments (WBLE). Some types of CBLEs are created with LMSs , which embed hypermedia and multimedia; are learner-centered; providing the learner with the responsibility for controlling many aspects of his or her learning, the computer environment, and other aspects of the learning context (Winters & Azevedo, 2005). Some CBLEs have been created using a set of pedagogical tools in a LMS, such as presentations, discussion boards, and hypermedia. Interest in these tools and their ability to scaffold or support SRL strategies has grown as LMSs continue to integrate new technologies and more complex pedagogical tools to facilitate teaching and learning. Studies suggest that students who are learning about complex and challenging topics within a CBLE depend on numerous self-regulatory processes such as planning, knowledge activation, metacognitive monitoring and regulation, strategy deployment, and reflection (Azevedo, 2007; Schraw, 2007).

The continuously evolving research on SRL has transitioned from investigating if students self-regulate in these environments *through* to design recommendations for the support of SRL in online environments –such as LMSs, and *finally*, to the recommendation of embedding SRL strategies training in courses which use LMSs (Dabbagh & Kitsantas, 2004). The following studies illustrate this progressive development in SRL research.

Azevedo and colleagues revealed that learners are able to self-regulate in hypermedia environments as they shift towards more sophisticated mental models (Azevedo et al., 2002; Azevedo, 2007; Azevedo, Guthrie, & Seibert, 2004; Azevedo,

Cromley, & Seibert, 2004; Azevedo & Cromley, 2004; Azevedo, 2005; Azevedo, 2007). Others have also found that students engage in SRL in an online environment (Lan et al., 2004). Hadwin and Winne (2001) suggested that SRL theory can inform the design of learning technologies that support self-regulation through tacit and explicit scaffolding. Quintana, Zhang, and Krajcik (2005) have developed a framework which describes four types of metacognitive strategies (--specifically *task understanding* and *planning, monitoring* and *regulation*, and *reflection*) which can be scaffolded by various software tools. Dabbagh and Kitsantas have identified categories of pedagogical tools found in most LMSs which support different SRL processes (Dabbagh & Kitsantas, 2004; Dabbagh & Kitsantas, 2005). Furthermore, specific systems have been developed to provide learners with a toolset to scaffold learning activities such taking notes; annotating content; working with concept maps; searching, and chatting (Leacock, Winne, Kumar, & Shakya, 2006). Similar web-based systems have been developed which include tools to foster SRL in learning by supporting content structure and organization, navigation; monitoring; annotation; task management and evaluation.

In their review of 33 empirical studies, Winters and colleagues found specific SRL skills can be supported by CBLE. Other studies show that self-regulated students perform better than those who do not regulate (Schunk & Zimmerman, 2006; Winne, 2001), and those who use more effective strategies when learning with CBLE are more academically successful (Winters et al., 2008). Others suggest that the quality of students' SRL may be a potential mediator between CBLEs and academic performance (Azevedo, 2005). The implication is that CBLEs such as those enabled by LMSs should

include design considerations for SRL strategies (Manlove, Lazonder, & de Jong, 2007). Furthermore SRL training should be included as part of the curricula.

Summary

The advancement of e-Learning as a paradigm for delivering instruction using Internet-based technologies has grown exponentially in recent years. New information and communication technologies commonly integrated into the functionality of LMS , Web-based learning (WBL), online learning, computer-based learning environments (CBLE) and technology-enhanced learning environments (TELE) have been the primary mechanism for managing the e-Learning environment. Such e-Learning applications have become mission critical applications for these institutions of higher education. At stake, therefore, is the selection and implementation of a LMS that provides both a high degree of *usability* and supports the *pedagogical goals* of all end-users. While heuristics may be used to effectively evaluate the usability of such systems, the metrics are typically system-oriented; using metrics such as task completion, degree of completion, number of errors, error recovery time. These criteria are based on the ISO definitions of usability that focus on "The extent to which a product can be used by specified users to achieve specified goals with effectiveness, efficiency and satisfaction in a specified context of use" (International Organization for Standardization/International Electrotechnical Commission, 1998). System-oriented heuristics fail to consider the pedagogical context of use. This problem has been recognized by others who advocate a synergy between usability practitioners and e-Learning researchers do develop user-centred criteria (learner and instructor) (Mehlenbacher et al., 2005; Reeves et al., 2002; Squires & Preece, 1999). Several frameworks and heuristics have been developed to reflect the

pedagogical goals of the LMS however most of these tools still focus on technical aspects of the user interface. System *utility*, as conceived by Neilsen, considers the acceptability of the system based on the capability of the system to support the user in accomplishing the desired task. *Pedagogical utility therefore is the capability of the system to support the desired tasks of the learner (and instructor).* System acceptability is subjective in nature and is based on the user's perception. Therefore the use of a self-report questionnaire was selected as the appropriate tool to measure learners' perceptions of the system's suitability to task.

Systematic questionnaire design requires that the content domain delineate the scope of the construct to be measured. The Standards for Educational and Psychological Testing recommends the use of a sound theoretical model as the basis for the construct to be measured (American Educational Research Association et al., 1999). The LESSON is designed to measure the LMS's ability to support selected learning strategies associated with self-regulated learning. These strategies are identified and operationalized in the Zimmerman and Martinez-Pons framework of SRL strategies. These 14 strategies combined with two additional strategies from the MSLQ form the content domain from which the item pool was developed.

A review of the significant SRL literature in the last 30 years suggested several directions for future research including: (1) perfecting the research methodology and measuring instruments, and (2) the design of learning environments to develop SRL and motivation to learn, and finally (3) the study of WBLE to see how they influence learners self-regulatory processes (Montalvo & Torres, 2004). This current research addresses the first direction and provides a method and tool to pursue research on the latter two

directions. The methodology used in the development and validation of the LESSON is discussed in the following chapter.

CHAPTER THREE

Introduction

This chapter describes the steps in phase 2 of this research. As shown in Figure 9, phase 2 includes specifying the construct, generating the item pool, and having experts review the item pool.

Phase	Research Flow	Output
Phase 1 (Chapters 1 & 2)	*Introduction* ↓ *Literature Review*	
Phase 2 Questionnaire Development (Chapter 3)	↓ *Specification of Construct* ↓ *Generate Item Pool* ↓ *Expert Review*	Draft Questionnaire
Phase 3 Administration of Questionnaire (Chapter 4)	↓ *Administration of Questionnaire and Data Analysis*	
Phase 4 Analysis and Discussion (Chapter 5)	↓ *Item Analysis via Factor Analysis*	Factor Structure

Figure 9. Research Flow

Research Problem and Objectives

As stated in Chapter One, the primary purpose of this thesis is to create an instrument (questionnaire) to assess the ability of learning management systems to support the learning strategies of their users. The questionnaire will also collect data on the relationship between the learning design (intended use of the system by the course

designer) and the actual use of the system by the learner, for use in subsequent research (Bratt et al., 2009). The goal of this study was to develop and provide a collection of validity evidence for the LESSON. Of course, validity is not a property of a test or instrument. Rather, "validity is an overall evaluative judgment of the degree to which empirical evidence and theoretical rationales support the adequacy and appropriateness of interpretations and actions based on test scores or other modes of assessment (Messick, 1989). Therefore, the purpose of this thesis is to provide a collection of empirical evidence and theoretical rationales in support of the appropriateness, meaningfulness, and usefulness of data generated by the LESSON. The methodology employed in this research is sequential in nature and each phase of the research generates its own set of general and specific objectives. These objectives are outlined below:

- To select an appropriate theoretical model as the conceptual basis for the construct measured by the LESSON.
    - To review literature on self-regulated learning strategy theories.
    - To conduct a focus group to assess suitability of theoretical model as basis for content domain.
    - To conduct an expert panel review to verify item relevance and representativeness
- To determine the factor structure of LESSON questionnaire.
    - To conduct pilot study with a small development sample.
    - To administer LESSON to a large development sample.
    - To conduct exploratory factor analysis to determine the number of latent factors measured by the LESSON.

The research questions that guided these objectives are presented next.

Research Questions

- What are the characteristics of pedagogical utility in the context of learning management systems and similar learning technologies?
- How might contemporary learning theories be used to design and evaluate an instrument designed to measure learning strategy support?
- Do the capabilities of these systems introduce learning strategies not previously identified in specific models of self-regulated learning?
- What is the factor structure of the LESSON questionnaire?

The answers to these questions will produce several significant outcomes such as (1) the introduction of new models of system utility that can extend HCI research and practice (2) the contribution of a new instrument and measures to educational research (3) a revision to a prominent model of self-regulated learning strategies that addresses learner-system interactions.

Study 1 – Construct Definition and Specification of Content Domain

Research Design

The procedures used to develop and validate the LESSON are described in three sections within the present chapter. The procedures follow conventional survey design methodology to develop and validate the instrument (Benson & Clark, 1982; Groves et al., 2004; Spector, 1992). Survey development and validation is a multi-phase process. Benson refers to these individual and distinct phases as separate studies (1982); each with a discrete research design. These studies typically involve construct definition,

specification of content domain, initial item pool, expert review, pilot test, and administration to a development sample and validation as illustrated in Figure 10.

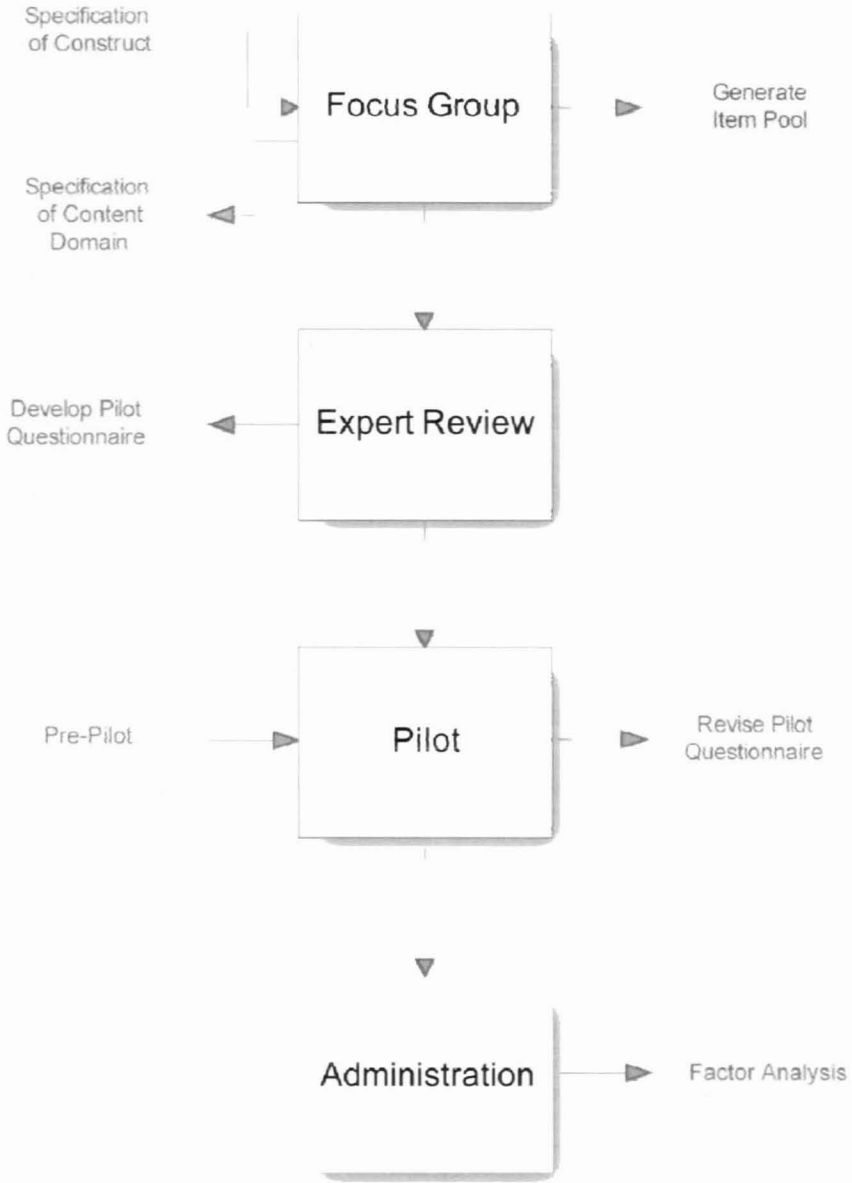

Figure 10. Flow chart for questionnaire development and validation (adapted from Benson, 1982).

The methods used for each of these separate steps are described in their own section. Given the sequential nature of the development process, the description of each methodology is immediately followed by a brief discussion of the results for that section.

The first section describes the content validation procedure. This study used focus group methodology to enhance the content and face validity of the construct's theoretical framework *within an e-Learning context*. The learning strategies identified by Zimmerman and Martinez-Pons were originally within the context of *non-technology mediated* environments. This preliminary study was necessary to determine if learners engaged the same learning strategies through their interactions with a learning management system. The second section describes the development of the item pool and domains to which the items are referenced. The third section describes the expert panel procedures used to verify the structure of the domain of pedagogical utility and to assess the relevancy and representativeness of the items constructed to characterize the domain and its sub domains. Finally, the fourth section describes a small pilot study conducted with six university students to determine the readability and clarity of the items.

Section One – Focus Group

Introduction

The Standards for Educational and Psychological Testing recommends the use of a sound theoretical model as the basis for the construct to be measured (American Educational Research Association et al., 1999). Spector recommends an inductive approach to scale development that begins with a clearly defined construct (Spector, 1992). Self-regulated learning was chosen as the theoretical model for measuring the dimension *support for learning strategies* for two reasons: the prominent role of learning

strategies in several theoretical models of learning, and the existence of a clearly defined and validated construct. First, cognitive and metacognitive learning strategies occupy important roles in several SRL models (Winne, 1998; Zimmerman & Pons, 1986; Zimmerman, 1986). Learning strategies are "any thoughts, behaviors, beliefs or emotions that facilitate the acquisition, understanding or later transfer of new knowledge and skills" (Weinstein, Husman, & Dierking, 2000). Specific strategies were selected by reviewing the literature on self-regulated learning. The review examined several models that include the use of cognitive strategies by learners to regulate their learning. Second, Zimmerman and Pons' model was ultimately chosen due to its conceptual framework and construct validation which includes 14 key cognitive and metacognitive strategies (Zimmerman & Pons1986; Zimmerman, 1986). The model's cognitive strategies and their definitions are found in

Table 9.

The strategies identified by Zimmerman and Martinez-Pons are being used as a framework for both the technical design of such systems (Hadwin & Winne, 2001; Hadwin, Winne, & Nesbit, 2005; Winne et al., 2006) as well as the instructional design of learning environments that use these systems (Dabbagh & Kitsantas, 2004; Dabbagh & Kitsantas, 2005; Vovides, Sanchez-Alonso, Mitropoulou, & Nickmans, 2007). The centrality of SRL theory in both technical and instructional design suggests that it could also provide a theoretical framework to construct the initial item pool. A set of open-ended questions were created and administered to a focus group representative of the target population. A description of this study appears in the following section.

Research Design - Focus Group

A fundamental concern in test construction is that the assessment instrument measures the construct for which it was designed to measure. Content validity is the degree to which elements of an assessment instrument are relevant and representative of the targeted construct for a particular assessment purpose (Haynes et al., 1995) and "whether the content sampled by an instrument allows an evaluator to validly infer [some quality of a respondent]" (Winne, 2009). Haynes et al. identified the use of focus groups and expert panels during initial item development as one of the general principles in assessment instrument development (p. 244). The purpose of a focus group is to increase the content validity and enrich and extend what is known about a concept and inform item development (Vogt, King, & King, 2004). For example, the 10 strategies originally identified by Zimmerman and Martinez-Pons form the basis of the construct *learning strategies support* which is central to this thesis. These strategies were developed into a series of questions to gather data on students' perceptions about Blackboard's support of these strategies. This method served two purposes: (1) preliminary confirmation of the suitability of the model as the content domain for the questionnaire based on students' perceptions, and (2) extend the content domain through the identification of additional strategies which are not part of the Zimmerman and Martinez-Pons model. These outcomes support face validity for this thesis, that is, preliminary evidence that the measure or procedure appears to be a reasonable method of obtaining data about the construct under investigation. Face validity provides an element of support for interpretations based on an instrument's data and context.

A focus group consisting of 11 members from the target population was conducted. An analysis of the data collected from the focus group confirmed whether the

content sampled by the instrument allows an evaluator to validly infer that it is measuring the targeted construct.

Participants

Eleven undergraduate education students volunteered to participate in the focus group. The six male and five female participants represent the target population of post-secondary education students who are enrolled in a traditional on-campus course that uses a learning management system to support instruction. Participants were enrolled in one of three sections of an instructional technology course held in the fall session of the academic term. The researcher provided an introduction and explanation of the study and invited students to participate. Students who expressed an interest in participating were requested to fill out a Request to Participate form that included an informal, 10-item questionnaire designed to assess their information literacy level. Two sampling techniques were combined to select participants. Extreme case sampling divided the sample population into either high, average or low users of computing technology based on both information literacy knowledge and skills (Wiersma & Jurs, 2005) Participants were selected from those respondents from either high or low user group. This technique was combined with convenience sampling since statistical representation of the target population was not a critical requirement for this phase of the scale's construction and the exploratory nature of this preliminary phase of scale construction is to discover new insights into the construct to be measured. Many studies whose participants are post-secondary students – a population not representative of the adult population in general – are subject to limited generalizability. However, the population in this study is post-secondary students. The final sample consisted of 6 high users and 5 low users.

Materials

A semi-structured interview schedule was developed by the investigator to explore the representativeness of the learning strategies identified by Zimmerman and Martinez-Pons within an e-Learning context. These learning strategies form the conceptual foundation: support for learning strategies.

Twenty-two opened ended questions examined how participants used the course learning management system to support those learning strategies.

Methods

The sample was divided into 2 groups consisting approximately equal distribution of males and females and high-low users. The focus groups were conducted in two separate sessions both moderated by the investigator. Participants were seated around a table to facilitate the participation of all members of the group. At the start of each session the moderator distributed and reviewed an information sheet which described the purpose of the research and how confidentiality and anonymity would be maintained. Participants were required to sign both an informed consent form and a confidentiality agreement. The moderator asked each participant to respond to the each of the 22 questions and encouraged elaboration through the use of probing questions to guide the discussion when participants did not spontaneously respond or seemed to be experiencing difficulty in articulating their thoughts.

Analysis

A qualitative approach was taken to analyze the focus group data. The moderator took notes during the focus group session to facilitate the coding and analysis of the data. The notes from the sessions were compiled for analysis. Key ideas were summarized into

an abridged transcript of the salient and useful portions of the sessions. A content analysis was used to identify which learning strategies participants felt were supported by Blackboard. Learning strategy support was confirmed based on the following conditions:

- Several participants *within* a session repeated words, phrases or sentences or made very similar statements concerning particular user-system interactions.
- Participants from *separate* sessions repeated words, phrases or sentences or made very similar statements concerning particular user-system interactions.
- When someone in the group made a statement, a substantial number of participants in the group demonstrated agreement either verbally or nonverbally.

The analysis confirmed the suitability of the theoretical model used to define the domain of the construct to be measured. The analysis also revealed a theme suggesting a discrepancy between participants' perceptions of learning strategy support and actual capabilities of the system. Interestingly this early theme emerged as a significant component of pedagogical utility in a subsequent study to determine the factor structure of the LESSON. This study is described in Chapter 4.

Results

Results indicated that the majority of the strategies by the Zimmerman and Martinez-Pons model were supported by the learning management system (Appendix A). The strategies that were not supported provide preliminary evidence that supports the hypothesis that the design of learning management systems does not fully support strategies associated with self-regulated learning. The results also provide preliminary

support for the development of a questionnaire to evaluate cognitive support in learning management systems and similar learning technologies based on learners' perceptions.

Results also suggest that are other factors that influence the participants' interactions with the system but are beyond the scope of this research and will not be elaborated upon in the chapter. The reported interactions with the system provided sufficient evidence to proceed with the next phase of the project, which is the development of the item pool.

Discussion

The purpose of the focus group was to enhance content validity by gathering participants' perceptions about their interactions with Blackboard, the course LMS. Normally a limitation of this type of study would be the subjectivity of the data based on the participants' knowledge and biases about the system. In fact, user perceptions are central to the construct of *utility* and in fact, provide helpful insights into the discrepancy between intended design and actual use.

Section Two – Expert Review

Introduction

The purpose of a panel of expert reviewers is to evaluate each item in the initial item pool for its relevance to the domain of the phenomenon under investigation. Each expert is asked to judge how relevant each item is to the construct being measured (DeVillis, 2003). An expert panel may also be requested to judge how adequately of a subset of items (subscale) covers a construct. Typically reviewers are invited to comment and provide recommendations to improve the relevance and representativeness of the item pool in order to enhance to the validity of the theoretical model that is the basis of

the questionnaire. This method provides a source of evidence that Messick refers to as "content aspect" and includes evidence of content relevance and representativeness that is central to defining the boundaries and structure of the construct domain (Messick, 1995, p. 6).

Item Development

There is currently no established scale designed to assess the utility of learning management systems with a pedagogical context. Therefore, existing research-based learning strategies scales and items from the educational psychology domain was considered. These items and scales included the Learning and Study Strategies Inventory (Weinstein & Palmer, 2002), the 81 items from the Motivated Strategies for Learning Questionnaire (Garcia & Pintrich, 1995), the Pedagogically Meaningful Learning Questionnaire (Nokelainen, 2006), and the Online Self-regulated Learning Questionnaire (Lan et al., 2004). The 49 items from the Learning strategies scales in the Motivated Strategies for Learning Questionnaire were used as the foundation for the item pool. These items make up the 9 subscales: rehearsal, elaboration, organization, critical thinking, metacognitive self-regulation, time and study environment management, effort regulation, peer learning, and help seeking. These subscales map directly to several of the categories of strategies identified by Zimmerman and Martinez-Pons (Zimmerman, 1986). Although none of Learning Strategies subscale items were used they did provide the conceptual basis for the initial item pool. An initial pool of 117 items representing the 10 subscales or categories of learning strategies identified by Zimmerman and Martinez-Pons as well as the strategies *Peer learning* (renamed Collaboration) and *Elaboration* as identified in the MSLQ.

Data Collection

Participants. Researchers in the area of self-regulated learning were invited to review and evaluate the relevance of each item and the overall representativeness of the items according to each subscale. Each reviewer was required to have a Ph.D. in educational psychology or closely related discipline as well as an established publication record in self-regulated learning.

