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Development and Validation of a Web-Based Module to Teach Metacognitive Learning Strategies to Students in Higher Education

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by

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Dedication

To my mother, Ms. Mahadai Pustam: Words cannot convey my appreciation for all the sacrifices you made for me, the ones known and unknown to me. Thank you for the continuous love and support you provide to me. As a child, I know it was you who instilled in me the importance of education. Maybe I did not appreciate it then but I do now. All I can hope is that I also will get the privilege to instill in others, the importance of education. So, I thank God and you for all my accomplishments, yesterday, today and tomorrow. I love you Mum.

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I would also like to acknowledge and thank all of my family and friends who understood how important this was to me and helped me with prayers and kind words. I would especially like to thank my sister Sharmatie for always helping me – she is the most generous person I know. I also recognize my friend Ms. Nadia Heinz for going to the library with me, just because I needed the motivation. I also thank Nadia for editing my document -- more than once. My deepest gratitude goes to Ms. Susan Cook for her support. Thank you also to Dr. Melissa Venable who set the "gold standard" for being disciplined about writing and gave me the motivation I needed to complete what I started.

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Development and Validation of a Web-Based Module to Teach Metacognitive Learning Strategies to Students in Higher Education

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ABSTRACT

This study used a design based-research (DBR) methodology to examine how an Instructional Systematic Design (ISD) process such as ADDIE (Analysis, Design, Development, Implementation, Evaluation) can be employed to develop a web-based module to teach metacognitive learning strategies to students in higher education. The goal of the study was twofold: (a) to examine the use of a systematic ISD process, ADDIE, to develop a web-based module that would be considered valid and effective, and (b) to use the design-based research (DBR) methodology to create relevant outcomes for practitioners in the field of IT while adding to the body of IT research.

As in other DBR studies, a large amount of qualitative data was collected. DBR studies usually call for a variety of data collection instrument. In this study, a total of two interviews and twelve questionnaires were used to gather data. The outcomes of the study suggested that using a systematic approach such as ADDIE to develop a valid and effective interactive web-based module was still viable. Additionally, although the outcomes from this study did not form a basis to propose a new ISD model, it highlighted five key activities that could be added to the ADDIE process to accommodate

development of a quality interactive web-based product. The five activities are as follows: (1) to conduct a detailed front-end analysis, (2) to develop a prototype early in the process, (3) to integrate formative and summative evaluations, (4) to assimilate iterations of "design-evaluate-refine" cycles throughout the process, and (5) to accommodate flexibility within the process. Furthermore, using the DBR methodology yielded results that added to the body of IT research and it provided support of the use of this methodology within the instructional technology discipline.

Chapter One

Introduction

This study applied a design-based research (DBR) approach to develop and validate a web-based module that teaches metacognitive learning strategies to learners within academic disciplines in higher education utilizing a systematic Instructional Systems Design (ISD) process: ADDIE (Analysis, Design, Development, Implementation, Evaluation). The process of analyzing, designing, developing, implementing and evaluating online content matters; especially if it affects the quality of learning modules which may in turn, affect the learning outcomes of online learners. In other words, quality matters. The quality of online courses should be such that it is equal or better than traditional type courses (Chao, Saj & Tessier, 2006).

Distance education (note: in this study distance education will not differ in meaning to online or web-based or computer-based education) may no longer be considered a new phenomenon (Phipps & Merisotis, 1999). During 1995 to 1997, statisticians at the National Center for Education Statistics (NCES) reported that the percentage of distance education courses increased from 33% to 44% among 2-year and 4-year institutions (Waits & Lewis, 2003). As of 2002 nearly 78% of adult students had completed a web-based course (Parker, 2003). From these percentages, it is apparent that web-based learning is becoming integrated into our education choices.

Background

Many educational researchers choose to focus on instructional approaches to enhance learning rather than on media comparisons. In the late 80's education technology researchers observed a need to shift their attention from media comparison to how learning occur online (Duin, 1998). The Clark (1994, 1991, 1985, 1983) and Kozma (1994, 1991) research studies and debate on this issue, also cited in Robyler and Wiencke (2003) influenced that shift of instructional technology research. Clark (1994, 1991, 1985, 1983) maintained that technology in and of itself cannot improve learning outcomes. Clark's review of the research at that time led him to ascertain that there was "no significant difference" in learner outcomes between traditional instruction and web-based instruction (WBI). Rather, Clark thought that research focus should shift from comparative media studies to studies that would help discover new or improve instructional approaches.

Kozma (1994, 1991) in contrast, did not disregard education technology research or media comparisons. However, he did suggest that if online instruction methods were carefully constructed to engage the learner then technology could provide the basis for successful learning opportunities. Some researchers, including Clark (1994, 1991, 1985, 1983) and Kozma (1994, 1991) saw the futility of focusing on comparative issues between the traditional and online forms of delivery (Brown & Wack, 1999). In essence, this debate accentuated the need for researchers to study other aspects of web-based instruction that could result in more effective methods and improved learner outcomes.

In fact, at a point when the comparative studies between traditional and online learning was at its peak, Moore (1989) encouraged future researchers to give attention to a different aspect of online education, the learners themselves. More recent studies like those highlighted by Ramage (2002) and what Kozma (1994, 1991) alluded to, infers that there is a difference in learner outcomes among online courses that may be affected by media, method, design, use and evaluation, and researchers should be encouraged to study these aspects. Web-based courses are now woven into the fabric of academia and the corporate world. Many instructional technology researchers are focusing on methods to improve the effectiveness of web-based courses.

In this study the researcher will explore the affect of employing the theoretically based ISD approach to analyze, design, develop, implement and evaluate a web-based module to teach metacognitive objective test-taking learning strategies. The ISD process incorporated into this study is ADDIE. Indeed, there are many ISD models in existence today that includes the systematic ADDIE process to some degree (Scafati, 1998; Allen, 2006). Key researchers (Dick, Carey & Carey, 2005; Dick & Carey, 1996, 1990; Seels & Glasgow, 1998; Scafati, 1998) within the instructional design discipline favor a systematic approach to developing WBI. They believe that quality WBI is developed by following a process that will analyze, design, develop, implement and evaluate training (Dick et al., 2005; Dick & Carey 1996, 1990; Seels & Glasgow, 1998; Scafati, 1998; Clark, 1989). Moreover, according to researchers (Dick et al., 2005; Dick & Carey 1996, 1990; Scafati, 1998), the models of a systems approach are the result of more than 25 years of research. Scafati (1998, 2004) believes that one of the primary strengths of the systems approach to developing curriculum is defining clear and measurable objectives

which lead to "a consistent and repeatable learning experience" (2004, p. 389). ADDIE provides the foundation of many systematic models that exists today.

Allen (2006, 2003) provides a different perspective on the ADDIE process, arguing that it is no longer adequate to sustain the development of WBI that is both high in quality and effectiveness. He identifies the exponential growth in technology (e.g. 3-D and simulation software and advances in network technology etc.) as one of the main reasons why ADDIE is inadequate (Allen, 2006). Also, ADDIE is generic and many designers, Allen included, modify the process to suit their individual purposes (Allen, 2006). Allen (2006) who is the Chief Executive Officer (CEO) of a successful e-learning development business believes that ADDIE leads to "boring" and "ineffective" WBI (p.33). Allen is not alone in his views. Gordon and Zemke (2000) have also notably criticized ADDIE as being inefficient and resulting in ineffective training. However, there may be other factors to consider that may also lead to poor quality online courses. Dick et al. (2005) note that it takes "time and effort" (p.10) to develop a module using a systematic approach. Could it be that quality is being affected because instructional designers may not have enough time to design a quality online course using a systematic approach? This is a valid question when reviewing the growth rate of online (i.e. web-based or distance) courses and the political aspects that are affecting this growth.

Currently in the United States, each state oversees their quality of education. Furthermore, institutes of higher education (IHEs) may be further regulated by different accreditation groups (e.g. SACS (Southern Association for Colleges and Schools)). This situation poses a threat to the future of distance education because distance education programs have to operate under many different regulatory systems (Levine & Sun, 2003).

What may be considered acceptable quality in one state may not be so in another. Unfortunately, in the process of meeting the growing demand for online access to course material, there also appears to be an increase in poorly designed online courses. In the rush to move courses online, some instructional designers are ignoring or unaware of the systematic approach to developing a web-based course. The results of this research study will help to clarify the need for instructional designers to implement a systematic approach to develop a web-based module. Designing a course and designing it well enough to meet the needs of the learners can be a reality. In addition, the outcome of this study will provide instructional designers refined, practical information on how a systematic approach can be implemented and adapted for their web-based initiatives.

Advances in information and computer technology (ICT) working in combination with a decrease in prohibitive costs, are driving IHEs to increase the use of technology into their curricula. In order to meet the growing demands externally (state) and internally (within the IHE), IHEs are introducing web-based courses into their curricula within a short period of time and are rapidly increasing the overall number of web-based courses. The results of a 2006 survey of approximately six hundred 2 and 4 year colleges showed that wireless networks in college classrooms, which could facilitate an increase in accessibility to online courses, had increased from 42.7%, approximately a little over two-fifths of the population surveyed in 2005 to 51.7% in 2006 (The Campus Computing Project, 2006).

To demonstrate how rapidly IHEs are moving their courses online, the National Center for Educational Statistics, conducted a series of studies on distance education in 2-year and 4-year Title IV IHE's (Waits & Lewis, 2003). For example, in 2000–01, 90% of

public 2-year and 89% of public 4-year institutions as well as 16% of private 2-year and 40% of private 4-year institutions offered distance education courses (Waits & Lewis, 2003). Furthermore, researchers (Allen & Seaman, 2007) who were funded by The Sloan Consortium (Sloan-C) conducted a more recent study of the growth of online courses in over 2,500 colleges in the U.S stated that in Fall 2006 approximately "3.5 million students were taking at least one online course" (p. 1). This represented an increase of 10% over the previous year. In regards to IHEs, in Fall 2006 at least 20% of all students surveyed had taken one online course (Allen & Seaman, 2007). The researchers of the Sloan-C study (Allen & Seaman, 2007) also found that the enrollment growth rate for online courses during the Fall semester of 2006 was 9.7%. This growth rate surpassed the overall growth rate for students enrolled in higher education, which was only 1.5%. As a result, the quality of web-based courses is a challenge and a concern among educators considering the rate at which it is expanding online.

Statement of the Problem

There has been a revelation in the last 10 years concerning web-based courses and curriculum and that is, the problem is not the rise in the numbers of web-based courses but rather the design and educational content are poor in quality (Janicki & Liegle 2001; Mariasingam & Hanna, 2006). A successful learning outcome for web-based learners is dependent on instruction that is well-designed and developed (Simonson, Smaldino, Albright, & Zvacek, 2003). A poorly designed web-based course can add to other problems that may lead to poor learning outcomes. Poor learning outcomes stemming from less-than adequately designed web-based courses need to be addressed by researchers in this field.

If instructional designers are currently designing online courses based on a systematic approach, then they need to understand clearly what works and what does not work in practical terms. There is a need in this field to clearly identify how the theoretical-based systematic approach of instructional systems design (ISD) is being translated into "day-to-day" operations of web-based initiatives for curricula. With the accessibility of web-based courses on the rise, it is critical that instructional designers of web-based courses understand the importance of using a systematic approach in design as well as to be aware of what translates best from theoretical to practical.

Purpose of Study

There were two purposes in conducting this study. First, one of the purposes of this study was to provide instructional designers with a practical guideline of how to design web-based courses that maintains a systematic approach adhering to the foundational strength of the ISD theories. To meet this purpose, the study focused on developing an intervention using the ADDIE process where a positive learning outcome was derived. The outcome of this study provided instructional designers and web-based instructional designers with guidelines to make better design decisions. Furthermore, it was the hope that this study would help instructional designers and researchers gain a deeper understanding of the ISD processes involved in WBI that is pedagogically, theoretically and practically sound.

Answering the call of many noted researchers in this field to use a DBR approach to study the problems and issues found within the instructional technology discipline was the second purpose of this study. Within the instructional technology discipline, DBR has been "gaining momentum" (van denAkker, Gravemeijer, McKenney & Nieveen, 2006, p.

3). As van den Akker et al. (2006) pointed out that many definitions of DBR exists and this is indicative of an "emerging trend" (p.4). Although DBR will be explored further in Chapter Two, one definition of DBR by Barab, Arici, and Jackson (2005) is as follows:

> Design-based research is a collection of innovative methodological approaches that involve the building of theoretically-inspired designs to systematically generate and test theories in naturalistic settings. Design-based research is especially powerful with respect to supporting and systematically examining innovation. (p. 15)

The DBR approach holds the possibility of providing deeper insights and practical outcomes that can truly aid the practitioners in this field. Also DBR provide the opportunity to study foundational theories with a new perspective therefore shedding light on factors that may have become obsolete or could be re-energized and utilized in a new fashion. From a DBR perspective, the guideline that emerged from the data gathered in the present study helped to refine the ADDIE process and provided an opportunity to explore the emergence of a new model altogether although this was not a primary objective of the study.

Research Question

What is the effect of applying a systematic approach to the development of a web-based module for teaching metacognitive learning strategies to students in a higher education environment?

Research Objectives

Research Objective 1: To create a systematically and rigorously designed product intended to meet research design goals.

Research Objective 2: To produce data that indicated the validity and effectiveness of the product.

Research Objective 3: Deliverables were:

Deliverable A: A list of generalized "Lessons Learned".

Deliverable B: Report on the effectiveness of the specific instructional strategies utilized.

Deliverable C: An analysis of quantitative, qualitative and descriptive outcome measures of learning among field test participants.

Deliverable D: A module that was considered valid and effective at the juncture where the study completed a second iteration of the "design-evaluate-refine" cycle. Consideration of the modules' validity and effectiveness was derived using data collected via formative and summative evaluations guided by the ADDIE process.

Significance of the Study

Significance of this study was twofold. First, it was important to let the readers understand that the research approach – design-based research (DBR) – was relatively new within the field of instructional technology and education itself. A widespread adoption of the DBR approach within education was encouraged by many key researchers (Edelson, 2002; Collins, 1992; Reeves, Herrington, & Oliver, 2005; Reeves, 2000; van den Akker, 1999; Brown, 1992;). In fact, a growing number of researchers, (Reeves, 1995, 2000; Resnick, 1999; van den Akker, 1999) are strong advocates of the DBR approach. They support DBR because they believe that it benefits the instructional technology (IT) discipline by providing more socially relevant information to designers

and developers. Reeves (1995) and Reeves et al. (2005) have opined that a lack of socially relevant studies in the field of instructional technology is a major dilemma that needs to be addressed.

Second, it is critical within any field to study anew long-held theoretical approaches. In this case, the study of practical usage of the systematic approach of instructional design using the generic ADDIE process was long overdue. A possibility exists that technological growth and improvement in ICTs within recent years have made an impact on the manner in which instructional design was being conducted. Additionally, ADDIE may or may not have evolved alongside these technological changes; therefore it was vital that research be conducted on this process. Some practitioners in the field of instructional technology eschewed the systematic approach saying that this approach was a poor fit in the practical instructional development world (Allen, 2006). In contrast, some education researchers were uncomfortable with the idea that quality instructional design can be accomplished without a systematic approach.

It is important, especially in instructional technology to create a bridge between the theoretical and the practical approach to create WBI that will add value in terms of quality and effectiveness. The nature of instructional design and development should accentuate the need for researchers and practitioners to work closely together. These were some of the expectations for this study. In addition, the researcher believed that this study emphasized the need for more avenues where the academic and practical world of instructional design collides and coalesces.

Assumptions

There were two assumptions made by the researcher in this study. First, noted researchers (Reeves et al., 2005; Reeves, 2000; van den Akker, 1999; Brown, 1992; Collins, 1992; Design-based Research Collective [DBRC], 2003) in the field of instructional technology believed that DBR is the appropriate methodology to advance the body of research. This shift in paradigm has come as a result of criticisms levied at the body of research in the field of instructional technology. Many researchers claim that instructional technology research has a diluted impact on practitioners.

Second, a systematic approach to design and to develop can be used to inculcate high quality web-based instruction (WBI). Unfortunately, it appears that this approach is being neglected since there are many courses being delivered via the Web that are considered "shovelware", that is, courses where the "content is taken from any source and put on the Web as fast as possible with little regard for appearance and usability" (Whatis.com, 2007, para. 1). In this study the researcher assumed that the systematic approach to instructional design was a productive way to create effective WBI. The researcher proposed that the ADDIE process will serve as a guideline to create an innovative web-based intervention that is high in quality and effectiveness.

Limitations and Threats of the Study

Instrumentation

There were a variety of instruments utilized to gather information in each phase of the ISD process and to create the proposed web-based module. The possibility existed that internal validity may have been compromised. Pre-testing and post-testing instruments were not employed in this study. However, some measures were taken to

counteract any internal validity threat. Notably, for each questionnaire, questions were derived from credible research sources and each questionnaire was expertly reviewed. For the present study, information was collected via questionnaires, interviews and an observation.

Researcher Bias

In regards to the qualitative data that was collected, the researcher guarded against bias when reporting results of exploratory or open-ended information that was collected. The researcher utilized the strategy known as "reflexivity" which promoted critical self-reflection to enhance awareness of any biases or predispositions thus reducing the threat of researcher bias (Johnson & Christensen, 2004). Another strategy that was employed in the study was to have the data and analysis reviewed by an editor.

Delimitations of the Study

The present study was not a longitudinal study therefore the number of "design-evaluate-refine" iterations was limited to one in the Development phase and two in the Evaluation phase of ADDIE. Information gathering occurred in a naturalistic setting. One of the strengths of conducting the study within this setting was that the results could be generalized across population to a certain extent. The results may be generalized to adults eighteen and over but is limited in regards to a younger population

Definition of Terms

In order to provide clarification to the reader, the following is a list of terms and what it connotes in the present study. Please note that the definitions with no citations are terms defined by the researcher.

ADDIE (Analysis, Design, Development, Implementation, Evaluation): a conceptual framework of the ISD process (Bichelmeyer, 2005).

Cognitive Strategies: Numerous ways by which learners guide their own learning, thinking, acting, and feeling (Driscoll, 1994, p. 341).

Effectiveness: The term "effectiveness" in this study will be interpreted as "perceived" effectiveness, that is, effectiveness of the product will be an interpretation made by the participants of the study such as the Instruction Design experts and the learners.

Internet: The *Internet* is a massive network of networks, a networking infrastructure. It connects millions of computers together globally, forming a network in which any computer can communicate with any other computer as long as they are both connected to the Internet. Information that travels over the Internet does so via a variety of languages known as protocols. (Webopedia.com, 2007, para. 2).

Instruction: The deliberate arrangement of learning conditions to promote the attainment of some intended goal (Driscoll, 1994, p. 332).

Instructional Design: The systematic and reflective process of translating principles of learning and instructions into plans for instructional material, activities, information resources, and evaluation (Smith & Ragan, 2005, p. 4).

Instructional Systems Design (ISD): The incorporation of processes to develop instructional materials that can facilitate learning that has measurable outcomes (Seels & Glasgow, 1998, p. 7).

Learning: A change in human disposition or capability, which persists over a period of time, and which is not simply ascribable to processes of growth (Gagné, 1977, p. 3).

Metacognition: One's awareness of thinking and self-regulatory behavior (Driscoll, 1994, p. 103).

Web-based Instruction (WBI): Instruction designed to be delivered on the computer using the Internet, World Wide Web (www) and its resources. The intervention can include interaction, feedback, knowledge and skills transfer to facilitate learning.

World Wide Web (www): The *World Wide Web*, or simply *Web*, is a way of accessing information over the medium of the Internet. It is an information-sharing model that is built on top of the Internet. The Web uses the HTTP protocol, only one of the languages spoken over the Internet, to transmit data. Web services, which use HTTP to allow applications to communicate in order to exchange business logic, use the Web to share information. The Web also utilizes browsers, such as Internet Explorer or Netscape, to access Web documents called Web pages that are linked to each other via hyperlinks. Web documents also contain graphics, sounds, text and video. The Web is just one of the ways that information can be disseminated over the Internet. The Internet, not the Web, is also used for e-mail, which relies on SMTP, Usenet news groups, instant messaging and FTP. So the Web is just a portion of the Internet, albeit a large portion, but the two terms are not synonymous and should not be confused. (Webopedia.com, 2007, para. 3).

Organization of the Study

In summary, Chapter One relates the background, problem, purpose, research questions and objectives of the present study. It also describes the significance of conducting the research, delimitations and purported threats of the study. Chapter Two is the literature review and the discourse covers several foundational research studies regarding design-based research (DBR), web-based instruction (WBI), instructional

systems design (ISD) and the ISD process, ADDIE (Analysis, Design, Development, Instruction, Evaluation) and learning. Several topics pertinent to this study and which relate to learning include metacognitive learning and teaching test-taking strategies. The dialogue in Chapter Three, describes the methods, procedures, research design, participants and various instruments utilized. An account of the pilot study, the first phase of the ISD process, Analysis, is also included in Chapter Three. Finally, Chapter Four and Chapter Five cover the results of the present study and the summary of the results respectively.

Chapter Two

Literature Review

This chapter reviews the literature regarding four topics applicable to this research: design-based research (DBR), web-based instruction (WBI), instructional systems (ISD), and learning. These broad topics have been narrowed down to focus on particular areas such as DBR within instructional technology, WBI in higher education, ADDIE within the ISD process and metacognitive learning, teaching test-taking strategies, learner satisfaction and quality of WBI. Also, due to the fact that there is a wide range of terminology referring to design and developmental research, for the purpose of clarity, this study will use the term "design-based research" (DBR) to encompass all the variations.

Design-based Research (DBR)

Overview of Design-Based Research

Education researchers are generally pursuing two main objectives: to better understand how people learn within their learning environment; and to design effective interventions to achieve positive learning outcomes (DBRC, para.1, n.d.). DBR may be relatively new to education but that is not the case in other disciplines (Bannan-Ritland, 2003; Bereiter 2002, Collins 1999; van den Akker, 1999). For instance, the engineering, medical and psychology fields were early adopters of DBR and have utilized it to sustain

innovation and development (Barab, Arici, & Jackson, 2005; Bannan-Ritland, 2003; Bereiter, 2002). Furthermore, according to the Association for Information Systems (AIS) (2006), adoption of DBR is currently growing in other disciplines besides education, such as the information systems (IS) arena at many colleges of business.