Recruitment of Panel Members. Ten experts were initially contacted by electronic mail and invited to participate in the study. The experts were asked to review the item pool within a seven-week window. Expert review packages containing the initial 115 items and rating scales, consent forms and information sheet were sent electronically to the reviewers who indicated they were willing and available to participate within the required timeline. Follow-up of non-responders was made via electronic email at the end of the seven-week timeline. A subsequent follow-up was also made after 12 weeks and again after 17 weeks. Ultimately 5 of the original 10 invited reviewers completed the expert review package.

Materials

Description of the Expert Review Package. The task of the expert reviewers was to judge content validity of the items. This involved judging both the relevance of each item to the subscale it represented, as well as the overall representativeness of the subscale items with the subscale it referenced (Messick, 1989). The expert review packages contained the initial 115 items and rating scales, consent forms and information sheet. Each subscale contained a definition of the learning strategy the items in the subscale referenced. A scale that required reviewers to indicate the degree of fit between the item

and its subscale accompanied each item. A consent form and an information sheet were also included in the package.

The item content review consisted of two steps. First, each expert reviewed the 115 PAQ items and used a 5-point scale from "No Fit" to "Excellent Fit" to rate the degree of fit between its content and the subscale definition that the item was intended to measure.

Second, in order to assess item representativeness, reviewers were to indicate if the items they rated as "3" or "4" together represent the specified subscale, if not, they were to comment on or to suggest item revisions. They were also invited to re-write the item if they felt that an item should be worded differently. All of the reviewers' responses were treated confidentially. Reviewers were requested to submit the consent form and review to a secure, password protected web site. A copy of the item content rating package, including the informed consent, information sheet and item review is provided in Appendix B.

Analysis

Assessment of Item Ratings - Content relevance. The responses of the expert reviewers were collected and entered into the Microsoft Excel. The mean for each item was calculated and items with a mean less than 2.00 were excluded from further consideration for inclusion in the item pool. A sample of a compiled subscale is presented in Table 12.

Table 12

Sample of reviewers' rating

	Subscale: Collaboration (Questions 94 - 99)	
Item #	Item	Mean ($\bar{x}$)
14.1	I can use this software to learn from my peers.	3.2
14.2	I can use this software to work on an assignment with other classmates.	3.6
14.3	I can use this software to share information with a classmate.	3.6
14.4	This software does not allow me work with other students from this class to complete the course assignments.	3.6
14.5	I can use this software to learn by observing the work of other classmates.	3.6
14.6	I can use this software to contact a classmate using tools such as email, or chat.	2.8

Assessment of Item Ratings - Content representativeness. The expert reviewers' responses were collected and entered into Microsoft Excel. A rating of YES was assigned a value of 1 while a NO rating was assigned a value of 0. Mean scores for each subscale were calculated. Mean scores greater or equal to 3 were not significantly modified. Mean scores less than 3 were considered not sufficiently representative therefore items were either revised according to reviewer comments and/or additional items were written for that subscale. The results of the content representativeness analysis are presented in Table 13.

Table 13

Results of the content representativeness analysis

	Reviewer					
Learning Strategy (Subscale)	Reviewer 1	Reviewer 2	Reviewer 3	Reviewer 4	Reviewer 5	$\overline{X}$
Self-evaluating	0	1	1	1	1	4
Monitoring	1	0	1	0	1	3
Keeping records	1	0	0	0	1	2
Organizing	0	0	1	0	0	1
Transforming	1	0	1	1	1	4
Goal-setting	1	1	1		0	3
Planning	0	1	1	1	1	4
Seeking help from others	1	1	1	0	1	4
Seeking information	1	0	1	1	1	4
Environmental structuring	1	1	1	1	0	4
Rehearsing and memorizing	1	0	1	1	0	3
Reviewing records	1	1	1	1	1	5
Self-consequencing	0	1		1	0	2
Collaboration	1	1	1	1	1	5
Elaboration	0	1	1	1	0	3

The results of the analysis indicated only 3 subscales were problematic. Revisions to these items are discussed in the following section.

Results

The compiled results of the reviewers' ratings for each item within each subscale are presented in Appendix B. The reviewers' comments pertaining to the items that were included for further consideration were compiled and used to guide the recommended revisions to the individual items. The most common comments were that the items were too general in nature and could be improved by being more specific, for example it was suggested that "I can use this software to study off campus" be revised to, "I use this

software to study off campus to avoid distractions or I like/prefer to use this software off campus to avoid distractions." The majority of reviewers (a) provided feedback in the form of reasons why an item did not fit the specified subscale, (b) suggested which subscale provided a more suitable fit for an item, and (c) provided modifications to an item to improve its representativeness of the subscale to which it was associated. The reviewers' comments and suggestions guided the revisions of the item pool in preparation for the next phase of the LESSON's development –the pilot study.

Discussion

Responses from reviewers provided many useful conceptual insights recommendations that could act improve the quality of the interpretations of the data generated from the LESSON based on the domain delineated by the instrument. Responses also illustrated the challenge of developing an instrument for the broader evaluation community consisting of members with different roles, evaluation goals and different e-Learning systems. Ideally there will be perfect agreement among the reviewers on all items. The discrepancy among reviewers' responses is illustrative of the subjective nature of evaluation. While it is common practice to request a panel of experts to evaluate the questions one must be cognizant of the fact the experts are providing an opinion based on their subject knowledge and constrained by their understanding of the goals of the research. The subjective nature of their responses may unintentionally introduce bias therefore judicious interpretation is recommended (DeVillis, 2003). Another limitation of the expert review study was the number of panel members. Ten reviewers were invited however only 5 participated. A larger sample size would have provided more data to guide the revisions of existing items and creation of new items.

Section Three – Pilot Study

Introduction

A pilot study is a small scale rehearsal of the larger administration of the questionnaire. Conducting a pilot test is generally recommended in the survey design literature (Benson & Clark, 1982; Converse & Presser, 1986; Netemeyer et al., 2003; Presser, 2004). Administering the questionnaire to a sample of the target population is useful in revealing a broad range of issues which may prove problematic during the formal administration of the questionnaire. Issues of instruction and item clarity and understanding, flow and participant interest can be identified at this stage. Preliminary feedback on practical issues such as response time, task difficulty that can be collected through a pilot study allow the investigator to optimize the administration of the questionnaire to the sample population. A small pilot study ($n = 6$) was conducted to determine the readability and clarity of the items, instructions, and response time. A description of this study including the results and discussion follow.

Data Collection

Participants

The pilot sample consisted of six undergraduate students. Three students were from the University of Alberta and three were from Grant MacEwan College. Four of participants were from Education programs, one was from a Science program and one was from a computing science program. Students were recruited informally using the network or "snowball method" in which individuals initially recruited to participate recommend the names of other potential participants who fit the profile of the sample population (Wiersma & Jurs, 2005).

Demographic information. Four of the participants were female. Participants ranged in age from 19 to 24. An initial set of questions was used to screen potential participants based on their experience with the learning management systems Blackboard and/or WebCT. All six individuals who expressed an interested in participating in the pilot were accepted based on their responses to the screening questions.

Instrumentation

The Learning Strategies Support Online (LESSON) was developed to evaluate learners' perceptions of the capability of learning management system software and similar e-learning technologies to support learning strategies associated with self-regulated learning. The first draft of the LESSON consisted of 104 items measuring the fifteen subscales (learning strategies) using a five-point Likert-type response with anchor points of *strongly disagree* and *strongly agree*. The dimensions measured by the LESSON are derived from the literature on learning strategies –in particular those identified by Zimmerman and Pons as associated with self-regulated learning (1986, 1988).

Procedure

Participants met individually with the principal investigator in a computer lab at Grant MacEwan University. Participants were requested to complete an online version of the questionnaire that was available as a Microsoft Word document with interactive forms to collect the participants' responses. Participants were instructed to read each item carefully and to use a think-aloud protocol in order to make explicit any concerns or difficulties with any of the item in terms of spelling, grammar, or comprehensibility, as well as any errors in the questionnaire's form or presentation (Litwin, 1995). Following

the completion of the questionnaire participants were asked probing questions regarding items that previous participants had identified as needing clarification or revision. Participants were also asked to review their responses to each of the questions and offered the opportunity to provide additional comments or suggestions.

Results

The results of the pilot study indicated that the clarity and comprehensibility of the LESSON was satisfactory and did not require any major revisions beyond fixing spelling mistakes and improving clarity of some items. However, several of the participants' comments indicated that the response format, the Likert type "Strongly Agree", "Agree", "Don't Know", "Disagree", "Strongly Disagree" did not provide a suitable fit for some of the items. For example, the item, "The software helps me to write my own notes on important concepts presented in class" prompted one participant to select "Disagree." However, after further discussion, the participant indicated that they *did not know* if there was a feature to make notes inside of Blackboard. Other participants voiced the same concern about this type of.scale. The questionnaire and the participants' comments are found in Appendix A. The ambiguity surrounding their response was indicative of an inadequate or incorrect distinction between "Don't know" and "Disagree", "Strongly Disagree." The items that generated this type of ambiguity were modified by adding a different response format as presented in *Figure 11*.

Using this software to:	Very difficult	Difficult	I don't know if the software does this	Easy	Very easy
1. Check how well I have done on an assignment is	○	○	○	○	○
2. Check if I've made mistakes on assignments is	○	○	○	○	○
3. Access course material is	○	○	○	○	○

Figure 11. Sample of revised item stem and response format

In addition, items which began with the same declarative statement, for example, "Using this software to…" were grouped under a single item stem as shown in Figure 12. The method addresses the issue of response fatigue by grouping those items under a single, common stem which reduces the repetitive nature of reading items with identical wording by.

Using this software to:	Very difficult	Difficult	I don't know if the software does this	Easy	Very easy
11. Find resources to help me learn what is being taught in the course is	○	○	○	○	○
12. Access web-based resources to help me complete a task or assignment is	○	○	○	○	○
13. Find information about an assignment is	○	○	○	○	○

It is very simple to use this software's tools to:	Strongly Disagree	Disagree	I don't know if the software does this	Agree	Strongly Agree
21. Memorize the concepts presented in class.	○	○	○	○	○
22. Pull together information from different sources, such as lectures, readings, videos and discussions.	○	○	○	○	○
23. Prepare for tests by reviewing the course notes.	○	○	○	○	○

This software's tools make it very easy to:	Strongly Disagree	Disagree	I don't know if the software does this	Agree	Strongly Agree
46. Summarize the main ideas from the lectures and readings.	○	○	○	○	○
47. Take notes from the lectures.	○	○	○	○	○
48. Set goals for what I want achieve for each of the assignments in this course.	○	○	○	○	○

Please select the appropriate response to the following questions.	Strongly Disagree	Disagree	I don't know if the software does this	Agree	Strongly Agree
66. I can use tools such as rubrics and mark sheets, etc. to check over my work to make sure I did it right	○	○	○	○	○
67. I can't use this software to ask the instructor a question.	○	○	○	○	○

Figure 12. Items grouped under common declarative statement

Discussion

A pilot study can provide useful feedback to optimize the administration of the questionnaire to the development sample. This study identified problems with response formats and grammatical errors in the questionnaire. It also indicated task completion time. However, the study was not an exact small scale replication of the larger study. The pilot involved individual sessions with the 6 participants whereas the administration of

the questionnaire to the development sample was conducted as a series of group sessions involving 3 cohorts over 12 months. This difference in interview structure manifested as a differential level of control over the sessions. The individual sessions provided a higher degree of investigator-participant interaction; the questionnaire was already displayed on the computer; participant questions were answered promptly and the interview schedule was consistent across all six session. In contrast, the administration of the questionnaire to the group sessions involved increased task completion time in order to (1) allow participants to log in to the course LMS, (2) direct participants to the web survey, (3) provide instructions, and (4) answer questions. Nevertheless, the pilot test was an invaluable precursor to the administration of the LESSON questionnaire to the development sample that is described in Chapter 4.

CHAPTER FOUR

Empirical Validation of the LESSON Questionnaire

Introduction

This section describes the empirical validation methodology and results of the statistical analysis including descriptions of the data collection procedures, development sample, statistical significance tests and exploratory factor analysis. The purpose of this study was to determine the dimensions measured by the LESSON by examining the relationships among the items in the LESSON using exploratory factor analysis in order to identify and interpret the number of latent factors. The results of the factor analysis will address the objective outlined at the start of Chapter 3:

- To determine the factor structure of LESSON questionnaire.
    - To administer LESSON to a large development sample.
    - To conduct exploratory factor analysis to determine the number of latent factors measured by the LESSON.

The results will also inform the responses to the research questions which have guided this thesis:

- Do the capabilities of these systems introduce new learning strategies not previously identified in specific models of self-regulated learning?
- What is the factor structure of the LESSON questionnaire?

A brief overview of exploratory factor analysis precedes the section describing the analysis of the empirical validation data.

Factor Analysis

Exploratory analysis serves two purposes: explanation and data reduction ((Floyd & Widaman, 1995). Exploratory factor analysis (EFA) is a statistical technique that is used to uncover the relationships between the variables in a data set. A factor is a variable which accounts for the covariance between a number of variables. Relationships among the variables are revealed in correlation matrices indicated by correlation coefficients. These correlation coefficients are known as factor loadings. The nearer the correlation coefficient approaches +1 the stronger the relationship between the variables. Variables which indicate a strong intercorrelation suggest that they are measuring or loading on the same factor. Factor loadings indicate a singular construct or dimension. Thus, one of the functions of EFA is to reduce the number of variables to unique factors –in other words the factor structure (Kim & Mueller, 1978). The final form of the LESSON would be a reduced number of items based on the factor structure as determined by the correlation matrix. The factor structure or number of dimensions should be directly related to the number of learning strategies identified in the conceptual framework of the LESSON. The results of the factor analysis appear later in this section.

Empirical Validation Methodology

Data Collection

The purpose of the study was to further develop and refine the LESSON questionnaire and report the results of the data analysis. The study was introduced to the two instructors who peer taught a cross-listed nursing course consisting of 4 identical sections in February 2008. The instructors had implemented the web-enhanced course design the prior semester and were interested in obtaining student feedback and research

data on the efficacy of the hybrid design. Permission was granted to the researcher to invite student participation in the study over 3 data collection sessions occurring in April and November 2008 and April 2009. The course web site design, curriculum and instructors did not change over this period of time thereby reducing variability that might be introduced over time.

Instrumentation

The Learning Strategies Support Online (LESSON) was developed to evaluate learners' perceptions of the capability of learning management system software and similar e-learning technologies to support learning strategies associated with self-regulated learning. The instrument had previously undergone an expert review, pre-pilot and pilot testing as part of the validation process. The dimensions measured by the LESSON are derived from the literature on learning strategies. Of particular interest are those identified by Zimmerman and Pons as associated with self-regulated learning (Zimmerman & Martinez-Pons, 1988; Zimmerman, 1986). Participants were also invited to provide comments about their interactions with Blackboard in a comment box at the end of the questionnaire. The study was introduced to the Nursing Practice Foundations students in their classroom one week prior to the data collection sessions. Participation in the study was voluntary. Data was collected over 3 semesters using 3 different cohorts. The data was collected during the final week of the semester in order to maximize the amount of time participants had to interact with the system as part of the requirements of the course.

LESSON Format. The LESSON is a web-based 101-item Likert-type rating scale using a 5 point response format with anchor points of strongly disagree and strongly

agree. The mid-point of the response scale used the statement "I don't know if the software does this". This qualitatively different response from the other points on the scale and is coded as missing data in the factor analysis.

Participants

Three hundred and twenty-seven post-secondary students participated in the study (F = 287, mean age = 22.5, SD = 5.38 [range, 18-52]). Participants were drawn from a Baccalaureate Nursing program at Grant MacEwan University that provided access to a convenience sample of students enrolled in a first year Nursing Practice Fundamentals course that used Blackboard to support the delivery of the course using blended learning. The students were enrolled in a first year nursing course, *Nursing 175 Nursing Practice Foundations*. A single course web site using Blackboard (version 8.0) supported several sections of Nursing 175. The sample was selected based on sample size, homogeneity of the sample, consistency of the course web site design and instructional design and complexity of user-system interactions. Analysis of the demographic data indicated the average number of years of post secondary education was 1.93 and the majority of students had experience with learning management systems. The mean age was 22.5 and majority of the sample were female. This sample was selected based on several important characteristics:

- Sample size
- Homogeneity of the sample
- Characteristics of the course learning design
- Consistency of the instructional design
- Characteristics of the sample

Sample size. Spector (1992) recommends a sample size that is between 100 – 200. Rogers (personal communication March 2, 2007) recommends an item-to-participant ratio of 1:5, while others recommend 300 participants as a sufficiently large enough size to eliminate subject variance as a significant concern (DeVillis, 2003). The sample selected for this study was large enough to sufficiently follow the above noted recommendations.

Homogeneity of the sample. The issue of prior knowledge of and experience with Blackboard was a consideration in the design of this study. Although participants were instructed to only consider their interactions with the Nursing 175 Nursing Practice Foundations course web site it was advantageous to ensure that one of the sample's characteristics was a limited experience with Blackboard. Nursing 175 is a first year, which further limits the extent to which the participants would have previous experience in other courses that also used Blackboard. Other characteristics that the participants would generally have in common are age, gender, and program of study. A statistical analysis of the homogeneity of the sample was conducted. The analysis and results of the analysis appear later in this chapter.

Learning design. (also known as instructional design), was an important consideration in the selection of this sample. The LESSON is designed to collect data about user-system interactions –in particular learning strategy support. It is common for courses that use a LMS to facilitate either an online or blended learning design to simply replicate traditional classroom instructional practices such as lecture notes, readings, quizzes, term papers, exams. Learning designs that engage the learner in a variety of activities that require the use of different learning strategies is more likely to result in richer, more

complex user-system interactions compared with a learning design that places the learner in a more passive role as recipient of information in the form of lecture notes. While Nursing 175 had many of the characteristics of the traditional classroom, it also embedded activities and accompanying tools that required the use of strategies associated with self-regulated learning. For example, students were required to maintain a weekly reflective journal to examine their own observations and activities in clinical practice. The purpose of this activity was to encourage students to engage at a deeper level through analysis of their lived experience. Assignments were accompanied by a rubric to support better task understanding and self-evaluation practices. A FAQs board also allowed student-student and student-teacher assistance. Finally, the collection of course materials and supplemental resources facilitated students' ability to seek information. A screen shot of the extensive resources available on the course home appears in Appendix G.

Homogeneity of the course web site design. The validity of the data would be compromised if there were variations in the learning design of the course across the 3 sections. Variation in the learning design across sections would cause variations in the user-system interactions across student experiences. For example, a learning design that integrated collaborative or cooperative learning facilitated through a course discussion board would likely result in participants responding differently to items designed to measure the learning strategy "seeking assistance" when compared with participants in a class which did not use collaborative or cooperative learning and therefore did not integrate communication tools that might support this instructional method. Similarly, the use of weekly quizzes or self-tests within Blackboard which are designed to enable students to monitor comprehension would likely elicit different responses when

compared with participants whose course did not provide an explicit method of self-monitoring via the Blackboard environment. A course design that posts interim assignment marks would likely result in participants responding differently to the items designed to measure the learning strategy "self-evaluation" when compared with participants in a class which only posted final grades. Finally, a site designed to enable students to review graded quizzes while another site design did not would affect how participants responded to the items that measure "reviewing records". Therefore use of a single course web site effectively held web site design constant and reduced its effects as a significant confounding variable.

Nursing Practice Foundations: Description of Course and Structure

Nursing Practice Foundations is a traditional face-to-face course that uses Blackboard to (1) support communication, (2) access to course content, and (3) course administration. Learning activities in the course included class lectures, lab, and clinical practice as shown in the course syllabus found in Appendix F. The theoretical component builds on knowledge learned from all pre- and co-requisite courses Class activities included a variety of individual and group learning activities to encourage the student to think critically and apply knowledge to case studies. The course design includes three core components: (1) face-to-face instructor led lectures, (2) face-to-face instructor led lab and simulation activities and, (3) instructor-supervised clinical practice. Instructional strategies used in the classroom included direct teaching, lecture, lecture with discussion, brainstorming, concept mapping, case studies, worksheets and guest speakers. Assignments included weekly reflective journaling and online quizzes. Course topics include: *The Context of Nursing Practice; Promoting Safety in Nursing Practice;*

Meeting Client Bio/psycho/social/cultural/spiritual Needs; and Approaches to Nursing Practice.

Procedure

The study was introduced to Nursing 175 students in their classroom one week prior to the data collection sessions. Either the researcher or one of the nursing instructors read aloud the "Participation Information Sheet" to the students. This information sheet was prepared by the researcher in order to provide information on the study's background, purpose, risks and benefits. This information was also displayed in web form as part of the LESSON's Participant Consent protocol that participants could read prior to beginning the questionnaire. Participation in the study was voluntary. Participants assembled in a computer lab during regular class time. The researcher briefly reiterated information about the study followed by instructions on how to access the web-based questionnaire that appeared as a link on the Nursing 175 course web site. Participants were requested to refer only to their interactions with the Nursing 175 course website when responding to the questions and not to consider their interactions with Blackboard that occur in other courses. All participants completed the questionnaire within 30 minutes.

Analysis

In some cases small sample sizes requires researchers to collected data from more than one sample over a period of time. This may result in variations in subject characteristics between samples. This may be due to subject characteristics evolving over time or changes in the (learning) environment over time. It is important to test for between group equivalency to identify possible bias introduced by one of the cohorts.

Two separate SPSS MANOVA procedures were conducted to verify the homogeneity of the pooled sample. A description of each test and their results are provided below.

Between-Group Differences

Demographic homogeneity. A multivariate analysis of variance (MANOVA) was used to evaluate the homogeneity of the three cohorts based on the demographic data (1) age, (2) gender, (3) level of post-secondary education completed, (4) previous LMS training.

$H\_0: \mu\_1 = \mu\_2 = \mu\_3$

$H\_\alpha: \mu\_1 \neq \mu\_2 \neq \mu\_3$

Results

Descriptive statistics show that the size of groups 1 and 3 were similar; group 2 was the least similar in size.

Between-Subjects Factors

		N
Group	1.00	116
	2.00	92
	3.00	119

Descriptive Statistics

	Group	Mean	Std. Deviation	N
Post Secondary Years	1.00	1.98	1.351	116
	2.00	1.87	1.491	92
	3.00	1.79	1.572	119
	Total	1.88	1.472	327
Blackboard Training	1.00	1.14	.346	116
	2.00	1.25	.435	92
	3.00	1.43	.497	119
	Total	1.28	.447	327
Age	1.00	23.67	6.733	116
	2.00	23.00	4.941	92
	3.00	21.18	3.746	119
	Total	22.58	5.392	327
Gender	1.00	1.85	.355	116
	2.00	1.84	.371	92
	3.00	1.93	.251	119
	Total	1.88	.328	327

We used an alpha level of .05 for all statistical tests. Box's test of equality indicates a significant difference between the groups: $F(20, 337847.9)=4.830$, $p < .001$).