Researchers (Cobb, Confrey, diSessa, Lehrer, & Schauble, 2003; Bereiter, 2002) pointed out that the nature of DBR sustains innovation and development within the disciplines that adopt it; which may provide an insight as to why researchers in the disciplines mentioned above are using DBR in their studies. In education, specifically in the instructional technology pedagogy where the emphasis is on designing effective interactions, the research methods that inspire innovation and sustained development are either missing or poorly executed (Sandoval, 2004; Bereiter, 2002; Reeves, 2000). Supporting the use of DBR in education research, Sandoval (2004) stated that a fundamental aspect of DBR is its ability to embody conjecture about the curriculum, interventions, design tools and interaction structures.

Before going further, a clear picture of the origins of DBR and some definitions of DBR must be addressed. The DBR movement can be traced back to the early 1990's. During this time two influential studies were conducted by scholars Ann Brown (1992) and Allan Collins (1992) (as cited in Collins, Joseph, & Bielaczyc, 2004; Bannan-Ritland, 2003). Brown (1992) is credited with introducing the term "design experiment" to the world of research (as cited in Collins et al., 2004, p. 15; Sandoval & Bell, 2004, p. 199).

In Brown's (1992) influential study, she deliberated that the learning environment was a naturalistic interactive system, consisting of outputs and inputs which can

contribute to learning theories and promote feasibility of an intervention. Figure 1 explains Brown's vision of a design-based experiment. The crux of Brown's argument was in her belief that the learning system is complex in nature therefore to study the various elements of the system in isolation or in a laboratory environment constricted the delivery as well as the outcome. In other words, studying an intervention in a synthetic environment did not account for the dynamic nature of the classroom, where the actual context of learning occurred.

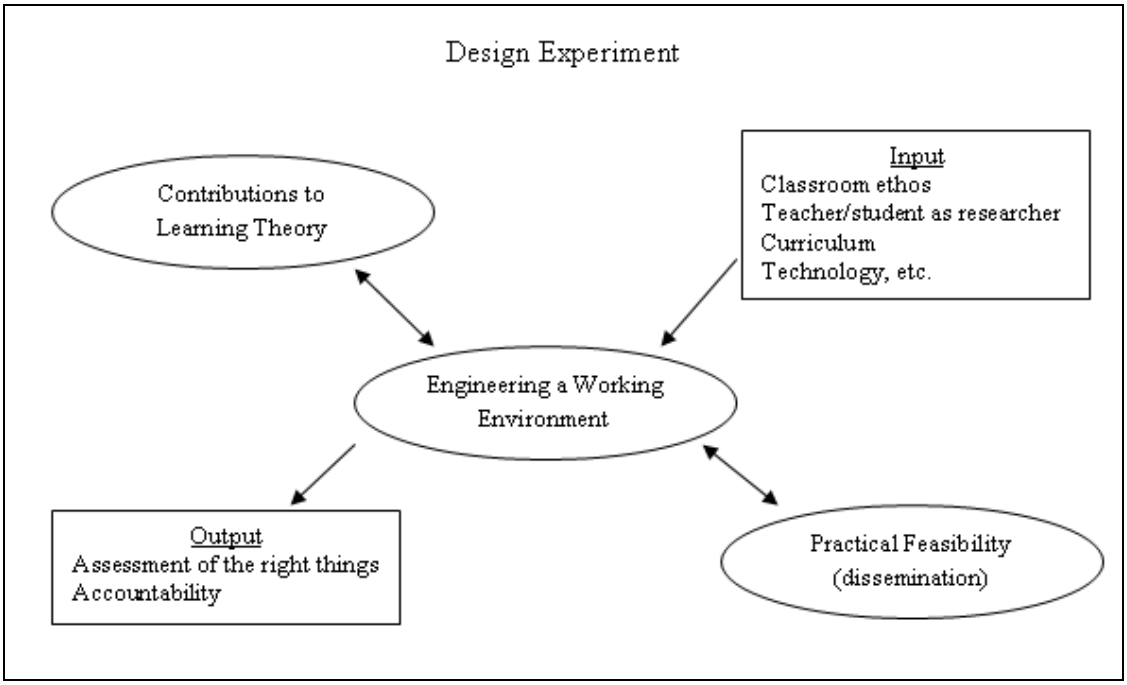


Figure 1. Design experiment.

Note. From "Design experiments: Theoretical and methodological challenges in creating complex interventions," by A. L. Brown, 1992, *Journal of the Learning Sciences*, *2*(2), pp. 141–178.

Brown compared her experience of conducting experiments in the laboratory versus her experience in the classroom. She found that the classroom was a dynamic environment, and when she placed the intervention in the classroom the results were different from the laboratory results. Once in the classroom, Brown discovered that she

could change the intervention to produce positive learning outcomes. She followed an iterative process of introducing the intervention, making changes, introducing the updated intervention, making further changes and repeating the process. Brown perceived the design experiment as iterative, encouraging innovation and providing a means of sustainability, and at the same time advancing ideas on learning theories and practical application. Brown acknowledged that design research is complex to execute, but the information it could yield was pertinent within the pedagogy.

There is a large amount of literature on DBR and the outcome of the research thus far proposes a variety of definitions. It is apparent that a clear definition of DBR is still being debated in the academic community (DBRC, 2003; Bell, 2004, van den Akker, 1999). Here are several attempts at defining DBR that may help the reader gain a better understanding of DBR. One of the simplest definitions that embody the overall goal of DBR was put forward by Joseph (2004):

> Design-based research approaches research in education by using intervention to provide insights into learning in real-world context. (p. 235)

A more comprehensive definition of DBR by Cobb et al. (2003):

> Prototypically, design experiments entail both "engineering" particular forms of learning and systematically studying those forms of learning within the context defined by the means of supporting them. This designed context is subject to test and revision, and successive iterations that result play a role to that of systematic variation in experiment. (p. 9)

Another position on DBR by van den Akker (1999):

> Development research is often initiated for complex, innovative tasks for which only very few validated principles are available to structure and support the design and development activities. Since in those situations the image and impact of the intervention to be developed is often still unclear, the research focuses on realizing limited but promising examples of those interventions. The aim is not to elaborate and implement complete interventions, but to come to (successive) prototypes that increasingly meet the innovative aspirations and requirements. The process is often cyclic or spiral: analysis, design, evaluation and revision activities are iterated until a satisfying balance between ideals and realization has been achieved. (p. 7)

These definitions of DBR, and there are others that are similar, are indicative of a scholarly process of an emerging trend within the pedagogical society. Researcher van den Akker (1999) points out that the myriad of terminology already in existence is another indication that DBR is an emerging trend within instructional technology. The following is a list of terminology that was/is used by various researchers; from the research of van den Akker (1999), Reeves et al. (2005), Hoadley (2002), Brown (1992) and Collins (1992): (a) Design studies, Design experiments, Design research, Design-based research, Design-based research methods; (b) Development/Developmental research; (c) Formative research, Formative inquiry, Formative experiments, Formative evaluation; (d) Action research; and (e) Engineering research. For the present study, this researcher has settled on the terminology "design-based research" or DBR to encompass all the terms listed previously (DBRC, 2003).

Some researchers (Collins et al., 2004; DBRC, 2003; Bell, 2002) offered further insight on the relevance of DBR and how it differs from other types of research. Collins et al. (2004) as well as the DBRC (2003) stated that DBR addresses several research needs that make it unique among other research methodologies. Some overlying needs that DBR addresses are (Collins et al., 2004):

1. The need to address theoretical questions about the nature of learning in context.
2. The need to approach the study of learning phenomena in the real world rather than the laboratory.
3. The need to go beyond narrow measures of learning.
4. The need to derive research findings from formative evaluation.

Adding to the research supporting the use of DBR, Cobb et al., (2003) as well as Wang and Hannafin (2005) pointed out five characteristics of DBR that distinguished it from other research methodologies: (a) DBR is grounded, in effect, the purpose of DBR is to develop or further learning theories, not only to instantiate "what works" (Cobb et al., 2003, p. 10) but to actively aid in the process and creation of design interventions in learning; (b) DBR is pragmatic since it helps to initiate, promote and support innovation to improve the learning process; (c) DBR is integrative, Cobb et al. explained that DBR has two perspectives, "prospective and reflective" (2003, p.10). DBR is prospective when design implementations and "hypothesized learning process" (Cobb et al., 2003, p. 10) are rigorous and can withstand scrutiny. DBR is reflective because the design interventions and its effects on the learning process are based on conjecture. This unique feature of DBR permits other conjectures to be introduced if the original one is refuted; (d) this leads us to the fourth feature of DBR, and that is, DBR designs are iterative or

cyclical, interactive and flexible. In other words, iterations of design change and revision "demands systematic attention to evidence of learning" (Cobb et al., 2003, p. 10). Consequently, this leads to the "development of measure sensitive to the changing ecology of learning" (Cobb et al., 2003, p. 10); and (e) it is contextual, that is, the theories developed by DBR must have the ability to work in the intended learning environment.

Further distinctions between DBR and other methods of research can be derived from investigating the outcome of the methodological processes. As noted by Bereiter (2002) DBR cannot be defined by its methodology since it can utilize many different methods, but by its purpose. Some researchers (Robyler, 2005; Reeves et al., 2005; Collins et al., 2004, Reeves, 2003; van den Akker, 1999) ventured to point out the differences between DBR and several other research methodologies. They do this by using the difference in perspectives utilized in the framework and the goals achieved. In Figure 2, Reeves (2000) explained the different framework and outcome between experimental and DBR methodologies. Reeves' (2000) Figure 2 highlights the difference in outcomes between an empirical and DBR approach. The iterative nature of DBR means that the research for the solution to a problem will go through the process of testing and refinement and it will have an impact on theory and practice. Furthermore, Reeves' (2000) Figure 2 shows the outcome of experimental research as refining theories and creating new hypothesis to be tested.

In addition, various comparative studies of DBR, qualitative and experimental methodologies have been conducted (Robyler, 2005). Dede's (2005) commentary on Robyler's article about the need for more DBR in educational technology stated that

Robyler (2005) sets the outcome of experimental research as having the ability to generalize the intervention to many sites whereas qualitative research is focused on one site. Robyler (2005) pointed out that design decisions are based on two things: (a) objectivity, implying quantitative type research such as experimental, quasi-experimental; and (b) "natural inquiry" implying qualitative methods such as "narratives, phenomenologies, ethnographies, grounded theory studies, or case studies" (p.196).

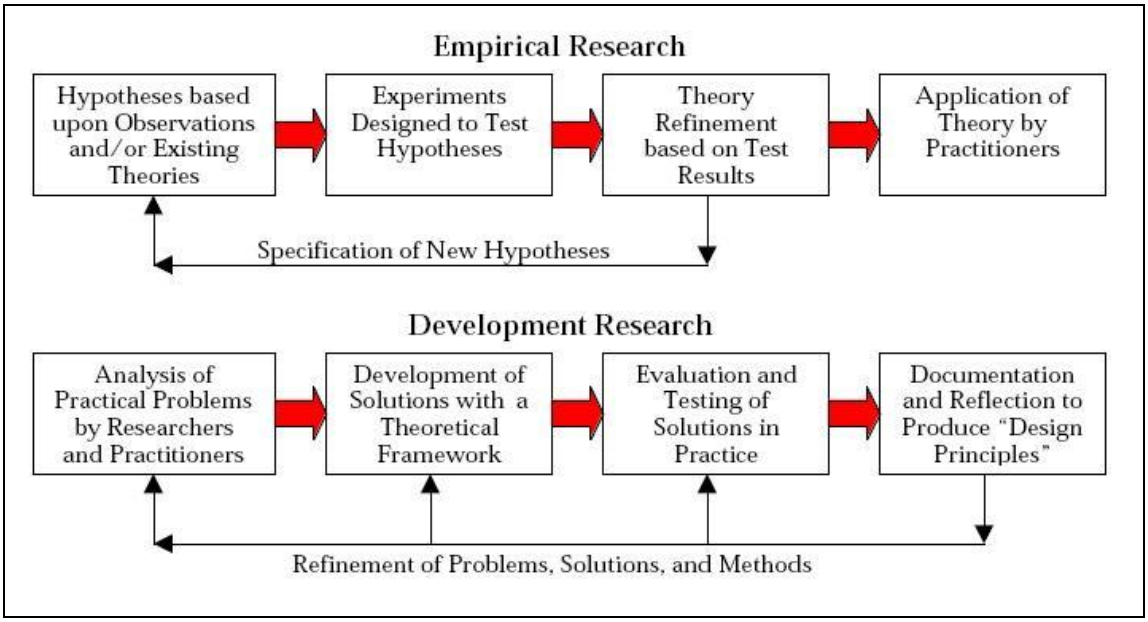


Figure 2. Comparison of development approach and empirical research.

From "Enhancing the worth of instructional technology through 'Design Experiments' and other developmental research strategies," by T. C. Reeves, 2000. Paper presented at session 41.29 "International Perspectives of Instructional Technology Research for the 21st Century," a symposium sponsored by SIG/Instructional Technology at the annual meeting of the American Educational Research Association, New Orleans, LA.

Dede (2005) also added that DBR research involves a type of "interventionist ethnography" (p. 346) which is the advancement of theory and practice by designing interventions. Moreover, the intervention designs are based on theories and measuring

their effects on the learners within the classroom environment involves both qualitative and quantitative methods (Dede, 2005).

The DBR approach may help researchers better understand the complexity that is involved in designing and developing learning interventions and the role teachers play in making learning material effective in the classroom (DBRC, 2003). Furthermore, DBR offers innovative insights to the design process that may add meaning to existing learning theories or create new ones (Sandoval & Bell, 2004; Dede, 2005). DBR also offers the opportunity for researchers and practitioners to work closely together to develop and design better learning environments.

Paradigm-shift: Design-Based Research and Instructional Technology

Dr. Thomas C. Reeves a noted scholar in the field of IT pointed out that "after decades of experimental technology instructional research, with theoretical or empirical goals" (Reeves, 2000, p. 11) we are now left with "insufficient foundation of theory and principles to guide practice, especially in K-12 schools, higher education, business training, or any other learning context" (p. 11). Reeves (2000) continued to support his belief by citing another top researcher in the IT field, Lauren Resnick (1999) who concluded that the research conducted so far within the instructional technology pedagogy, has contributed very little to the solution of education problems. Reeves' (2000) and Resnick's (1999) perspectives were corroborated by another noted IT researcher, van den Akker, who is of the opinion that instructional designers are unable to find relevancy from IT studies because the studies are sometimes "too narrow to be meaningful, too superficial to be instrumental, too artificial to be relevant, and, on top of that, they usually come too late to be of any use" (van den Akker, 1999, p. 2)

According to van den Akker (1999) DBR can be interpreted differently among various education disciplines. For example, within a curriculum discipline the major goal of development research is to "inform the decision making process during the development of a product/program in order to improve the product/program being developed and the developers' capabilities to create things of this kind in the future" (van den Akker, 1999, p. 3). Within the media and technology education discipline, development research focuses on formative evaluation and program improvement (van den Akker, 1999). Researchers (Reeves et al., 2005; Reeves, 2000; Robyler, 2005) including van den Akker (1999) also hold a broader view of DBR. These researchers support the idea that DBR should emphasize using technology and theory for the creation of new designs and should improve the aspects of learning such as communication, instructional interventions and performance.

Instructional designers are often challenged when faced with the dynamic nature of their task and sometimes seek help from past research studies. However, van den Akker (1999) pointed out that research usually does not meet their needs due to lack of relevance in terms of superficiality and timeliness. Further issues with the existing body of instructional technology research relates to the lack of consistency concerning methodology (Bell, 2004). Brown (1992) examined the disconnect that occurs when testing learning designs in the classroom versus in laboratories. As mentioned previously, Brown (1992) believed that the laboratory environment minimized the dynamic nature of the classroom. Research outcomes are affected by this disconnect. Levin and O'Donnell referred to a "credibility gap" (1999, p. 177) in education research, where "research" in education is not clearly defined. Another issue is one of social relevance, Reeves (2000)

and Reeves et al., (2005) called for more research within instructional technology that researches complex learning problems, focusing on pedagogical methods as opposed to technology per se, increasing collaboration between practitioners and researchers, refining the learning environment or revealing new designs and being highly collaborative.

Early calls for changes in research methods for instructional technology came from Clark (1994, 1991, 1985, 1983). Several distinguished researchers (Kozma ,1994, 1991; Brown 1992; Collins 1992) conducted relevant, rigorous and specific research on technology in education that could advance pedagogy and address concerns. More recently, several researchers (Dawson & Ferdig, 2006; Reeves et al. 2005, 2000; Robyler, 2005; Schrum, Thompson, Sprague, Maddux, McAnear, Bell & Bull, 2005; Barab & Squire, 2004; Bell, 2004; Collins et. al, 2004; Cobb et al., 2003) have made an effort to inform and encourage researchers in instructional technology to engage in DBR. They support the belief that DBR can add coherence in respect to methodology, relevance, and rigor, thereby advancing the body of instructional technology research.

A Practical Approach to Using DBR, Evaluating WBI and Advancing Research

Cox and Ogsuthorpe (2003) have attempted to address the question "How do instructional design professionals spend their time?" Of the 142 respondents to Cox and Ogsuthorpe's (2003) online survey, instructional designers reported that they spent most of their time, 23%, developing original design work, followed closely by 22% on administrative and project management tasks respectively. In addition, they spent 14% of their time in meetings. Surprisingly, 12% of their time, including those outside of academia, where it was not a job requirement, was spent conducting research. These

findings by Cox and Ogsuthorpe (2003) especially regarding the research aspects of the instructional designer are encouraging to researchers like Reeves and Hedberg (2003) who believed that DBR's evaluative characteristics can provide practitioners in the field, a means to advance design principles of interactive learning systems.

Reeves and Hedberg's (2003) book "Interactive Learning Systems Evaluation" provided guidelines for practitioners to follow. In an exclusive online interview about the book, Reeves, when asked about the importance of evaluation of interactive learning systems stated "evaluation activities are critical to the effective development of interactive learning systems" (DistanceEducator.com, 2003, para. 7). Moreover, the terms, assessment and evaluation were clearly distinguished as they were in the book. Although, both assessment and evaluation informs decision-making, assessment entailed measurement activities such as "attitude, aptitude, achievement" of people and were often part of evaluation whereas evaluation pertains to the "effectiveness" or "impact" (DistanceEducator.com, 2003, para. 23) of a product or program and often involves making a judgment.

In their book, Reeves and Hedberg (2003) also presented an evaluation model that listed six forms of evaluation associated with the different phases of the design and development of an interactive learning system, web-based instruction, or multimedia product. The six forms or "functions" (Reeves & Hedberg, 2003, p.58) of evaluations are as follows: (a) review, this affords the developer clarification as to why the product is necessary; (b) needs assessment is crucial because it guides the instructional development process and supplies project objectives in addition to design components; (c) formative evaluation occurs as the product is being developed and attention is paid to the details of

the interface and learning objectives; (d) effectiveness evaluation reviews the product in context; (e) impact evaluation which as the term implies, is how well the product integrates into the organization in regards to strategy and training goals, and (f) maintenance evaluation can aid tremendously in continuous growth and improvement of the product but this type of evaluation is often neglected (Reeves & Hedberg, 2003).

Informed by the evaluation functions and guided by the four phases of the DBR approach (Reeves, 2000) mentioned earlier in a previous section (see Figure 2) researchers Seeto and Herrington (2006) offered a "how-to" guide to give valuable insight on design principles to practitioners and researchers. The guide that Seeto and Herrington (2006) developed maps the four phases of DBR to the five phases of ADDIE and includes the six functions of evaluations (see Figure 3 in Appendix). The information is pertinent especially from a methodological perspective to the present study. In this guide, Seeto and Herrington (2006) examined all the phases of ADDIE and provided a guide to researchers and/or practitioners on how the phases can be evaluated. Along with this information, they shared possible outcomes of the evaluation. Undoubtedly, there are benefits of using the DBR approach to further advance the body of research within instructional technology. However there are also challenges to be faced as described in the next section.

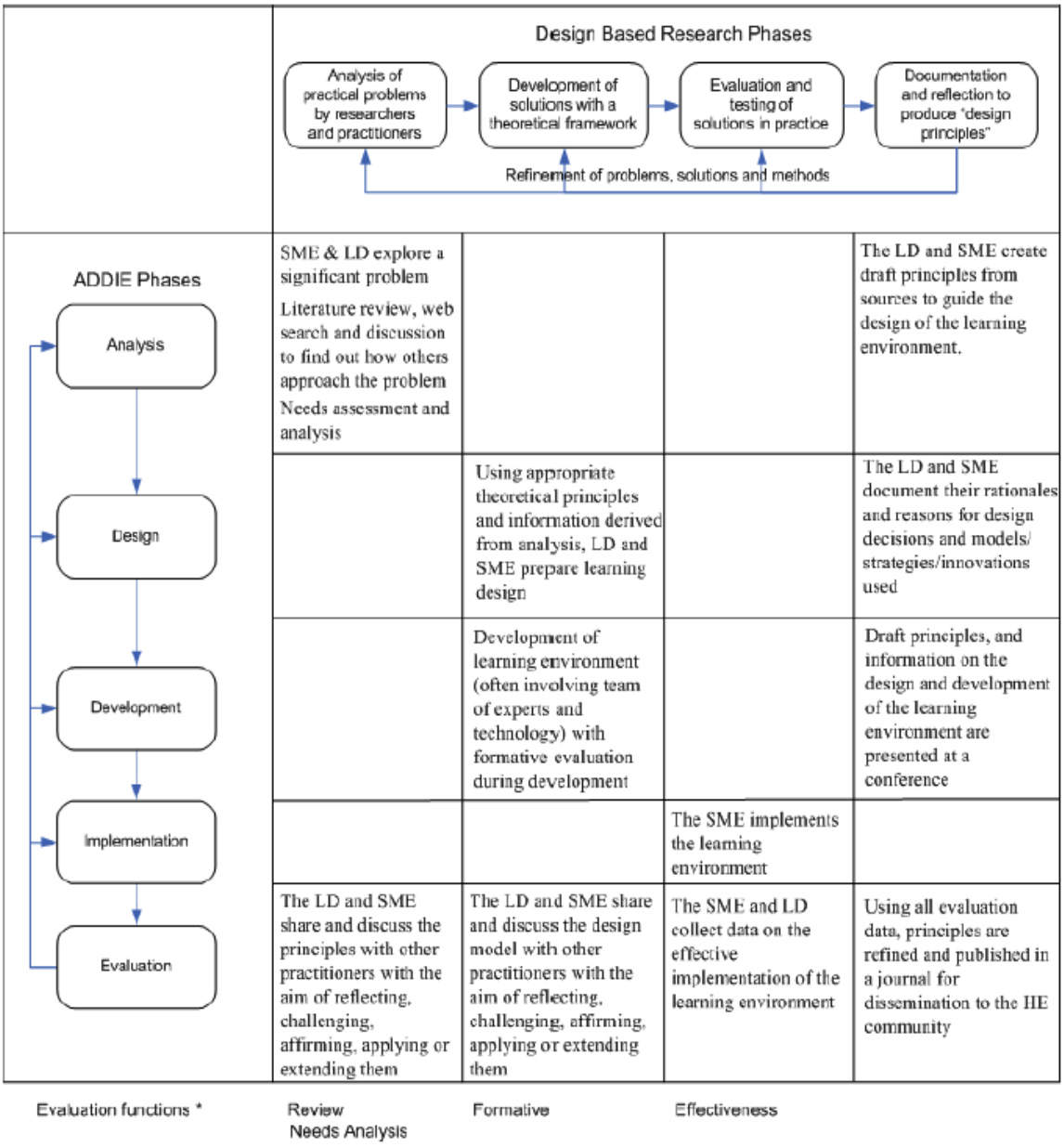
Challenges of Design-Based Research in Instructional Technology

DBR is a relatively new research approach and holds its own set of challenges. The DBRC (2003) and another group of researchers, @Peer Group (2006), outlined several challenges facing DBR researchers: credibility of data, generalizability, and collaborative partnership. In addition, three more challenges can be added to this list (@

Peer Group, 2006): sustainability, funding and publication, and achieving Institutional Review Board (IRB) approval. To understand clearly how these challenges can affect research, an explanation of each challenge follows.