Box's Test of Equality of Covariance Matrices[a]

Box's M	98.379
F	4.830
df1	20
df2	3.378E5
Sig.	.000

Multivariate tests' results also found statistically significant differences between groups.

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.988	6.341E3	4.000	321.000	.000	.988
	Wilks' Lambda	.012	6.341E3	4.000	321.000	.000	.988
	Hotelling's Trace	79.013	6.341E3	4.000	321.000	.000	.988
	Roy's Largest Root	79.013	6.341E3	4.000	321.000	.000	.988
Group	Pillai's Trace	.132	5.672	8.000	644.000	.000	.066
	Wilks' Lambda	.869	5.842[a]	8.000	642.000	.000	.068
	Hotelling's Trace	.150	6.010	8.000	640.000	.000	.070
	Roy's Largest Root	.146	11.744[b]	4.000	322.000	.000	.127

Variance-Covariance Matrix Homogeneity

A separate MANOVA procedure was used to evaluate between-group homogeneity of responses to the items. Box's test of equality indicates a significant difference between the groups: F (4186, 162798.3) =1.228, $p < .05$).

Multivariate tests also found statistically significant differences between groups.

Multivariate Tests[c]

Effect		Value	F	Hypothesis df	Error df	Sig.	Partial Eta Squared
Intercept	Pillai's Trace	.995	470.245	91.000	234.000	.000	.995
	Wilks' Lambda	.005	470.245	91.000	234.000	.000	.995
	Hotelling's Trace	182.873	470.245	91.000	234.000	.000	.995
	Roy's Largest Root	182.873	470.245	91.000	234.000	.000	.995
Group	Pillai's Trace	.689	1.358	182.000	470.000	.005	.345
	Wilks' Lambda	.428	1.361[a]	182.000	468.000	.005	.346
	Hotelling's Trace	1.066	1.365	182.000	466.000	.005	.348
	Roy's Largest Root	.638	1.647[b]	91.000	235.000	.001	.389

Discussion

The purpose of this MANOVA was to evaluate the homogeneity of the groups. The original hypothesis was that there was no significant difference between the groups. While Box's Test of Equality shows a significance difference these statistics were

extremely sensitive because of large numbers of degrees of freedom of the denominator. Therefore, although the results indicate a statistically detectable difference between subjects –which is contrary to expectations, they are not of practical significance. The Multivariate Test further corroborates this interpretation. Again, although $p < 0.001$ indicate a statistically detectable difference the magnitude of the effect size is small for all 4 variables. An effect size of 0.2 to 0.3 is considered to be "small" in magnitude, around 0.5 is a "medium" effect size and 0.8 to infinity, a "large" effect size in the behavioural and social sciences (Cohen, 1988). Thus, while the variance between groups appeared to be statistically significant it was not of practical significance. Given these results, the groups have homogeneity. The interpretation of these results was further substantiated by the second MANOVA that evaluated the homogeneity of the groups based on the item scores of the variance-covariance matrices. Although a statistically significant difference was found, the effect size in all of the Multivariate Tests and Between-Subjects Tests were small based on Cohen's levels and therefore not of practical significance. The results of these tests are reported in Appendix D.

It is useful to discuss the value of statistical significance testing and its predominant role as the standard for interpretation of statistical significance often at the expense of other significant and more meaningful measures such as effect size (Shaver, 1993). Critics of this practice, such as Shaver (1985), Biskin (1998) and Vacha-Haase (1998) provide well-constructed; persuasive arguments that statistical significance must be carefully interpreted based on the context in which they are used and in relation to other statistical measures. For example, Biskin notes "accurate significance testing requires randomization (random sampling or assignment) to be interpretable". This point

is central to this present study since the sampling procedure used non-random convenience sampling which, according to Biskin, given a sufficiently large sample "will usually result--correctly--in rejection of the null hypothesis because the groups compared do not, in fact, belong to the same population". Biskin argues that in some cases, effect size should be of prime consideration. This argument is echoed by other critics who argue that attention be paid to effect size (Carver, 1993). The fourth edition of the American Psychological Association style manual recognized the inherent deficiencies of statistical significance tests and encouraged researchers to provide effect size information (p. 18). For the purposes of this thesis, the term *effect size* refers to "any statistic that quantifies the degree to which sample results diverge from the expectations" (Vacha-Haase & Thompson, 2004) which can be used to inform the judgment regarding the practical significance of study results (ibid). Our interpretation of the statistical significance tests and effect sizes produced by these MANOVAs followed that line of reasoning leading to the conclusion that despite a statistically detectable difference, the small effect size suggests that this difference is not of practical significance.

Factor Analyses

An exploratory factor analysis of the LESSON and internal consistency measures were conducted in order to identify and interpret the number of latent factors (Kline, 1994). Data were imported from a Microsoft Excel file into SPSS 15.0. In order to avoid missing data the design of the LESSON used a forced response feature that prevented participants from leaving any questions unanswered. The response scales were corrected for reversed-polarity items. However, the scale included "I don't know if the software does this" at the midpoint. Therefore, data points that recorded this response were treated

as missing data. The means scores on those items were substituted using the *Missing data* function in SPSS 15.0.

The analysis is presented beginning with the rationale for the extraction method, a description of the rotation procedures and the results of preliminary statistical tests to confirm the suitability of data for factor analysis.

The iterative nature of exploratory factor analysis requires a variety of statistical measures in order to determine the adequacy of the solution. A variety of extraction methods and rotations were explored with each iteration leading to modifications of the tests' parameters in order to optimize the results. However only the most interpretable solution that reflects the theoretical model used in this thesis is described here. The results of the factor analysis are preceded by a brief description of an initial analysis that resulted in a data reduction in order to optimize the results of the factor analysis.

EFA is used to "identify the factor structure or model for a set of variables" (Bandalos, 1996). There are two factor analytic models –principal component analysis (PCA) and principal axis factoring (PAF). Although both methods were initially used to explore potential solutions using a variety of parameters PAF was ultimately selected for use in the final analysis. Several important considerations resulted in the selection of PAF as the preferred method over PCA. First, the purpose of the analysis was to model the structure of the correlations based on the theoretical framework used in the design of the LESSON that was hypothesized to measure 14 learning strategies (variables). Oblique rotations were performed because of the presumed correlated nature of the factors. By contrast, PCA is primarily used as a method of data reduction (Fabrigar, Wegener, MacCallum, & Strahan, 1999; Floyd & Widaman, 1995). Second, PAF is well suited for

testing a hypothesized factor structure (Gorsuch, 2003). Third, PAF provided the most interpretable solution and presented a factor structure that supported the original hypothesis (Fabrigar et al., 1999). Finally, PAF is most suitable for detecting structure by answering questions such as

- "How many factors?"
- "What are the factors?"
- "What is the relationship amongst the factors?"

These questions are a subset of the question identified in early in this thesis –"What is the factor structure of the questionnaire developed in this thesis?"

In order to obtain the best fitting factor structure and a correct number of factors two variables were removed from the variable set. First, *self-consequencing* as it was not of strong practical utility. Second, the variables measuring *elaboration* were not adequately represented in the questionnaire and did not load well in the preliminary factor analyses. In addition, several of the reverse-worded items were removed due to the ambiguity of the item's direction.

Two statistical tests were done to determine the suitability of the data for EFA. These were Bartlett's Test of Sphericity and Kaiser-Meyer-Olkin (KMO). The results are reported in

Table 14.

A number of criteria were used to determine the number of factors to extract including a priori criterion and the latent root criteria. Principal axis factoring method with Promax using Kaiser Normalization with factors set to 12 and a factor loading 0.30 or greater was conducted. The internal consistency measure Cronbach's alpha (Cronbach,

1951) was computed to identify the reliability of the LESSON sub-scales following completion of factor analysis.

Results

Sampling Adequacy and Exploratory Factor Analysis

Bartlett's test of sphericity (chi-square 12660.732, df = 2278, $p < 0.001$), indicated that the intercorrelations were satisfactory, while the KMO measure was high (0.935), indicating low partial intercorrelation among items. Kaiser identified KMO measures of 0.80 and above as 'meritorious', and Field (Field, 2005) recommends values of 0.60 and above for good factor analysis. The above findings indicated that factor analysis was appropriate for this set of variables.

EFA using principal axis factoring (promax rotation) was implemented. Fourteen eigenvalues above one were found Table 14

Table 14

KMO and Bartlett's Test

KMO and Bartlett's Test

Kaiser-Meyer-Olkin Measure of Sampling Adequacy.		.935
Bartlett's Test of Sphericity	Approx. Chi-Square	12660.732
	df	2278
	Sig.	.000

The number of eignenvalues greater than one indicated that 14 factors should be retained (Kaiser, 1960) as shown in

Table 15. However when the a priori criterion and latent root criterion were examined together it was decided that a 11 factor solution would provide the most interpretable solution. The results of this final 11-factor, principal-axis, oblique-rotated solution are reported in Table 16 . Loadings of < 0.3 have been omitted for clarity. In exploratory analysis factor loadings are considered meaningful when they exceed .30 or .40 (Floyd & Widaman, 1995). Initial communalities estimates are reported in Appendix E.

Table 15

Total Variance Explained

Factor	Initial Eigenvalues			Rotation Sums of Squared Loadings(a)
	Total	% of Variance	Cumulative %	Total
1	21.196	31.171	31.171	15.925
2	3.696	5.435	36.605	12.356
3	2.564	3.771	40.376	9.410
4	2.511	3.693	44.069	10.205
5	2.005	2.949	47.018	13.377
6	1.695	2.492	49.510	7.858
7	1.526	2.244	51.754	8.309
8	1.474	2.168	53.922	10.888
9	1.368	2.012	55.934	5.515
10	1.281	1.884	57.817	5.087
11	1.212	1.782	59.599	10.209
12	1.138	1.674	61.274	
13	1.088	1.600	62.874	
14	1.024	1.506	64.379	
15	.981	1.442	65.822	
16	.961	1.414	67.235	
17	.892	1.312	68.548	
18	.858	1.262	69.810	
19	.843	1.240	71.050	
20	.800	1.177	72.227	
21	.782	1.149	73.376	
22	.739	1.087	74.463	
23	.724	1.065	75.529	
24	.701	1.030	76.559	
25	.668	.982	77.541	
26	.642	.943	78.484	
27	.632	.930	79.414	
28	.627	.922	80.336	
29	.623	.916	81.252	
30	.577	.848	82.100	
31	.556	.818	82.918	
32	.543	.798	83.717	
33	.532	.783	84.500	
34	.498	.733	85.232	
35	.491	.722	85.954	
36	.472	.694	86.649	
37	.456	.670	87.319	
38	.443	.652	87.971	
39	.432	.636	88.606	
40	.414	.609	89.215	
41	.401	.589	89.804	
42	.395	.581	90.385	
43	.381	.560	90.946	

Table 16

Exploratory factor analysis of the Learning Strategies Support Online (LESSON) with principle axis factoring (PAF) extraction and Promax rotation

		Factor										
		1	2	3	4	5	6	7	8	9	10	11
Q47	Organizing - Take notes from the lectures	.876										
Q46	Organizing - Summarize main ideas from lectures and readings	.770										
Q24	Keep records - Make notes about important concepts	.723										
Q54	Keep records - Take notes based on class discussion	.646										
Q62	Keep records - Write my own notes	.635										
Q34	Organizing - Make lists of important concepts	.617										
Q45	Organizing - Write brief summaries of main ideas	.605										
Q48	Planning - Set goals for what I want to achieve for each assignment	.420										
Q39	Review records - Review my notes in preparation for tests	.321										
Q53	Organizing - Outline the material to help organize thoughts	.312										
Q35	Organizing - Make simple charts, diagrams or tables	.309										
	Review records - Review course content to prepare for an exam											
Q58	Self-evaluation - Judge how well I am doing in the course		.942									
Q59	Self-evaluation - Check if I achieved the grade I set to achieve		.905									
Q30	Monitor Comprehension - Monitor my performance		.790									
Q52	Self-evaluation - Check my progress in the course		.720									
Q82	Review records - This software makes reviewing course content for exam difficult		.393									
Q10	Seeking help - Ask instructor for help		.351									
Q38	Keep records - Record the marks I received on tests		.322			.310						
	Monitoring Comprehension - I can use tools such as rubrics to check over my work											

		Factor										
		1	2	3	4	5	6	7	8	9	10	11
Q7	Goal setting - Identify tasks that need to be completed			.823								
Q8	Planning - Decide when tasks need to be completed			.736								
Q6	Goal setting - Determine my learning goals such as what needs to be done before next class			.577								
Q3	Seeking Info - Access course material			.463								
Q13	Seeking Info - Find information about an assignment			.362				.341				
Q1	Self-evaluating - Check how well I have done on an assignment											
Q32	Collaboration - Share information with a classmate				.778							
Q9	Seeking help - Ask a classmate for help				.707							
Q56	Seeking help - Get help on an assignment from classmate				.698							
Q17	Collaboration - Collaborate with a classmate using tools such as email				.669							
Q49	Collaboration - Work on an assignment with classmate				.656							
Q40	Collaboration - Learn from my peers				.565							
Q74	Collaboration - This software has tools that support collaborative learning				.377							
Q10	Seeking help - Ask the instructor for help on an assignment											
Q73	Goal-setting - This software helps me to set goals to complete assignments on time					.740						
Q71	Planning - This software does not help me plan my homework activities					.603						
Q39	Planning - Record when assignments are due					.593						
Q36	Planning - Plan homework activities	.307				.586						
Q42	Planning - Plan when to study for an exam					.580						
Q75	Planning - This software does not help me to identify which tasks need to be completed		.324			.474						
Q61	Planning - Plan what I should review for a test					.448						
Q28	Planning - Plan a weekly schedule to meet assignment deadlines					.408						
Q57	Goal-setting - Help me set a goal for the final grade					.306						
Q77	Keep records - I can use tools within software to write my own notes						.557					
Q5	Transforming - Download lecture notes so that I can edit them (highlight, mark up annotate)						.532					
Q50	Transforming - Add notes to important passages of text						.519					

		Factor										
		1	2	3	4	5	6	7	8	9	10	11
Q80	Keep records - It's very difficult to use this software to write my own notes						.497					
Q4	Transforming - Change the appearance of the lecture notes						.447					
Q25	Transforming - Modify or add to my lecture notes						.432					
Q63	Monitor Comprehension - Monitor if I understand what is being taught							.686				
Q81	Monitor Comprehension - This software makes it easy to check if I understand course readings							.634				
Q51	Monitor Comprehension - Check if I understand the material							.525				
Q55	Seeking Info - Find out more about an assignment							.392				
Q16	Environment - Complete assignments on the weekend								.899			
Q15	Environment - Complete the assignment at home								.884			
Q64	Environment - Study in a location I prefer								.515			
Q44	Environment - Study off campus								.469			
Q37	Review records - Re-read passed tests or quizzes									.795		
Q33	Rehearse/Memorize - Memorize answers from passed tests									.673		
Q2	Monitor Comprehension - Check if I have made mistakes on assignments											
Q12	Seeking Info- Access web-based resources										.512	
Q11	Seeking Info - Find resources to help me learn what is being taught										.479	
Q68	Seeking Info - If I am unsure about a task I can use this software to find information										.355	
Q83	Seeking Info - This software provides links to supplemental information that can help me										.308	
Q27	Rehearse/Memorize - Memorize key words to remind me of important concepts											.592
Q21	Rehearse/Memorize - Memorize concepts presented in class											.543
	Rehearse/Memorize - When studying I read class notes over and over											
	Organizing - Organize the content presented in the course											

Internal Consistency

Reliability is an indication that the scale consistently reflects the construct that it is measuring (Cronbach, 1951; Field, 2005). The dimensionality of the scale was estimated through exploratory factor analysis. Internal consistency of each resulting subscale was estimated by computing Cronbach alpha. The internal reliability for ten of the 11 subscales met the conventional criteria of 0.70 for exploratory factor analysis: 0.907 (Subscale 1), 0.838 (Subscale 2), 0.843 (Subscale 3) 0.872 (Subscale 4), 0.876 (Subscale 5), 0.792 (Subscale 6), 0.791 (Subscale 7), 0.820 (Subscale 8), 0.721 (Subscale 9), 0.685 (Subscale 10), 0.732 (Subscale 11).

Discussion

Criteria for Factor Retention

The identification of the factor structure (or dimensions) follows Henson et al. recommendation of both multiple criteria and reasoned reflection. The first criterion is based on a combination of indicants and their loadings. According to Thorkildsen (Thorkildsen, 2005) factors (dimensions) can be kept reliable if they:

- Contain four or more indicants with loadings that are each greater than the absolute value of |.60| regardless of the sample size.
- Contain three or more indicants with loadings that are each greater than the absolute value of |.80| regardless of the sample size.
- Contain ten or more indicants with low loadings (near +/-.40 for sample sizes less than 150

Given these guidelines, the investigator chose to retain factors 1 – 11 indicating that the LESSON is a multidimensional scale consisting of 11 subscales. Each subscale

was named based on an analysis of which learning strategy the collection of variables in the subscale theoretically represent regardless of their original label. Some variables loaded on two factors which may be attributed to a conceptual overlap or how the item was interpreted by the participants. In this case the loading which provided a stronger conceptual interpretation was retained. The use of these criteria resulted in 54 items being retained with each of the 11 factors being composed of items from the original theoretically hypothesized subscales. The factors (or dimensions) were labeled based on either the original subscales from which the items were derived or based on a composite of the items that loaded on that factor. In certain instances, the item with the highest loading served as the primary indicator of that factor's identity. Thus, Factor 1 is labeled *Note taking* as the composite of retained items are indicative of note taking activities. The naming and description of each dimension are delineated in this section.

Formation of Final Dimensions and Item Retention

Analyses of the 54 items revealed 11 interpretable factors. However, several dimensions in the initial questionnaire were revised taking into consideration the findings of the factor analyses. The 11 factors were quite well defined, that is, there were very few items that significantly loaded on more than one factor, and items that loaded together on factors were almost all from the same group of items developed to measure separate learning strategies. The dimensions are presented in Table 17.

Table 17

LESSON Dimensions and related items

Dimension	Items
Note taking	47, 46, 24, 54, 62, 34, 45, 48, 53, 39, 35
Self-evaluating	58, 59, 30, 52, 82, 10, 38
Goal-setting	7, 8, 6, 3, 13, 1
Collaboration	32, 56, 9, 49, 40, 74
Planning	73, 36, 42, 39, 71, 42, 28, 61, 75, 57
Monitoring comprehension	63, 81, 51, 55
Environmental structuring	15, 16, 64, 44
Transforming	5, 4, 50, 25, 77
Reviewing records	37, 33
Rehearsing and memorizing	21, 27
Seeking information	68, 12, 11

The subscale modifications reported in this section reflect both our empirical findings and conceptual understandings acquired from the literature on self-regulated learning strategies. The need to limit the final number of items in the LESSON questionnaire to a manageable size required the retention of selected items from the dimensions that contain more than 4 items. The naming and description of each dimension, and items retained are delineated in this section.

Factor 1 – Note taking. The first dimension was marked by eleven items that were originally designed to measure several different learning strategies. Six of the items were originally derived from the learning strategy Organizing; 3 strategies were originally from Keeping records; 2 items were from Reviewing records and 1 item from Planning. However, the items appear to be conceptually related to the concept of note taking therefore all items were retained and combined into one dimension labeled as "note taking". Items 24, 46 and 47 were retained in the final version of the questionnaire. The remaining items were removed because of their similarity to the retained items.

Factor 2 – Self-evaluating. The second dimension is a combination of conceptually related items from Self-evaluating, Monitoring comprehension, Reviewing records and Seeking help. Conceptually they represent the learner's judgment of the quality of their performance. Items 58, 59, 30 and 52 were retained based on their higher factor loading and their conceptual similarity.

Factor 3 – Goal-setting. Items representing several different categories of learning strategy comprise this dimension- including Goal setting, Planning, and Seeking information. Conceptually they represent the learner's identification of tasks and efforts to find information related to the successful completion of those tasks. Items 7, 8 and 6 were retained based on their higher factor loading and their strong conceptual similarity.

Factor 4 – Collaborating. The fourth dimension is composite of 5 items from *Collaboration* and 3 items from *Seeking help*. Conceptually these items share a focus on activities related to collaborative learning. Items 32, 56, 9 and 49 were retained based on their higher factor loading.

Factor 5 – Planning. The items in this dimension represent the learner's effort to schedule tasks and study activities. Items 73, 71, 36, and 39 were retained based on their higher factor loading.

Factor 6 — Transforming. This dimension is composed of items that represent the learner's efforts to change the appearance of instructional materials to improve learning. Items 5, 77, 50 and 4 were retained based on their higher factor loading and their strong conceptual similarity.

Factor 7 – Monitoring comprehension. This dimension represents the learner's efforts to determine their understanding of course content during learning and studying

activities. Items 63, 81, and 51 were retained based on their higher factor loading and their strong conceptual similarity.

Factor 8 – Environmental structuring. The items in this dimension represent the learner's efforts to select or arrange the physical environment which is most suitable for their learning and studying activities. Items 16, 15, and 64 were retained.

Factor 9 – Reviewing records. This dimension measures the learner's effort to re-read instructional materials. Both items were retained.

Factor 10 – Seeking information. The items in this dimension represent the learner's effort to find further task information and resources from non-social sources when undertaking a task or assignment. All of the items were retained.

Factor 12 – Memorizing. The items in this dimension represent the learner's effort to memorize information presented in instructional materials. Both items were retained.

Summary of Study Results

The purpose of this study was to seek answers to the research questions which have guided this thesis by administering the LESSON questionnaire to a development sample in order to conduct an exploratory factor analysis to determine (a) the factor structure, and (d) the underlying dimensions of the instrument. This section summarizes the findings of the factor analysis in response to those questions as well as the dimensions of the finalized scale.

Research Question 1 - Do the capabilities of the sampled learning management system introduce learning strategies not previously identified in specific models of self-regulated learning?

Although the results of this study did not introduce learning strategies that had not previously been identified in the Zimmerman and Pons model, several interesting results emerged from the study. First, results suggest that several of the self-regulated learning strategies, which the Zimmerman and Pons model identify as conceptually overlapping or unified, are actually separate and distinct strategies. Table 18 illustrates this finding.

Table 18

Comparison of learning strategies and dimensions identified in LESSON questionnaire

Categories of strategies (from Zimmerman and Pons, 1986)	LESSON Questionnaire dimensions
Self-evaluation	Self-evaluating
Organizing and transforming	Transforming
Goal-setting and planning	Goal-setting
	Planning
Seeking information	Seeking information
Keeping records and monitoring	Monitoring comprehension
Environmental structuring	Environmental structuring
Self-consequences	
Rehearsing and memorizing	Rehearsing and memorizing
Seeking social assistance	Collaboration
Reviewing records	Reviewing records
Other	Note taking

These findings indicate that the strategies "transforming"; "monitoring comprehension"; and "goal-setting and planning" are conceptually distinct from their counterparts originally identified by Zimmerman and Pons. Second, the new model created by the researcher for this thesis identified two new learning strategies not represented by the original Zimmerman and Pons model. These strategies are "note taking" and "collaboration". Finally, the factor analysis suggests that "keeping records" and "organizing" are conceptually overlapping and were therefore integrated into a new

dimension labeled "note-taking". Thirty-four items were retained in the final version of the LESSON questionnaire developed and validated in this thesis.

Research Question 2 - What is the factor structure of the LESSON questionnaire?

The results of this study provide evidence that the LESSON questionnaire is comprised of 11 dimensions. These dimensions closely matched with those proposed by Zimmerman and Pons (Zimmerman & Martinez-Pons, 1988) which provided the theoretical framework for the design of the questionnaire. The similarities between the theoretical dimensions proposed by this thesis and empirical evidence enhance the construct validity of the instrument (Netemeyer et al., 2003). Although the results in this study provide initial evidence for the validity of the LESSON questionnaire, methodological rigor requires that limitations to generalizability be reported.

Limitations of Study

Several factors, statistical and methodological potentially limit the generalizability of this study. First, factor analytic theorists differ in what is considered an acceptable variance. Streiner (1994) suggested that factors should explain at least 50% of the total variance. The percent of total variance accounted for by each factor in this study was 63.896. Although this was close to Hair et al.'s (1998) recommendation that 60 percent is acceptable it is lower than the 75 - 80% recommended by others (Stevens, 2009). Myers suggests what constitutes an acceptable value for R^2 as dependent upon *context*. In the physical sciences a very high value is demanded, however, the subjective nature of human behavior may preclude the same degree of rigor (Myers, 1990) in the social sciences. Henson and Roberts' review of 432 articles from the psychological and educational literature that used EFA noted a reported mean variance of just under 52%.

Decreasing the number of factors to increase the total variance explained by the remaining factors may result in under factoring which overlooks potential factors. The solution presented in this thesis provides balance between what is considered theoretically interpretable and statistically acceptable.

A second limitation is the number of items loadings on factors 9 (*Reviewing records*) and 10 (Memorizing). Only two items load on each of these factors –which may not be a significant indicator of a dimension (Spector, 1992). However, this condition may be redressed in subsequent studies by adding and empirically testing additional items which are qualitatively similar (Pedhazur & Schmelkin, 1991).

The third limitation of this study is the characteristics of the development sample and its degree of representativeness to the target population. *Sampling* refers to the procedure used to select a representative sample of the target population. The sampling procedure produces the sample. There are two main sampling methods, random and nonrandom. An in-depth explanation of sampling methods is beyond the scope of this thesis therefore the reader is directed to Groves et al. (Groves et al., 2004). A non-random convenience sample was selected based on the need to control for sample size, homogeneity of the sample, consistency of the course web site design and instructional design, and complexity of user-system interactions as potential confounding variables. The use of these criteria may reflect a sample which may not fully represent the population for which the scale was intended (DeVillis, 2003). This sampling issue is mitigated by two considerations. First, the selection criteria were guided by the research purpose which was to determine the internal consistency of the LESSON questionnaire. Therefore, even if the sample possesses a different range of attributes from the target

population (i.e. gender or age) it does not necessarily disqualify the sample for purposes of scale development (DeVillis, 2003). Furthermore, an integral component of validation is to empirically test the instrument in other studies using different samples. This measurement procedure employs the same design over a number of separate studies.

Conclusion

The results of the current study provide evidence that the LESSON questionnaire consists of 11 dimensions which are derived from Zimmerman and Pons' original categories of self-regulated learning strategies. However, results suggest that several of the self-regulated learning strategies which the Zimmerman and Pons model identify as conceptually overlapping or unified are, in the context of this study and instrument reported as separate and distinct strategies. The reliability and validity evidence of this study provide further support of the instrument's overall validity. However, validity evidence is not achieved through one study (Wainer & Braun, 1988). The purpose of this thesis is to provide a collection of evidence to support the validity of inferences and interpretations derived from the application of this instrument in further studies . The final chapter of this thesis summarizes the significant outcomes from the studies which comprise this thesis and serve to enhance to validity of interpretations which may be made the data generated by the LESSON questionnaire, as well as a discussion of their limitations, implications and recommendations for future research.

CHAPTER FIVE

Discussion and Conclusions

Introduction

Measurement involves linking abstract concepts and empirical indicators. Historically validity was considered evident when measures behave as they are supposed to behave in support of an underlying theory (Zeller & Carmines, 1980). Contemporary views hold that it is the meaning or interpretation of the data which must be valid. This thesis has developed and provided evidence that the LESSON can generate data to support valid interpretations of pedagogical utility based on contemporary learning theories. The purpose of this chapter is to (1) summarize the thesis (2) review each of the four studies that provide a collection of reliability and validity evidence in support of the development of the LESSON questionnaire and comprise this thesis. The findings and conclusion from each study are briefly summarized in order to remind the reader of the accumulation of validity evidence provided by the thesis. The overall conclusions extend beyond the original research questions posed in Chapter 1 and more broadly consider the limitation of the LESSON, the implications of the thesis for both research and practice and proposed next steps. The chapter concludes with recommendations for future research.

Summary of the Thesis

A comprehensive and interdisciplinary review of the literature was conducted in order to determine the current state of LMS evaluation. To date little research has focused on whether and to what extent learning management systems and similar learning technologies achieve the pedagogical goals for which they were designed. Efforts to

evaluate these systems frequently employ usability measures that consider ease of use based on technical aspects of the user interface. This gap may be due to both the inadequacy of evaluation methods and the lack of tools appropriate for the specific context of use under investigation that is e-Learning. Current evaluation methods typically do not include the learner as part of the evaluation team. Evaluation tools, such as heuristics and questionnaires are generic in nature and thus do not account for the context of use (users, tasks, and their working environments) unique to e-Learning (Usability Net, 2006). Thus the purpose of this thesis was to develop and provide evidence for the scale designed here as providing data for making valid inferences about the pedagogical utility of the software system as perceived by the learner.

There is general agreement in the field of measurement and evaluation of the centrality of validity in instrument development. Validity has evolved into a unitary concept which, according to Nunnally and Bernstein (1994) is, "a matter of degree rather than an all-or-none property and validation is an unending process" (p. 84). This thesis presents a comprehensive collection of evidence that supports the development of a new instrument to measure the pedagogical utility of learning managements systems and similar learning technologies. This thesis was guided by two important research questions:

- Do the capabilities of the sampled learning management system introduce new learning strategies not previously identified in specific models of self-regulated learning?
- What is the factor structure of the LESSON questionnaire?

Evidence bearing on the validity of interpretations about these questions was gathered through subjecting the LESSON to an extensive logical and psychometric assessment which included: (a) specifying the domain of learning strategy support; (b) developing a pool of items; (c) accumulating validity evidence for the item pool, and, therefore, the domain to which the items are referenced, and (d) by subsequently selecting and collecting empirical validity evidence for a final set of items which constitute the LESSON. Questionnaire development and justification is a specific type of survey methodology which involves multiple phases. Each phase consists of several generally agreed upon steps and set of procedures (DeVillis, 2003; Haynes et al., 1995; Netemeyer et al., 2003; Spector, 1992). Each phase in the development of the LESSON questionnaire provides a particular type of evidence. This thesis presented each phase as separate study research objective, method, and results. This chapter includes the significant outcomes from each phase; the limitations of the research; implications for practice proposed next steps and recommendations for future research.

Significant Outcomes

This section reviews the significant outcomes produced by this thesis that contribute to the body of knowledge in the areas of human computer interaction, contemporary learning theory, and instructional technology. These outcomes are presented in the order in which they emerged in this thesis.

Pedagogical Utility Framework

Research frameworks provide context for the area under investigation by identifying and describing the components of a system or object of interest. It delineates the boundaries and content of the area. The structure and terminology provided by a

framework help to ground the research. The conceptual framework designed by the researcher (Bratt, 2007) for this thesis advances evaluation measures used in usability research and practice by extending existing frameworks and introducing new theory-based measures for assessing pedagogical utility of LMS and similar e-Learning technologies. While frameworks provide the architecture they are limited in what they can express. More complex information is afforded by models which are abstract representations of a system or object capable of expressing the relationships and functions of each component. One of the significant outcomes of this research is the development of a working model which represents the relationship between utility and usability.

Usability – Utility Model Development

A primary function of model development especially at a preliminary stage, is one of focusing or reduction (Sidebotham, 2001). Models are effective tools for simplifying and representing abstract phenomena. The model developed as part of this thesis is the first to illustrate the orthogonal relationship between utility and usability which in turn provides the conceptual basis for extending software evaluation into two dimensions – usability *and utility*. This new model is designed to further the development of both research and evaluation practice based on potential dimensions of utility beyond what has been introduced in this thesis.

Human-Computer Interaction and Human Factor Measures

The contribution of a new model that illustrates the relationship between system usability and utility provides substantive opportunities for both HCI and human factors researchers to develop new evaluation measures. HCI may benefit from new measures

that evaluate system utility based on a particular context of use or those which consider both usability *and* utility factors. Similarly, human factors research may benefit from the development of measures that consider both usability *and* utility to evaluate user-device interactions

Instrument Development

This thesis contributes a questionnaire (with supporting reliability and validation evidence) to assess the pedagogical utility of LMS. Pedagogical utility is "the capability of the system to enable teaching and learning by facilitating or supporting key facets of the entire instructional system, from learner through instructor through instructional design and tools" (Bratt, 2007). The questionnaire will determine the efficacy of these systems based on criteria that extend beyond traditional usability into theories of self regulated learning, and it will enable institutions to optimize the capabilities of these systems to support academic success Such research is highly relevant to post-secondary institutions that have become increasingly reliant on such systems to deliver instruction to students. However, evidence bearing on the validity of interpretations validation of a scale is not firmly established during scale development. DeVellis (2003) describes validation as a cumulative, ongoing process that involves the administration of the questionnaire to other samples (p. 159). Recommendations for future studies to accumulate further validity evidence are detailed later in this chapter.

Limitations of this Research

Scale development and validation is a well-established prescriptive process replete with principles, guidelines and caveats. Nevertheless, compromises arise naturally even with careful adherence to the methodology. Although the results in this study

provide initial evidence bearing on the validity of interpretations validation the LESSON questionnaire methodological rigor requires that limitations to generalizability be reported. The limitations of the individual studies that constitute this thesis have been previously reported in prior chapters therefore they will be only briefly reviewed in this section.

Expert Panel

One method for establishing content validity is to subject the initial item pool to an expert panel to review and evaluate each item for relevancy and representatives. Ten reviewers were invited however only 5 were able to participate in the study. A larger sample size would have provided more data to guide the revisions of existing items and creation of new items thereby providing additional evidence of content validity.

Characteristics of the Development Sample

As discussed in Chapter 4, the development sample was purposefully selected based on criteria that would minimize potentially confounding variables. Consequently, the sample is predominantly female, first or second year university students enrolled in nursing fundamentals course. While these characteristics do not negate the validity of the sample, they do suggest the need for further validity studies with more diverse samples that is a standard requirement in the scale validation process.

Homogeneity of the Sample

Two tests for statistical significance were conducted to determine between group equivalencies. The result showed a statistically detectable difference in age and prior LMS training for Group 3 compared with Groups 1 and 2 that were more homogenous across demographic factors (age, gender, years of post-secondary education, and prior

LMS training). However, the magnitude of the effect size in both cases suggests that although there is a *statistically* detectable difference, the difference may not be of practical significance. Nevertheless, homogeneity across all groups would have been the preferred methodology.

Self Report Measures

The LESSON is a self-report questionnaire, which by its nature makes it susceptible to issues such as item interpretation and social desirability.

Item interpretation refers to the meaning of the item *as perceived by the respondent* –not necessarily the actual meaning as intended by the scale's developer. While it is improbable that item interpretation fidelity will be consistent across all participants, actions can be taken to minimize errors of interpretation. Such measures were taken in the development of the LESSON questionnaire by including a pilot study that elicited participants' interpretation of each item in the initial pool. Results from this data analysis led to revisions to any items whose interpretations were potentially problematic for the development sample. Such actions may reduce the occurrence of item *mis*-interpretation but not necessarily eliminate them.

Social desirability bias refers to the tendency of respondents to reply in a manner that will be viewed favorably by others especially on more sensitive indices such as measures of psychological or ethical behavior. However, the object of interest is the software system; participants are responding to items that assess the capabilities of the software system–*not attributes of the users*. The items are not inherently sensitive in nature that reduces but does not necessarily eliminate the instrument's susceptibility to socially desirable responses.

The development and the initial validation of the LESSON establishes the first step of a on-going validation process to ensure that valid interpretations can be made with respect to evaluating the pedagogical utility of learning management systems. The LESSON is the first instrument to specifically assess the capability of software systems to support strategies associated with self-regulated learning. The practical applications of this instrument are discussed in the following section.

Implications for Practice

The interdisciplinary nature of this thesis is reflected in discussion on the implications for practice. The conceptualization of the LESSON questionnaire is based on the convergence of two disciplines – human-computer interaction and education. The application of the LESSON has implications for the design and evaluation practices that occur in both disciplines.

Utility Studies

As originally intended, the LESSON can be used in what might be considered a new HCI practice called "utility studies" based on the new framework and model that has emerged from this thesis. The LESSON may be used alone or in conjunction with other usability measures and evaluation practices to improve the design of learning management systems and similar eLearning technologies. Integrating the LESSON into software evaluation practices has two important implications. First, it involves learners as participants in the evaluation process, and second, it may potentially identify discrepancies between the *intended* capabilities of the system and the *actual* capabilities as perceived by the user/learner. This information can be applied a posteriori to the design phase of software development to improve the system's utility.

Instructor Training

Qualitative data was also collected as part of the fourth study in this thesis that involved the administration of questionnaire to development sample. Participants were invited to comment on their experience using the LMS. However, the results were beyond the immediate scope of thesis therefore not reported as part of the analysis and discussion presented in Chapter 4. The results, which are presented in an article related to this thesis (Bratt et al., 2009) reveal some noteworthy findings with implication for both practice and future research (which will be discussed later in the chapter). Analysis of the participants' comments revealed that factors such as instructor's skill level, the navigation and the organization of the course site influenced learners' perceptions about the utility of the system in supporting their learning tasks and goals. Comments such as: *"These online resources work great when the instructors understand how to use them. I believe proper training is essential if the tool is to be used for the benefit of the students/instructors"* and *"Black board is a tool, and much of the issues with it are due to the use of this tool by the users... Education needs to be to instructors as well, not just students."* suggest issues with how the system is being used –not with the system itself. There are clear implications that instructor training should extend beyond the functional aspects of the LMS to include information design, learning design and pedagogy. The learning design of the course combined with the skills and knowledge of the instructor are significant contributors to the learner's interactions with the course learning management system and therefore their perceptions of the system's utility. For example, a learning design that requires students to use the communication and collaboration tools of a LMS to facilitate their role as collaborators and co-constructors of new knowledge through authentic learning, project-based activities directly influence how students

interact with the system. A teacher or instructional designer with sound knowledge of project-based learning may include rubrics to enable students to self-evaluate their work; a FAQs board to allow students to seek assistance; a calendar to facilitate planning; and an annotation tool to enable students to summarize lecture notes. In contrast, a teacher with minimal understanding of pedagogy and the functionality of their course LMS may use the system simply to provide access to course materials. This rudimentary use of the system fails to utilize the system's capabilities to support learning in more complex and pedagogically meaningful ways that support the learner through knowledge transmission, knowledge construction and finally, knowledge representation. Therefore, knowledge of instructional design and pedagogy are important factors in the learner's perception of the capabilities of these systems. Effective teachers or instructional designers create opportunities to engage learning strategies part of the instructional design of the course. They may employ technologies from multiple sources such as wikis, blogs, streaming media, groupware and other web-based interactive collaborative applications in order to support their learning design. Ideally, a well-designed LMS would support a range of learning strategies as determined by the instructional design and the teacher would be sufficiently familiar with the capabilities of the system to optimize their use in the instructional design of the course.

Program Evaluation

The wide-scale adoption of LMSs by post-secondary institutions to facilitate both onsite, online and hybrid teaching and learning suggests the need for student orientations on how to use these systems as part of the implementation process. In response to this need, the LESSON may be used in applications involving both the design and evaluation

of LMS courses intended to improve students' use of this technology. However, further work remains in the refinement of the scale. The steps to accomplish this task are proposed in the next section.

Proposed Next Steps

The next step towards finalizing the LESSON questionnaire is to address the limitation identified in Chapter 4. The exploratory factor analysis suggests that the number of items loadings on factors 9 (*Reviewing records*) and 10 (*Memorizing*) may not be a significant indicator of a dimension (Spector, 1992). Perhaps the items are substantively conceptually related and could be combined into one dimension. Alternatively, this condition may be redressed in subsequent studies by developing and empirically testing additional items that are qualitatively similar (Pedhazur & Schmelkin, 1991). This proposed next step should also include reverse-worded items that are under-represented in the current version of the LESSON questionnaire. A factor analysis should be conducted to confirm the factor structure which was identified in this thesis. The final version of the LESSON will then be ready for subsequent validation studies as the recommended practice in the scale development literature.

Recommendations for Future Research

The vision of this thesis extends beyond the immediate goal of scale development and validation. The research was carried out with the dual purpose of generating information that can be used for the specific purpose of improving design and evaluation practices as well as the development of new knowledge based in both HCI and education.

The remainder of this section offers recommendation to the research community to advance these efforts.

Further Validation of the LESSON

It is well established in the scale development literature that evidence bearing on the validity of interpretations of the data generated by the instrument is an ongoing process. Future studies involving the LESSON will continue to accumulate additional reliability and validity evidence. Future research should examine whether qualitative interviews can add to the representativeness of the instrument. For example, are there other learning strategies, not represented by the LESSON, that might be identified through interviews or open-ended questions integrated in to the questionnaire?

Emerging Areas of Inquiry

Qualitative data was also collected as part of the fourth study in this thesis that involved the administration of questionnaire to development sample. Participants were invited to comment on their experience using the LMS. However, the results were beyond immediate scope of thesis therefore not reported as part of the analysis and discussion presented in Chapter 4. The results, which are presented in an article related to this thesis (Bratt et al., 2009) reveal some noteworthy findings with implication for future research. Analysis of the participants' comments revealed that instructor skill level, knowledge of information design and pedagogy influenced learners' perceptions about the utility of the system in supporting their learning tasks and goals. Could *instructor characteristics* be a factor in the perceived capabilities of the system to support learner tasks and goals? How do learning design and instructor characteristics affect pedagogical utility? These are research questions worthy of investigation.

The addition of qualitative data may also shed light on the difference between *intended* capabilities of the system and *perceived* capabilities. This interesting discrepancy emerged from the qualitative data collected during the empirical validation of the questionnaire and is worthy of further study. Preliminary results (Bratt et al., 2009) suggest that learners are unaware of of the system's capabilities. Could training sessions on LMS features improve perceptions of pedagogical utility? Further research is recommended in this area.

Pedagogical utility. One significant outcome of this thesis is the contribution of new pedagogical utility framework which includes four dimensions: (1) support for learning strategies (2) support of knowledge construction (2) support for knowledge representation (4) Support for instructional methods. The LESSON currently assesses support for learning strategies. This emerging framework provides opportunities to develop the other three dimensions.

Utility research. Another significant outcome of this thesis is the contribution of new model that represents the relationship between usability and utility. The model may be used as the basis for developing new research that investigates this relationship or to develop new utility measures for diverse applications and devices. HCI research (as well as human factors) may also develop new guidelines that include standards for both usability and utility. The contributions of this thesis provide a gateway to developing those standards by exploring question such as "can an object possess utility without usability? Or what factors influence users' perceptions of utility?"

Final Thoughts

A principal goal of research is the contribution of new knowledge that may lead to practical applications of the results as well as foundations upon which others may build. This thesis is respectfully submitted in that tradition.

APPENDICES

Appendix A

Questionnaire for Pre-Pilot of Pedagogical Utility Questionnaire

---

Part 1: Background knowledge (Group A)

PARTICIPANT#	1		2		3		4		5		6	
	Chris		Jessica		Natalie		Lori		Kristia		Jeremy	
	Yes No		Yes No		Yes No		Yes No		Yes No		Yes No	
4. Prior to this course did you use WebCT?	○ ☑		○ ☑		☑ ○		☑ ○		☑ ○		☑ ○	
5. How did you learn to use WebCT?	In a course	☑	In a course	☑	In a course	○	In a course	☑	In a course	☑	In a course	☑
	Self taught	☑	Self taught	☑	Self taught	☑	Self taught	☑	Self taught	☑	Self taught	☑
	From a friend	☑	From a friend	○	From a friend	☑	From a friend	☑	From a friend	○	From a friend	☑
	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○
6. In terms of months, how long have you been using WebCT?	4		4		18		9		18		18	

Part 1: Background knowledge (Group B)

PARTICIPANT#	1		2		3		4		5		6	
	Paul		Jesse		Christine		Dan		Bana			
	Yes No		Yes No		Yes No		Yes No		Yes No		Yes No	
1. Prior to this course did you use WebCT?	☑ ○		○ ☑		○ ☑		○ ☑		○ ☑		○ ○	
2. How did you learn to use WebCT?	In a course	○	In a course	○	In a course	○	In a course	☑	In a course	○	In a course	○
	Selftaught	☑	Selftaught	☑	Selftaught	☑	Selftaught	☑	Selftaught	☑	Selftaught	○
	From a friend	○	From a friend	○	From a friend	○	From a friend	○	From a friend	○	From a friend	○
	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○	Other (please specify)	○
3. In terms of months, how long have you been using WebCT?	11		4		4		4		4			

Part 2: WebCT Use

Please describe how you use WebCT to:

Identify your learning goals
- Check for bulletins (announcements)
- Check for assignments
- Posted lecture notes prompts studying
- General exploration of site for
- Samples posted as guidelines on how to complete work
- Calendar of events
- Marksheets (rubrics)
- Discussion board for group work; general discussion board (FAQs page).