As mentioned in a DBRC (2003) journal article, a credibility gap (Levin & O'Donnell, 1999) exists in education research. Levin and O'Donnell (1999) observed that the gap exists partly because of a lack of consensus within the discipline as to what constitutes "research". Another reason for the existence of the credibility gap is that theories are not well articulated in practice to display how well they work or do not work (Levin & O'Donnell, 1999). Credibility in research is traditionally dependant on whether the data can withstand validity, objectivity and reliability tests (@Peer Group, 2006).

With DBR research, this issue of credibility is problematic. In DBR there is interaction, rather than separation, between context and intervention. Moreover, there is social interaction which may result in the Hawthorne effect (i.e. when attention is paid to the participant they react by trying to perform tasks at a higher than normal level) (Levin & O'Donnell, 1999). O' Donnell stated that DBR "involved messy situations that were difficult to characterize." (2004, p. 256). Furthermore, O'Donnell (2004) goes so far to state that the issue of objectivity is not possible in DBR. However, O' Donnell (2004) concedes that DBR does offer credibility, though on a limited basis, via its iterative nature. Credible evidence can be established with DBR if the outcome of the intervention can be replicated, relationship established, and appropriate group comparisons can be conducted (O' Donnell, 2004). Likewise, the group of researchers that comprise DBRC (2003) added the point that "good DBR methods should exhibit" (p.5) among other things



*Impact and maintenance evaluations are conducted only after a learning system has been operating as intended for a year or more.

Figure 3. Extending the role of the learning designer through design-based research.

Note. LD = Learning Designer. From "Design based research and the learning designer," by D. Seeto and J. Herrington, J, 2006, in L. Markauskaite, P. Goodyear, & P. Reimann (Eds.), *Proceedings of the 23rd Annual Conference of the Australasian Society for Computers in Learning in Tertiary Education: Who's Learning? Whose Technology?* pp. 741-745. Sydney: Sydney University Press.

"continuous cycles of design, enactment, analysis and redesign" (Cobb, 2001; Collins, 1992; as cited in DBRC, 2003, p.5).

Generalizability of results is another challenge for DBR researchers. In general, if any success with a particular intervention within a particular context can be claimed, then the research outcome should be replicated in various contexts to claim generalizability. Critics often note that if learning can be claimed in one context, it could be due to other factors not measured such as interaction with other factors, environment, instructor, learners or numerous other elements (DBRC, 2003). To address this argument within DBR, the DBRC (2003) researchers viewed interventions "holistically" (p. 5), that is, "educational interventions are enacted through the interactions between material, teachers and learners." (p. 5). From this viewpoint, the educational intervention is in itself an outcome of the context.

Collaborative partnership is another issue that can be a challenge for DBR researchers. Instructional technology research in secondary education, according to Reeves et al. (2005) may possibly involve one or a few researchers from a single department. However, DBR encourages collaboration among many disciplines (Reeves et al., 2005). As an example, DBR was conducted for the Quest Atlantis project (Barab, Arici & Jackson, 2005) which is a 3-D interactive narrative environment developed for 9-12 year olds, to study the value of "play spaces for learning" (p. 15). The research interests of the contributing researchers were as follows: Barab's research background is in Learning Sciences, Instructional Technology and Cognitive Science, Arici's focus is on Cognitive and Educational Psychology, and Jackson's is on Early Childhood Education as well as Curriculum and Instruction research.

Reeves et al. (2005) highlighted the collaborative nature of DBR further by providing a hypothetical problem: geoscience instructors in large universities are frustrated with having to teach the fundamental concepts repeatedly in their classes. According to Reeves et al. (2005), using a DBR approach, the collaborative aspects would include a diverse team of geoscience faculty members (creating the research core), instructional designers, programmers, educational researchers, and multi-media specialists. Sandoval and Bell (2004) support Reeves et al. (2005) views on the collaborative aspects of DBR and add a distinction between the research and design aspects. From the research aspect, researchers engaged in DBR can be from "developmental psychology, cognitive science, learning science, anthropology and sociology" disciplines and from the design aspect, researchers can be from "computer science, curriculum theory, instructional design and teacher education" (Sandoval & Bell, 2004, p. 200).

The challenge in collaboration lies with the length of time it takes for a DBR study to be completed. It may take up to two years or more before a DBR study is completed (@ Peer Group, 2006; Reeves et al., 2005). A study conducted over a long period of time may be subjected to participant burnout, loss of motivation, and other unexpected factors (@Peer Group, 2006).

Three more challenges faces DBR researchers, they are: sustainability, funding and publication, and IRB approval (@Peer Group, 2006). Lack of sustainability can be counteracted by researchers themselves being "self-motivating and self-sustaining" (@Peer Group, 2006, para. 11). In addition, including the instructors in the design of the intervention would build commitment to the project and help them to perceive the value

of the intervention either through a "methodological or philosophical" viewpoint (@Peer Group, 2005, para. 12).

Funding and publishing a DBR study is difficult because it is not easily categorized and it is not standardized (@Peer Group, 2006; Collins et al., 2004). Collins et al. (2004) noted that DBR diverse methodologies are considered new and lacks standardization within the research community making publishing and funding studies difficult. To overcome the problem, the @Peer Group suggested that DBR researchers needed to provide "exemplary" (2006, para. 15) studies that typify the core elements of DBR (e.g. iterative/cyclical, integrative, interactive, and flexible).

Another challenge for design-based researchers is obtaining IRB approval (@Peer Group, 2006). IRB reviewers have a clear set of rules and guidelines that they follow. The design based researchers are already challenged with the scope of their DBR study and the length of their research study. IRB reviewers are seeking a clear start and end time but the iterative and flexible nature of DBR studies makes it difficult to supply this information (@Peer Group, 2006). To overcome this problem, @Peer Group (2006) recommended splitting the study into various phases and submitting approval requests to the IRB for each phase. Another recommendation made by @Peer Group (2006) is to clearly state the main idea and course of the study in the first submission for IRB approval.

Some researchers in the field of instructional technology strongly campaign for the inclusion of DBR as a viable methodology. DBR answers the call among distinguished instructional technology scholars to use a methodology that is focused on either creating new theories or enhancing existing ones. In addition, DBR concentrates on

refining the design process through an iterative process that includes a real world environment. DBR bridges the gap between the work of researcher and practitioner, the theoretical and practical.

Web-Based Instruction (WBI)

Learning occurring on the World Wide Web (www) using the Internet has given rise to various terminology (Bitpipe.com, 2007) such as: Web-Based Training (WBT), Interactive Training, Online Tutorials, Technology-Based Learning, Computer-based Training (CBT), Electronic Learning, Interactive Learning, Internet-Based Learning, Web Learning, Computer-Based Learning (CBL), Computer-Based Instruction (CBI), Media-Based Training (MBT), Web Training, Online Learning, Online Courses, Computer-Based Training, Web-Based Education, Online Training, Technology-Based Training (TBT), e-Learning. This researcher recognizes that there may be differences among the types of e-learning mentioned in the previous list but has chosen, for simplicity sake, to use the term "web-based instruction" (WBI) to encompass learning using the Internet and its resources or any online intervention designed to include interaction, feedback or use of the World Wide Web for delivery of the intervention to facilitate learning. Khan (1997) as well as Relan and Gillami (1997) explained that using the resources of the World Wide Web to facilitate learning defines web-based instruction. Relan and Gillami defined WBI as "the application of a repertoire of cognitively oriented instructional strategies within a constructivist and collaborative learning environment, utilizing the attributes and resources of the World Wide Web." (1997, p. 43).

In November 1999, a 16-member Web-based Education Commission was created by President Clinton, the Democratic and Republican Congress leaders and then

Education Secretary, Richard Riley. The commission which dissolved in March, 2001, studied the impact and the promise of the Internet on education and made recommendations for policy reforms for pre-K, K-12, post-secondary and corporate training institutions (The Web-based Education Commission, 2000). Among the many recommendations, the ones of particular interest to this researchers' present study were: (a) build a new research framework of how people learn in the Internet age, and (b) develop high quality online educational content that meets the highest standards of educational excellence (The Web-based Education Commission, 2000, p. 12).

When the 2001 National Association of State Boards of Education (NASBE) released a study group report on e-learning, it was apparent that there was top-level leadership support for web-based instruction (NASBE, 2001). NASBE officials recognized the affect of the Internet in the field of education. In fact, one of the reports' conclusions proclaimed "e-learning will improve American education in valuable ways and should be universally implemented as soon as possible" (NASBE, 2001, p. 4). Also, the group recognized that technology per se was not a panacea to cure all learning problems but could be the answer to some of the educational challenges (NASBE, 2001).

Fast forward to April, 2007 where a $10 million grant was awarded to the Department of Education (DOE) to study the use of various educational software programs in schools (eSchool News & wire service reports, 2007). Review of the study was pertinent here in the sense that it reviewed a different approach to teaching, not the traditional instructor-led classroom but rather the use of technology in the classroom, and it set out to"…examine the effectiveness of 15 classroom software programs in four categories: early reading (first grade); reading comprehension (fourth grade); pre-algebra

(sixth grade) and algebra (ninth grade)" (eSchool News & wire service reports, 2007, p. 1).

For the study, researchers used 132 schools and surveyed approximately 10,000 students in 439 classrooms (eSchool News & wire service reports, 2007). When the researchers compared achievement scores between groups that used the educational software and those that did not, the results yielded no statistical differences. Although the results were disappointing to education technology experts, it was not surprising since they believed that implementation was problematic in the study (eSchool News & wire service reports, 2007). The experts listed three major reasons why the study failed in some sense: (a) participating teachers did not receive the necessary coaching or support, (b) strong leadership for the project was absent, and (c) student usage of the software accounted for an average 10% or 11% of the total instructional for the school among all four experimental groups (eSchool News & wire service reports, 2007).

Also in this article, Mary Ann Wolf, executive director of the State Educational Technology Directors Association (SETDA), stated the study lacked several key ingredients such as strong leadership which other researchers clearly agree were needed to successfully affect change "to transform teaching and learning" (p.26). According to Wolf, a successful federal evaluation grant study on the use of technology and the effect on students' achievement is North Carolina's IMPACT program. In the IMPACT study, the teachers and students were provided required support including hardware, software, connectivity, personnel, and professional development (eSchool News & wire service reports, 2007). The results revealed that students in the IMPACT model schools, who originally had poorer test scores than their peers in reading and math, not only caught up

but surpassed their peers in the first year of the study and maintained this lead in the second. Wolf referred to another successful technology program, eMINTS that was integrated into several schools in Utah, Missouri and Maine. A study on the eMints program revealed that when students were involved in technology-based curricula, it increased their test scores 10% to 20% higher when compared to students in the control groups (eSchool News & wire service reports, 2007).

Despite the criticisms made about the 2007 DOE study, Phoebe Cottingham, the commissioner of education evaluation and regional assistance for the Institution of Education Science and Mark Dynarski, the lead researcher, defended their methods by stating that the study was flawless. They were also "mystified" (eSchool News & wire service reports, 2007, p. 26) by the results and stated that no one should make premature conclusions based on the results. They believe that more research is required and plan to do a second round. As noted from the previous discourse, how various technology-based interventions are incorporated into the curriculum, whether web-based or not, and their affect on learning is still being researched by education researchers.

Web-Based Instruction for Institutes of Higher Education (IHEs) and Quality Concerns

Researchers funded by the National Center for Education Statistics (NCES) using the Postsecondary Education Quick Information System (PEQIS), conducted a 1-year study of 130 IHEs (see Table 1) to establish national estimates on distance education at 2-year and 4-year Title IV-eligible, degree-granting institutions (Waits & Lewis, 2003). Waits and Lewis (2003) stated in their report that between the academic year of 2000 and 2001 public universities were more likely to offer distance learning courses. According to

the researchers, 90% of public 2-year and 89% of public 4-year institutions offered distance education courses (Waits & Lewis, 2003). In comparison, 16% of 2-year and 40% of 4-year private institutions offered distance education courses (Waits & Lewis, 2003).

Table 1

Number and percentage distribution of 2-year and 4-year Title IV degree-granting institutions, by distance education program status and institutional type and size: 2000-2001

Institutional type and size	Total number of institutions	Distance education program status					
		Offered distance education in 2000-2001		Plan to offer distance education in the next 3 years		Did not offer in 2000-2001 and did not plan to offer in the next 3 years	
		Number	Percent	Number	Percent	Number	Percent
All institutions…….	4,130	2,320	56	510	12	1,290	31
Institutional type							
Public 2-year…….	1,070	960	90	50	5	50	5
Private 2-year……	640	100	16	150	23	400	62
Public 4-year……..	620	550	89	20	3	50	8
Private 4-year…….	1,800	710	40	290	16	790	44
Size of institution							
Less than 3,000…..	2,840	1,160	41	460	16	1,220	43
3,000 to 9,999……	870	770	88	50	5	60	7
10,000 or more…...	420	400	95	10	2	10	2

Note. The percentages are based on the estimated 4,130 2-year and 4-year Title IV-eligible, degree-granting institutions in the nation. Detail may not sum to totals because of rounding. From "Survey on Distance Education at Higher Education Institutions, 2000-2001," by the U.S Department of Education, 2002, National Center for Education Statistics, Postsecondary Education Quick Information System.

Popularity of distance learning was evidenced by having 48% of 4-year public institutions and 33% of private institutions design programs that could be completed totally via online (Waits & Lewis, 2003). In regards to certificate programs completed totally through distance education, 2-year public and 4-year private institutions offered

15% and 14% respectively in comparison to 25% offered by 4-year public institutions. These statistics reveal a growing movement among IHEs to rapidly develop online accessibility to their programs.

IHEs mainly used the Internet and two-way video technologies to deliver their courses online (Waits & Lewis, 2003). Among the IHEs, 90% researched delivered asynchronous computer-based instruction via the Internet (Waits & Lewis, 2003). Asynchronous means that availability of the courses to learners is "24/7", anytime and anyplace. Other technologies employed by IHEs to deliver online courses were two-way videos with two-way audio (43%) and CD-ROMS (29%) (Waits & Lewis, 2003). Interestingly enough, 88% of IHEs planned to create more online courses within the next 3 years to be delivered asynchronously through the Internet (see Table 2) (Waits & Lewis, 2003).

After considering the rate of expansion and types of technologies employed by IHEs to create a distance learning curriculum, there were factors that existed in preventing some IHEs from developing one. Some of these factors stated by Waits and Lewis (2003) included:

> …inability to obtain state authorization (86 percent), lack of support from institution administrators (65 percent), restrictive federal, state, or local policies (65 percent), lack of fit with institution's mission (60 percent), lack of access to library or other resources for instructional support (58 percent), inter-institutional issues (57 percent), legal concerns (57 percent), and lack of perceived need (55 percent).… (p.16).

The list quoted above is a partial list. Table 3 displays a complete list. The prohibiting factor with the utmost relevance to the present study is the concern IHEs expressed about

course quality. Of all the IHE respondents, 35% of IHEs in the Waits and Lewis (2003) report who did not intend to create a distance learning curriculum listed course quality as a prohibitive factor. In contrast, 14% of IHEs who wanted to conduct a major expansion of their existing online curriculum were concerned about quality but did not find it prohibitive. Similarly, IHEs who wanted a minor and moderate expansion, 29% and 23% respectively, were concerned about course quality but continued with their plans. Overall it was program development costs that were considered more prohibiting rather than concerns about quality.

However, according to researchers Mariasingam and Hanna (2006), they believe that quality assessment of online course is in its infancy and certainly more research of this nature is needed. Mariasingam and Hanna (2006) emphasize that: "The most important of all is the need to establish a systematic process for developing and delivering high quality online programs" (Online Journal of Distance Learning Administration (OJDLA), para. 25). Furthermore, Mariasingam and Hanna (2006) pointed out that "Quality, as is well known, lies in the eye of the beholder. There are, therefore, many different ways quality can be conceptualized." (OJDLA, para. 8). Although it may be difficult to conceptualize the meaning of quality in regards to online learning some researchers have tried to do just that. In a news release in year 2000, the National Education Association (NEA) listed twenty-four measures divided into seven categories of quality in Internet-Based Distance Learning (see Table 4) (NEA, 2000). Although the list can be used as a basic guideline for educators to develop an online program, it lacks specificity and details in regards to actual elements used to assess quality of a web-based module.

Table 2

Percentage distribution of 2-year and 4-year Title IV degree-granting institutions that offered distance education courses in 2000-2001 or planned to offer distance education in the next 3-years, by the planned level of distance education course offerings over the next 3 years, and by the planned primary technology for instructional delivery: 2002

Primary technology for instructional delivery	Planned level of distance education course offerings			
	Reduce the number	Keep the same number	Start or increase the number	No plans to use the technology
Two-way video with two-way audio (two-way interactive video)……	4	13	40	43
One-way video with two-way radio……..	2	4	12	82
One-way live video……..	1	4	11	84
One-way prerecorded video…….	6	15	23	56
Two-way audio transmission……	1	4	9	86
One-way audio transmission…….	1	5	13	81
Internet courses using synchronous computer-based instruction……..	1	4	62	33
Internet courses using asynchronous computer-based instruction……..	1	6	88	6
CD-ROM……...	1	8	39	53
Multi-mode package…….	*	2	31	67
Other technologies……	#	#	5	94

Rounds to zero

* Reporting standards not met.

Note. This question was asked in the present tense rather than referring to 2000-2001, and thus the estimate reflect the responses of the institutions at the time the data were collected in Spring 2002. Percentages are based on the estimate 2,500 institutions that either offered distance education course in 2000-2001 (2, 320 institutions), or that planned to offer distance education courses in the next 3 years an d could report their technology plans (490). Details may not sum totals because of rounding. From "Survey on Distance Education at Higher Education Institutions, 2000-2001," by the U.S Department of Education, 2002, National Center for Education Statistics, Postsecondary Education Quick Information System.

Table 3

Percentage distribution of 2-year and 4-year Title IV degree-granting institutions by the extent to which various factors are preventing the institution from starting or expanding distance education course offerings: 2002

Factor	Not at all	Minor extent	Moderate extent	Major extent
Lack of fit with institution's mission	60	14	9	17
Lack of perceived need (e.g., limited student market)	55	21	15	9
Lack of support from institution administrators	65	19	9	7
Program development costs	23	24	27	26
Equipment failures/costs of maintaining equipment	41	28	19	12
Limited technological infrastructure to support distance education	40	25	19	15
Concerns about faculty workload	30	26	29	15
Lack of faculty interest	37	33	23	8
Lack of faculty rewards or incentives	39	30	20	11
Legal concerns (e.g., intellectual property rights, copyright laws)	57	30	10	3
Concerns about course quality	35	29	23	14
Lack of access to library or other resources for instructional support	58	28	9	5
Interinstitutional issues (e.g., allocations of financial aid, course credit)	57	27	11	4
Restrictive federal, state, or local policies (e.g., limitations on the number of distance education credits students may earn, student ineligibility for financial aid)	65	22	8	6
Inability to obtain state authorization	86	10	3	1

Note. This questions was asked in the present tense rather than referring to 2000-2001, and thus the estimate reflect the responses of the institutions at the time the data were collected in Spring 2002. Percents are based on the estimate 4, 130 2-year and 4-year Title IV-eligible, degree-granting institutions in the nation. Detail may not sum to totals because of rounding. From "Survey on Distance Education at Higher Education Institutions, 2000-2001," by the U.S Department of Education, 2002, National Center for Education Statistics, Postsecondary Education Quick Information System.

Table 4

NEA's list of 24 measures of quality for internet-based distance learning

Institutional Support Benchmarks

- A documented technology plan that includes electronic security measures to ensure both quality standards and the integrity and validity of information.
- The reliability of the technology delivery system is as failsafe as possible.
- A centralized system provides support for building and maintaining the distance education infrastructure.

Course Development Benchmarks

- Guidelines regarding minimum standards are used for course development, design, and delivery, while learning outcomes -- not the availability of existing technology -- determine the technology being used to deliver course content.
- Instructional materials are reviewed periodically to ensure they meet program standards.
- Courses are designed to require students to engage themselves in analysis, synthesis, and evaluation as part of their course and program requirements.

Teaching/Learning Benchmarks

- Student interaction with faculty and other students is an essential characteristic and is facilitated through a variety of ways, including voice-mail and/or e-mail.
- Feedback to student assignments and questions is constructive and provided in a timely manner.
- Students are instructed in the proper methods of effective research, including assessment of the validity of resources.

Course Structure Benchmarks

- Before starting an online program, students are advised about the program to determine if they possess the self-motivation and commitment to learn at a distance *and* if they have access to the minimal technology required by the course design.
- Students are provided with supplemental course information that outlines course objectives, concepts, and ideas, and learning outcomes for each course are summarized in a clearly written, straightforward statement.
- Students have access to sufficient library resources that may include a "virtual library" accessible through the World Wide Web.
- Faculty and students agree upon expectations regarding times for student assignment completion and faculty response.

Student Support Benchmarks

- Students receive information about programs, including admission requirements, tuition and fees, books and supplies, technical and proctoring requirements, and student support services.
- Students are provided with hands-on training and information to aid them in securing material through electronic databases, inter-library loans, government archives, news services, and other sources.

Table 4 (*continued*).

- Throughout the duration of the course/program, students have access to technical assistance, including detailed instructions regarding the electronic media used, practice sessions prior to the beginning of the course, and convenient access to technical support staff.
- Questions directed to student service personnel are answered accurately and quickly, with a structured system in place to address student complaints.

Faculty Support Benchmarks

- Technical assistance in course development is available to faculty, who are encouraged to use it.
- Faculty members are assisted in the transition from classroom teaching to online instruction and are assessed during the process.
- Instructor training and assistance, including peer mentoring, continues through the progression of the online course.
- Faculty members are provided with written resources to deal with issues arising from student use of electronically-accessed data.

Evaluation and Assessment Benchmarks

- The program's educational effectiveness and teaching/learning process is assessed through an evaluation process that uses several methods and applies specific standards.
- Data on enrollment, costs, and successful/innovative uses of technology are used to evaluate program effectiveness.
- Intended learning outcomes are reviewed regularly to ensure clarity, utility, and appropriateness.

Note. From "Study Finds 24 Measures of Quality in Internet-Based Distance Learning 'Quality On The Line' study released at Blackboard Summit," by National Education Association (NEA), 2000.

The Instructional Systems Design (ISD) Process

Review of the literature on systems design led to an understanding that considerable confusion exists among the definitions and usage of the terms Instructional Design (ID), Instructional Systems Design (ISD) and Instructional Design Theories (IDTs) within the field of instructional technology. Although the present research is focused on instructional systems design (ISD) and its systematic process, it is important to bring the readers' attention to the grey areas that are present within the field. Perhaps interpretation of the terms ID, ISD and IDTs are dependent on perspective, usage and the researcher. This observation is highlighted by the discussion between Bichelmeyer (2003) and Reigeluth (2003). In Bichelmeyer's (2003) article, she attempted to show

what she claims is the misuse of the terms used for instructional theory and IDT. It should be noted first that Bichelmeyer clearly stated that she is basing her definitions of the terms "instruction" and "instructional design" from a job description perspective rather than an academic perspective. She began her argument by pointing the difference between instruction and instructional design but the two were inter-related because they impacted and informed each other (see Figure 4).

To clarify, Bichelmeyer acknowledged that both instruction and instructional design were derived from learning theories. However, they differed in relation to context, objectives, activities and concerns. For example, an instructional designer is focused on conducting analysis, designing and developing instruction, addressing issues with implementation, and conducting formative and summative evaluations (see Table 5 for summary of differences). Bichelmeyer characterized instruction theory as having more to do with implementation whereas IDTs relates more to "value of instructional design models, exploring issues such as the efficiency and effectiveness of ADDIE and rapid-prototyping models" (Gordon & Zemke, 2000 as cited in Bichelmeyer, 2003, IDT Record, para 12).

She pointed out this confusion with term usage as represented in print by the books, Instructional-Design Theories and Models: An Overview of their Current Status, edited by Charles Reigeluth (1983) and in Instructional-Design Theories and Models, Volume II, edited by Reigeluth (1999). Bichelmeyer referred to these books as the "Green Books" because of the color of their covers. The editor, Charles Reigeleuth is a well respected scholar in instructional technology and a colleague of Bichelmeyer. These "Green Books" are widely used within the instructional technology discipline.

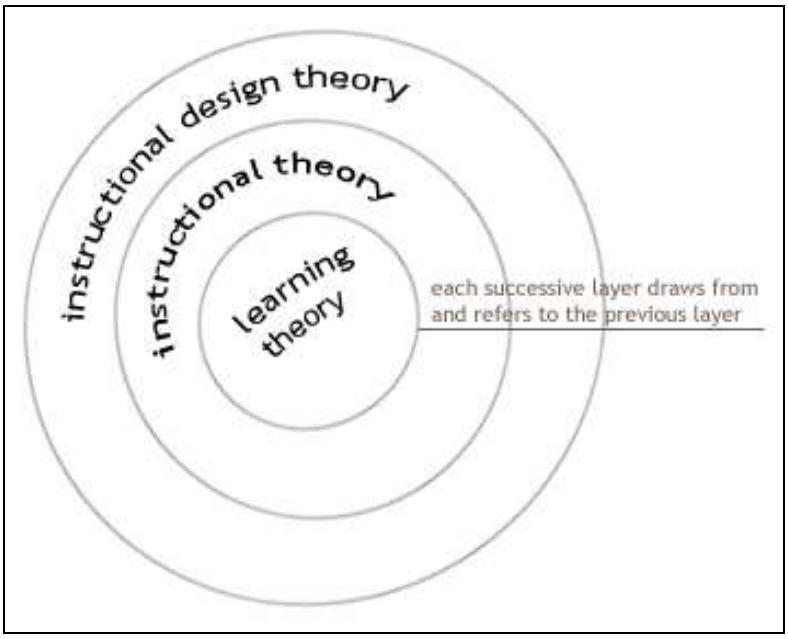


Figure 4. Relationship and differences between instruction and instructional design. From "Instructional theory and instructional design theory: What's the difference and why should we care?" by B. Bichelmeyer, 2003, *IDT Record.*

Bichelmeyer stated that although the titles of the "Green Books" included the term "Instructional Design Theory", the articles themselves, written by distinguished scholars within the discipline referred to instruction theory rather than instructional design theory. Some titles with the first book include "The Algo-Heuristic Theory of Instruction," and "A Cognitive Theory of Inquiry Teaching." A sample of articles from the second book include (as cited in Bichelmeyer, 2003) David N. Perkins and Chris Unger on "Teaching and Learning for Understanding," and Hannafin, Land and Oliver's "Open Learning Environments."

Reigeluth (2003) responded to Bichelmeyer's charges by explaining his interpretation of the terms. Reigeluth agreed that there is confusion surrounding usage of

Table 5

Summary of differences between instruction and instructional design

	Instruction	**Instructional Design**
Objectives	Ensure learning to the best of each student's abilities, given variation between and individual differences of learners	Facilitate standardization of instruction by accounting for variation between instructors, locations and schedules
Activities	- Set expectations - Present examples - Provide resources - Facilitate practices - Administer assessments - Give feedback	- Task analysis - Context analysis - Learner analysis - Instructor analysis - Identify design constraints - Materials development - Evaluation
Prototypical Theories	- Gagne's Nine Events of Instruction (Gagne, Briggs & Wager, 1992) - Merrill's 5-Star Instruction (Merrill, 2003)	- Instructional Systems Design model (Briggs, 1977) - Rapid Prototyping model (Tripp & Bichelmeyer, 1990)
Concerns	- Sufficiency of instructional approaches - Variation between learners	- Efficiency of design process - Efficiency of instructional products - Standardization of instructional delivery

Note. From "Instructional theory and instructional design theory: What's the difference and why should we care?" by B. Bichelmeyer, 2003, *IDT Record.*

these terms; however he lays the blame squarely on the "professionals in our field" (IDT Record, para. 3). First, he tackled the term that most in the field agree upon, ISD process, which involves analysis, design, development, implementation, and evaluation (ADDIE).

Reigeluth suggested that confusion arises when we use "Instructional Systems Design" or "Instructional Systems Development" or "instructional design" or even "instructional development" to address the whole ISD process. These terms have part of a named ISD process in the title. Reigeluth suggested we use the term "ISD process" to avoid confusion. He also predicted further confusion like Bichelmeyers', among

researchers and practitioners in the field if they only study our field through the lens of the "ISD process and its parts" (IDT Record, para. 7). Reigeluth (2003) agreed with Bichelmeyer (2003) that there is a need for:

> (1) a knowledge base (aka design theory) about what instruction should be like and (2) one about what the process for creating instruction should be like, but we also need (3) a knowledge base about how to evaluate existing instruction (independent of the ISD process) and perhaps (4) one about how to manage instruction (unless you view that as part of #1). These are all different but highly interdependent knowledge bases… (IDT Record, para. 7)

The discussion above highlights again, the disparate views of various researchers and practitioners in the field of instructional technology. A consensus has not been reached about the meanings of the terms. It is somewhat dependent on the researcher or practitioner (or both) and the context in which it is being used. ISD is defined in the next section as it relates most to the present study.

A Systematic Approach for Web-Based Instruction

A system is an "integrated set of elements that interact with each other" (Banathy, 1987, as cited in Gustafson & Branch, 2002). A system may occur naturally or it may also be constructed (Dick et al., 2005). Prominent ISD researchers, (Dick et al., 2005; Dick & Carey, 1996) strongly believed that successful technology-based instruction began with a systematic approach. ISD as defined by Seels and Glasgow (1998) is the incorporation of processes to develop instructional materials that facilitate learning with measurable outcomes. Dick and Carey (1996) listed a number of compelling reasons why a systematic approach to instructional design has been effective. According to Dick and

Carey (1996) a systematic approach to design provided focus and helped to determine instructional strategy for a desired outcome. However, the most salient reason for using a systematic approach in instructional design, according to Dick and Carey (1996), "is that it is an empirical and replicable process" (p. 8). Likewise, Seels and Glasgow (1998) also believed that a systematic approach helps to "measure" (p. 7) whether learning objectives have been met and may also provide a means to improve the instruction through evaluation and revision until the learning objectives have been achieved.

In order to reach a deeper understanding of this topic a historical perspective into the ISD methodology is needed. By the early 1970s, the ISD approach had grown from a standard training approach within the military to becoming the standard among corporations (Gustafson & Branch, 2002). Furthermore, the systematic approach helped instructional designers to develop instruction that was "more effective, efficient, and relevant than less rigorous approaches" (Gustafson & Branch, 2002, p. 19). In the 1980s the growing accessibility of computers and their usefulness in instructional development initiated the practice of creating "computer-based instruction" (Reiser, 2002, p. 43). Simultaneously during this timeframe there was also the introduction of the "performance technology movement" (Reiser, 2002, p. 43). Some of the characteristics from this movement were "front-end analysis, on the job-performance, business results, and non-instructional solutions to performance problems" (Reiser, 2002, p. 43). These characteristics altogether formed a major impact on the practices of instructional design by the 1990s.

Some researchers (Dick et al., 2005; Dick & Carey, 1996; Dempsey & Van Eck, 2002; Seels & Glasgow, 1998; Gagné, Briggs & Wager, 1988; Reiser, 2002; Rothwell &

Kanzansas, 2004) believed that a systematic approach to instructional design produced several advantages for instructional development. First, a systematic approach helped instructional designers plan and develop their instruction through an analytical approach (Seels & Glasgow, 1998; Gustafson & Branch, 2002). In other words, the systematic approach was goal oriented (Gustafson & Branch, 2002). All inputs, interactions and outputs of the process were analyzed and synthesized. Second, the planning that occurred during the analysis of instruction integrated "objectivity and orderliness" (Seels & Glasgow, 1998, p. 18) into the process and assured quality. Third, Seels and Glasgow (1998) have stated that the ISD has been a problem solving approach during which cause and effect relationships can be identified thus reducing the reliance of "intuition or trial-and-error planning" (p. 18). Fourth, the systematic approach created documentation and established an audit trail so reliable examination and evaluation can occur (Seels & Glasgow, 1998).

The fifth advantage of a systematic approach has been the careful analysis and storage of the information in a database. A database that showed the characteristics of the instructional problem, the demographics, the learning habits of the targeted audience and the learning objectives is a knowledge base that is very useful to instructional designers (Seels & Glasgow, 1998). Learning outcomes are important in ISD (Seels & Glasgow, 1998). When instruction has been developed through the use of the knowledge base, the performance standards set in a systematic approach have been assured because the learning goals have cycled through several iterations of testing and revisions before any implementation has occurred (Seels & Glasgow, 1998). Therefore, learners may rest

assured that the quality of learning is high. Creating learner-centered instruction is a major goal of the systematic process (Gustafson & Branch, 2002).

There are several factors that introduce variability in instruction. This variability affects the quality of instruction. For example, some factors affecting quality in instructor-led classes could be the environment, the instructor, the learning material, the student-teacher ratio, a student's ability and a student's motivation (Seels & Glasgow, 1998). However, a systematic approach may reduce the incident of variability in instruction by the way it can "deliver instruction the same way every time" (Seels & Glasgow, 1998, p. 18). Furthermore, it may also help the instructional designer create instruction that addresses individual learning needs (Seels & Glasgow, 1998).

Another advantage of the systematic approach has been its ability to augment replicability (Seels & Glasgow, 1998). To clarify, a web-based course in comparison to an instructor-led course is not constricted by a physical classroom; therefore it can be designed to be more accessible to more learners. Replicability can also affect cost (Seels & Glasgow, 1998). A larger number of learners can be served when a course has been replicated therefore the cost-per student has been reduced considerably (Seels & Glasgow, 1998). Clearly there are many justifiable reasons for using a systematic approach to create web-based instruction. The next section will describe a systematic approach for instructional development: ADDIE.

The ISD Process: ADDIE

ISD is articulated in theory and practice through the use of models. A generic process known as ADDIE is synonymous with the ISD process. Presently there are discussions as to whether ADDIE is a model or a conceptual framework (Molenda, 2003;

Bichelmeyer, 2005). In the present study, ADDIE has been defined as a conceptual framework of the ISD process. ADDIE is comprised of analysis, design, development, implementation, and evaluation phases. It also provides a conceptual framework for the ISD process (Reiser, 2002; Bichelmeyer, 2005, Magliaro & Shambaugh, 2006). ADDIE has been described as generic because other ISD models include the phases of ADDIE to some extent (Scafati, 1998; Reiser, 2002). For example, all five phases of ADDIE have been included in the Dick and Carey ISD model (Dick & Carey, 1990, 1996; Dick et al., 2005).

Figure 5 shows a comparison between the ADDIE processes and the Dick and Carey model (McGriff, 2001). In this figure the phases of ADDIE have been clearly represented in the Dick and Carey model (1990, 1996; Dick et al., 2005). Further comparison can be seen in Table 6 between the Seels and Glasgow model (S&G) and ADDIE. The five phases of ADDIE, as defined by Seels and Glasgow (1998) are:

1. Analysis: "Collecting and analyzing data to determine needs, tasks and content, and instructional requirements. The process of defining what is to be learned." (p. 327).
2. Design: "The process of specifying how learning will occur." (p. 329).
3. Development: "The process of authoring and producing the materials." (p. 329).
4. Implementation: "The process of installing the process in the real world." (p. 330)
5. Evaluation: "The process of determining the adequacy of instruction and learning." (p. 330).

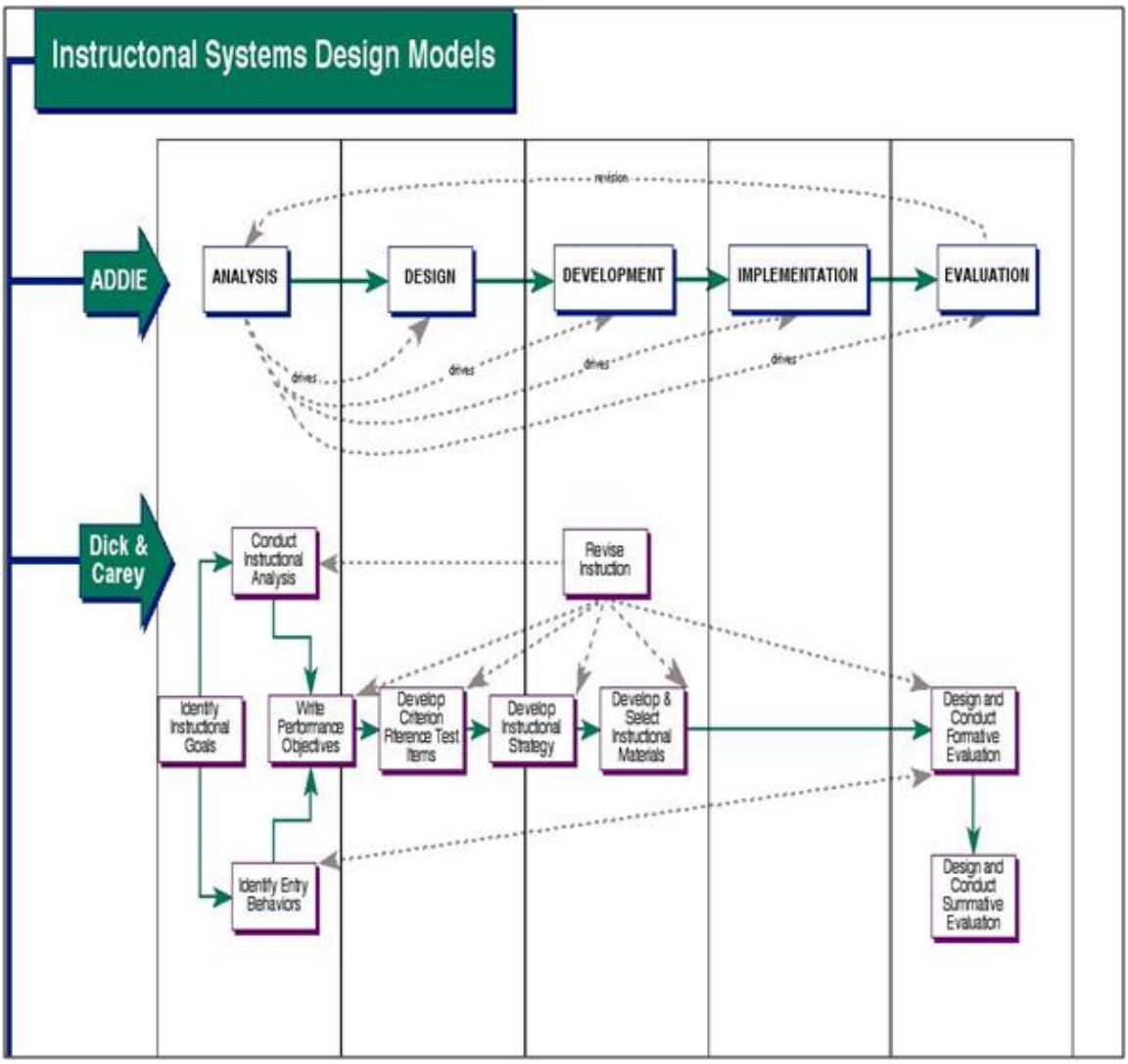


Figure 5. *Instructional systems design models.*

From "ISD knowledge base / Instructional design & development .Instructional systems design models," by S. J. McGriff, 2001. Portfolio of Steven J. McGriff (modified).

There are several benefits of using a process to guide development. In general, ADDIE or any ISD model has helped people to "visualize the overall process" (Gustafson & Branch, 2002, p. 19). In addition, ADDIE has been utilized to establish guidelines and to manage the development process (Gustafson & Branch, 2002). Moreover, ADDIE does facilitate an important aspect of successful development: communication between the client and the developers (Gustafson & Branch, 2002).

Instructional designers use ADDIE not only for the benefits mentioned previously but also because it answers specific questions (see Table 6). Note in Table 6 the list of questions that are addressed in each phase of ADDIE. ADDIE is methodical, which is a characteristic of a systematic approach. The questions that are addressed in ADDIE help to provide clarity to instructional designers (Gustafson & Branch, 2002). The approach used was a deductive approach which means the instructional designer has moved from having a general idea of the need to having specific details of the need. The point of view of the learner in instructional development has also been included in this approach (Kemp, Morrison & Ross, 1994). Even though there are several benefits to utilizing ADDIE there are still researchers and practitioners in the field of instructional design that find ADDIE restrictive in its approach.

Some challengers of ADDIE (Allen, 2006; Gordon & Zemke, 2000; Zemke & Rossett, 2002) believed that ADDIE produces ineffective instruction. Moreover, they think that the instruction produced from this process is awkward (Gordon & Zemke, 2000). Also, it tends to direct the attention of the instructional designer on the process rather than on the outcome (Gordon & Zemke, 2000). Additionally, Allen (2006) believed that ADDIE is inadequate because it does not take into consideration the technological advances in the tools used for instructional development. Allen (2006) stated that technologically advanced tools which create powerful visual effects, such as 3-D graphics, simulations and interactions for a more engaging learning experience cannot utilize ADDIE simultaneously to guide development. Another researcher, Notess (2004) made an interesting commentary as he reviewed Zemke and Rossett's (2002) research concerning the responses they had received to Gordon and Zemke's (2000) first article

criticizing ADDIE. Notess (2004) found that Zemke and Rossett (2002) divided the responses into two categories: responses that concurred with Gordon and Zemke (2000) that is, those that believed ADDIE was pre-disposed to producing faulty instruction and responses that stated bad instruction was the result of practitioners' misuse of ADDIE.

Table 6

ADDIE phases: Questions answered

ADDIE Phases	Steps in S&G Model	Questions Answered
Analysis	1. Needs Analysis	What is the problem/need? What are the parameters of the problem/need?
	2. Task and Instructional Analysis	What should the content be
Design	3. Objectives and Assessment	What should be assessed and how?
	4. Instructional Strategy	How should instruction be organized?
	5. Delivery System Selection and Prototyping	What will the instruction look and sound like?
Development	6. Materials Development	What should be produced?
	7. Formative Evaluation	What revisions are needed?
Implementation	8. Implementation and Maintenance	What preparation is needed?
Evaluation	9. Summative Evaluation	Are the objectives achieved?
	10. Diffusion and dissemination	Has the innovation been disseminated and adopted?

Note. From *Making instructional design decisions* (2nd ed.), (p. 180), by B. Seels, B and Z. Glasgow, 1998, Upper Saddle River, New Jersey: Prentice-Hall, Inc.

Other researchers (for e.g. Gustafson & Branch, 2002; Dick et al., 2005) who believed that ADDIE does create quality instruction advised that although ADDIE is drawn in a linear fashion (see Figure 5) it should not be articulated this way when developing instruction. As data is collected during the lifespan of a project developers gain insight by moving "back and forth among the activities" (p. 19) of ADDIE. The apparent strength of the ISD process has been its "iterative and self correcting nature" (Gustafson & Branch, 2002, p. 19).

Learning

The discussion on "learning" is written in an attempt to help the reader understand the term "learning" and how it is used in this research context. Understanding how learners learn can help instructional designers design an effective multimedia learning module (Mayer, 2003). Discussions on "Metacognitive Learning" and "Teaching Study Skills" will also be addressed in this section. In this section, contributions to foundational theories of learning by John B. Carroll and Robert M. Gagné will be discussed. In addition, how these foundational theories add value to instructional technology will be addressed. Learning is a complex process and how we learn or how we acquire knowledge is a question philosophers, educators, psychologists and learners themselves have pondered at one time or another. Learning as described by Driscoll (1994) is based on two assumptions, first, that "learning is a persisting change in human performance" (p. 8), and second, the change in the learners performance must be dependent on their interaction with the environment. Gagné (1977) defines learning as "a change in human disposition or capability, which persists over a period of time, and which is not simply ascribable to processes of growth" (p. 3). Although there have been an abundance of inquiries on the topic of learning throughout the decades, it still continues to be studied and defined by researchers presently.