Plan your studying activities
- Calendar of events provides timeline
- Viewing samples helps with planning
- Accessing the lecture notes
- Printed and completed sample exams; focused studying on questions that were most difficult to answer
- Looked at the assignments and their due dates

Keep track of assignment due dates
- Calendar but not as much as using one's own day timer
- Read the due dates attached to the assignments' page
- Read the announcements

Manage your time as it relates to your learning activities
- Calendar
- Due dates in calendar
- Check assignment due dates (inside of assignment module)
- Print notes prior to class
- Checked the web site daily.
- Checked the discussion board
- Plan time according to assignment due date
- If notes are available student would print them

Accomplish your studying tasks
- Used supplemental links from instructor's notes to other sites
- Reread lecture notes
- Looked at lecture notes
- Completed weekly/bi-weekly quizzes
- Used lecture notes as guideline for final lab project and final exam
- Did practice quizzes and tests
- Reviewed the publisher's chapter notes posted as a link in WebCT
- Organized a study group; printed practice exams, notes for use in study group
- If you knew in advance that you would miss a class you would access the lecture notes to learn what you missed in class

---

Organize course materials such as notes, handouts
- Printed out notes before class
- Rewriting lecture notes as a study tactic
- Saved notes to a folder. Organized files chronologically

Monitor how well your learning and studying strategies are working
- Check grades
- Completed weekly quizzes
- View class statistics on assignments, quizzes and exams
- Checked midterm statistics to assess progress in course and relative class standing
- Checked chronological progress of quizzes (should be getting better)
- Read comments from instructor
- Read the discussion board to see if you were up to date with everything; if there was something you were not familiar with.

Monitor your performance on assignments and tests
- Checked grades and classroom statistics
- Feedback/comments from instructor
- Reviewed error on quizzes to see where mistakes were made

Organize the instructional materials to suit the way you learn
- Printed off notes and annotated them at home on in class during the lecture.
- Physically transfer (write) due dates into own calendar
- Rewrite own notes in point form

Change the look of the lecture notes to suit your needs
- Changed the format of the PowerPoint slides (layout and notes)
- Changed font size
- Printed notes. Highlighted and annotated them
- Copied and pasted meaningful graphics from lecture notes into own notes
- Deleted extraneous content
- Summarized notes
- Added notes to print outs
- Checked off slides in during class lecture to remind oneself that they were covered in class even though student did not add notes to their print out.

Ask for help
- Read the discussion board topics for FAQs and for the group projects.
- Email
- Used search function to find resources (e.g. lesson plan template)

Find information to help with an assignment
- Instructor provided links to supplemental websites (more likely to visit them if instructor told students)
- Used links provided by instructor to help with final exam and final lab project (and WebQuest)
- Looked at student samples
- Looked for meta information about the assignment (e.g. rubrics)
- Discussion board

Know how well you are doing in the course
- Checked grades and class statistics
- Compared work to others (if other students' work was published)
- Compared individual marks to class statistics
- (If marks weren't posted student had no idea how well they were doing)
- Kept a running total of mark
- Instructor's comments/feedback

Study at a time and location you prefer
- Printed notes to study at home
- Reviewed notes at home
- Print and read notes before or after class
- Took laptop to LRC (Learning Resources Centre) to read notes online while writing the take home final exam
- Took the weekly quizzes at home to avoid network issues
- Read the notes on campus at the LRC
- Read notes during spares

Work with others
- The group discussion board provided a communication tool to discussion where to access important resources on WEBCT; posted your PowerPoint; review tasks with group members and receive feedback.
- Submit assignment for group
- Found contact information (email)
- Send an email
- Printed off notes for study group session
- Used rubric to see what had to be done for an assignment

Learn from others
- View samples of students' work (from prior term)
- View other students' assignments
- Read the discussion board (class FAQs and group board)

Recall concepts from lectures and readings
- Looked at lecture notes, PowerPoint and quizzes.
- The organization of the notes (structure) helped student see the flow and connection between the major sections of the course (e.g. learning theory, learning style etc)
- Used reference slides at the end of the lecture notes
- Activities that followed the notes helped student remember the concept covered in the notes.

Review tests and quizzes
- Reviewed PowerPoint notes and sample quizzes (if quizzes were configured so that they could be reviewed)
- Completed the practice final.

Acknowledge your successes
- Grades were an indication that more effort was required
- Marks on individual assessments indicated where effort was needed.
- My Grades provides quick access to results. Used relative standing to class average to indication of one's success.
- Weighting of assignments that reflect "mark to date" provides some sense of control i.e. I have earned 17 of a possible 20% so far in the course.
- Empowers student to calculate mark and negotiate outcome with instructor i.e. "I am .25 away from a B+"
- Set manageable goals and could see the short term progress (e.g. result of weekly quiz)

Apply ideas from the lecture notes in to other class activities such as projects and assignments
Used Educational Foundations lesson plan template for Educational Technology lab project.
Would like to have access to course notes from prior term but access in denied.

Pull together content from other courses
Would like to but tools do not exist.

Pull together information from different sources, such as lectures, readings, and discussions
Used links provided by instructor to go above and beyond the lecture notes
Reviewed the lecture notes and quizzes
Downloaded notes to own computer
Annotated printed notes during class discussion/lecture.

Part 3: WebCT Assessment

Now that you have used WebCT for several months what would you change about WebCT to:

Improve how it supports your learning and studying strategies

The Discussion board should be limited to relevant information
Include more learning resources such as practice quizzes and self-assessments
Include an RSS feed
All lecture notes should be posted
Include a lesson on how to use WebCT instead of trying to teach oneself (spent too much time trying to learn WebCT)
Content should be standardized across all courses
Instructor should review slides from previous class
Use practice quizzes
Instructor should make full use of the features such as content and updating grades
Calendar should be editable for students
Should be able to write your own learning goals
System should notify you of upcoming due dates
Links between resources should be more direct (i.e. less clicks needed to get to site)
Increase the session time before system logs you out
More concise layout (content organization should have more intuitive structure)

Improve the way its used in the course?

Publish other students' work
Provide sample exams
Emphasize the inclusion of meaningful content (quality not quantity)
Talk about the relevant content (provides a cue that the material is important to know)
System does not modify the appearance of visited links so students can't monitor what they have already read (instructor's supplemental links)
There should be some incentive for using it e.g. bonus marks
Make sure site is organized
More concise layout
Add lecture audio file (e.g. podcast)
Add an RSS feed
Simplify the navigation (fewer clicks between links)

Improve how you learned to use it?

Instructor should include the most relevant WebCT content in the syllabus e.g. discussion board, quizzes
First day of class should include a crash course on WebCT i.e. where to find it; what needs to be accessed regularly
A Help feature.
Nothing to change; self taught is fine

Now that you have used WebCT for several months please comment on:

What tools or features in the program do you find most helpful?

Quizzes
Lecture notes
Grades
Quiz results
Class averages
Search feature
Ability to review quizzes
Reminders
Links
Student samples
Discussion board
Assignment rubrics
Comments
Practice quizzes/exams

What tools or features in the program do you find least helpful?

Class discussion board (unfocussed, irrelevant)
Links to Fun Stuff (Hal)
Grades not being updated

Is there anything about the features of WebCT that interfere with how you normally study?

Quiz timer was distracting and unnerving
Convenience of having lecture notes can make you lazy; you don't bother taking your own notes which requires you to pick out the critical details of the lecture
Supplemental notes can be overwhelming and difficult to track what's been visited and read.

Appendix B

ITEM CONTENT REVIEW FORM

Reviewer ID Number _____ Date: _____

The PAQ (Pedagogical Assessment Questionnaire) is an instrument which is designed to evaluate the pedagogical utility of e-learning applications such as learning management systems (LMS). *Pedagogical utility* is a new construct which is defined here as, the capability of the software product to enable learning by facilitating or supporting:

1. The learner's use of cognitive and meta cognitive processes, and knowledge representation

2. The educator's ability to implement cognitive and socio-constructivist teaching strategies

3. Peer and learner-instructor collaboration

Fifteens subscales have been adapted from existing questionnaires on self-regulated learning, and learning strategies (Zimmerman, & Pons, 1986; Duncan & McKeachie, 2005; Lan, Bremer, Stevens & Mullen, 2004). The definition for each subscale appears in blue and is located in the top right corner of the subscale chart. Each of the 117 items in the questionnaire has been categorized according to which subscale it represents.

Directions

1. Read carefully through the PAQ items.

2. Read carefully through the definitions for each of the 15 subscales

3. For each item, indicate how well you feel the item reflects the definition it was written to measure.

Judge an item solely on the basis of the match between its content and the subscale definition that the item was intended to measure.
Please use the following five point rating scale shown below:

0	1	2	3	4
NO FIT				EXCELLENT FIT

For each item, click on the box corresponding to your rating (this will insert an "X").
If you choose "NO FIT" for any item, please provide reasoning for this judgment and indicate which category, if any, this item would fit.

4. Upon completion of steps 1 to 3, please examine the items you have indicated as fitting the definitions with a rating of "3" or "4".

Do the items you rated as "3" or "4" together represent the specified subscale?

If yes, please indicate this at the bottom of the table in the row titled, "Content Representativeness".
If no, please indicate what items should be added.

5. Please feel free to comment on or to suggest item revisions. For example, if you think an item should be worded differently, please re-write the item in the space provided under "Suggested Revisions".

There is additional space following each section to for any additional comments.

Sample Subscale Item Content Rating Review Form

Subscale: Self-evaluation (Questions 1 - 11)		**Definition**: Student initiated performance evaluations of their progress or learning outcomes, e.g., "I check the grade on an assignment to see how well I did."					
		Item Rating Scale: 0 "No Fit" 1 2 3 4 "Excellent Fit"					
Item #	Item	Item Rating					Suggested Revisions
		0	1	2	3	4	
1.1	I can use this application to know how well I have done on an assignment.	☐	☐	☐	☐	☐	
1.2	I can use this application to check over my work to make sure I did it right.	☐	☐	☐	☐	☐	
1.3	I can use this software to judge how well I am doing in the course.	☐	☐	☐	☐	☐	
1.4	I can use this software to evaluate the quality of my work.	☐	☐	☐	☐	☐	
1.5	This software makes it very easy to check if I understand what has been taught in class.	☐	☐	☐	☐	☐	
1.6	This application allows me to compare my assignment to other students' assignments in order to check its accuracy and completeness.	☐	☐	☐	☐	☐	
1.7	This software has features that allow me to check my understanding of what I am reading in the course.	☐	☐	☐	☐	☐	
1.8	This software has features that allow me to check if I have completed an assignment correctly.	☐	☐	☐	☐	☐	
1.9	This software has features that allow me to check my progress in the course.	☐	☐	☐	☐	☐	
1.10	It's difficult to use this software to check the grade on an assignment.	☐	☐	☐	☐	☐	
1.11	I cannot use this application to check if I understand what I am reading in the course.	☐	☐	☐	☐	☐	
1.12	I can use this software to set standards and use them to judge how I am doing in the course.	☐	☐	☐	☐	☐	
1.13	It's difficult to use this software to complete practice tests.	☐	☐	☐	☐	☐	

Comments:

Appendix C

Pedagogical utility framework

Pedagogical tools	Self-evaluation	Reviewing records	Seeking information	Seeking help from others	Goal-setting	Planning	Monitoring comprehension	Organizing	Transforming	Keeping records	Rehearsing and memorizing	Self-consequencing	Environmental structuring	Collaborating	Elaboration
Content Creation & Delivery															
Lecture notes															
Assignments															
Rubrics															
Web links															
Syllabus															
Glossary															
RSS feeds															
Administrative															
Calendar															
Collaborative and Communication															
Chat															
Discussion boards															
Email															
Wikis															
Blogs															
Announcements															
Assessment															
Gradebook															
Quizzes															
Other?															

Appendix D

Tests of Between-Subjects Effects

	Dependent Variable	Type III Sum of Squares	df	Mean Square	F	Sig.	Partial Eta Squared
Group	Self-evaluating - Check how well I have done on an assignment	1.576	2	.788	1.915	.149	.012
	Monitor Comprehension - Check if I have made mistakes on assignments	.237	2	.119	.130	.878	.001
	Seeking Info - Access course material	.353	2	.177	.312	.732	.002
	Transforming - Change the appearance of the lecture notes	.884	2	.442	.372	.690	.002
	Transforming - Download lecture notes so that I can edit them (highlight, mark up annotate)	1.210	2	.605	.460	.632	.003
	Goal setting - Determine my learning goals such as what needs to be done before next class	4.019	2	2.009	3.060	.048	.019
	Goal setting - Identify tasks that need to be completed	3.754	2	1.877	2.535	.081	.015
	Planning - Decide when tasks need to be completed	2.777	2	1.389	1.729	.179	.011
	Seeking help - Ask a classmate for help	2.455	2	1.228	1.365	.257	.008
	Seeking help - Ask the instructor for help on an assignment	4.162	2	2.081	3.516	.031	.021
	Seeking Info - Find resources to help me learn what is being taught	1.665	2	.832	1.376	.254	.008
	Seeking Info- Access web-based resources	3.733	2	1.867	3.037	.049	.018
	Seeking Info - Find information about an assignment	4.144	2	2.072	3.726	.025	.022
	Seeking Info - Access the course notes	.529	2	.264	.653	.521	.004
	Environment - Complete the assignment at home	2.303	2	1.151	2.578	.077	.016

Environment - Complete assignments on the weekend	1.592	2	.796	1.493	.226	.009
Collaboration - Collaborate with a classmate using tools such as email	4.331	2	2.166	2.244	.108	.014
Seeking Info - Learn by observing work posted by classmates	4.103	2	2.052	3.213	.042	.019
Elaboration - Apply ideas from prior lectures to new class	1.855	2	.927	1.176	.310	.007
Self consequencing - Feel satisfied when task is completed	.303	2	.152	.390	.677	.002
Rehearse/Memorize - Memorize concepts presented in class	4.312	2	2.156	2.280	.104	.014
Elaboration - Pull together info from different sources	2.601	2	1.301	1.669	.190	.010
Review records - Prepare for tests by reviewing notes	2.396	2	1.198	1.851	.159	.011
Keep records - Make notes about important concepts	4.225	2	2.113	2.577	.078	.016
Transforming - Modify or add to my lecture notes	2.513	2	1.256	1.114	.329	.007
Self consequencing - Remind me of consequences of failing course	4.154	2	2.077	2.038	.132	.012
Rehearse/Memorize - Memorize key words to remind me of important concepts	3.053	2	1.526	1.679	.188	.010
Planning - Plan a weekly schedule to meet assignment deadlines	3.702	2	1.851	2.271	.105	.014
Organizing - Organize the concepts presented in class	1.960	2	.980	1.407	.246	.009
Monitor Comprehension - Monitor my performance	.317	2	.158	.419	.658	.003
Review records - Review my notes in preparation for tests	4.328	2	2.164	3.191	.042	.019
Collaboration - Share information with a classmate	5.075	2	2.538	2.975	.052	.018
Rehearse/Memorize - Memorize answers from passed tests	6.559	2	3.280	2.493	.084	.015

	Organizing - Make lists of important concepts	2.931	2	1.465	1.904	.151	.012
	Organizing - Make simple charts, diagrams or tables	2.579	2	1.290	1.647	.194	.010
	Planning - Plan homework activities	.008	2	.004	.005	.995	.000
	Review records - Re-read passed tests or quizzes	5.153	2	2.577	2.097	.124	.013
	Keep records - Record the marks I received on tests	.165	2	.083	.139	.871	.001
	Planning - Record when assignments are due	9.067	2	4.534	5.854	.003	.035
	Collaboration - Learn from my peers	3.934	2	1.967	1.936	.146	.012
	Review records - Review course content to prepare for an exam	1.798	2	.899	1.525	.219	.009
	Planning - Plan when to study for an exam	2.221	2	1.110	1.365	.257	.008
	Elaboration - Make connections between concepts that have been taught and new concepts	4.985	2	2.493	3.101	.046	.019
	Environment - Study off campus	1.585	2	.792	1.587	.206	.010
	Organizing - Write brief summaries of main ideas	7.834	2	3.917	4.794	.009	.029
	Organizing - Summarize main ideas from lectures and readings	2.882	2	1.441	1.676	.189	.010
	Organizing - Take notes from the lectures	4.067	2	2.033	2.334	.099	.014
	Planning - Set goals for what I want to achieve for each assignment	5.543	2	2.772	3.386	.035	.020
	Collaboration - Work on an assignment with classmate	9.822	2	4.911	4.604	.011	.028
	Transforming - Add notes to important passages of text	3.242	2	1.621	1.717	.181	.010
	Monitor Comprehension - Check if I understand the material	.921	2	.461	.529	.590	.003
	Self-evaluation - Check my progress in the course	.451	2	.225	.541	.583	.003
	Organizing - Outline the material to help organize thoughts	5.667	2	2.833	3.624	.028	.022

Keep records - Take notes based on class discussion	1.005	2	.503	.532	.588	.003
Seeking Info - Find out more about an assignment	8.804	2	4.402	4.838	.009	.029
Seeking help - Get help on an assignment from classmate	3.391	2	1.696	1.690	.186	.010
Goal-setting - Help me set a goal for the final grade	4.425	2	2.213	2.274	.105	.014
Self-evaluation - Judge how well I am doing in the course	.359	2	.179	.372	.690	.002
Self-evaluation - Check if I achieved the grade I set to achieve	.338	2	.169	.320	.726	.002
Organizing - Organize the content presented in the course	1.412	2	.706	.921	.399	.006
Planning - Plan what I should review for a test	3.895	2	1.948	2.389	.093	.015
Keep records - Write my own notes	6.151	2	3.075	3.423	.034	.021
Monitor Comprehension - Monitor if I understand what is being taught	4.575	2	2.287	2.397	.093	.015
Environment - Study in a location I prefer	3.300	2	1.650	2.647	.072	.016
Seeking help - Ask instructor for help	.773	2	.387	.575	.563	.004
Monitoring Comprehension - I can use tools such as rubrics to check over my work	7.497	2	3.749	3.849	.022	.023
Seeking help - I can't use this software to ask the instructor a question	3.035	2	1.517	2.049	.131	.012
Seeking Info - If I am unsure about a task I can use this software to find information	3.631	2	1.816	1.955	.143	.012
Environment - This software does not allow me to study off campus	2.098	2	1.049	1.907	.150	.012
Transforming - It's very difficult to change the appearance of course material	2.001	2	1.000	.800	.450	.005

Planning - This software does not help me plan my homework activities	3.620	2	1.810	1.700	.184	.010
Monitor Comprehension - Using this software to check if I achieved learning goal is difficult	2.460	2	1.230	1.214	.298	.007
Goal-setting - This software helps me to set goals to complete assignments on time	3.527	2	1.764	1.785	.169	.011
Collaboration - This software has tools that support collaborative learning	10.534	2	5.267	5.861	.003	.035
Planning - This software does not help me to identify which tasks need to be completed	3.362	2	1.681	2.015	.135	.012
Self-evaluation - It's very difficult to use this software to check grade on assignment	3.550	2	1.775	4.006	.019	.024
Keep records - I can use tools within software to write my own notes	1.783	2	.892	.853	.427	.005
Self-consequencing - The software makes me aware of the consequences of doing poorly	2.514	2	1.257	1.056	.349	.006
Organizing - It's very difficult to use this software to create folders	1.273	2	.637	.717	.489	.004
Keep records - It's very difficult to use this software to write my own notes	.785	2	.392	.359	.699	.002
Monitor Comprehension - This software makes it easy to check if I understand course readings	1.917	2	.958	.856	.426	.005
Review records - This software makes reviewing course content for exam difficult	3.619	2	1.809	2.824	.061	.017
Seeking Info - This software provides links to supplemental information that can help me	.019	2	.010	.017	.983	.000

	Self-consequencing - I can use this software to reward myself for doing well	.737	2	.368	.333	.717	.002
	Rehearse/Memorize - When studying I read class notes over and over	3.772	2	1.886	1.936	.146	.012
	Elaboration - I try to apply ideas from readings to other class activities	.002	2	.001	.001	.999	.000
	Organizing - When I study for this course I go over my notes and make outline	.031	2	.016	.014	.986	.000
	Collaboration - I try to work with other students from this class	.180	2	.090	.089	.915	.001
	Seeking help - I ask the instructor to clarify concepts	.601	2	.301	.317	.729	.002
	Environment - I usually study in a place where I can concentrate	.136	2	.068	.151	.860	.001
	Monitor Comprehension - when studying I try to determine concepts I don't understand	.233	2	.116	.222	.801	.001
Error	Self-evaluating - Check how well I have done on an assignment	133.329	324	.412			
	Monitor Comprehension - Check if I have made mistakes on assignments	295.524	324	.912			
	Seeking Info - Access course material	183.066	324	.565			
	Transforming - Change the appearance of the lecture notes	385.599	324	1.190			
	Transforming - Download lecture notes so that I can edit them (highlight, mark up annotate)	426.239	324	1.316			
	Goal setting - Determine my learning goals such as what needs to be done before next class	212.752	324	.657			
	Goal setting - Identify tasks that need to be completed	239.897	324	.740			

	Planning - Decide when tasks need to be completed	260.219	324	.803			
	Seeking help - Ask a classmate for help	291.349	324	.899			
	Seeking help - Ask the instructor for help on an assignment	191.789	324	.592			
	Seeking Info - Find resources to help me learn what is being taught	196.066	324	.605			
	Seeking Info- Access web-based resources	199.135	324	.615			
	Seeking Info - Find information about an assignment	180.168	324	.556			
	Seeking Info - Access the course notes	131.166	324	.405			
	Environment - Complete the assignment at home	144.725	324	.447			
	Environment - Complete assignments on the weekend	172.830	324	.533			
	Collaboration - Collaborate with a classmate using tools such as email	312.696	324	.965			
	Seeking Info - Learn by observing work posted by classmates	206.888	324	.639			
	Elaboration - Apply ideas from prior lectures to new class	255.546	324	.789			
	Self consequencing - Feel satisfied when task is completed	126.045	324	.389			
	Rehearse/Memorize - Memorize concepts presented in class	306.391	324	.946			
	Elaboration - Pull together info from different sources	252.463	324	.779			
	Review records - Prepare for tests by reviewing notes	209.666	324	.647			
	Keep records - Make notes about important concepts	265.573	324	.820			
	Transforming - Modify or add to my lecture notes	365.438	324	1.128			
	Self consequencing - Remind me of consequences of failing course	330.268	324	1.019			