Over the years, researchers have derived many learning theories based on various "epistemological traditions" such as objectivism (i.e. "reality is objective, singular, fragmentable"), pragmatism (i.e. "reality is interpreted, negotiated, consensual") and interpretivism (i.e. "reality is constructed, multiple, holistic") (Driscoll, 1994, p. 15). These epistemologies have formed the foundation of many learning theories, for example

according to Driscoll (1994): objectivism is associated with behaviorism, cognitive information processing and Gagné's Instructional Theory; pragmatism is associated with educational semiotics and Jerome Bruner's and Lev Semenovich Vygotsky's views of learning and development; interpretivism is associated with Jean Piaget's developmental theory and constructivism.

In regards to learning, the research work of Gagné (explained later) as well John B. Carroll, the Model School of Learning is applicable in the present study. Carroll (1963, 1973, 1981, 1989) concluded that learners needed time to understand concepts and that instructors also needed to recognize this as a factor affecting learning. He emphasized that time was an important factor in learning. Carroll's Model of Learning predicted the amount of learning as a ratio of time actually spent to the amount of time needed (Gentile, 1997):

$$\text{Amount of Learning} = \frac{\text{Time Actually Spent}}{\text{Time Needed}}$$

However, Carroll (1989) attributed the above interpretation to Benjamin Bloom (1968, as cited in Carroll 1989). Carroll believed that his model represents a broader view of interpreting learning in schools. In a 1989 article, Carroll discussed a somewhat modified view of his theory, Model School of Learning, which he first presented two decades earlier.

Carroll (1989) listed five variables that affected a learner's achievement. Three were associated with the factor of time, they were (Carroll, 1989; Gentile 1997): (a) *aptitude* which is the amount of time the learner needs to learn a particular task to reach a pre-defined level of mastery. When a learner has a high aptitude, it means the learner needs less time to learn, while a learner with a low aptitude needs more time to learn

(more than average); (b) *opportunity to learn* is the time the learner is allowed to learn, for example, a school schedule. Learners usually view this time as less than adequate; (c) *perseverance* is how much time the learner is willing to spend learning a task. This factor, Carroll (1989) believed, was the "operational definition of motivation for learning" (p. 26). The next two factors discussed relate to achievement. They were (Carroll, 1989): (d) *quality of instruction* relates to how well directions and explanations are given to the learners. How clearly the learners understand what they need to do is an indication of quality of instruction. If a learner requires more time to learn, it could indicate that quality of instruction is less than ideal; and (e) *ability to learn* refers to the learner's comprehension of the instructions. Sometimes language barriers or the inability to understand what is required of them to accomplish the task affects the learner's ability to learn. Carroll's Model of School Learning gave further insights on how learning occurs. Instructors as well as instructional designers can use these insights to create instruction that is effective and relevant to their learners.

Although there are a large number of learning theories in existence, it is the work of eminent instructional psychologist and theorist Robert M. Gagné's relating to the conditions of learning that adds value to this discourse as well. Driscoll (1994) states that Gagné and Benjamin Bloom, another influential education psychologist whose work on the levels of thinking (known colloquially as "Bloom's Taxonomy"), understood the concept that humans had various capabilities which required different conditions of learning. The result of their work parallels each others'. The discussion that follows will give insight to Gagné's work and its relevance to the present study.

In the field of instructional technology, which some say is still grappling with its identity within academia, there is a struggle to find foundational research that defines the discipline. Instructional designers and researchers of early online courses used existing seminal work on learning to guide them in online course creation. Gagné's theory, conditions of learning and its practical guideline, known as "Gagné's events of instruction" is still being used today by instructional technology researchers because it adds theoretical substance and value to their body of research in instructional design. It also offers a practical guideline to instructional designers. These are some of the reasons why Gagné's work is included in the present study.

Gagné's (Gagné, 1965; Gagné, 1977; Gagné, 1984; Gagné et al., 1988) theory, conditions of learning, provides several categories of learning that give insight to various capabilities of humans and the "complexity of human experience" (Gredler, 2001, p. 133). Gagné described capabilities of a human as their skills, knowledge, attitudes and values and it is by learning that they acquire these capabilities (Gredler, 2001). Gagné described five conditions of learning that lead to the attainment of these capabilities, they are: intellectual skills, cognitive strategy, verbal information, motor skill and attitude (Gagné et al., 1988). Gredler's (2001) overview of Gagné's five conditions of learning is listed in Table 7.

In Table 7, Gredler (2001) describes intellectual skills as how the learner can make decisions using symbols and interacting with their environment. She explains how symbols are denoted by "numbers, letters, words, and pictorial diagrams" (Gredler, 2001, p. 136). Gagné et al., (1988), Gredler (2001) and Driscoll (1994) also identified a learner's own capability to manage their "learning, remembering and thinking," (Gredler,

2001, p. 138). Gagné (1988) termed this capability "cognitive strategies". Sometimes the term metacognition which will be discussed in the next section is used to refer to these types of strategies. However, Gredler (2001) disagrees because she believes metacognition is more aligned with the learner's knowledge about the learning tasks rather than a description of skills as Gagné intended. Next, verbal information is a capability where the facts and labels and large bodies of knowledge can be learned and meaningful connections made (Gredler, 2001). An example of verbal information is stating the provisions of the first Amendment to the United States constitution (Gagné, 1977).

Table 7

Overview of the five conditions of learning

Category of Learning	Capability	Performance	Example
Verbal Information	Retrieval of stored information (facts, labels, discourse)	Stating or communicating the information in some way	Paraphrasing a definition of patriotism
Intellectual Skills	Mental operations that permit individuals to respond to conceptualizations of the environment	Interacting with the environment using symbols	Discriminating between red and blue; calculating the area of a triangle
Cognitive Strategy	Executive control processes that govern the learner's thinking and learning	Efficiently managing one's remembering, thinking, and learning	Developing a set of note cards for writing a term paper
Motor Skill	Capability and "executive plan" for performing a sequence of physical movements	Demonstrating a physical sequence or action	Tying a shoelace; demonstrating the butterfly stroke
Attitude	Predisposition for positive or negative actions toward persons, objects, and events	Choosing personal actions toward or away from objects, events or people	Electing to visit art museums; avoiding rock concerts

Note. From *Learning and instruction: Theory into Practice* (4th ed.), (p. 135), by M. E. Gredler, 2001, Upper Saddle River, New Jersey: Prentice-Hall.

Motor skills are when an individual can perform movements or physical actions that are organized, precise and performed smoothly (Gagné, 1977; Gredler, 2001). Highly developed motor skills are underscored by a "high degree of internal organization" and

can improve over time with practice (Gagné, 1977, p. 43). Finally, attitude pertains to the personal choices an individual makes (Gagné, 1977). An individuals' behavior can be affected by their attitude (Gagné, 1977, Gredler, 2001). Attitude is largely an internal state and is comprised of three characteristics, first is the cognitive characteristic, the ideas an individual may have, second is affective characteristic, that is, decisions are made based on emotions and feelings, and thirdly, a behavioral characteristic that refers to one's "predisposition for action" (Gredler, 2001, p. 137). Gagné et al. (1988) also describes these five conditions as "outcomes of learning" (p. 43).

According to Gagné (1984):

> …any set of categories that purports to describe human learning should meet at least four major criteria:
>
> 1. Each category should represent a formal and unique class of human performance that occurs through learning.
> 2. Each category should apply to a widely diverse set of human activities and be independent of intelligence, age, race, socioeconomic status, classroom, grade level, and so on.
> 3. Each category should require different instructional treatments, prerequisites, and processing requirements by the learner.
> 4. Factors identified as affecting the learning of each category should generalize to tasks within the category but not across categories (with the exception of reinforcement). (Gagné, 1984, p. 2, as cited in Gredler, 2001 p. 133)

The five capabilities or outcomes of learning meet all four of the aforementioned criteria (Gredler, 2001).

In relation to instruction, Gagné's (Gagné et al., 1988) five conditions of learning can lead to simplification of instructional planning if learning objectives are assigned to each of the five human capabilities. Gagné (1977) went further to distinguish the conditions of learning by identifying their internal or external qualities. Gagné (1977) explains that for learning to occur or to achieve any of the five learning outcomes, there are some conditions that are internal (within) the learner and some conditions are external (outside) to the learner.

To clarify, to increase intellectual skill capability, for example, if children need to learn to find the difference between the $22^{3}/_{16}$ and $24^{1}/_{8}$, assuming that they do not know how to do this already, Gagné (1977) described a situation where a child may have component or subordinate skills. A child having component or subordinate skills (internal conditions) may learn quickly that they have to form "equivalent fractions by dividing the numerator and denominator by the same (small) number" and "finding the difference by subtracting fractions having common denominators" (p. 30). Gagné believed that if these internal conditions were previously learned, then learning the new skill will not be difficult. However, if there is no component or subordinate skills to be recalled, then the skills will have to be learned.

A verbal communication is an example of an external condition that is often used to help learners remember a subordinate skill. First, to continue with the example, a verbal hint may be "remember how to subtract fractions like $^{3}/_{16}$ from $^{4}/_{16}$" (p. 30), this communication may be followed by other hints to guide the learner, as well as an opportunity for the learner to use his/her new skill. Therefore, according to Gagné (1977), when learning an intellectual skill the internal conditions consist of:

1. The previously learned skills which are components of the new skill;
2. The processes which will be used to recall them and put them together in a new form; (p. 31)

He also listed the external conditions also termed "external events" involved in learning an intellectual skill:

1. Stimulating recall of the subordinate skills;
2. Informing the learner of the performance objective;
3. "Guiding" the new learning by a statement, question or hint; providing an occasion for the performance of the just-learned skill in connection with a new example;" (Gagné, 1977, p. 31)

This leads us to one of Gagné's most popular and practical guide for instructional design that stems out of the conditions of learning theory, "events of learning" (Gagné, 1977, p. 51).

Gagné was always concerned about the practical applications of his research (Gentile, 1997; Driscoll, 1994). His "events of learning" or "nine events of instruction" offered a practical guide to an instructional designer, whether the instruction is traditional or web-based. To fully comprehend the "events of learning" the reader needs to understand that the act of learning is largely internal and involves different "kinds of processing" (Gagné et al., 1988; p. 180; Gagné, 1977). In Gagné et al. (1988), eight "kinds of processing" (p. 81) are listed: (a) attention: which helps a learner verify the "extent and nature" of the arriving "stimulation"; (b) selective perception also known as pattern recognition: this is the conversion of arriving stimulation to a form that can be stored in short-term memory; (c) rehearsal: this is how the information received is

"maintained and renewed" in short-term memory; (d) semantic encoding: preparation for storage in long-term memory; (e) retrieval/search: when information from stored memory moves to the working memory to help provide a response; (f) response organization: "selects and organizes performance"; (g) feedback: the "process of reinforcement" begins when the learner receives information about their performance; and (h) executive control processes: also known as "cognitive strategies" is defined as "numerous ways by which learners guide their own learning, thinking, acting, and feeling" are "selected and activated," influencing changes to all of the other internal processes (Driscoll, 1994, p. 341).

Gagné et al. (1988) stated that it is possible for external events to influence the "kinds of processing" (p. 180) listed previously and it is what makes instruction possible. As an aside, instruction is defined by Driscoll (1994) as "the deliberate arrangement of learning conditions to promote the attainment of some intended goal" (p. 332). The events of instruction were presented to the learner to aid them in advancing from their present situation to where they want to be in terms of learning capability (Gagné et al., 1988). Sometimes, the events are followed in a sequence as a natural chain of events but usually it takes an instructional designer or a teacher to arrange the events in a particular fashion to enhance learning (Gagné et al., 1988).

Table 8 shows the connection between processes of learning, instructional events and procedures using an English grammar concept as an example. This also offered direction to instructional designers when creating a computer-based lesson (Gagné, Wager, Rojas, 1981 as cited in Gagné et al., 1988).

Table 8

Instructional events and their relation to processes of learning in design of a computer-based lesson

Instructional Event	**Relation to Learning Process**	**Procedure**
1. Gaining attention	Reception of patterns of neural impulses	Present initial operating instructions on screen, including some displays that change second by second. Call attention to screen presentation by using words like "Look!", "Watch", etc.
2. Informing learner of the objective	Activating a process of executive control	State in simple terms what the student will have accomplished once she or he has learned. Example: Two sentences, such as "Joe chased the ball." "The sun shines brightly." One of these sentences contains a word that is an object, the other does not. Can you pick out the object? In the first sentence, *ball* is the *object* of the verb *chased*. You are about to learn how to identify the *object* in a sentence.
3. Stimulating recall of prerequisite	Retrieval of prior learning to working memory	Recall concepts previously learned. Example: Any sentence has a subject and a predicate. The subject is usually a noun, or a noun phrase. The predicate begins with a verb. What is the *subject* of the sentence? 'The play began at eight o'clock." What verb begins the predicate of this sentence? "The child upset the cart?"
4. Presenting the stimulus material	Emphasizing features for selective perception	Present a definition of the concept. Example: An *object* is a noun in the predicate to which action (of the verb) is directed. For example, in the sentence, "The rain pelted the roof" *roof* is the *object* of the verb "pelted."
5. Providing learning guidance	Semantic encoding; cues for retrieval	Take a sentence like this: "Peter milked the cow." The answer is *the cow*, and that is the *object* of the verb. Notice, though, that some sentences do not have objects. "The rain fell slowly down." In this sentence, the action of the verb *fell* is not stated to be directed at something. So, in this sentence, there is *no object*.
6. Eliciting the performance	Activating response organization	Present three to five examples of sentences, one by one, ask, "Type *O* if this sentence has an object, then type the word that is the object." Examples: "Sally closed the book." "The kite rose steadily."
7. Providing feedback about performance correctness	Establishing reinforcement	Give information about correct and incorrect responses. Example: *Book* is the object of the verb *closed* in the first sentence. The second sentence does not have an object.
8. Assessing the performance	Activating retrieval; making reinforcement possible	Present a new set of concept instances and noninstances in three to five additional pairs of sentences. Ask questions requiring answers. Tell the learner if mastery is achieved and what to do next if it is not.
9. Enhancing retention and transfer	Providing cues and strategies for retrieval	Present three to five additional concept instances, varied in form. Example: Use sentences such as: "Neoclassical expressions often supplant mere platitudes." Introduce review questions at spaces intervals.

Note. From *Principles of instructional design* (3rd ed.), by R.M Gagné, L. J. Briggs and W.W. Wager, 1988, New York, NY: Holt, Rinehart and Winston Inc.

The following is Gentile's (1997) review of Gagné's (1965, 1977) list of instructional event and the corresponding process of learning:

1. Gain the learner's attention – attention;
2. State the instructional objective – expectancy;
3. Stimulate memory of relevant information – accessing long-term memories, bringing to working memory;
4. Present the stimulus, information, or distinctive features to be learned – pattern recognition, perception
5. Guide the learning – encoding (the process of categorizing labeling, or finding meaning in incoming information or other stimuli. This allows the information to pass from working memory into long-term storage (Gentile, 1997, p. 601)), chunking (the process of combining separate pieces of information into meaningful units (Gentile, 1997, p. 598)), practice
6. Elicit performance – retrieval, active participation, practice;
7. provide feedback – correction of errors, reinforcement;
8. Assess performance – metacognition, retention;
9. Provide for retention and transfer – overlearning, distributed practice, generalization; (p. 413)

All nine events do not have to be included by the instructional designer simultaneously or in sequence. The inclusion of an event and its sequence depends on the objective, the audience and instructional content (Gagné et al., 1988). Designing instruction can be simplified if each skill to be learned is defined by a performance objective (Gredler,

2001). This aids in the selection of suitable instructional events which can then aid in finding appropriate media and other support aid for effective instruction.

Metacognitive Learning

Driscoll (1994) defines metacognition as "one's awareness of thinking and self-regulatory behavior" (p. 103). Adding to this is another definition that refers to metacognition as the "knowledge people have about their own thought processes" (Bruning, Schraw, Norby & Ronning, 2004, p. 81). Review of the literature about metacognition showed that college students in particular, freshmen, were not aware of their learning styles and most were neither self-regulated nor independent learners (Cukras, 2006). According to Zimmerman (1986) a self-regulated learner is one who is "metacognitively, motivationally and behaviorally active participants in their own learning" (as cited in Zimmerman, 1990, p. 4).

In an effort to help students become self-regulated and independent learners, many colleges have programs where instructors teach study skills courses (Cukras, 2006). Studies have indicated that metacognitive awareness develops with age and older learners are much more capable of describing their cognitive characteristics (Bruning et al., 2004). Furthermore, these studies have also indicated that younger learners can be easily trained in metacognitive knowledge (Bruning et al., 2004). Additionally, instructors have been encouraged because research has indicated that learners with low ability and poor knowledge can be helped if they become metacognitively aware of their situation (Bruning et al., 2004). Studies also provided evidence to indicate that metacognitive awareness aids learners who have been considered high or low level achievers (Bruning

et al., 2004). Instructors should note that teaching metacognitive strategies has been helpful to students especially those who are trying to learn new concepts.

Teaching Test-Taking Strategies

This topic is important to the present study because the module that will be converted from an instructor-led format to a web-based format pertains to objective test-taking strategies. Researchers (Scruggs & Mastropieri, 1992) believed that teaching test-taking strategies or "test-wiseness" promoted school success and helped students to be better prepared in test-taking situations. The term test-wiseness was defined by Millman, Bishop and Ebel (1965) as "a subject's capacity to utilize the characteristics and formats of the test and/or the test-taking situation to receive a high score" (as cited in Scruggs & Mastropieri, 1992, p. 707). Another researcher, Durham (2007) explains further that test-wiseness incorporates one's familiarity with test techniques and the format of a test. Durham (2007) believes that a learner past experiences also help to acquire test-wiseness which is why for example elementary school children usually have little or no test-wiseness. Sarnacki (1979) added that test-wiseness was not about guessing at answers, although teaching guess-taking strategies has been part of test-wiseness. Furthermore, this knowledge alone does not guarantee that the learner will pass every test (Sarnacki, 1979).

Sarnacki (1979) reviewed a number of research studies pertaining to test-wiseness in his article and concluded that a variety of methods can be used to teach this subject. He found that research studies have shown that teaching low test-wise individuals test-wiseness strategies has helped to increase their test performance. Instructors were helped by the research work of Millman et al. (1965, as cited in Scruggs & Mastropieri, 1992)

who developed a "taxonomy of test-taking skills" (p. 2) that were comprised of six elements. Of the six elements, two were considered dependent on the instructors' knowledge and test objectives while four were considered independent of the instructors' knowledge (Scruggs & Mastropieri, 1992). According to Scruggs and Mastropieri (1992) the four independent elements are:

1. *Time-using strategies*. Working quickly and efficiently, solving problems and answering items you know, and saving more difficult items for last.
2. *Error-avoidance strategies*. Paying careful attention to directions, careful marking of answers, and checking answers.
3. *Guessing strategies*. Making effective use of guessing when it is likely to benefit the test-taker.
4. *Deductive reasoning strategies*. Applying a variety of strategies, including eliminating options known to be incorrect, or using content information from the stem (question) or other test information. (p. 2)

Also, as stated by Scruggs and Mastropieri (1992) the two elements dependent on the knowledge of the instructor as well as his/her test objectives are:

1. *Intent consideration strategies***.** Include consideration of the purpose of the test or intent of the test constructor when selecting answers.
2. *Cue using strategies.* Include use of known idiosyncrasies of the test maker, such as avoidance of options using words such as "always," "all" or "never" (specific determiners), when it is known that such options are rarely correct. (p. 3)

These elements could be used to help guide the instructor when teaching test-taking strategies.

There are several factors that affect how test-taking skills are taught. Teaching test taking strategies was about the "format or other conditions of testing" it was not about teaching specific test items or subjects (Scruggs & Mastropieri, 1992, p. 4). A learner's age, their ability as well as the specificity of the skills to be learned were factors that affected teaching test-taking strategies. Scruggs and Mastropieri (1992) strongly advised instructors that the point of view of the learner should always be taken into consideration. The goal of the instructor should be to help the learners respond and answer the test questions to the best of their ability (Scruggs & Mastropieri, 1992).

Bruning et al. (2004) discussed seven guidelines for instructors teaching strategies:

1. *Match encoding strategies with the material to be learned.* Instructors need to encourage their learners to be "strategic and flexible" in regards to encoding information. For example, learners need to match the strategies they use with their learning goals, materials and the type of evaluation they will encounter. Instructors should provide materials to encourage their learners.
2. *Encourage students to engage in deeper processing*. Deeper processing of information results in a stronger formation in the memory. To encourage deeper processing of information, first, instructors can concurrently encourage their learners to make some connection with their prior knowledge as well as with the context in which the learning occurred. Secondly instructors can promote affective type responses to the information. Finally instructors can

answer questions about the information to be learned while encouraging learners to also ask questions. These suggestions can help promote deeper processing of the information to be learned.

3. *Use instructional strategies that promote elaboration*. Instructors should use instructional strategies that will help learners gain meaning in what they are learning. When learners have been active participants in their learning, they were more likely to take responsibility for their learning. A technique an instructor can use is schema activation. Schema activation is about finding ways to help learners recall information. An instructor has several ways to help their students process this new information such as brainstorming sessions, pre-teaching, explaining key concepts, or even asking the learners to categorize the information.
4. *Help students become more metacognitively aware.* Effective learners are learners who have declarative and procedural knowledge as well as metacognitive awareness. Learners who are highly aware of how, why and when they learn can regulate their learning. Therefore, instructors should teach metacognitive strategies since it is vital to good learning.
5. *Make strategy instruction a priority*. Research indicates that a learner possession of knowledge does not make an independent or self-regulated learner. Therefore the learner should also know how to use the knowledge strategically. Instructors should actively discuss strategies, introduce one strategy at a time allowing the learners to practice and discuss the strategies in detail while providing feedback to the learners. Research shows that learners

who had been taught strategies were empowered by their learning ability which their high achievements reflected.

6. *Look for opportunities to help students transfer strategies*. Frequently, learners have been unable to transfer the strategic knowledge from one learning context to another. Bruning et al recommended that instructors inform learners of the various context in which they can use the strategies. In addition, they also recommended that instructors try to limit the number of strategies presented to the learner.
7. *Encourage reflection on strategy use.* Time to reflect has been an important aspect to developing metacognitively aware learners. Writing journal entries, group discussions and short essays have been strategies that an instructor can utilize to help learners reflect. (pp. 86-87)

These seven guidelines can assist instructors to teach strategies, including test-taking strategies, to learners.

Scruggs and Mastropieri (1992) also described their experience in teaching test taking strategies in the classroom. They stated that they would first teach the concepts followed by a practice session where the students had been given a practice test. Afterwards, the instructors would follow up with review, evaluation and feedback. The learners have an important part in this process as well. The learners have the responsibility to practice the skills. However applying the information "learned in one context to another context is a major problem" for some learners (Scruggs & Mastropieri, 1992, p. 3). This has been especially problematic for learners who have difficulty

learning and usually they are the ones that can benefit the most from learning test taking strategies (Scruggs & Mastropieri, 1992).

Learner Satisfaction and Quality of Web-based Instruction

Researchers Shaik, Lowe and Pinegar (2006) stated:

> Satisfaction is generally associated with a single transaction whereas service quality is based on the cumulative assessment of the quality of services rendered over time (functional quality) and the outcome resulting from those services (technical quality). (OJDLA, p. 1, para. 4)

Shaik et al.'s (2006) study employed a validated instrument called DL-sQUAL (Distance Learning Service Quality) to analyze the quality of distance learning services. The researchers' review of the literature revealed that there was a strong need to measure distance learning service quality due to the rise in demand of distance [web-based] courses. Education services are made up of core services such as teaching and learning while supporting services are "real-time information about institutional policies, procedures and courses, student advising, registrations, orientation, student accounts, help-desk, complaint handling, feedback, and student placement" (Shaik, Lowe & Pinegar, 2006, p. 1, para. 4). Shaik et al. (2006) believed that emphasis should be placed on measuring what comprises quality in distance [web-based] education. Although Shaik et al.'s (2006) study focused on validation of the DL-sQUAL instrument, other researchers were able to shed light on what comprises learner satisfaction and what is considered quality in web-based instruction.

Although review of the literature revealed that "learner satisfaction" could be defined, the problem exists in measurement of this variable. Astin (1993) defined student

satisfaction as the "student's perception that pertains to the college experience and perceived value of the education received while attending an educational institution" (as cited in Bolliger and Martindale, 2004, p. 62). This is consistent with a common factor among many of the studies that attempt to measure learner satisfaction where researchers found that satisfaction is based on the learner's perception of successful learning. In particular, learner satisfaction is dependent on elements the learner perceives as constituting successful web-based learning which affects the learners' motivation level (Hong, 2002; Stokes, 2001; Northrup, Lee & Burgess, 2002; Neuhauser, 2002; Moore, 2002; Frederickson, Pickett, Shea, Pelz & Swan, 2000; Bolliger & Martindale, 2004).

Bolliger and Martindale (2004) claimed that a learners' satisfaction with online [web-based] courses is based on three constructs "(a) instructor variables, (b) technical issues, and (c) interactivity" (p. 61) whereas learner satisfaction in traditional courses are based on different factors. Factors such as (Astin, 1993 as cited in Bolliger & Martindale, 2004): "(a) contact time with faculty members and administrators, (b) availability of career advisors, (c) student social life on campus, and (d) overall relationships with faculty and administrators" (p. 63). Furthermore, it was inconclusive whether factors such as gender, age, learning styles, time spent on the course, perceptions of student–student interactions, and course activities affected learner satisfaction (Hong, 2004; Kim & Moore, 2005).

Along with the three constructs that Bolliger and Martindale (2004) proposed another factor to consider is quality of web-based courses. Swan (2003) reviewed several studies on what constituted effective learning using computers and learning in higher

education. From her review, Swan (2003) provided a list of common elements that web-based course developers and instructors should consider:

1. Clear goals and expectations for learners;
2. Multiple representations of course content;
3. Frequent opportunities of active learning;
4. Frequent and constructive feedback;
5. Flexibility and choice in satisfying course objective;
6. Instructor guidance and support; (p. 19)

Swan (2003) notes that although the course design elements listed above is an acceptable framework it is uncertain whether they apply specifically to web-based courses. Indeed, she proposes that there is a need for researchers to study how particular "design principles" and instruction affects learner perceptions (Swan, 2005, p. 19). Swan (2003) set about to analyze several research studies conducted on this premise. The results of Swan's research findings resulted in practical insights for web-based instructional designers and instructors (see Tables 9, 10, and 11).

In summarizing Swan's (2005) research findings, Table 9 shows the importance of interaction, consistency in terms of navigation, design elements and organization and the importance of immediate feedback. Moving on to Table 10, there appeared to be a direct correlation between student-instructor interaction and student satisfaction. Frequency and timeliness, and the "nature of the messages posted" indicating an instructor's presence and even their support is seen as having a positive effect on the web-based learner (Swan, 2005, p. 36). Table 11 reports on the importance of designing to encourage online discussion and a web-based social presence of the learner.

Table 9

Interaction with course interfaces and content: Research findings and practical implications

RESEARCH FINDING	IMPLICATIONS FOR PRACTICE
Interactions with course interfaces are a real factor in learning; difficult or negative interactions with interfaces can depress learning	Work with major platforms to improve interfaces to support learning. Develop consistent interfaces for all courses in a program. Provide orientations to program interfaces that help students develop useful mental models of them. Provide 24/7 support for students and faculty. Make human tutors available
Greater clarity and consistency in course design, organization, goals, and instructor expectations lead to increased learning	Review courses being taught and/or being developed to insure clarity and consistency. Establish quality control guidelines that address issues of clarity and consistency Address issues of course design and organization and instructional goals and expectations in faculty development
Ongoing assessment of student performance linked to immediate feedback and individualized instruction supports learning.	Automate testing and feedback when possible. Provide frequent opportunities for testing and feedback. Develop general learning modules with opportunities for active learning, assessment and feedback that can be shared among courses and/or accessed by students for remediation or enrichment.

Note. From *"Learning effectiveness: What research tells us,"* by K. Swan, 2003, in J. Bourne, & J. Moore (Eds.), Elements of quality online education: Practice and direction (pp.13-45). Needham, MA: Sloan-C.

Further design guidelines for instructional designers are offered by Mehlenbacher (2002) who is particularly concerned with the usability of WBI. In Table 12, Mehlenbacher (2002) pointed out that the environment is an important issue to consider when learning takes place on the Web. The design guidelines that Mehlenbacher (2002) emphasized are similar to those of Swan's (2005). The web-based learning environment is considered well-designed if it is "easy to navigate, convenient, reliable, accurate, and comprehensive" (Mehlenbacher, 2003, p. 94).

Table 10

Interaction with instructors: Research findings and practical implications

RESEARCH FINDING	IMPLICATIONS FOR PRACTICE
The quantity and quality of instructor interactions with students is linked to student learning.	Provide frequent opportunities for both public and private interactions with students. Establish clear expectations for instructor-student interactions. Provide timely and supportive feedback. Include topic of instructor interaction in faculty development.
Instructor roles change in online environments	Include the topic of changing roles in faculty development and provide examples of how other instructors have coped. Provide ongoing educational technology support for faculty. Develop forums for faculty discussion of changing roles – online and F2F.

Note. From *"Learning effectiveness: What research tells us,"* by K. Swan, 2003, in J. Bourne, & J. Moore (Eds.), Elements of quality online education: Practice and direction (pp.13-45). Needham, MA: Sloan-C.

Table 11

Interaction with classmates and vicarious interactions: Research findings and practical implications

RESEARCH FINDING	IMPLICATIONS FOR PRACTICE
Learning occurs socially with communities of practice; there is greater variability in sense of community ratings among online courses than in F2F courses.	Design community-building activities. Model the use of cohesive immediacy behaviors in all interactions with students. Develop initial course activities to encourage the development of swift trust. Address issues of community in faculty development.
Verbal immediacy behaviors can lessen the psychological distance between communicators online; overall sense of social presence is linked to learning.	Develop initial course activities to encourage the development of swift trust. Model and encourage the use of verbal immediacy behaviors in interactions with students. Encourage students to share experiences and beliefs in online discussion. Introduce social presence and verbal immediacy in faculty development.
Student learning is related to the quantity and quality of postings in online discussions and to the value instructors place on them.	Make participation in discussion a significant part of course grades. Develop grading rubrics for participation. Require discussion participants to respond to their classmates' postings and/or to respond to all responses to their own postings. Stress the unique nature and potential of online learning
Vicarious interaction in online course discussion may be an important source of learning from them.	Encourage & support vicarious interaction . Require discussion summaries that identify steps in the knowledge creation process. Use tracking mechanisms to reward reading as well as responding to messages.
Online discussion may be more supportive of experimentation, divergent thinking, exploration of multiple perspectives, complex understanding & reflection than F2F discussion.	Encourage experimentation, divergent thinking, multiple perspectives, complex understanding & reflection in online discussion through provocative, open-ended questions, modeling & support & encouragement for diverse points of view. Develop grading rubrics for discussion participation that reward desired cognitive behaviors . Develop initial course activities to encourage the development of swift trust.
Online discussion may be less supportive of convergent thinking, instructor directed inquiry & scientific thinking than F2F discussion.	Use other course activities to support these such as written assignments, one-on-one tutorials, small group collaboration & self-testing. Develop grading rubrics for discussion participation that reward desired cognitive behaviors .

Note. From *"Learning effectiveness: What research tells us,"* by K. Swan, 2003, in J. Bourne, & J. Moore (Eds.), Elements of quality online education: Practice and direction (pp.13-45). Needham, MA: Sloan-C.

Table 12

Usability design principles for WBI

Accessibility	Has the WBI been viewed on different platforms, browsers, modem speeds? Is the WBI ADA compliant (e.g., have you avoided the use of colors such as red and yellow which are problematic for visually challenged users)? Have you consulted the Center for Applied Special Technology's Bobby (http://www.cast.org/bobby) or W3C's Web Assessibility Initiative (http://www.w3.org/WAI)?
Aesthetic appeal	Does the design appear minimalist (uncluttered, readable, memorable)? Are graphics or colors employed aesthetically? Are distractions minimized (e.g., movement, blinking, scrolling, animation, etc.)?
Authority and authenticity	Does the WBI establish a serious tone or presence? Are humor or anthropomorphic expressions used minimally? Is direction given for further assistance if necessary?
Completeness	Are levels clear and explicit about the "end" or parameters of the Web-based course? Are there different "levels" of use and, if so, are they clearly distinguishable?
Consistency and layout	Does every page begin with a title/subject heading that describes the contents? Is there a consistent icon design and graphic display across pages or screens? Are the layout, font choices, terminology use, colors, and positioning of items the same throughout the WBI (<4 of any of the above is usually recommended)?
Customizability and maintainability	Does printing of the WBI require special configuration to optimize presentation and, if so, is this indicated in the documentation? Are individual preferences/sections clearly distinguishable from one another? Is manipulation of the WBI possible and easy to achieve?
Error support and feedback	When users scan or select something does it differentiate itself from other information chunks or unselected items? Do cross-references, menu instructions, prompts, and error messages (if necessary) appear in the same place on each page or screen?
Examples and case studies	Are examples, demonstrations, case studies, or problem-based situations available to facilitate learning? Are examples divided into meaningful sections (e.g., overview, demonstration, explanation, and so on)?
Genre representation	Is task-oriented help or support materials easy to locate and access? Is the WBI's "table of contents" or main menu organized functionally, according to user tasks and not according to instructional jargon or generic "topics"?

Table 12 (continued.)

Usability Design Principles for Web-Based Instruction (WBI), 2 of 2	
Intimacy and presence	Is an overall tone of the WBI present, active, and engaging? Does the WBI act as a learning environment for users, and not simply as a warehouse of unrelated topics or links?
Metaphors and maps	Does the WBI establish an easily recognizable metaphor that helps users identify additional instructional materials in relation to each other, their state in the system, and options available to them?
Navigability and user movement	Does the WBI clearly separate navigation from content? How many levels down can users traverse and, if more than three, is returning to their initial state easy to accomplish? Can users see where they are in the overall WBI at all times? Do the locations of navigational elements remain consistent (e.g., tabs or menus)? Is the need to scroll or traverse multiple pages for a single topic minimized across screens or pages?
Organization and information relevance	Is a site map or comprehensive index available? Is the overall organization of the WBI clear from the majority of pages or screens? Are primary options emphasized in favor of secondary and tertiary ones?
Readability and quality of writing	Is the text in active voice and concisely written (>4 <15 words/ sentence)? Are terms consistently plural, verb + object or noun + verb, avoiding unnecessarily redundant words? Does white space highlight a modular text design that separates information chunks from each other? Are bold and color texts used sparingly to identify important text (limiting use of all capitals and italics to improve readability)? Can users understand the content of the information presented easily?
Relationship with real-world tasks	Are terminology and labeling meaningful, concrete, and familiar to the target audience? Do related and interdependent WBI functions appear on the same screen or page? Is sequencing used naturally, if sequences of common events are expected? Does the WBI allow users to easily complete their transactions or tasks on-line?
Reliability and functionality	Do all the titles, menus, icons, links, and opening windows work predictably across the WBI?
Typographic cues and structuring	Does the text employ meaningful discourse cues, modularization, chunking? Is information structured by meaningful labeling, bulleted lists, or iconic markers? Are legible fonts and colors employed? Is the principle of left-to-right placement linked to most-important to least-important information?

Note. From "*Usability Design Principles for Web-Based Instruction (WBI)",* 1 of 2 (cf. Najjar, 1998; Nielsen, 1994; Selber, Johnson-Eilola, and Mehlenbacher, 1997)) as cited in Mehlenbacher 2002.

Summary

Developing and validating a web-based module to teach metacognitive learning strategies to students in higher education is the focal point of the present study. Researchers of instructional technology acknowledge that WBI development has a unique set of characteristics that differentiates it from developing traditional-type instruction. Development of WBI can be viewed from several perspectives, a research perspective, a design and development perspective, and a learning perspective. Chapter Two is a discourse on the literature that is considered pertinent to the present study. Four major topics were covered: design-based research (DBR) (i.e. a research perspective), web-based instruction (WBI) and instructional systems design (ISD) (i.e. a design and development perspective), and learning (i.e. a learning perspective).

From a research perspective, it was critical that the research method utilized in the present study be defined and discussed carefully since DBR is still considered by some in the instructional technology field as a new and untraditional approach. The definitions of DBR presented here underscored the ongoing discussions among researchers about its scope and value to the field of instructional technology. Moreover, the advantages of a DBR research approach and how it can meet the unique characteristics of studying the design process was clearly presented in the literature review. Critical guidance for the methodology adopted in the present study was presented in the discussion of Seeto and Herrington's (2006) guide for DBR research. Additionally, some top researchers in the field of instructional design are advocates of DBR and are calling for more studies of design and development to utilize this research approach, therefore the present study will add to the body of research.

In consideration of a design and development perspective, other topics of importance that were highlighted in the literature review were WBI in higher education and the ADDIE process within ISD. The Internet, World Wide Web and its resources create a unique environment for learning. As discussed in the literature, WBI provides increased accessibility to learners yet for some IHEs there are prohibitive factors to developing WBI, with concerns of the quality of WBI being one such factor. It is important to not only understand what WBI is but equally important is to understand the design and development perspective that could affect the quality of WBI.

The premise of the present study was based on studying the effect of utilizing systematic approach to design and develop WBI. Hence the reason for the inclusion of a review of the systematic approach, ISD and the ISD process, ADDIE. The literature reviewed contends that using a systematic approach should result in quality WBI. ADDIE which is a generic process is used by many instructional designers to guide them in creation of WBI. Conversely, there are some practitioners and researchers that do not support the use of ADDIE for WBI creation. The conflict among practitioners and researchers in using ADDIE is another reason why the present researcher is interested in discovering whether the systematic approach using the ADDIE process will result in a WBI that is high in quality. In other words, it is important and socially relevant to understand what process creates WBI that is considered educationally valuable to learners.

Another perspective considered when developing WBI is learning. In particular, how learners can learn in a web-based environment is vital in helping to design the WBI for the study. Included in this portion of the literature review were foundational research

studies on learning, metacognitive learning, teaching test-taking skills, and elements of learner satisfaction and quality of WBI. How one learns and in particular, how one learns metacognitive learning strategies provides a theoretical framework germane to the present research. Furthermore, research on teaching test-taking skills provided relevant approaches for designing content for the WBI created for the present study. It was also important to understand what elements comprised learner satisfaction and quality as it pertains to web-based courses. The information here provided guidelines to determine the attributes of a product that is effective and of high quality.

All four topics reviewed DBR, WBI, ISD and learning are the foundation of the present study. Moreover, the analyses of some of the relevant studies conducted within these disciplines provide a strong theoretical framework for designing and developing WBI. The impact of the theoretical framework discussed here in Chapter Two influences the methods used in this study. Chapter Three follows with a review of the methodology of the present study.

Chapter Three

Methods

This chapter provides an overview of the research design and the research methods of the study. Furthermore, a pilot study was conducted, and it was comprised of the completion of the Analysis phase of the ADDIE process and development of the prototype of the web-based module that is part of the Design Phase of ADDIE. A description of the methods, outcomes and "Provisional Lessons Learned" derived from the pilot study are part of the discussion included in this chapter. The data collection method in the Analysis phase set the precedence for the rest of the phases of ADDIE. Therefore, following the pilot study discussion, the methods of the rest of the phases of ADDIE, that is Design, Development, Implementation and Evaluation are included in this chapter.

Since a number of instruments were used in this study, a detailed description of the instruments, instrument development and validation (i.e. the expert review of the instruments) for each phase of ADDIE are included in this chapter as well. As in other DBR studies, a large amount of qualitative data was collected and the method utilized for data analysis and data reduction is described fully later in this chapter. The reader will also notice reference to data displays throughout the chapter. According to Miles and Huberman (1994, 1984) data displays are a crucial part of the data analysis and reduction process.

Overview of the Study

The present study was designed to answer the research question "What is the effect of applying a systematic approach to development of a web-based module for teaching metacognitive learning strategies to students in a higher education environment?" It was also designed to meet a number of objectives that comprised the outcome of the study. The following objectives were met:

Research Objective 1: To create a systematically and rigorously designed product intended to meet research design goals.

Research Objective 2: To produce data that indicated the validity and effectiveness of the product.

Research Objective 3: Deliverables:

Deliverable A: A list of generalized "Lessons Learned".

Deliverable B: Report on the effectiveness of the specific instructional strategies utilized.

Deliverable C: An analysis of quantitative, qualitative and descriptive outcome measures of learning among field test participants.

Deliverable D: A module that is considered valid and effective at the juncture where the study completes a second iteration of the "design-evaluate-refine" cycle. Consideration of the modules' validity and effectiveness will be derived using data collected via formative and summative evaluations guided by the ADDIE process.

Information was gathered by researching the systematic process, ADDIE, where it was used to guide the conversion of one learning module of a course that is currently an instructor-led course into a web-based module. The targeted module for conversion was part of an undergraduate course "Learning Strategies within Academic Disciplines" taught at a major research university. Further discussion about the course, the targeted module and why it was used in this study is explained in a later section of this chapter. The systematic process ADDIE was used as the conceptual framework for designing and developing the web-based module.

Since this research study was designed to conduct formative and summative evaluations, the data collected provided generalized "Lessons Learned" that constituted refinements of the ADDIE process and insights for the basis of a new ISD model altogether. Systematically going through the phases of ADDIE provided information on the feasibility of this web-based development process. For example, the design of the study provided data about the overall time and cost factors involved in creating a web-based module. Most importantly it provided insight into the design decision-making process. Figure 6 displays a timeline of the ADDIE process and the length of time taken to complete each phase of ADDIE.

Setting

All the phases of ADDIE were examined in a naturalistic setting. There were a number of reasons for conducting this study in a naturalistic setting. Foremost of which is the "intention of research is to create a vivid reconstruction as possible…" (Cohen, Manion & Morrison 2000, p. 138). According to Cohen, et al. (2000) some further reasons for utilizing a naturalistic setting are "description and reporting, the creation of

key concepts, theory generation and testing" (p. 138). The study was conducted at a public research university. The university was recognized by the Carnegie Foundation as one of 39 community engaged public universities and one of the top 63 research university in the nation.

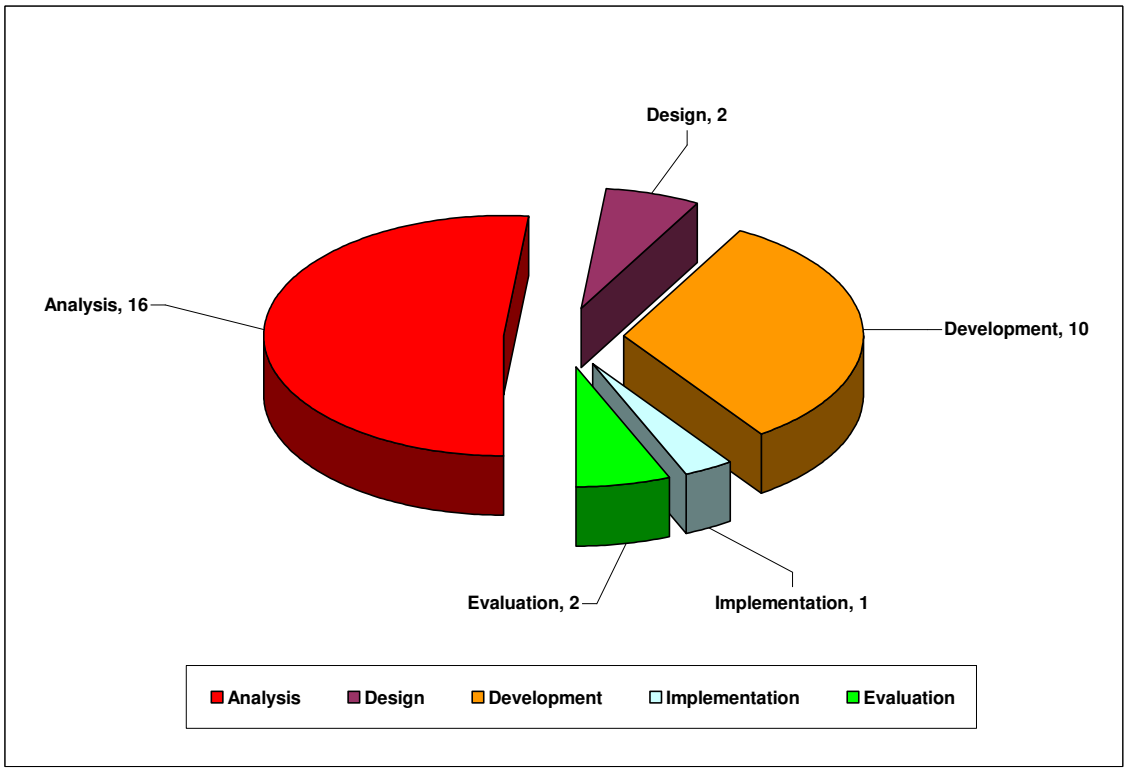


Figure 6. Timeline in weeks for web-based development.