	Rehearse/Memorize - Memorize key words to remind me of important concepts	294.568	324	.909			
	Planning - Plan a weekly schedule to meet assignment deadlines	264.041	324	.815			
	Organizing - Organize the concepts presented in class	225.715	324	.697			
	Monitor Comprehension - Monitor my performance	122.588	324	.378			
	Review records - Review my notes in preparation for tests	219.709	324	.678			
	Collaboration - Share information with a classmate	276.344	324	.853			
	Rehearse/Memorize - Memorize answers from passed tests	426.175	324	1.315			
	Organizing - Make lists of important concepts	249.406	324	.770			
	Organizing - Make simple charts, diagrams or tables	253.775	324	.783			
	Planning - Plan homework activities	234.329	324	.723			
	Review records - Re-read passed tests or quizzes	398.131	324	1.229			
	Keep records - Record the marks I received on tests	192.771	324	.595			
	Planning - Record when assignments are due	250.933	324	.774			
	Collaboration - Learn from my peers	329.148	324	1.016			
	Review records - Review course content to prepare for an exam	191.015	324	.590			
	Planning - Plan when to study for an exam	263.639	324	.814			
	Elaboration - Make connections between concepts that have been taught and new concepts	260.415	324	.804			
	Environment - Study off campus	161.737	324	.499			
	Organizing - Write brief summaries of main ideas	264.723	324	.817			

	Organizing - Summarize main ideas from lectures and readings	278.537	324	.860			
	Organizing - Take notes from the lectures	282.288	324	.871			
	Planning - Set goals for what I want to achieve for each assignment	265.172	324	.818			
	Collaboration - Work on an assignment with classmate	345.597	324	1.067			
	Transforming - Add notes to important passages of text	305.865	324	.944			
	Monitor Comprehension - Check if I understand the material	282.345	324	.871			
	Self-evaluation - Check my progress in the course	134.968	324	.417			
	Organizing - Outline the material to help organize thoughts	253.312	324	.782			
	Keep records - Take notes based on class discussion	306.010	324	.944			
	Seeking Info - Find out more about an assignment	294.780	324	.910			
	Seeking help - Get help on an assignment from classmate	325.031	324	1.003			
	Goal-setting - Help me set a goal for the final grade	315.318	324	.973			
	Self-evaluation - Judge how well I am doing in the course	156.418	324	.483			
	Self-evaluation - Check if I achieved the grade I set to achieve	171.338	324	.529			
	Organizing - Organize the content presented in the course	248.301	324	.766			
	Planning - Plan what I should review for a test	264.184	324	.815			
	Keep records - Write my own notes	291.121	324	.899			
	Monitor Comprehension - Monitor if I understand what is being taught	309.187	324	.954			
	Environment - Study in a location I prefer	201.930	324	.623			

	Seeking help - Ask instructor for help	217.692	324	.672		
	Monitoring Comprehension - I can use tools such as rubrics to check over my work	315.585	324	.974		
	Seeking help - I can't use this software to ask the instructor a question	239.956	324	.741		
	Seeking Info - If I am unsure about a task I can use this software to find information	300.925	324	.929		
	Environment - This software does not allow me to study off campus	178.238	324	.550		
	Transforming - It's very difficult to change the appearance of course material	404.953	324	1.250		
	Planning - This software does not help me plan my homework activities	344.931	324	1.065		
	Monitor Comprehension - Using this software to check if I achieved learning goal is difficult	328.354	324	1.013		
	Goal-setting - This software helps me to set goals to complete assignments on time	320.075	324	.988		
	Collaboration - This software has tools that support collaborative learning	291.142	324	.899		
	Planning - This software does not help me to identify which tasks need to be completed	270.289	324	.834		
	Self-evaluation - It's very difficult to use this software to check grade on assignment	143.557	324	.443		
	Keep records - I can use tools within software to write my own notes	338.682	324	1.045		
	Self-consequencing - The software makes me aware of the consequences of doing poorly	385.724	324	1.191		

	Organizing - It's very difficult to use this software to create folders	287.699	324	.888			
	Keep records - It's very difficult to use this software to write my own notes	354.231	324	1.093			
	Monitor Comprehension - This software makes it easy to check if I understand course readings	362.799	324	1.120			
	Review records - This software makes reviewing course content for exam difficult	207.629	324	.641			
	Seeking Info - This software provides links to supplemental information that can help me	187.785	324	.580			
	Self-consequencing - I can use this software to reward myself for doing well	358.278	324	1.106			
	Rehearse/Memorize - When studying I read class notes over and over	315.623	324	.974			
	Elaboration - I try to apply ideas from readings to other class activities	215.619	324	.665			
	Organizing - When I study for this course I go over my notes and make outline	368.305	324	1.137			
	Collaboration - I try to work with other students from this class	327.569	324	1.011			
	Seeking help - I ask the instructor to clarify concepts	307.142	324	.948			
	Environment - I usually study in a place where I can concentrate	146.090	324	.451			
	Monitor Comprehension - when studying I try to determine concepts I don't understand	170.122	324	.525			
Total	Self-evaluating - Check how well I have done on an assignment	7034.000	327				

	Monitor Comprehension - Check if I have made mistakes on assignments	4482.000	327				
	Seeking Info - Access course material	6402.000	327				
	Transforming - Change the appearance of the lecture notes	3252.000	327				
	Transforming - Download lecture notes so that I can edit them (highlight, mark up annotate)	4700.000	327				
	Goal setting - Determine my learning goals such as what needs to be done before next class	5667.000	327				
	Goal setting - Identify tasks that need to be completed	5645.000	327				
	Planning - Decide when tasks need to be completed	5487.000	327				
	Seeking help - Ask a classmate for help	4749.000	327				
	Seeking help - Ask the instructor for help on an assignment	5460.000	327				
	Seeking Info - Find resources to help me learn what is being taught	5022.000	327				
	Seeking Info- Access web-based resources	5182.000	327				
	Seeking Info - Find information about an assignment	5537.000	327				
	Seeking Info - Access the course notes	6359.000	327				
	Environment - Complete the assignment at home	6201.000	327				
	Environment - Complete assignments on the weekend	6100.000	327				
	Collaboration - Collaborate with a classmate using tools such as email	4787.000	327				
	Seeking Info - Learn by observing work posted by classmates	3525.000	327				
	Elaboration - Apply ideas from prior lectures to new class	4757.000	327				

	Self consequencing - Feel satisfied when task is completed	5675.000	327			
	Rehearse/Memorize - Memorize concepts presented in class	4188.000	327			
	Elaboration - Pull together info from different sources	5041.000	327			
	Review records - Prepare for tests by reviewing notes	5695.000	327			
	Keep records - Make notes about important concepts	4919.000	327			
	Transforming - Modify or add to my lecture notes	4028.000	327			
	Self consequencing - Remind me of consequences of failing course	3803.000	327			
	Rehearse/Memorize - Memorize key words to remind me of important concepts	4349.000	327			
	Planning - Plan a weekly schedule to meet assignment deadlines	4263.000	327			
	Organizing - Organize the concepts presented in class	4757.000	327			
	Monitor Comprehension - Monitor my performance	6473.000	327			
	Review records - Review my notes in preparation for tests	5748.000	327			
	Collaboration - Share information with a classmate	4612.000	327			
	Rehearse/Memorize - Memorize answers from passed tests	4160.000	327			
	Organizing - Make lists of important concepts	4410.000	327			
	Organizing - Make simple charts, diagrams or tables	3564.000	327			
	Planning - Plan homework activities	4876.000	327			
	Review records - Re-read passed tests or quizzes	4829.000	327			
	Keep records - Record the marks I received on tests	6093.000	327			

	Planning - Record when assignments are due	5492.000	327			
	Collaboration - Learn from my peers	3609.000	327			
	Review records - Review course content to prepare for an exam	5725.000	327			
	Planning - Plan when to study for an exam	4968.000	327			
	Elaboration - Make connections between concepts that have been taught and new concepts	4765.000	327			
	Environment - Study off campus	6321.000	327			
	Organizing - Write brief summaries of main ideas	4625.000	327			
	Organizing - Summarize main ideas from lectures and readings	4744.000	327			
	Organizing - Take notes from the lectures	5057.000	327			
	Planning - Set goals for what I want to achieve for each assignment	4500.000	327			
	Collaboration - Work on an assignment with classmate	4049.000	327			
	Transforming - Add notes to important passages of text	3497.000	327			
	Monitor Comprehension - Check if I understand the material	4491.000	327			
	Self-evaluation - Check my progress in the course	6354.000	327			
	Organizing - Outline the material to help organize thoughts	4766.000	327			
	Keep records - Take notes based on class discussion	4422.000	327			
	Seeking Info - Find out more about an assignment	5236.000	327			
	Seeking help - Get help on an assignment from classmate	3797.000	327			
	Goal-setting - Help me set a goal for the final grade	4336.000	327			

	Self-evaluation - Judge how well I am doing in the course	6125.000	327			
	Self-evaluation - Check if I achieved the grade I set to achieve	6157.000	327			
	Organizing - Organize the content presented in the course	5028.000	327			
	Planning - Plan what I should review for a test	4993.000	327			
	Keep records - Write my own notes	4391.000	327			
	Monitor Comprehension - Monitor if I understand what is being taught	4500.000	327			
	Environment - Study in a location I prefer	6182.000	327			
	Seeking help - Ask instructor for help	5726.000	327			
	Monitoring Comprehension - I can use tools such as rubrics to check over my work	5132.000	327			
	Seeking help - I can't use this software to ask the instructor a question	5966.000	327			
	Seeking Info - If I am unsure about a task I can use this software to find information	4745.000	327			
	Environment - This software does not allow me to study off campus	6610.000	327			
	Transforming - It's very difficult to change the appearance of course material	3069.000	327			
	Planning - This software does not help me plan my homework activities	4863.000	327			
	Monitor Comprehension - Using this software to check if I achieved learning goal is difficult	5271.000	327			
	Goal-setting - This software helps me to set goals to complete assignments on time	4517.000	327			

	Collaboration - This software has tools that support collaborative learning	4056.000	327				
	Planning - This software does not help me to identify which tasks need to be completed	5339.000	327				
	Self-evaluation - It's very difficult to use this software to check grade on assignment	6900.000	327				
	Keep records - I can use tools within software to write my own notes	3491.000	327				
	Self-consequencing - The software makes me aware of the consequences of doing poorly	3477.000	327				
	Organizing - It's very difficult to use this software to create folders	3214.000	327				
	Keep records - It's very difficult to use this software to write my own notes	3733.000	327				
	Monitor Comprehension - This software makes it easy to check if I understand course readings	4153.000	327				
	Review records - This software makes reviewing course content for exam difficult	5686.000	327				
	Seeking Info - This software provides links to supplemental information that can help me	5484.000	327				
	Self-consequencing - I can use this software to reward myself for doing well	2897.000	327				
	Rehearse/Memorize - When studying I read class notes over and over	4946.000	327				
	Elaboration - I try to apply ideas from readings to other class activities	4971.000	327				

	Organizing - When I study for this course I go over my notes and make outline	5010.000	327				
	Collaboration - I try to work with other students from this class	3610.000	327				
	Seeking help - I ask the instructor to clarify concepts	4303.000	327				
	Environment - I usually study in a place where I can concentrate	6391.000	327				
	Monitor Comprehension - when studying I try to determine concepts I don't understand	5810.000	327				
Corrected Total	Self-evaluating - Check how well I have done on an assignment	134.905	326				
	Monitor Comprehension - Check if I have made mistakes on assignments	295.761	326				
	Seeking Info - Access course material	183.419	326				
	Transforming - Change the appearance of the lecture notes	386.483	326				
	Transforming - Download lecture notes so that I can edit them (highlight, mark up annotate)	427.450	326				
	Goal setting - Determine my learning goals such as what needs to be done before next class	216.771	326				
	Goal setting - Identify tasks that need to be completed	243.651	326				
	Planning - Decide when tasks need to be completed	262.997	326				
	Seeking help - Ask a classmate for help	293.804	326				
	Seeking help - Ask the instructor for help on an assignment	195.951	326				
	Seeking Info - Find resources to help me learn what is being taught	197.731	326				

	Seeking Info- Access web-based resources	202.869	326			
	Seeking Info - Find information about an assignment	184.312	326			
	Seeking Info - Access the course notes	131.694	326			
	Environment - Complete the assignment at home	147.028	326			
	Environment - Complete assignments on the weekend	174.422	326			
	Collaboration - Collaborate with a classmate using tools such as email	317.028	326			
	Seeking Info - Learn by observing work posted by classmates	210.991	326			
	Elaboration - Apply ideas from prior lectures to new class	257.401	326			
	Self consequencing - Feel satisfied when task is completed	126.349	326			
	Rehearse/Memorize - Memorize concepts presented in class	310.703	326			
	Elaboration - Pull together info from different sources	255.064	326			
	Review records - Prepare for tests by reviewing notes	212.061	326			
	Keep records - Make notes about important concepts	269.798	326			
	Transforming - Modify or add to my lecture notes	367.951	326			
	Self consequencing - Remind me of consequences of failing course	334.422	326			
	Rehearse/Memorize - Memorize key words to remind me of important concepts	297.621	326			
	Planning - Plan a weekly schedule to meet assignment deadlines	267.743	326			
	Organizing - Organize the concepts presented in class	227.676	326			

	Monitor Comprehension - Monitor my performance	122.905	326			
	Review records - Review my notes in preparation for tests	224.037	326			
	Collaboration - Share information with a classmate	281.419	326			
	Rehearse/Memorize - Memorize answers from passed tests	432.734	326			
	Organizing - Make lists of important concepts	252.336	326			
	Organizing - Make simple charts, diagrams or tables	256.355	326			
	Planning - Plan homework activities	234.336	326			
	Review records - Re-read passed tests or quizzes	403.284	326			
	Keep records - Record the marks I received on tests	192.936	326			
	Planning - Record when assignments are due	260.000	326			
	Collaboration - Learn from my peers	333.083	326			
	Review records - Review course content to prepare for an exam	192.813	326			
	Planning - Plan when to study for an exam	265.859	326			
	Elaboration - Make connections between concepts that have been taught and new concepts	265.401	326			
	Environment - Study off campus	163.321	326			
	Organizing - Write brief summaries of main ideas	272.557	326			
	Organizing - Summarize main ideas from lectures and readings	281.419	326			
	Organizing - Take notes from the lectures	286.355	326			
	Planning - Set goals for what I want to achieve for each assignment	270.716	326			

	Collaboration - Work on an assignment with classmate	355.419	326			
	Transforming - Add notes to important passages of text	309.107	326			
	Monitor Comprehension - Check if I understand the material	283.266	326			
	Self-evaluation - Check my progress in the course	135.419	326			
	Organizing - Outline the material to help organize thoughts	258.979	326			
	Keep records - Take notes based on class discussion	307.015	326			
	Seeking Info - Find out more about an assignment	303.584	326			
	Seeking help - Get help on an assignment from classmate	328.422	326			
	Goal-setting - Help me set a goal for the final grade	319.743	326			
	Self-evaluation - Judge how well I am doing in the course	156.777	326			
	Self-evaluation - Check if I achieved the grade I set to achieve	171.676	326			
	Organizing - Organize the content presented in the course	249.713	326			
	Planning - Plan what I should review for a test	268.080	326			
	Keep records - Write my own notes	297.272	326			
	Monitor Comprehension - Monitor if I understand what is being taught	313.761	326			
	Environment - Study in a location I prefer	205.229	326			
	Seeking help - Ask instructor for help	218.465	326			
	Monitoring Comprehension - I can use tools such as rubrics to check over my work	323.083	326			

	Seeking help - I can't use this software to ask the instructor a question	242.991	326			
	Seeking Info - If I am unsure about a task I can use this software to find information	304.557	326			
	Environment - This software does not allow me to study off campus	180.336	326			
	Transforming - It's very difficult to change the appearance of course material	406.954	326			
	Planning - This software does not help me plan my homework activities	348.550	326			
	Monitor Comprehension - Using this software to check if I achieved learning goal is difficult	330.813	326			
	Goal-setting - This software helps me to set goals to complete assignments on time	323.602	326			
	Collaboration - This software has tools that support collaborative learning	301.676	326			
	Planning - This software does not help me to identify which tasks need to be completed	273.651	326			
	Self-evaluation - It's very difficult to use this software to check grade on assignment	147.107	326			
	Keep records - I can use tools within software to write my own notes	340.465	326			
	Self-consequencing - The software makes me aware of the consequences of doing poorly	388.239	326			
	Organizing - It's very difficult to use this software to create folders	288.972	326			

	Keep records - It's very difficult to use this software to write my own notes	355.015	326			
	Monitor Comprehension - This software makes it easy to check if I understand course readings	364.716	326			
	Review records - This software makes reviewing course content for exam difficult	211.248	326			
	Seeking Info - This software provides links to supplemental information that can help me	187.804	326			
	Self-consequencing - I can use this software to reward myself for doing well	359.015	326			
	Rehearse/Memorize - When studying I read class notes over and over	319.394	326			
	Elaboration - I try to apply ideas from readings to other class activities	215.621	326			
	Organizing - When I study for this course I go over my notes and make outline	368.336	326			
	Collaboration - I try to work with other students from this class	327.749	326			
	Seeking help - I ask the instructor to clarify concepts	307.743	326			
	Environment - I usually study in a place where I can concentrate	146.226	326			
	Monitor Comprehension - when studying I try to determine concepts I don't understand	170.355	326			

Appendix E

Communalities

	Initial	Extraction
Self-evaluating - Check how well I have done on an assignment	.450	.379
Monitor Comprehension - Check if I have made mistakes on assignments	.466	.333
Seeking Info - Access course materia	.562	.470
Transforming - Change the appearance of the lecture notes	.437	.436
Transforming - Download lecture notes so that I can edit them (highlight, mark up annotate)	.434	.418
Goal setting - Determine my learning goals such as what needs to be done before next class	.601	.545
Goal setting - Identify tasks that need to be completed	.746	.734
Planning - Decide when tasks need to be completed	.714	.661
Seeking help - Ask a classmate for help	.623	.615
Seeking help - Ask the instructor for help on an assignment	.564	.444
Seeking Info - Find resources to help me learn what is being taught	.603	.572
Seeking Info- Access web-based resources	.562	.539
Seeking Info - Find information about an assignment	.633	.554
Environment - Complete the assignment at home	.728	.707
Environment - Complete assignments on the weekend	.740	.719
Collaboration - Collaborate with a classmate using tools such as email	.560	.519
Rehearse/Memorize - Memorize concepts presented in class	.532	.569
Keep records - Make notes about important concepts	.617	.564
Transforming - Modify or add to my lecture notes	.584	.547
Rehearse/Memorize - Memorize key words to remind me of important concepts	.577	.599

Extraction Method: Principal Axis Factoring.

	Initial	Extraction
Organizing - Outline the material to help organize thoughts	.571	.504
Keep records - Take notes based on class discussion	.614	.523
Seeking Info - Find out more about an assignment	.559	.482
Seeking help - Get help on an assignment from classmate	.653	.647
Goal-setting - Help me set a goal for the final grade	.569	.483
Self-evaluation - Judge how well I am doing in the course	.679	.697
Self-evaluation - Check if I achieved the grade I set to achieve	.636	.595
Organizing - Organize the content presented in the course	.614	.504
Planning - Plan what I should review for a test	.680	.601
Keep records - Write my own notes	.651	.607
Monitor Comprehension - Monitor if I understand what is being taught	.647	.653
Environment - Study in a location I prefer	.590	.535
Seeking help - Ask instructor a question	.545	.375
Monitoring Comprehension - I can use tools such as rubrics to check over my work	.374	.267
Seeking Info - If I am unsure about a task I can use this software to find information	.453	.376
Planning - This software does not help me plan my homework activities	.571	.530
Goal-setting - This software helps me to set goals to complete assignments on time	.626	.621
Collaboration - This software has tools that support collaborative learning	.589	.547
Planning - This software does not help me to identify which tasks need to be completed	.614	.595
Keep records - I can use tools within software to write my own notes	.481	.451

Extraction Method: Principal Axis Factoring.

	Initial	Extraction
Planning - Plan a weekly schedule to meet assignment deadlines	.448	.343
Monitor Comprehension - Monitor my performance	.641	.634
Review records - Review my notes in preparation for tests	.617	.551
Collaboration - Share information with a classmate	.647	.650
Rehearse/Memorize - Memorize answers from passed tests	.537	.579
Organizing - Make lists of important concepts	.648	.610
Organizing - Make simple charts, diagrams or tables	.556	.556
Planning - Plan homework activities	.617	.586
Review records - Re-read passed tests or quizzes	.492	.635
Keep records - Record the marks I received on tests	.574	.458
Planning - Record when assignments are due	.593	.491
Collaboration - Learn from my peers	.576	.533
Review records - Review course content to prepare for an exam	.631	.513
Planning - Plan when to study for an exam	.707	.632
Environment - Study off campus	.593	.569
Organizing - Write brief summaries of main ideas	.606	.558
Organizing - Summarize main ideas from lectures and readings	.741	.695
Organizing - Take notes from the lectures	.698	.678
Planning - Set goals for what I want to achieve for each assignment	.607	.526
Collaboration - Work on an assignment with classmate	.618	.610
Transforming - Add notes to important passages of text	.528	.511
Monitor Comprehension - Check if I understand the material	.616	.584
Self-evaluation - Check my progress in the course	.610	.541

Extraction Method: Principal Axis Factoring.

Appendix F

Grant MacEwan College
Faculty of Health and Community Studies
School of Nursing
Bachelor of Science in Nursing Program

Winter 2009

NURS 175 – Nursing Practice Foundations

Sections 5, 6, 7, 8 and 9

Course Outline

CALENDAR DESCRIPTION: 5 Credits (30: 30: 75)

Foundational nursing practice knowledge and skills are attained and integrated within classroom, laboratory, simulation, and practice settings with an individual patient/client. The nursing process is introduced and applied with regard to the provision of basic nursing care in collaboration with an individual patient/client in order to promote health, safety and comfort. Developmental and physiological considerations related to activities of daily living are discussed across the lifespan. Communication skills are implemented in the development of a nurse-patient/client relationship, establishment of professional boundaries and collaboration with other health care providers in the organization and implementation of direct care.