Sampling

In this study an exploratory, inductive qualitative approach was utilized. This approach did not have pre-determined directions or delimitations set for the course of this study (Trochim, 2001). The sampling method used in this study was non-probabilistic and the sample was convenient. Non-probability sampling or purposive sampling means the chances of members of the "wider population" being included in the sample is

unknown, that is, not everyone had an "equal chance" to be included in the sample (Cohen et al., 2000, p. 99).

Participants

The participants in the study varied depending on the phase and the type of evaluation required. For example, in order to test usability of the web-based module throughout the phases of the ISD process (i.e. ADDIE) measures from learners, a subject matter expert (SME), two instructional design experts, an instructional designer and a programmer's perspectives were sought. A further discussion of each type of participant in the study follows. It should be noted that the Principal Investigator (PI) also functioned in the roles of Instructional Designer and a programmer in this study.

Learners

Learner participants were students enrolled in courses conducted by the Student Learning Services (SLS) program. Learners were enrolled in Learning Strategies, Critical Reading and Writing and The University Experience courses which were all within the Academic Disciplines coursework. The Critical Reading and Writing "…course helps students develop the fundamentals of reflective and critical reading and on effective analytical writing utilizing multiple sources from various disciplines. The course meets the criteria of Gordon Rule Writing requirements" (University of South Florida (USF), http://www.ugs.usf.edu/sab/sabs.cfm , para. 1). The University Experience course is a "first year 'student success' course. In seminars, small groups discuss the academic qualities necessary to succeed at USF: test-taking and study skills, time management, writing, critical thinking, computer and library resources, career planning and USF policies" (USF, http://www.ugs.usf.edu/sab/sabs.cfm, para. 1). These courses were all

part of the LEARN Program, now called Student Learning Services at the university where the research was conducted. The commonalities among these courses were that they all contained a metacoginitive component to help guide their students to recognize their learning habits and learning style and they represented the target audience demographics. All participants were 18 years old or older and participation was voluntary.

Subject Matter Expert (SME)

From a design perspective, a critical participant in the study was the SME. The SME was also one of the instructors of the Learning Strategies course and was a participant in seven of the twelve questionnaires and two interviews conducted in the present study. The SME was also a doctoral candidate in Instructional Technology. She taught the Learning Strategies course for two years. Her experience resulted in reliable content knowledge of the Learning Strategies course that was used to guide content development of the web-based module.

Instructional Design Experts

Two experts in the field of instructional technology reviewed the development of the instruments and the product. They were also participants in two questionnaires. Both experts hold doctoral degrees in Instructional Technology and have over three years of expertise in this field. One ID expert, referred to as ID Expert A in the study is currently the program manager and instructional designer for the Distance Course Design and Consulting Group at a major research university. She has worked as an Instructional Designer in both higher education and with a military contractor. In higher education, this expert was an Instructor for First-Year Student programs and an Academic Advisor. The

other ID expert, referred to in this study as ID Expert B is the Assistant Dean of Curriculum, School of Nursing, at a private for-profit university. Her area of expertise includes managing and directing all aspects of the course development for Associates, Bachelors, and Master's degree nursing programs at the private for-profit university.

Instructional Designer

The PI was also the instructional designer in this study. Later in this discussion when the role of the instructional designer takes priority over the role of the PI, the reader will see a reference to the PI (as Instructional Designer). The PI is a doctoral candidate in the field of instructional technology. She is currently employed as an instructional designer at a private liberal arts university. As an instructional designer, she has over three years of expertise in developing web-based courses. She has participated in several ID projects where she has converted existing traditional lessons into a web-based format. She has analyzed, designed, developed, implemented and evaluated several web-based training. Also, the PI has expertise in using several development tools such as Authorware® 6.0 , Adobe® Captivate 3.0 and Lectora.

Programmers

Two programmers were assigned to this study. One programmer developed the prototype and for the rest of the study, will be referred to as Programmer 1. Programmer 1 holds a master's degree in Instructional Design and has over three years programming experience. Although he developed the prototype Programmer 1 did not participate in any other phases of the study. The second assigned programmer, Programmer 2 was also the PI of the present study. The PI has over six years of programming experience and developed the web-based module. Later in this discussion when the role of the

Programmer 2 takes priority over the role of PI the reader will see reference to PI (as Programmer 2).

Ethical Considerations

Participation in the study was voluntary and all participants were assured that the data collected would be anonymous and confidential. No participant in the study was harmed in any way and no incentives were used to entice participants to take part in this study. The data was not used for any purpose other than to meet the objectives of this study. IRB (Institutional Review Board) permission had been sought and adhered to for all the phases of the ADDIE as well as for the DBR evaluations. Initially IRB approval was sought and granted for the first phase of ADDIE: Analysis. Once this phase was completed, IRB approval was sought and granted to conduct the rest of the ADDIE phases. The study was granted the status of "exempt" by the IRB.

The Principal Investigator (PI)

The role of the PI in the study must be examined to allay any suspicions on potential researcher bias. Along with her role as PI, she acted as an instructional designer and as one of the two computer programmers for the study. The PI has more than six years of computer programming experience that was utilized to facilitate the development of the web-based module. She has been employed as an instructor in the College of Education at a major research university and has taught courses on integrating technology into the classroom. She is currently employed as an instructional designer at a private liberal arts university.

Since much of this inquiry was qualitative in nature, which implied some interpretation of the data, it is important to delve into the scholarly qualities of the PI. A

major scholarly interest of the PI is to understand the use of technology to enhance and supplement learning. Although the PI has a technical educational background and has worked in the information technology field for a number of years, the PI believes that technology in and of itself cannot fill all the gaps that occur in the learning environment. She believes that technology should be teamed with other successful learning interventions to influence learning outcomes in a positive manner. For example, web-based learning should have well-thought out interactions that should create active and not passive learners. The PI is also interested in understanding how educators can create online interventions that can produce positive learning outcomes by using innovative tools and teaching methods.

It should be noted that prior to the start of the study, the PI had been acquainted with both the SME and Programmer 1. Programmer 1 developed the prototype for the study. Also, the PI attended various instructional design courses together with the SME and Programmer 1. Additionally, the SME, also being an instructional designer, did make suggestions in reference to design elements of the web-based module. However, the PI's personal acquaintance with the SME and the SME's instructional design knowledge and background did not introduce a bias. The content information gathered was strictly from a SME's perspective. Similar to a typical practical scenario, the SME's perspective on how best to present the information and what kind of design elements may be feasible within the environment were taken into consideration.

The information derived did not involve any personal or subjective information. The questionnaires and interview questions used in the study were derived from noted researchers in the field of instructional technology. Finally, the PI documented the entire

research process of the ADDIE phases by logging entries on a weekly basis (see Appendix D for an excerpt of the Logbook). The entries captured the progress and provided a source of information for performing DBR evaluative functions in the study.

Description of the Course for Conversion: Learning Strategies within Academic Disciplines

The Learning Strategies course is based on a model of developing self regulated learners through understanding concepts related to motivation, attitude, goal planning, and the process of learning. It is a two credit seminar-style course with three main objectives: to encourage critical thinking, to help students self regulate their academic actions, and to create reflective learners. The goal of the course is to help learners develop an understanding of their learning style through the practice of reflection. The hope is that this understanding will serve them well in their academic career and beyond.

Currently the course is experiencing low enrollment rates. The target audience for the course is any student who requires help acquiring learning strategies skills. If this course is made available on the Web, it would more than likely increase enrollment rate and also attract higher level students such as juniors and seniors. Furthermore, in the present state the course does not allow any flexibility in terms of content development. It is not flexible, modular or scalable. Instructors in this course may have to teach a variety of students who range from freshmen to seniors in one combined learning session. At the moment, the rigidity of the course design at times makes this concept too difficult for freshmen and at the same time too easy for juniors and seniors. As a result of the audience not being typical, instructors are asking for a web-based module that is

comprised of several subsets to suit the learner. Web-based courses, if designed properly, can fit the needs of many individual learners.

In this study the PI created a web-based module using the content of the metacognition module "Test Taking Strategies" as its foundation. In particular, the concept of self-regulatory learning strategies in combination with test preparation skills was converted to a web-based format. Comments from students and instructors for the Learning Strategies course suggested that the learning module on metacognition was one of the most difficult of all the concepts in this course. This module was ideal to transition to the Web because it combined theory with practice. Focusing on the outcome of transitioning this module from instructor-led to web-based has added value and relevance to this study.

Data Collection Instruments

This section describes the instruments utilized in the data collection for the ISD process, ADDIE as well as for the DBR approach. Table 13 is an overview of the instruments and their relation to the phases of the ISD process and the DBR evaluation functions. The method of analysis for each instrument is also displayed. Examples of all the instruments employed and results of the Analysis Phase of ADDIE can be found in Appendix A, the instruments and results for the rest of the phases of ADDIE can be found in Appendix B.

Interview

This study contained two interviews. The first interview titled "Analyze the Problem" was conducted with the SME and the Director of the LEARN program at the beginning of the Analysis phase. Recently, the LEARN program was renamed to Student

Learning Services (SLS). The interview was informal and conversational. Although this was a "less systematic approach" in regards to interviewing, it nevertheless provided the relevant information (Cohen et al., p. 271). Moreover, a rapport between the PI and the SME was established and a general idea of why a web-based module was desired was explicitly addressed. Leadership support for the module development was also established with the Director of the LEARN program, now the Director of the Student Learning Services.

The second interview, "Design Module Discussion" used a "guided approach" (Cohen et al., 2000, p. 271) type of interview with the SME, Programmer 1 and the PI who relied on her instructional design and programming expertise (see Specimen B-1 in Appendix B). The PI outlined the interview questions prior to the meeting. Like the previous interview, this one was also conversational in nature but systematically followed the questions outlined prior to the interview and provided a comprehensive collection of the data (Cohen et al., 2000).

Questionnaires

There were twelve questionnaires included in this study. More details of the validation process of each of these questionnaires are included in a later section of this chapter. All questionnaires were reviewed by two ID experts. The questionnaires generated the numerical data that was pertinent to the study and supplemented the descriptive narratives of the study (Cohen et al., 2000). See Table 13 for a detailed view of the ADDIE phases and the assigned instruments as well as the targeted participants for each instrument.

Table 13

Overview of instruments showing relationship between ADDIE and DBR evaluation functions

ADDIE Phases	DBR Evaluation Function	DBR Instruments/Tools	ADDIE Instrument Name	Type of Instrument	Participants	Method of Analysis for ADDIE Phase
Analysis	Review	Logbook Results from analysis phase Literature review sources	Analyze the Problem	Interview	SME, Director of LEARN Program	Observational, descriptive
	Needs Analysis		Needs Analysis	Questionnaire	SME	Descriptive
			Audience Analysis	Questionnaire	SME	Descriptive
			Task Analysis	Questionnaire	SME	Descriptive
			Content Analysis	Questionnaire	SME	Descriptive,
			Context Analysis	Questionnaire	SME	Descriptive
			Learner Analysis	Questionnaire	Learner	Descriptive, frequencies
Design	Formative	Logbook Results from design phase Literature review sources	Design Module Discussion	Interview	SME, ID, Programmer	Observational, descriptive
		Evaluate Design Decisions Questionnaire		Questionnaire	SME, ID, Programmer	Descriptive, frequencies
Development	Formative, Effectiveness	Logbook Results from development phase Literature review sources	Evaluate Usability of Module	Questionnaire	SME	Descriptive, frequencies
			Expert Review of Module	Questionnaire	ID Expert	Descriptive, frequencies
			Learner: Evaluate Usability of Module Survey	Questionnaire	Learner	Descriptive, frequencies
		Module Development Questionnaire		Questionnaire	ID, Programmer	Descriptive, frequencies
Implementation	Formative	Logbook Results from implementation phase Literature review sources	Implementation of Module	Observation	ID, SME	Observational
Evaluation	Summative, Effectiveness	Logbook Results from summative survey	Summative Usability Evaluation	Questionnaire	Learner, ID Expert	Descriptive, frequencies

The following details the list of questionnaires and the assigned ADDIE phases:

1. Analysis: Needs Analysis; Audience Analysis; Task Analysis; Content Analysis; Context Analysis; Learner Analysis;
2. Design: Evaluate Design Decisions Questionnaires (DBR perspective);
3. Development: Evaluate Usability of Module (DBR perspective); Module Development Questionnaire; Expert Review of Module; Learners: Evaluate Usability of Module;
4. Evaluation: Summative Usability Evaluation

Table 14 summarizes all the participants for each instrument and includes type of instrument and participant for each instrument as well as the learner's course name. In regards to learner participants, three questionnaires were developed to gather their observations and opinions. For the pilot study, in the Analysis phase, the participants of the Learner Analysis questionnaire were enrolled in a Learning Strategies course. Similarly, in the Development and Evaluation phases participants of the Learners: Evaluate Usability of Module (see Specimen A-1 in Appendix A) and the Summative Usability Evaluation (see Specimen B-6 in Appendix B) questionnaires were enrolled in the Critical Reading and Writing course and The University Experience course respectively. All three courses had common metacognitive learning strategies components and were all under the umbrella of the Student Learning Services department.

Again, as seen in Table 14, participants of the remaining questionnaires also included the SME, Programmer 1, PI (as Programmer 2), ID experts and the PI (as

Instructional Designer). For five of the questionnaires in the Analysis phase the participant was the SME.

Table 14

List and type of instruments, participants and learner course descriptions

ADDIE Phases	ADDIE Instrument Name	Type of Instrument	Participants	Learner Course
Analysis	Analyze the Problem	Interview	SME, Director of LEARN Program	
	Needs Analysis	Questionnaire	SME	
	Audience Analysis	Questionnaire	SME	
	Task Analysis	Questionnaire	SME	
	Content Analysis	Questionnaire	SME	
	Context Analysis	Questionnaire	SME	
	Learner Analysis	Questionnaire	Learner	Learning Strategies
Design	Design Module Discussion	Interview	SME, ID, Programmers	
	Evaluate Design Decisions Questionnaire	Questionnaire (DBR)	SME, ID, Programmers	
Development	Evaluate Usability of Module	Questionnaire	SME	
	Module Development Questionnaire	Questionnaire (DBR)	Programmer 2/ID	
	Expert Review of Module	Questionnaire	ID Expert	
	Learners: Evaluate Usability of Module	Questionnaire	Learner	Critical Reading and Writing:
Implementation	Implementation of Module	Observation	PI	
Evaluation	Summative Usability Evaluation	Questionnaire	Learner, ID/ID Expert	The University Experience (2 sections):

The list of questionnaires in the Analysis phase was Needs Analysis, Task Analysis, Audience Analysis, Content Analysis, and Context Analysis (see Appendix A) and they were distributed to the SME via email. At the Design phase of ADDIE, to gain insight from a DBR perspective the Evaluate Design Decisions questionnaire (see Specimen B-10 in Appendix B) was administered and the target participants were the SME, PI (as Instructional Designer) and the programmers. The responses to this questionnaire provided rich details of the decision-making process from a DBR perspective.

There were four questionnaires included in the Development phase of ADDIE. The participant of the Evaluate Usability of Module was the SME (see Specimen B-2 in Appendix B). Programmer 1 who developed the prototype at the Design phase did not participate in any of the other phases in the study therefore he was not a participant of any other questionnaire from the Development and Evaluation phases. For the Expert Review of Module questionnaire of the Development phase the participants were ID Expert A and ID Expert B (see Specimen B-3 in Appendix B). The Learner: Evaluate Usability of Module was a third questionnaire administered to learner participants in the Development phase of ADDIE (see Specimen B-4 in Appendix B). The final questionnaire of the Development phase was the Module Development Questionnaire and the intended participant was the Programmer 2 and the Instructional Designer (see Specimen B-11 in Appendix B). As noted the PI was both the Instructional Designer and Programmer 2 in the study. Data collected from this questionnaire aided the DBR analysis of the present study. According to Cohen et al. (2000) questionnaires, like the ones deployed on the Web for this study, provided an economical and efficient way to meet a larger audience. In this case, most of the participants of the study were

geographically dispersed therefore these questionnaires were deployed on the Web using the survey tool http://survey.acomp.usf.edu.

Observation

The implementation of the module was not extensive in nature. The module was placed on the Web by simply copying the files from the PI's computer to a web-server owned by the university where the research was conducted. To implement the module, a hyperlink was created to a site that the PI deemed a "test site". All participants were provided a password to gain access to the hyperlink. A direct observation of the implementation process by the PI was sufficient to provide data for review in this phase.

Logbook

When the study commenced, the PI kept a log of all events pertaining to the research (see Appendix D for excerpt of the logbook). She wrote one entry per week regarding the progress of the ISD process. This logbook provided substantial data for DBR analyses. The logbook was also used as an organizational tool during the lifespan of the study.

Research Design

As mentioned previously, the DBR approach calls for an assortment of evaluation instruments to be utilized for the phases of ADDIE. The result of the DBR approach provided a comprehensive view of the ISD process. A conceptual model of the research design is shown in Figures 7 and 8. This model built upon Seeto and Herrington's (2006) model (see Figure 3). Using the ADDIE process as a conceptual framework to guide the study aided in providing construct validity at the core of the study. Johnson and

Christensen (2004) explain that construct validity is the "extent to which a high-order construct is represented in a particular study." (p. 247).

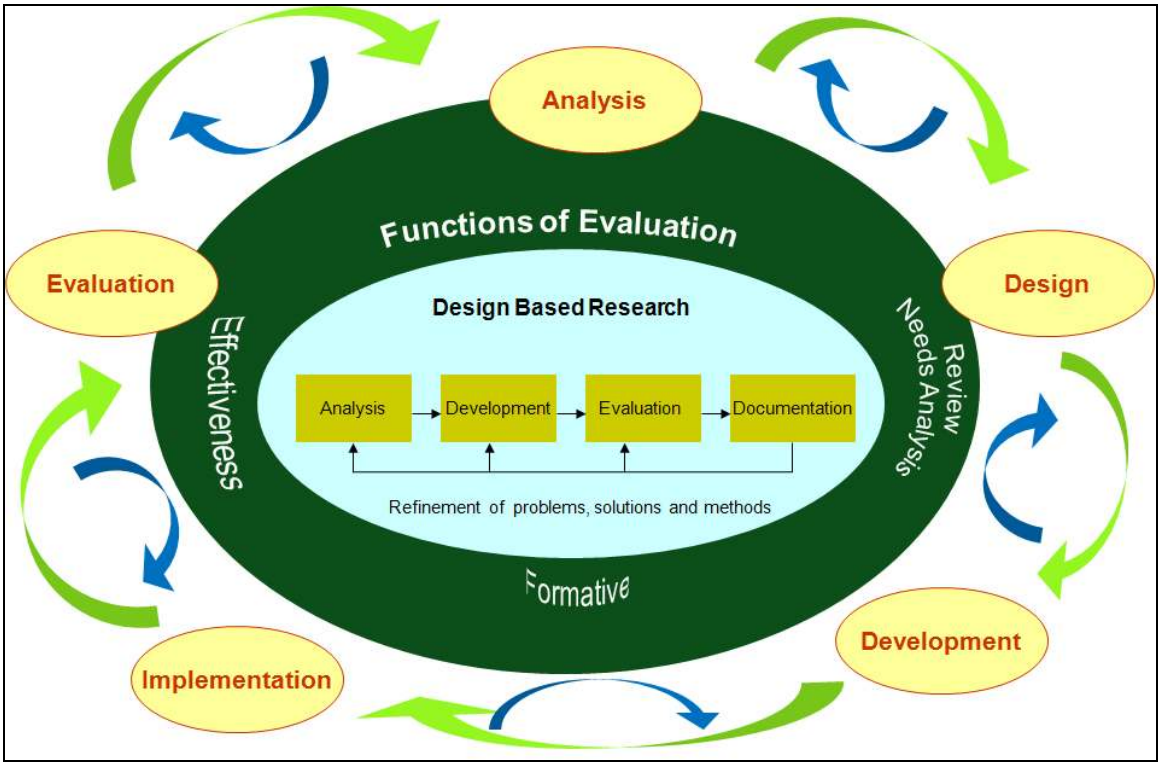


Figure 7. Pictorial representation of construct validity elements included in the research design.

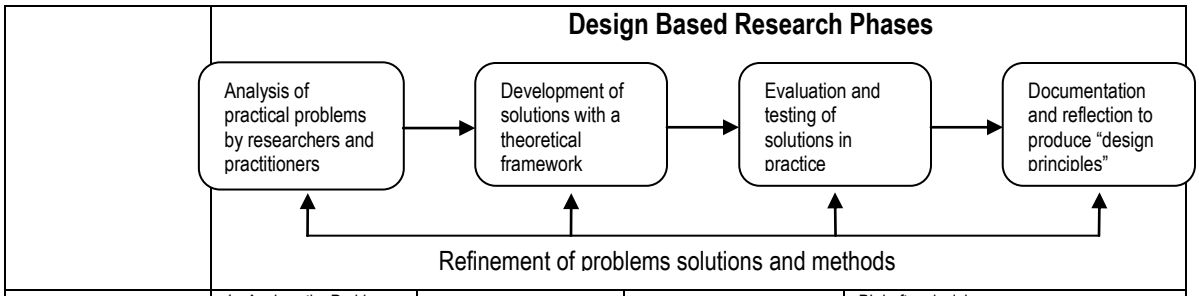
Construct Validity: Overall Study

There were two tiers to the research that provided construct validity to the study. First, the five phases of the ADDIE process provided the overarching goal of the entire study. Second, the four phases of DBR research phases (see Figure 2 in Chapter Two) were at the core of the study and integrated a research perspective that resulted in improved design principles. Additionally, Reeves and Hedberg's (2003) functions of evaluation as listed in Chapter Two were used to assess the entire study from a DBR

perspective. Additionally, Figure 8 displays the overview of the study. It shows the relationship between the ADDIE phases, the DBR phases and the evaluations functions.

Furthermore, the systematic development of the web-based module high-order constructs was represented by the phases of ADDIE (Analysis, Design, Development, Implementation, Evaluation). Some of the phases (e.g. Analysis and Implementation) were easier to operationalize, that is, construct is represented by specific steps to follow by using ADDIE to guide the study. In contrast, information was gathered in an iterative fashion between the design and development phases, therefore operationalizing the sequence was somewhat complex but when accomplished provided clarity. Although the complexity of the study had increased because a variety of measures were employed per phase that called for multiple operationalism (i.e. more than one measure per construct), there were clear constructs that guided the process.