COURSE HOURS: Theory/Seminar: 30 Laboratory: 30 Clinical: 75

COURSE PRE-REQUISITES: minimum grade of C- in NURS 150 or 170, HLSC 120, HLST 152

COURSE PRE-REQUISITES OR CO-REQUISITES: HLSC 124, HLSC 126, and HLST 154

COURSE INSTRUCTORS:

Theory Instructors:

Irene Coulson BScN, MSA, PhD, RN
Office # 9-503S Availability: Tuesdays & Wednesdays 1000-1200
Phone: 497-5571 E-mail: coulsoni@macewan.ca

Sandy Kostashuk BScN, MAdEd, GNC, RN
Office # 9-507F Availability: Monday 1500 - 1600, Tuesday & Wednesday 1400 - 1600
Phone: 497-5754 E-Mail: kostashuks@macewan.ca

Both theory instructors will teach a portion of the course to all sections. Students are encouraged to contact Irene Coulson or Sandy Kostashuk for issues regarding the theory portion of the course. Students are encouraged to contact their individual lab and clinical instructors with questions related to labs and clinical experiences.

Lab and Clinical Instructors:

Lab and clinical instructor names, office and phone numbers, as well as e-mail addresses, availability times, and clinical course schedules will be distributed/announced in the first week of the course.

COURSE OBJECTIVES:

In addition to maintaining competency with previous course objectives, upon completion of Nursing 175, the nursing student will:

1. Apply a nursing model in the provision of care to an individual patient/client.
2. Integrate theory and evidence in the provision of foundational nursing care.
3. Demonstrate behaviours that reflect caring and respect in the patient/client learning experience.
4. Demonstrate appropriate professional communication skills within the phases of the therapeutic nurse-patient/client relationship.
5. Collaborate with other health care providers to report, organize and implement direct care.
6. Describe and apply the nursing process in the provision of safe, foundational nursing care for an individual patient/client.
7. Describe the application of the principles of primary health care within selected practice settings.
8. Assess health determinants for an individual patient/client within a health care setting.
9. Apply principles of documentation to an individual patient/client situation.
10. Perform selected foundational nursing practice psychomotor skills with competence and safety.
11. Demonstrate selected risk management processes within the clinical practice setting.
12. Adhere to the professional nursing practice standards as established by the College and Association of Registered Nurses of Alberta (CARNA).

DESCRIPTION OF COURSE CONTENT:

Learning activities in this course will include class lectures, lab, and clinical practice. Theory presented in class will build on knowledge learned from all pre-requisite courses in the first term of the program and knowledge from co-requisite courses in the second term. Class activities will include a variety of individual and group learning activities to encourage the student to think critically and apply knowledge to case studies.

Lab experiences will give the student the opportunity to participate in hands-on learning activities to practice a variety of selected psychomotor skills. Required online activities will assist the student to prepare for these lab activities.

Clinical practice will give the student the opportunity to participate in the care of individual clients in clinical settings appropriate for the beginning student. Clinical practice will be instructor led and closely supervised.

Students will study the following topics in class and have the opportunity to apply theory to practice in both lab and clinical settings. Students should consult Blackboard for more detailed information about classroom, lab and clinical activities.

The Context of Nursing Practice

- The Journey to Clinical Excellence
- Applying Best Practice Principles
- Principles of Living
- Understanding the Nature of Human Experience: The Experience of Being Ill or Well
- Health Determinants: Relevance to practice
- Applying Principles of Primary Health Care to Nursing Practice

Promoting Safety in Nursing Practice

- Concepts of Safety and Preventing Injury in Practice (client and nurse)
- Standard Precautions and General Concepts in Infection Control
- Introduction to Principles of Documentation

Meeting Client Bio psycho social cultural spiritual Needs

- Comfort Theory and application to practice
- Facilitating hygiene, nutrition, oral care, elimination, mobility, positioning

Approaches to Nursing Practice

- The Nursing Decision Making Process, Clinical Judgment
  - Applying Nursing Process, Use of Standardized Language, Using a Model in Practice
- Principles of Teaching and Learning Client Education

Schedule of Classes – Please refer to Blackboard

REQUIRED RESOURSES:

Potter, P. A., Perry, A. G., Ross-Kerr, J. C. & Wood, M. J. (Eds.). (2006). *Canadian fundamentals of nursing* (3rd ed.). Toronto, ON: Mosby.

Wilkinson, J. (2007). *Nursing process and critical thinking*. (4th ed.). Upper Saddle River, NJ: Pearson

Tutton, E. & Seers, K. (2003). Exploration of the concept of comfort. *Journal of Clinical Nursing, 12*, 689-696.

Corbin, J.M. (2002). The body in health and illness. *Qualitative Health Research*, 13, 256-267.

REQUIRED EQUIPMENT:

- A current Nursing Medical Dictionary
- Uniform (see Student Handbook section on "Dress Guidelines While in Uniform")
- Stethoscope (same or similar quality to Littman II)
- Watch with a second hand

PROGRAM GUIDELINES:

To facilitate success in the nursing program, students should expect to do a minimum of two (2) hours of independent search study for each hour of course content.

In order to facilitate discussion and integration of concepts in classroom time, students are expected to come to class prepared to discuss relevant topics. It is expected that all students will have completed textbook and other readings and reviewed materials pertaining to the class topic in advance of attending the class. Unless otherwise indicated, students may be evaluated on any material that is covered during class time, in required readings, or in required out-of-class activities.

Students are expected to be knowledgeable about the guidelines published in the current Student Handbook regarding examinations, assignments, and plagiarism. Audio taping of classes requires permission from both the instructor and the other members of the class.

This course will also utilize Blackboard to enhance students' learning. Students are expected to be knowledgeable about using Blackboard. Help is available to student from the MacEwan HelpDesk (497-HELP). Unless otherwise indicated, students may be evaluated on any material that is covered during class time, in required readings, or in required out-of-class activities.

In accordance with information and protocols provided in the Student Handbook and as a prerequisite for clinical courses, students must have a current N95 mask size, current Health Care Provider Level C (Heart and Stroke Foundation) CPR certification, and knowledge of WHMIS.

As well, provision of a current clear security clearance report may be required by clinical agencies as a prerequisite for clinical practice experiences.

Students must consistently demonstrate safe, competent, and ethical nursing practice and professional behaviour. Students who do not prepare adequately or who exhibit unsafe practice or unprofessional conduct or dress will be required to leave the clinical area. This may jeopardize success of the student in the course.

ATTENDANCE:

We believe that the professional practice of nursing should reflect caring, professional responsibility and accountability, scholarship, clinical excellence, leadership, and respect. Safe, competent, ethical professional nursing practice derives from a foundation of knowledge, skills, attitudes, and values acquired through active engagement in program activities. Regular, punctual attendance is therefore expected for ALL course activities. Absences will jeopardize opportunities for success in the course and, ultimately, in the program. Students are referred to the current Student Handbook for further information about management of absences.

Students are expected to be present for ALL clinical lab experiences, except when illness would jeopardize their ability to provide safe care. Attendance and punctuality are considered when the Clinical Practice Evaluation Tool is completed. *Missed clinical and/or lab experience may compromise the student's ability to meet the course objectives.*

> *Alberta Health Services (Oct 2008) states that 'students may ONLY provide patient care and perform nursing-related skills after they have received formal instruction in an educational institution or clinical setting & have been deemed competent to safely meet the minimum standards to practice, in an educational institution or clinical setting*

Lab experiences provide students with opportunities to learn the skills necessary for safe clinical practice. It is the student's responsibility to ensure that they have practiced the skill in a lab educational setting, prior to performing this skill in a clinical setting. Therefore, students who are ill or who have other extenuating circumstances necessitating their absence from lab *must inform* their **lab and clinical instructor** in advance, either by email or voice mail. In addition, the student will complete a '**Missed Experience Form**', available on the NURS 175 Blackboard Homepage and forward a completed copy to the **clinical and lab instructor** within 48 hours of the missed experience. Failure to do so may result in the student being prohibited from attending clinical learning experiences.

The undergraduate nursing programs reserve the right to prohibit commencement of a clinical course if a student's absence prevents participation in scheduled orientation activities and or has the potential to compromise the student's ability to provide safe, competent, ethical client care.

EVALUATION:

Completion of all assignments is a mandatory requirement for course completion. Students must receive a grade of **Pass** in the clinical practice evaluation in order to be successful in the course. **The minimum course grade for course credit is C-.**

Guidelines for Assignments

Complete guidelines for all assignments are found on the NURS 175 Blackboard homepage. All assignments are to be submitted on, or before, the published due date. An extension may be granted for extenuating circumstances. A request for an extension must be made a minimum of 24 hours in advance of the due date. All assignments are to be typed.
There is a late submission penalty of **5%** per day or partial day including weekends and holidays. Students are responsible for ensuring assignments reach the intended instructor. Assignments submitted on weekends or holidays must be submitted electronically with a hard copy provided on the following business day.

Scholarly behaviour is an expectation of all students. Academic dishonesty includes plagiarism, cheating, improper collaboration, fabrication or falsification, assisting in dishonest behaviour, and obtaining an unfair advantage (MacEwan's Academic Integrity Policy C1000). Plagiarism is "the use and submission of another's words, ideas, results, work, or processes without providing appropriate credit to the individual(s) responsible for same" (MacEwan's Academic Integrity Policy C1000 3.5.2). Consequences for plagiarism and other forms of academic dishonesty will be considered on an individual basis, but may result in a grade of zero on the assignment or exam. Students are responsible for being informed about the Academic Integrity Policy, adhering to the principles of Academic Integrity in all work, and to refrain from assisting other students in any attempts to violate the policy. Please refer to the Student Handbook for more information regarding Academic Integrity and avoiding academic dishonesty.

SUMMARY OF EVALUATION:

Midterm Examination	25%
Final Examination	35%
Clinical Practice Evaluation	Pass Fail*
In-class Group Project	10%
On-line LAB Quizzes	10%
Journal of Reflective Practice	20%
Total	**100%**

*Students must receive a grade of **Pass** in the clinical practice evaluation in order to successfully complete the course.

DATES FOR EXAMS, QUIZZES AND COMPLETION OF ASSIGNMENTS

Grades feedback for assignments and midterm exam will be provided within 14 calendar days of assignment submission or writing of the exam. Final course grades will be submitted within 5 business days of the final exam.

Dates for Midterm Exam (written during the first hour of class time)
Section 5 Tuesday February 24, 2009
Sections 6 & 8 Thursday February 26, 2009
Sections 7 & 9 Friday February 27, 2009

Date for Final exam TBA

Dates for Clinical Practice Evaluation are set in collaboration with your clinical instructor.

Dates for In-class Group Project:

Section 5 Tuesday March 31, 2009
Sections 6 & 8 Thursday April 2, 2009
Sections 7 & 9 Friday April 3, 2009

Dates for Lab Quizzes (available to students online during these times):

Quiz 1: Infection Control, Safety in Practice, Transfers
Jan 12-Feb 13: Covers lab 3 & 4 & 5

Quiz 2: Comfort and Hygiene
Feb 2 - March 6: Covers Lab 6 & 7

Quiz 3 - Mobility
Feb 23-March 13: Covers Lab 8

Quiz 4 – Vital Signs and Blood Pressure
March 2 - March 27: Covers Lab 9 & 10

Quiz 5 – Nutrition and Client Teaching
March 16 - April 10: Covers Lab 11 & 13

Dates for Journal of Reflective Practice

Your clinical instructor will advise the specific date each journal entry is due
To be written in clinical weeks -

4 (Jan 26-Jan 30)
7 (Feb 23-Feb 27)
9 (March 16-March 20)
13 (April 6-April 10)

GRADING SYSTEM:

The official grading system at Grant MacEwan College is the 4 point letter grade system. While instructors may use percentages to aid in their grade development, percentages are not part of Grant MacEwan College's official final grades. Students should NOT expect percentage equivalents to letter grades to be the same in all courses. All final grades shall be reported to the Office of the Registrar using letter grades. Letter grades shall be converted to the four-point grading scale of the Alberta Common Grading Scheme for the calculation of a Grade Point. More information about academic policies and procedures, including grading and program performance standards, is available in the current Student Handbook, MacEwan's Policies, and the College Calendar.

Letter Grade	Grade Point Value	Percentage Equivalent	Grade Descriptions (Based on College Grading policy and program requirements for course credit)
A+	4.0	94.45 - 100	**Outstanding**, i.e., exemplary achievement
A	4.0	89.45 - 94.44	
A-	3.7	84.45 - 89.44	**Excellent**, i.e., superior performance showing sustained excellence in meeting course objectives
B+	3.3	79.45 - 84.44	**Good**, i.e., above average performance with good knowledge of subject material
B	3.0	74.45 - 79.44	
B-	2.7	69.45 - 74.44	
C+	2.3	65.45 - 69.44	**Satisfactory**, i.e. average and adequate performance, demonstrating a basic understanding of the subject matter, and meeting course requirements
C	2.0	62.45 - 65.44	
C-	1.7	59.45 - 62.44	
D+	1.3	54.45 - 59.44	**Poor**, i.e., minimally competent performance showing significant weakness in many areas. Performance insufficient to satisfy course and course prerequisite requirements for undergraduate nursing programs
D	1.0	49.45 - 54.44	
F	0.0	Less than 49.45	**Fail**; i.e., unsatisfactory performance. Course requirements have not been met
WF	0.0		**Withdraw Failure**, i.e., a Registrar assigned grade that signifies a student failed to meet the published deadlines for the given course

In the undergraduate nursing programs, a minimum grade of C- on each course MUST be achieved for course credit and to maintain enrolment within the program.

ACADEMIC INEGRITY

MacEwan has a policy on Academic Integrity (C1000), and the student is responsible for being aware of and adhering to this policy.

STUDENT APPEALS:

MacEwan has a policy on Student Appeals (E3103).

Appendix G

Your location: **Home Page**

NURS 175 Nursing Practice Foundations

Outline & Schedule & Evaluation Tool

Content 'Week by Week SCHEDULE OF ACTIVITIES'

Group Nursing Care Plan Assignment
To be done in Week 12

Clinical Reflective Practice Journal Assignment, Weeks 4, 7, 10, 13

Week 1 Jan 5-Jan 9 THERE IS LAB FIRST WEEK
Context Nursing Practice, LAB FIRST WEEK

Week 2 Jan 12-Jan 16
The Context of Nursing Practice

Week 3 Jan 19-Jan 23
Promoting Safety in Practice

Learning Resources
To assist your assignments and clinical practice. Enjoy!

Week 5 Feb 2 - Feb 6
Meeting Client Needs

Week 6 Feb 9 - Feb 13
Documentation

Week 4: Meeting, Client Bio-Psycho-Social-Cultural -Spiritual Needs
Meeting Client Needs

Week 8 March 2 -March 6
Approach to Nursing Practice

Week 9 March 9-March 13
Approaches to Nursing Practice

Week 7: Approaches to Nursing Practice
Approaches to Nursing Practice

Week 11 March 23-March 27
Approaches to Nursing Practice

Week 12 March 30- April 3
Putting it all Together, In-Class Group Assignment

Week 10 March 9 -March 13
Approaches to Nursing Practice

Week 13: Approaches to Nursing Practice
Approaches to Nursing Practice

Nursing Practice LAB Videos

Assignment Due Dates
Includes Reflective Journal Questions

MacEwan Clinical Laboratories
LAB MANUAL, Lab Orientation & Media Simulation Clips

Questions and Answers about this course AND Troubleshooting

REQUIRED READINGS & QUIZZES

NURS175 Clinical Groups WI 20091

MANADATORY STUDENT Missed Lab Experience Report NURS 175

References

Abran, A., Khelifi, A., Suryn, W., & Seffah, A. (2003). Usability meanings and interpretations in ISO standards. *Software Quality Control, 11*(4), 325-338.

Alexander, P., & Winne, P. (Eds.). (2006). *Handbook of educational psychology* (2nd ed.). Mahwah, New Jersey: Lawrence Erlbaum Associates.

American Educational Research Association, American Psychological Association, & The National Council on Measurement in Education. (1999). *Standards for educational and psychological testing*. Washington: American Psychological Association.

Anderson, S. (2008). Effective integration of sound pedagogy in an online format. Paper presented at the *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2008,* 3579-3586.

Ardito, C., Costabile, M. F., De Marsico, M., Lanzilotti, R., Levialdi, S., Plantamura, P., et al. (2004). Towards guidelines for usability of e-learning applications. In C. Stary, & C. Stephanidis (Eds.), *User-centered interaction paradigms for universal access in the information society* (pp. 185-202). Berlin Heidelberg: Springer-Verlag.

Arh, T., & Blazic, B. J. (2007). A multi-attribute decision support model for learning management systems evaluation. Paper presented at the *ICDS '07: Proceedings of the First International Conference on the Digital Society,* 11.

Azevedo, R. (2007). The role of self-regulation in learning about science with hypermedia. In D. Robinson, & G. Schraw (Eds.), *Current perspectives on cognition, learning, and instruction* (pp. 127-156). Charlotte, NC: Information Age Publishing

Azevedo, R., Seibert, D., Guthrie, J. T., Cromley, J. G., Wang, H., & Tron, M. (2002). How do students regulate their learning of complex systems with hypermedia? *American Educational Research Association,* New Orleans, LA.

Azevedo, R. (2005). Using hypermedia as a metacognitive tool for enhancing student learning? The role of self-regulated learning. *Educational Psychologist, 40*(4), 199-209.

Azevedo, R. (2007). Understanding the complex nature of self-regulatory processes in learning with computer-based learning environments: An introduction. *Metacognition and Learning, 2*(2), 57-65.

Azevedo, R., & Cromley, J. G. (2004). Does training on self-regulated learning facilitate students' learning with hypermedia?, *Journal of Educational Psychology, 96(3), 523--535.*

Azevedo, R., Cromley, J. G., & Seibert, D. (2004). Does adaptive scaffolding facilitate students' ability to regulate their learning with hypermedia? *Contemporary Educational Psychology, 29*(3), p344.

Azevedo, R., Guthrie, J. T., & Seibert, D. (2004). The role of self-regulated learning in fostering students' conceptual understanding of complex systems with hypermedia. *Journal of Educational Computing Research, 30*(1-2), p87.

Bandalos, B. (1996). Confirmatory factor analysis. In J. Stevens (Ed.), *Applied multivariate statistics for the social sciences* (3rd ed., pp. 389-420) Lawrence Erlbaum.

Bates, T., & Picard, J. (2005). *Technology, e-learning and distance education* (2nd ed.). London: New York Taylor & Francis Routledge.

Bennett, J. L. (1979). The commercial impact of usability in interactive systems. *Man/computer communication: Infotech state of the art report* (pp. 1-17). Maidenhead: Infotech International.

Benson, J., & Clark, F. (1982). A guide for instrument development and a validation. *The American Journal of Occupational Therapy, 36*(12), 789-800.

Bevan, N., & Macleod, M. (1994). Usability measurement in context. *Behaviour and Information Technology, 13*, 132-145.

Biskin, B. H. (1998). Comment on significance testing. *Measurement & Evaluation in Counseling & Development (American Counseling Association), 31*(1), 58.

Blackboard. (2007). *Blackboard: In practice.* Retrieved August 10, 2007, 2007, from http://www.blackboard.com/

Boekaerts, M., Pintrich, P. R., & Zeider, M. (Eds.). (2000). *Handbook of self-regulation.* San Diego: Academic Press.

Bratt, S. (2007). A framework for assessing the pedagogical utility of learning management systems. *World Conference on E-Learning in Corporate, Government, Healthcare, and Higher Education (ELEARN),* Quebec City, Canada. 218-225.

Bratt, S., Coulson, I., & Kostashuk, S. (2009). Utilizing a learning management system in a blended learning design to enhance self-regulated learning strategies in a baccalaureate nursing fundamentals course. *International Conference on Information Communication Technologies in Education,* Corfu, Greece.

Britto, M. (2002). *An exploratory study of the development of a survey instrument to measure the pedagogical dimensions of web-based instruction.* Unpublished Doctoral Thesis from The University of Georgia.

Butler, D. (2002). Individualizing instruction in self-regulated learning. *Theory into Practice, 41*(2), 81-92. Retrieved from Academic Search Elite database.

Butler, D. L., & Winne, P. H. (1995). Feedback and self-regulated learning: A theoretical synthesis. *Review of Educational Research, 65*(3), 245.

Carver, R. P. (1993). The case against statistical significance testing, revisited. *Journal of Experimental Education, 61*(4), 287-292.

Chang, C. L. (2008). *Faculty perceptions and utilization of a Learning Management System in higher education*. Unpublished Doctoral Thesis from Ohio University.

Chen, M. (1995). A methodology for characterizing computer-based learning environments. *Instructional Science, 23*, p183.

Chua, B. B., & Dyson, L. E. (2004). Applying the ISO9126 model to the evaluation of an e-learning system. Paper presented at the *Beyond the Comfort Zone,* Perth, Australia. 184-190.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences* (2nd ed.). Hillsdale, NJ: Erlbaum.

Conole, G., Dyke, M., Oliver, M., & Seale, J. (2004). Mapping pedagogy and tools for effective learning design. *Computers and Education2, 43*(1), 17-23.

Converse, J. M., & Presser, S. (1986). *Survey questions: Handcrafting the standardized questionnaire*. Thousand Oak, California: Sage Publications.

Corno, L., & Mandinach, B. E. (1983). The role of cognitive engagement in classroom learning and motivation. *Educational Psychologist, 18*(2), 1-8.

Cronbach, L. J. (1951). Coefficient alpha and the internal structure of tests. *Psychometrika, 16*(3)

Cronbach, L. J. (1988). Five perspectives on validity argument. In H. Wainer, & H. Braun (Eds.), *Test validity* (pp. 3-17). Hillsdale, New Jersey: Lawrence Erlbaum Associates, Inc.

Dabbagh, N., & Kitsantas, A. (2004). Supporting self-regulation in student-centered web-based learning environments. *International Journal on E-Learning,* (1537), 40-47.

Dabbagh, N., & Kitsantas, A. (2005). Using web-based pedagogical tools as scaffolds for self-regulated learning. *Instructional Science: An International Journal of Learning and Cognition, 33*(5), 513.

DeVillis, R. F. (2003). *Scale development: Theory and applications* (2nd ed.). Thousand Oaks: CA: Sage Publications, Inc.

Economics A-Z. (2008, July 27, 2008). *The Economist, 2008*

EduTools. *CMS: Feature list.* Retrieved May 10, 2009, from http://landonline.edutools.info/feature_list.jsp?pj=4

Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, cognitivism, constructivism:. comparing critical features from an instructional design perspective. *Performance Improvement Quarterly, 6*(4), 50-72.

Fabrigar, L. R., Wegener, D. T., MacCallum, R. C., & Strahan, E. J. (1999). Evaluating the use of exploratory factor analysis in psychological research. *Psychological Methods, 4*, 272-299.

Falvo, D. A., & Johnson, B. F. (2007). The use of learning management systems in the united states. *TechTrends: Linking Research and Practice to Improve Learning, 51*(2), p40.

Field, A. P. (2005). *Discovering statistics using SPSS for windows* (2nd ed.). London: Sage Publications.

Flavell, J. H. (1976). Metacognitive aspects of problem solving. In L. B. Resnick (Ed.), *The nature of intelligence* (pp. 231-235) Lawrence Erlbaum Associates.

Flavell, J. H. (1979). Metacognition and cognitive monitoring: A new area of cognitive-developmental inquiry. *American Psychologist,*

Flavell, J. H. (2004). Theory-of-mind development: Retrospect and prospect. *Merrill Palmer Quarterly Journal of Developmental Psychology, 50*(3), p274.

Flavell, J. H., Green, F. L., & Flavell, E. R. (1995). The development of children's knowledge about attentional focus. *Developmental Psychology, 31*(4), p706.

Flavell, J. H., & Wellman, H. M. (1975). *Metamemory.* Minnesota Univ.,Minneapolis.Inst.of Child Development.

Floyd, F. J., & Widaman, K. F. (1995). Factor analysis in the development and refinement of clinical assessment instruments. *Psychological Assessment, 7*(3), 286-299.

Garcia, T., & Pintrich, P. R. (1995). *Assessing students' motivation and learning strategies: The motivated strategies for learning questionnaire*

Garrett, R. (2002). *Leading learning platforms: International market presence* No. 2). Observatory on Borderless Higher Education.

Global Industry Analysts. (2007). *eLearning: A global strategic business report.* Global Industry Analysts.

Gorsuch, R. L. (2003). Factor analysis. In J. A. Schinka, & W. F. Velcier (Eds.), *Handbook of psychology: Volume 2 research methods in psychology* (pp. 143-164). Hoboken, NY: John Wiley & Sons, Inc.

Groves, R. M., Fowler, F. J., Couper, M. P., Lepkowski, J. M., Singer, E., & Tourangeau, R. (2004). *Survey methodology*. Hoboken, NJ: John Wiley & Sons.

Hacker, D. J., Dunlosky, J. A., & Graesser, A. C. (Eds.). (1998). *Metacognition in educational theory and practice* Lawrence Erlbaum Associates.

Hadjerrouit, S. (2007). Applying a system development approach to translate educational requirements into E-learning. *Interdisciplinary Journal of Knowledge and Learning Objects, 3*, 107-134.

Hadwin, A. F., & Winne, P. H. (2001). CoNoteS2: A software tool for promoting self-regulation. *Educational Research and Evaluation, 7*(2-3), 313-334.

Hadwin, A. F., Winne, P. H., & Nesbit, J. C. (2005). Roles for software technologies in advancing research and theory in educational psychology. *British Journal of Educational Psychology, 75*(1), p1.

Hair, J., Anderson, R., Tatham, R., & Black, W. (1998). Multivariate analysis. (5th ed.,). New Jersey: Prentice Hall.

Harmon, M. G. (1993). *The role of strategies and knowledge in problem solving: A review of the literature.* Paper presented at the annual meeting of the National Association for Research in Science Teaching, Anaheim, CA, 1993. ERIC Document Reproduction Service No. ED 366640.

Haynes, S. N., Richard, D. C. S., & Kubany, E. S. (1995). Content validity in psychological assessment: A functional approach to concepts and methods. *Psychological Assessment, 7*, 238-247.

Hofer, B. K., Yu, S. L., & Pintrich, P. R. (1998). Teaching college students to be self-regulated learners. In D. H. Schunk, & B. J. Zimmerman (Eds.), *Self-regulated learning; from teaching to self-reflective practice* (pp. 57-85). New York, NY: Guilford Press.

Hornbaek, K. (2006). Current practice in measuring usability: Challenges to usability studies and research. *International Journal of Human-Computer Studies, 64*(2), 79-102.

Human Factors Research Group (HFRG). (n.a.). *WAMMI.* Retrieved August 5, 2008, 2008, from www.wammi.com.

IEEE. (1990). *IEEE standard glossary of software engineering terminology (IEEE std. 610.12-1990).* New York: IEEE.

International Organization for Standardization/International Electrotechnical Commission. (1998). *ISO 9241-11:1998 ergonomic requirements for office work with visual display terminals (VDTs) -- part 11: Guidance on usability.* Geneva: ISO.

International Organization for Standardization/International Electrotechnical Commission. (2001). *ISO/IEC 9126-1:2001. software engineering - product quality - part 1: Quality model.* Geneva: ISO.

Inversini, A., Botturi, L., & Triacca, L. (2006a). Evaluating LMS usability for enhanced eLearning experience. Paper presented at the *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2006,* 595-601.

Inversini, A., Botturi, L., & Triacca, L. (2006b). Evaluating LMS usability for enhanced eLearning experience. Paper presented at the *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2006,* 595-601.

Johnson, T. R., Zhang, J., Tang, Z., Johnson, C., & Turley, J. P. (2004). Assessing informatics students' satisfaction with a web-based courseware system. *International Journal of Medical Informatics, 73*, 181-187.

Kaiser, H. F. (1960). The application of electronic computers to factor analysis. *Edzlcatioizal and Psyclzological Measurement, 20*(14), 1-151.

Kelemen, W. L. (2000). Metamemory cues and monitoring accuracy: Judging what you know and what you will know. *Journal of Educational Psychology, 92*(4), p800.

Kim, J., & Mueller, C. W. (1978). *Factor Analysis : Statistical methods and practical issues*. Toronto: Sage Publications.

Kline, P. (1994). *An easy guide to factor analysis*. New York: Routledge.

Kommers, P., Jonassen, D. H. & Mayes T. (1992). *Cognitive tools for learning*. Heidelberg FRGÀ: Springer-Verlag.

Lan, W., Bremer, R., Stevens, T., & Mullen, G. (2004). Self-regulated learning in the online environment. Paper presented at the *American Educational Research Association Annual Meeting,* San Diego, CA.

Lanzilotti, R., Ardito, C., Costabile, M. F., & De Angeli, A. (2006). eLSE methodology: A systematic approach to the e-learning systems evaluation. *Educational Technology Society, 9*(4), 42.

Leacock, T. L., Winne, P. H., Kumar, V., & Shakya, J. (2006). Using technology to support self-regulation in university writing. Paper presented at the Kerkrade, The Netherlands. , *0* 1073-1075.

Litwin, M. S. (1995). *How to measure survey reliability and validity. the survey kit, volume 7.* Thousand Oaks:CA: Sage Publications Inc.

Lopes, V. M. (2009). *The efficacy of a course management system in learning: Perceptions of students and faculty at one Ontario college*. Unpublished Doctoral Thesis from the University of Toronto.

Manlove, S., Lazonder, A., & de Jong, T. (2007). Software scaffolds to promote regulation during scientific inquiry learning. *Metacognition and Learning, 2*(2), 141-155.

McCormick, C. B. (2003). Metacognition and learning. In I. B. Weiner, J. A. Freedheim, J. A. Schinka, W. F. Velcier & A. M. Goldstein (Eds.), *Handbook of psychology* (pp. 79-102) John Wiley and Sons.

McDougall, A., & Squires, D. (1995). A critical examination of the checklist approach in software selection. *Journal of Educational Computing Research, 12*(3), 263-274.

McMillan, J. H., & Hearn, J. (2008). Student self-assessment: The key to stronger student motivation and higher achievement. *Educational Horizons, 87*(1), p40.

McTavish, D. G. (1997). Scale validity: A computer content analysis approach. *Social Science Computer Review, 15*(4), 379-393.

Mehlenbacher, B., Bennett, L., Bird, T., Ivey, M. Jan Lucas: Morton, J., & Whitman, L. (2005). Usable E-learning: A conceptual model for evaluation and design. *Proceedings of HCI International 2005: 11th International Conference on Human-Computer Interaction, Volume 4 – Theories, Models, and Processes in HCI,* Las Vegas, Nevada. , *4* 1-10.

Messick, S. (1980). Test validity and the ethics of assessment. *American Psychologist, 35*(11), p1012.

Messick, S. (1989). Validity. In R. L. Linn (Ed.), *Educational measurement* (3rd ed., pp. 13-103). New York: MacMillan.

Miller, P. H. (1985). Metacognition and attention. In D. Forrest-Pressley, G. E. MacKinnon & T. G. Waller (Eds.), *Metacognition, cognition, and human performance: Vol. 2, instructional practices* (pp. 181-221). New York: Academic Press.

Montalvo, F. T., & Torres, M. C. G. (2004). Self-regulated learning: Current and future directions. *Electronic Journal of Research in Educational Psychology, 2*(1), November 13, 2004-34.

Moodle. *Moodle statistics.* Retrieved August 10, 2007, 2007, from http://moodle.org/stats/

Myers, R. (1990). *Classical and modern reqression with applications* (2nd ed.). Boston, MA: Duxbury Press.

Narciss, S., Proske, A., & Koerndle, H. (2007a). Promoting self-regulated learning in web-based learning environments. *Computers in Human Behavior, 23*(3), 1126-1144.

Narciss, S., Proske, A., & Koerndle, H. (2007b). Promoting self-regulated learning in web-based learning environments. *Computers in Human Behavior, 23*(3), 1126-1144.

Netemeyer, R. G., Bearden, W. O., & Sharma, S. (2003). *Scaling procedures: Issues and applications.* Thousand Oaks: CA: Sage Publications.

Newby, T. J., Stepich, D. A., Lehman, J. D., & Russell, J. D. (2006). *Educational technology for teaching and learning* (3rd ed.). Upper Saddle River: New Jersey: Pearson Merrill Prentice Hall.

Nielsen, J. (1993). *Usability engineering.* San Francisco: Morgan Kaufmann.

Nokelainen, P. (2006). An empirical assessment of pedagogical usability criteria for digital learning material with elementary school students. *Educational Technology & Society, 9*(2), 178-197.

Nunnally, J., & Bernstein, I. (1994). *Psychometric theory* (3rd ed.). New York: McGraw-Hill.

Paulsen, M. F., & Keegan, D. (2003). European experiences with learning management systems. *Educational Technology & Society, 6*(4), 134-148.

Pedhazur, E., & Schmelkin, L. (1991). *Measurement, design, and analysis* . Hillsdale: Lawrence Erlbaum.

Perry, N. E., & Winne, P. H. (2006). Learning from learning kits: GStudy traces of students' self-regulated engagements with computerized content. *Educational Psychology Review, 18*(3), p211.

Petherbridge, D. T. (2007). *A concerns-based approach to the adoption of Web-based learning management systems.* Unpublished Doctoral Thesis from North Carolina State University.

Pinelle, D., & Gutwin, C. (2002). Groupware walkthrough: Adding context to groupware usability evaluation. *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems: Changing our World, Changing Ourselves,* Minneapolis, Minnesota, USA. 455-462.

Pintrich, P. R., & Schunk, D. H. (1996). *Motivation in education: Theory, research, and applications*. Englewood Cliffs, N.J.: Merrill/Prentice Hall.

Presser, S., et al. (Ed.). (2004). *Methods for testing and evaluating survey questionnaires*. Hoboken, NY: John Wiley & Sons, Inc.

Pressley, M., & Levin, J. R. (Eds.). (1983a). *Cognitive strategy research: Educational applications*. New York: Springer-Verlag.

Pressley, M., & Levin, J. R. (Eds.). (1983b). *Cognitive strategy research: Psychological foundations*. New York: Springer-Verlag.

Puustinen, M., & Pulkkinen, L. (2007). Models of self-regulated learning: A review. *Scandinavian Journal of Educational Research, 45*(3), 269-286.

Quintana, C., Zhang, M., & Krajcik, J. (2005). A framework for supporting metacognitive aspects of online inquiry through software-based scaffolding. *Educational Psychologist, 40*(4), p235.

Reeves, T. C., Benson, L., Elliot, D., Grant, M., Holschuh, D., Kim, B., Kim, H., Lauber, E., and Loh, S. (2002). *Usability and instructional design heuristics for e-learning evaluation.* Paper presented at the World Conference on Educational Multimedia, Hypermedia & Telecommunication (ED-MEDIA), Denver, CO.

Reiser, R. A. & Kegelmann, H. W. (1994). Evaluating instructional software: A review and critique of current methods. *Educational Technology Research and Development, 42*(3), 63-69.

Rentróia-Bonito, M. A., Guerreiro, T., Martins, A., Fernandes, V., & Jorge, J. (2006). Evaluating learning support systems usability: An empirical approach. Paper presented at the *3rd E-Learning Conference – Computer Science Education,* Coimbra, Portugal. Retrieved from

Research Methods Knowledge Base. (2006). *Survey research.* Retrieved June 25, 2008, from http://www.socialresearchmethods.net/kb/survey.php

Resnick, L. B. (Ed.). (1976). *The nature of intelligence.* New Jersey: Lawrence Erlbaum.

Root, R. W., & Draper, S. (1983). Questionnaires as a software evaluation tool. Paper presented at the *CHI '83: Proceedings of the SIGCHI Conference on Human Factors in Computing Systems,* Boston, Massachusetts, United States. 83-87.

Ryu, Y. S. (2005). *Development of usability questionnaires for electronic mobile products and decision making methods.* Unpublished Doctor of Philosophy, Virginia Polytechnic Institute and State University,

Salkind, N. J., & Rasmussen, K. (2008). Cognitive view of learning. In Neil J. Salkind (Ed.), *Encyclopedia of educational psychology* (pp. 164 - 165) Sage Publications.

Schneider, W., & Sodian, B. (1997). Memory strategy development: Lessons from longitudinal research, *Developmental Review, 17*(4), 442.

Schober, B., Wagner, P., Reimann, R., & Spiel, C. (2008). Vienna E-lecturing (VEL): Learning how to learn self-regulated in an internet-based blended learning setting. *International Journal on E-Learning, 7*(4), 703-723.

Schooley, C. (2007). *How to select A learning management system.* Retrieved January 2, 2008, 2007, from http://www.forrester.com/Research/Document/Excerpt/0,7211,43408,00.html

Schraw, G. (2007). The use of computer-based environments for understanding and improving self-regulation. *Metacognition and Learning, 2*(2), 169-176.

Schraw, G., & Graham, T. (1997). Helping gifted students develop metacognitive awareness. *Roeper Review, 20*(1), p4.

Schunk, D. H., & Zimmerman, B. J. (2006). Competence and control beliefs: Distinguishing the means and the ends. In P. Alexander, & P. H. Winne (Eds.), *Handbook of educational psychology* (pp. 349-367)

Shackel, B. (1991). Usability - context, framework, design and evaluation. In R. S. Shackel B. (Ed.), *Human factors for informatics usability* (pp. 21-38). Cambridge University Press: Cambridge.

Sharma, P., & Hannafin, M. J. (2007). Scaffolding in technology-enhanced learning environments. *Interactive Learning Environments, 15*(1), p27.

Shaver, J. (1993). What statistical significance testing is, and what it is not. *Journal of Experimental Education, 61*, 239-316.

Shaver, J. P. (1985). Chance and nonsense: A conversation about interpreting tests of statistical significance, part 1. *Phi Delta Kappan, 67*(1), 57.

Sidebotham, P. (2001). An ecological approach to child abuse: A creative use of scientific models in research and practice. *Child Abuse Review, 10*(2), 97.

Silius, K., Tervakari, A., & Pohjolainen, S. (2003). A multidisciplinary tool for the evaluation of usability, pedagogical usability, accessibility and informational quality of web-based courses. Paper presented at the *The Eleventh International PEG Conference: Powerful ICT for Teaching and Learning,* St. Petersburg, Russia.

Spector, P. E. (1992). *Summated rating scale construction: An introduction (sage university paper series on quantitative applications in the the social sciences, no. 82).* Newbury Park: CA: Sage Publications.

Squires, D., & Preece, J. (1999). Predicting quality in educational software: Evaluating for learning, usability and the synergy between them. *Interacting with Computers, 11*, 467-483.

Squires, D., & Preece, J. (1996). *Computers & Education, v27 n1 p15-22*

Steffens, K. (2006). Self-regulated learning in technology-enhanced learning environments: Lessons of a european peer review. *European Journal of Education, 41*(3/4), p353.

Stevens, J. P. (2009). *Applied multivariate statistics for the social sciences* (4th ed.). Mahwah, N.J.: Lawrence Erlbaum.

Streiner, D. L. (1994). Figuring out factors: The use and misuse of factor analysis. *Canadian Journal of Psychiatry, 39*(3), 135-143.

Syllabus. (2004, June 29, 2004). Learning management systems: Are we there yet? *Campus Technology,* Retrieved from http://campustechnology.com/articles/39862/

Tergan, S. (1998). Checklists for the evaluation of educational software: Critical review and prospects. *Innovations in Education and Training International, 35*(1), 9.

Tergan, S., & Schenkel, P. (2003). Assessing the instructional power of e-learning applications: A learner-centred checklist approach. Paper presented at the *Proceedings of World Conference on Educational Multimedia, Hypermedia and Telecommunications 2003,* 604-609.

Tervakari, A. M., & Silius, K. (2002). Tietoverkkoavusteisen opetuksen käyttökelpoisuus. *DMI/Hypermedia Laboratory.,* Retrieved from http://www.virtuaaliyliopisto.tut.fi/verkkopakki/liitteet/kayttokelpoisuus_teoria.pdf

Thomas, K. (2006). *Learner perspectives on the use of a learning management system in first-year economics students*. Unpublished Doctoral Thesis from University of Pretoria.

Thorkildsen, T. (2005). *Fundamentals of measurement in applied research* (1st ed.). Toronto: Pearson Education, Inc.

Trigano, P. (2006). Self-regulated learning in a TELE at the université de technologie de compiègne: An analysis from multiple perspectives. *European Journal of Education, 41*(3/4), p381.

Usability Net. (2006). *Context of use.* Retrieved June 21, 2008, 2008, from http://www.usabilitynet.org/tools/r_context.htm

Vacha-Haase, T., & Thompson, B. (1998). Further comments on statistical significance tests. *Measurement and Evaluation in Counseling and Development, 31*(1), 63.

Vacha-Haase, T., & Thompson, B. (2004). How to estimate and interpret various effect sizes. *Journal of Counseling Psychology, 51*(4), 473.

Vogt, D. S., King, D. W., & King, L. A. (2004). Focus groups in psychological assessment: Enhancing content validity by consulting members of the target population. *Psychological Assessment, 16*(3), 231-243.

Wainer, H., & Braun, H. (Eds.). (1988). *Test validity* (1st ed.). Hillsdale, New Jersey: Lawrence Erlbaum Associates.

Weinert, F. E., & Kluwe, R. H. (Eds.). (1987). *Metacognition, motivation, and understanding*. New Jersey: Lawrence Erlbaum Associates.

Weinstein, C. E. (1987). Fostering learning autonomy through the use of learning strategies. *Journal of Reading, 30*(7), p590.

Weinstein, C. E., Husman, J. & Dierking, D. R. (2000). Self-regulation interventions with a focus on learning strategies. In Pintrich, P. R. and Boekaerts, M. (Ed.), (pp. 727-747). San Francisco, CA: Elsevier.

Weinstein, C. E., & Mayer, R. E. (1986). *The teaching of learning strategies* . In M. Wittrock (Ed.), *Handbook of research on teaching* (3rd ed., pp. 315-327). New York, New York: MacMillan Publishing Company.

Weinstein, C. E., & Palmer, D. R. (2002). *User's manual: Learning and study strategies inventory* (2nd ed.). Clearwater, FL: H&H Publishing Company, Inc.

Wiersma, W., & Jurs, S. G. (2005). *Research methods in education* (8th ed.). Toronto: Pearson Education.

Winne, P. H. (2001). Self-regulated learning viewed from models of information processing. In B. J. Zimmerman (Ed.), *Self-regulated learning and academic achievement: Theoretical perspectives* (pp. 152-189). Malwah, New Jersey: Lawrence Erlbaum Associates.

Winne, P. H., Nesbit, J. C., Kumar, V., Hadwin, A. F., Lajoie, S. P., Azevedo, R., et al. (2006). Supporting self-regulated learning with gStudy software: The learning kit project. *Technology, Instruction, Cognition and Learning, 3*(1), 105-113.

Winne, P. H. (1998). Self-regulated learning viewed from models of information processing. In B. J. Zimmerman, D. H. Schunk (Ed.), *Self-regulated learning and academic achievement: Theoretical perspectives* (2nd ed., pp. 153-189). Malwah, New Jersey: Lawrence Erlbaum Associates.

Winne, P. H. (1996). A metacognitive view of individual differences in self-... *Learning & Individual Differences, 8*(4), p327.

Winters, F. I., & Azevedo, R. (2005). High-school students' regulation of learning during computer-based science inquiry. *Journal of Educational Computing Research, 33*(2), 189-217.

Winters, F., Greene, J., & Costich, C. (2008). Self-regulation of learning within computer-based learning environments: A critical analysis. *Educational Psychology Review, 20*(4), 429-444.

Wittrock, M. C. (1986). Students' thought processes. In M. C. Wittrock (Ed.), *Handbook of research on teaching* (pp. 297-314). New York: MacMillan.

Woolfolk, A. E., Winne, P. H., & Perry, N. E. (2003). *Educational psychology* (2nd ed.). Toronto: Pearson Education Canada.

Zeller, R. A., & Carmines, E. G. (1980). *Measurement in the social sciences*. Cambridge: Cambridge University Press.

Zimmerman, B. J., & Pons, M. M. (1986). Development of a structured interview for assessing student use of self-regulated learning strategies. *American Educational Research Journal, 23*(4), 614-628.

Zimmerman, B. J., & Schunk, D. H. (Ed.). (2001). *Self-regulated learning and academic achievement : Theoretical perspectives.* New Jersey: Lawrence Erlbaum Associates.

Zimmerman, B. J., & Martinez-Pons, M. (1988). Construct validation of a strategy model for student self-regulated learning. *Journal of Educational Psychology, 80*(3), 284-290.

Zimmerman, B. J., & Schunk, D. H. (1989). *Self-regulated learning and academic achievement: Theory, research, and practice.* New York: Springer-Verlag.

Zimmerman, B. J., & Tsikalas, K. E. (2005). Can computer-based learning environments (CBLEs) be used as self-regulatory tools to enhance learning? *Educational Psychologist, 40*(4), 267-271.

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? *Contemporary Educational Psychology, 11*(4), 307-313.

Zimmerman, B. J. (1986). Becoming a self-regulated learner: Which are the key subprocesses? *Contemporary Educational Psychology, 11*(4), 307-313.

Zimmerman, B. J. (2008). Investigating self-regulation and motivation: Historical background, methodological developments, and future prospects. *American Educational Research Journal, 45*(1), p166.