As mentioned earlier, another element that provided further construct validity in this study was Reeves and Hedberg's (2003) functions of evaluation. In particular, four functions of evaluation: review, needs analysis, formative and effectiveness were employed throughout the phases of the ISD process. Reeves and Hedberg (2003) recommended that the last two functions of evaluation, impact and maintenance be conducted after a module has been in use for more than a year. For this study the last two functions were not feasible due to time constraints. As recommended by Reeves and Hedberg (2003), formative evaluations were conducted throughout the phases of the ADDIE process. There was one iteration of the "design-evaluate-refine" cycle occurring in the Development phase before the module was implemented. A summative evaluation was administered at the Evaluation phase of ADDIE and prompted two iterations of



ANALYSIS	1. Analyze the Problem – SME – Director of Learn Program- Interview 2. Needs Analysis – SME – Questionnaire 3. Audience Analysis – SME – Questionnaire 4. Task Analysis – SME - Questionnaire 5. Content Analysis – SME – Questionnaire 6. Context Analysis – SME - Questionnaire 7. Learner Analysis – Learners - Online Survey			PI drafts principles – 1. use Logbook 2. use results from analysis 3. use literature review sources
DESIGN		1. Design Module Discussion – SME, Programmer and ID – Interview 2. Evaluate Design Decisions- – SME, ID, Programmer – Questionnaire		PI drafts principles and document rationales for design decisions and models/strategies/innovations used – 1. use Logbook 2. use results from design analysis 3. use literature review sources
DEVELOPMENT		1. Module Development Questionnaire – Programmer – Questionnaire 2. Evaluate Usability of Module – SME – Questionnaire 3. Evaluate Module - Instructional Expert Review of Module – ID expert – Questionnaire 4. Evaluate Usability of Module Survey – Learners – Survey		PI drafts principles and information on design and development of the product/learning environment – use Logbook use results from development analysis use literature review sources
IMPLEMENTATION			5. Implement Module – SME and Programmer – Observation	PI drafts principles and information on implementation of the product/learning environment – 6. use Logbook 7. use results from implementation observations 8. use literature review sources
EVALUATION	9. Evaluate all artifacts from the Analysis phase – PI – Refine analysis principles	10. Evaluate all artifacts from the design and development phase – PI – Refine design and development principles	11. Summative Usability Evaluation – Learner and ID expert - Survey 12. Evaluate artifact from implementation process – PI – refine implementation principles	PI refines principles for overall study - 13. use Logbook 14. use results from all phases 15. use literature review sources 16. Evaluate all artifacts from the ADDIE phases – PI – Refine design principles
	Review	Needs Analysis	Formative	Effectiveness

Figure 8. Overview of research design.

"design-evaluate-refine" cycles. Figure 9 shows details of the systematic approach to the research and how the research was conducted.

Construct Validity for Instrument Development: Expert Review of Instruments

The basis of each question in the instruments was derived or modified from credible sources like those that have been cited in the literature review in Chapter Two. To re-iterate, research by Seels and Glasgow (1998), guidelines by Bruning et al. (2004), Swan (2003) and Mehlenbacher (2002) were influential in this study. Furthermore, to add rigor and to reduce researcher bias to these instruments, all of them were expertly reviewed prior to being distributed to the participants. Two Instructional Design (ID) experts with doctoral degrees in the field and with over three years of expertise reviewed the questionnaires.

For the Analysis phase, description of the expert review process of the instruments is included in the summary of the pilot study in this chapter. Seels and Glasgow (1998) provided a list of questions that should be answered at each phase of ADDIE. Their guideline was also used to conduct the data reduction and analysis for the study. Bruning et al. (2004) has put forward seven recommended guidelines to be used by instructors of metacognitive learning methods. Also, both Swan (2003) and Mehlenbacher (2002) offered practical design guidelines for instructional designers and instructors to create a product that is effective and high in quality.

There was an expert review process developed by the PI for ID Expert A and ID Expert B. The procedure of expertly evaluating the instruments was as follows: (1) the four guidelines, by Seels and Glasgow (1998) Bruning et al. (2004), Mehlenbacher (2002), and Swan (2003) was emailed to the ID experts (2) the questionnaires pertaining

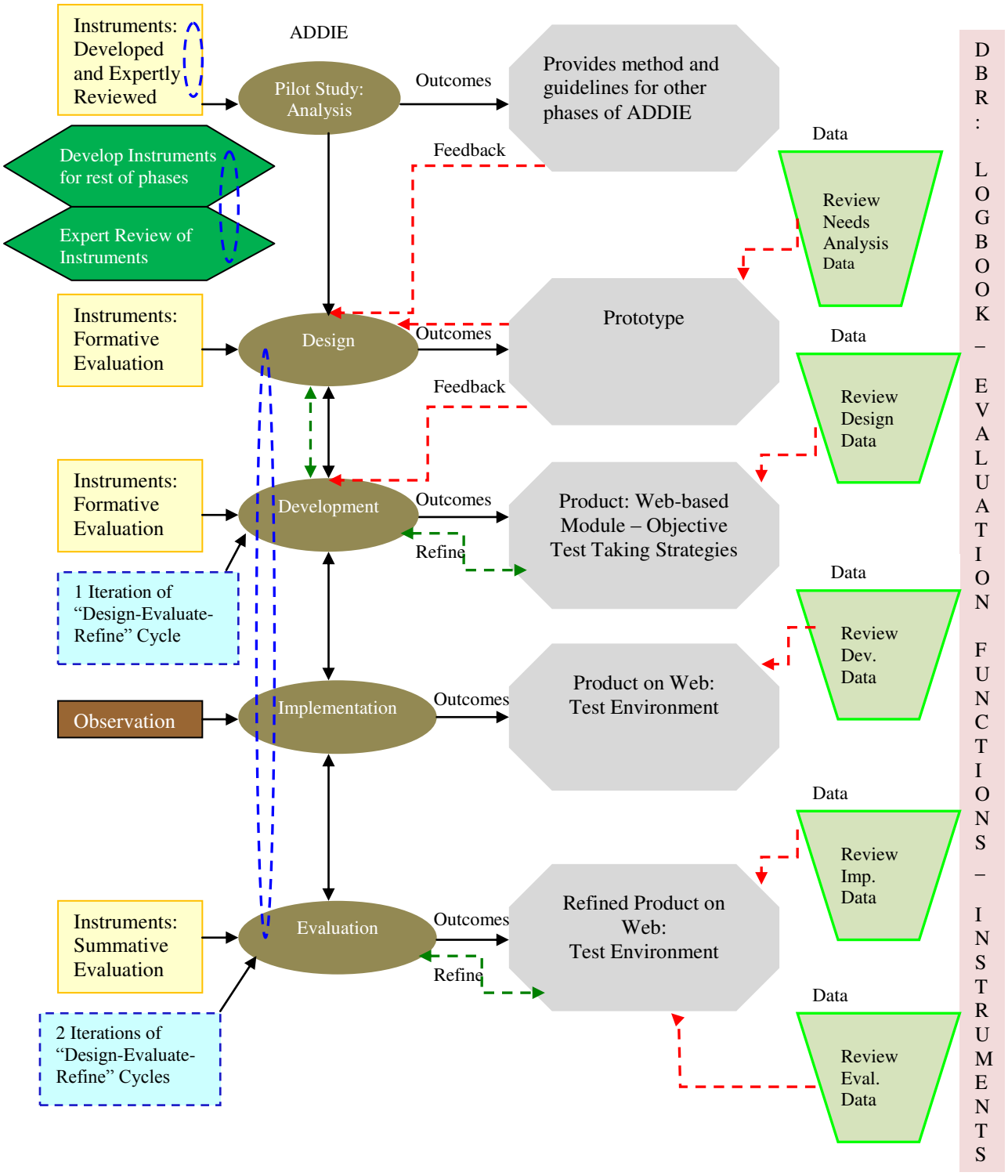


Figure 9. Execution of research plan.

to each phase was emailed to the ID experts as an email attachment (3) ID Expert A and ID Expert B were asked to read the guidelines first and to use these guidelines as the common criteria to assess each questionnaire (4) the experts were asked to respond with their suggested changes using via email within one week if their schedule permitted (5) the PI reviewed each suggested change (6) the PI after making suggested changes re-sent the links to the questionnaires to ID Expert A and ID Expert B (7) ID experts reviewed the questionnaires for a second time (8) again, the suggested changes for the questionnaires were emailed to the PI (9) the PI reviewed and made the changes, and (10) the PI puts the final version of the questionnaire on the Internet. Beyond this, no specialized training was necessary for the ID experts. By reading the guideline research, the ID experts made informed recommended changes to the instruments. Such independent assessment of the instruments helped the PI in collecting relevant and unbiased data.

Data Reduction and Analysis

Data reduction and analysis began at the point of data collection and continued until the end of the study. Cohen et al (2000) stated that data analysis "involves organizing, accounting for, and explaining the data." (p. 147). The phases of ADDIE were the core organizing element of the study. Data reduction is an iterative process (Miles & Huberman, 1994; Bogdan & Biklen, 1992). Bogdan and Biglen (1993) states that "analysis involves working with data, organizing them, breaking them into manageable units, synthesizing them, searching for patterns, discovering what is important and what is to be learned…" (p. 153). As seen in Figure 9 after the collection of data from each phase, the data was carefully analyzed and summarized from two

perspectives: the instructional design perspective and from the DBR perspective. Figure 9 shows the execution of the research plan for the study.

Researchers LeCompte and Preissle (1993) stated that the goal for qualitative data analysis is to convincingly progress from "descriptions to explanations and theory generation" (as cited in Cohen et al., 2000, p. 148). To progress to theory generation LeCompte and Preissle (1993, as cited in Cohen et al., 2000) made the following recommendations:

1. "…set out the main outlines of the phenomena that are under investigation";
2. "…assemble chunks or groups of data, putting them together to make a coherent whole (e.g. through writing summaries of what has been found)";
3. "…they should painstakingly take apart their field notes, matching, contrasting , aggregating, comparing and ordering notes made."; (p. 148)

These guidelines were adhered to by the PI.

The objectives of the study that were listed in Chapter One and at the beginning of this chapter are the main outlines of the study. Data was collected in chunks if the reader considers that at each phase there was data collection via various methods. At each phase the data had to be analyzed and summarized so information could be extracted to continue to the next phase and proceed with the development of the web-based module. Finally, when all the data was collected, this together with the PI's logbook was used to compare, contrast, synthesize and aggregate information to develop a comprehensive view of the study.

Summary of Pilot Study Results: Analysis Phase and Prototype Outcomes

The outcome of the Analysis phase created a foundation and robust guideline for conducting the Design, Development, Implementation and Evaluation phases of ADDIE. In particular, the method used in the Analysis phase set the premise for conducting the next four phases, Design, Development, Implementation and Evaluation. Included in the pilot study was the development of the prototype which was part of the Design phase (see Appendix A for instruments and summary of results from the pilot study). The DBR approach resulted in qualitative outcomes in this study. Reeves and Hedberg's (2003) evaluation functions as well as Seeto and Herington's (2006) guide (see Figures 3 and 8) was employed and expanded to lend direction to the study. Guidelines developed by Seels and Glasgow (1998) Bruning et al. (2004), Swan (2003) and Mehlenbacher (2002) provided constructs that aided in the development of the qualitative and the quantitative measures that were utilized in the study.

IRB permission was granted to complete the Analysis phase. In this phase, seven instruments were employed, six questionnaires and one interview. The goal of the Analysis phase was to identify the need for the web-based instruction and to understand why a learning gap existed (Dick et al., 2005). Moreover, the information gathered at this phase assisted the instructional designer to comprehend the reasons for developing the learning module.

For the pilot study, data collection at the Analysis phase was conducted for the duration of one week during the summer semester after the instruments were expertly reviewed. The interview "Analyze the Problem" was a one hour meeting with the SME, Director and PI (see Appendix A). From this interview, the PI learned the reasons why a

web-based module was desired. Most importantly the SME pointed out that the need for a web-based product was not in response to a problem per se but instead it was being reactive to the needs of the learners and the availability of the technology. During this initial meeting, the target class and module for web-based conversion were introduced by the SME. The Director concurred with the SME's suggestion.

Analysis Phase: Instruments

Following the interview, the PI turned her attention to developing the six questionnaires. For the pilot study, the instruments were expertly reviewed by the SME and an instructional design expert. There were two iterations of the "design-evaluate-refine" cycles for the validation of the instruments. This method of expert review of instruments set the standard for the rest of the phases in regards to expert review on instruments. The instruments provided insights into the characteristics of the target audience and the content that should be included in the module. It also provided a clear reason as to why a web-based module was needed. The seven instruments, participants and type of instrumentation were as follows:

1. Analyze the Problem – SME – Director of LEARN program (LEARN has been renamed to Student Learning Services) - Interview
2. Needs Analysis – SME – Questionnaire
3. Task Analysis – SME - Questionnaire
4. Audience Analysis – SME – Questionnaire
5. Content Analysis – SME – Questionnaire
6. Context Analysis – SME - Questionnaire
7. Learner Analysis – Learners – Questionnaire

For the DBR perspective the PI reviewed the Analysis phase using:

1. Logbook
2. Results from the analysis phase
3. Literature review sources

The objective was to reflect on the process, to review the instruments and literature review, and to develop principles of design that enhanced the process.

Six questionnaires (see Appendix A for pilot study instruments and results) were developed using several guidelines from noted researchers (Dick et al., 2005; Seels & Glasgow, 1998; Mager, 1984; Mager 1997). All six instruments were reviewed by an ID expert and the SME. The six questionnaires were emailed to the SME and ID expert for a first review via email. After a week, the first round of suggested changes was sent to the PI. The recommendations for changes were made, and afterwards a second ID expert reviewed the instruments. The suggested changes were obtained, again via email, within two weeks. In general, for all instruments, changes were made regarding grammar and objectivity of certain questions. The SME asked that the word "problem" not be used and instead suggested it be replaced with the word "need". Feedback from the second round demanded only minor changes, such as keeping verb tense consistent and some minor spelling corrections. The PI made the recommended changes to all the instruments. After the second round of recommended changes was completed, five of the instruments, Needs Analysis, Audience Analysis, Task Analysis, Content Analysis and Context Analysis were delivered via email to the SME for data collection since she was now a participant in the study. The delivery method was email, preferred by the SME given a lack of availability to meet face to face.

The only instrument of the Analysis phase intended for learner participants was the Learner Analysis (see Specimen A-1 in Appendix A for instrument and summary of results). This instrument was comprised of twenty-two questions with four sections: Student Information, Computer Usage, Online/Distance Learning Course Information and the final section was an open-ended question asking for the learner's opinion regarding online courses. The instrument was developed for the web using a survey tool (http://survey.acomp.usf.edu) adopted by the University at which the research was conducted. The instrument was delivered online. A url (universal resource locator) link to the instrument was delivered via email to the SME. As noted previously, the SME was also an instructor of one of the LEARN courses. As an instructor, the SME asked students in her class to participate in the analysis on a voluntary basis. The students were given the option to complete the questions online in class or at another convenient time outside of classroom. The instrument was kept online for two weeks. Ten responses were received at the end of two weeks and this marked the completion of the Analysis phase.

Analysis Phase: Outcomes

The data was analyzed from two perspectives: an instructional designer perspective and a DBR perspective. Analysis of the data from an instructional design perspective of the pilot study included identifying design elements as well as development requirements of the web-based module. Careful scrutiny of the Analysis phase data collected from the seven instruments revealed a wealth of information. The review of the data explained to the instructional designer the need for the web-based module. The data also provided an understanding of the current learning environment. The characteristics of the target audience for the web-based module was also derived

from the data collected. Initially, when the SME reviewed the Needs Analysis instrument it appeared that the word "problem" which was used in several questions was not appropriate terminology. The SME requested that the term be changed to "need." The instrument was reworded and resent via email. As the SME pointed out, the reason for seeking development of a web-based module was to search for "new opportunities to diversify current academic support services," and this should not be defined as a "problem".

Also, the request for a web-based module was the result of the leadership stakeholder (the Director of the LEARN program) wanting to take advantage of available technological advances. Other reasons cited for needing a web-based module were as follows: (a) a need to make the course more accessible in order to serve a larger number of students; (b) more flexible in terms of changing the content to easily meet different curricula criteria and target audience; and (c) having the ability to adapt quickly to future changes. Clearly the needs analysis explained the purpose of the web-based module. Additionally, the current learning environment was described. Altogether, this gave the instructional designer information to help make design decisions.

The information derived from the Needs Analysis provided an explanation to the instructional designer as to why a web-based module was needed (see Appendix A). The SME described the target audience and together with the information gathered from the Learner Analysis instrument, a much richer profile was developed. An instructional designer should be able to use the Needs Analysis not only to discover what the learning gap is but why the learning gap had occurred (Rothwell & Kanzansas, 2004). In this study, the instructional designer found that the Needs Analysis information provided an

answer to the "what" and "why" of the request for developing the web-based module. The instructional designer discovered that the web-based module was desired because the Director of the program wanted to reach out to more students and to diversify current program services.

From the Audience Analysis we learned some of the demographic details of the audience. For example, the respondents' age ranged from 19 to 25 years old and they were comfortable using computers. More importantly the respondents were not opposed to learning the material online. Some were enrolled in the course because it was a requirement course. To explain, a requirement course is a course a student must take in order to meet some specified university rule. The SME pointed out that the students were learning a skill (i.e. test taking strategies) and the requirements outside the classroom, for example, reading and homework assignment were "light" or in other words, required two hours or less of homework per week. The responses from the Audience Analysis gave the instructional designer valuable information in regards to who would be using the web-based module. Furthermore, this type of information could help instructional designers design a module to meet specific needs of a target audience (Rothwell & Kanzansas, 2004).

There was no pre-requisite knowledge needed for taking the course beyond baseline knowledge of a college freshman. In the Task Analysis (see Appendix A) the data revealed that the current instructors tried to engage the learners by having them participate in various activities. Some of the activities included administering various types of tests such as objective or subjective to the students in an effort to help the students understand the different approaches. A task analysis according to Rothwell and

Kanzansas (2004) should be a "thorough analysis of how people perform work activities." (p. 132). Data from the Task Analysis did help to specify which module needed to be developed as a web-based module and what pre-requisite information, if any, was required by the learners. For the instructional designer, the data collected from the Task Analysis specified the task and expectations of the module.

However, the Content Analysis provided detailed information to the instructional designer about the learning objective of the proposed web-based module Test Taking Strategies (see Appendix A). How the content should be arranged and presented as well as how the information should be processed by the learner was defined in this instrument. Important information about the instructor's methods of teaching test-taking strategies for objective tests was derived from the Content Analysis. Teaching test-taking strategies for objective tests lesson were taught in the following manner: students were administered objective tests, followed by the instructor pointing out several strategies for choosing the correct answer and encouraging several discussions. Various kinds of declarative knowledge such as: levels of knowledge, levels of intellectual ability, characteristics of objective and subjective test, commonly used test-taking strategies and general rules of test taking strategies were also presented to the learner. Furthermore, affective knowledge such as: being responsible for studying, being self-regulated, being self-motivated and being committed to their studies were also discussed with the students.

More importantly, the SME described some of her preferences in an online environment such as creating a "fun" environment with a high level of interactivity and including video and audio, if they add value, should also be considered. Content information was important to the instructional designer because it helped to guide design

decisions. The Content Analysis informed the instructional designer of how the current instructor-led class was being taught. Specific information pertaining to the modules was also divulged in the questionnaire.

The environment for planning, learning and performing (Seels & Glasgow, 1998) were considered in the Context Analysis (see Appendix A). In regards to planning, financial constraints for implementing a web-based module were examined. This was an area where the study differed from a project occurring outside the context of research. The development of the module was funded by the PI. Cost analysis is an important aspect of web-based development or any development for that matter. The study was limited in this area. Although a cost structure was developed after the initial meeting among the PI, the SME and the Director, it was apparent to the PI that the research and development would not be funded by the department. However, there was strong support in the sense of accommodation to the PI and accessibility to information from key personnel (e.g. the SME and Director). In respect to the learning context, the SME made it clear that students were held ultimately responsible to understand their own learning style. She pointed out that a possible social or physical constraint that may prevent web-based learning of the target audience could be lack of access to a personal computer (PC). However the SME proposed that this problem could be overcome with open-use labs on the campus. The Context Analysis instrument did not yield much more information than what was previously garnered from the other instruments. This points to a poor fit for the study or that the instrument needed further modification.

Further information about the intended audience was divulged from the Learner Analysis instrument (see Specimen A-1 in Appendix A). This instrument provided more

details about computer usage and the learner's opinions about distance courses. Specimen A-1 in Appendix A shows the full list of participants' responses to items in the Learner Analysis instrument. From this survey, 90% of the students surveyed were full-time while 10% were part-time. As far as computer usage was concerned, most of the students (70%) were comfortable using computers as a study aid. Interestingly, although 70% of the students either strongly agreed or agreed that they were comfortable using the computer to do real time chats or online discussions, 20% strongly disagreed and 10% disagreed that they were comfortable with online chats or discussions.

Pertaining to the participants' opinions regarding distance learning courses, the majority of participants (80%) were currently enrolled in a distance learning course. A little more than half of the participants (60%) agreed that distance learning courses were easy compared to traditional instructor-led course. However the rest (40%) of the participants disagreed that distance learning courses were easy in comparison to instructor led courses. Most relevant to instructional designers were the participants' opinions of the Learning Strategies course itself, all of the participants either agreed (50%) or strongly agreed (50%) that the material covered in the Learning Strategies course would help them improve their grades in other courses. If the course was online, the majority of students (80%) would choose the web-based version rather than the instructor-led version while a minority (20%) would prefer the instructor-led version. In Section D of the Learner Analysis instrument there was a comment area for participants to write their thoughts about features they would like to see in a web-based version of the Learning Strategies course. Overall, students expressed a desire for more interaction and more examples of test questions.

From an instructional design perspective, according to Seels and Glasgow (1998) data analysis at the Analysis phase should answer three important questions. These questions and the response to the questions after data analysis were as follows:

1. *What is the problem or need?* (Seels & Glasgow, 1998, p. 180):

The conversion of the course to web-based was initiated by the Director to: (a) take advantage of the availability of advanced technology, (b) diversify current program services, and (c) reach out to more students. From the SME's response, she stated that a web-based course would: (a) provide flexibility to access information and content, (b) decrease barriers to distance learning (e.g. help commuter students), and (c) increase the possibility of reaching students in regional campuses. The responses from both the Director and the SME were similar and convergent. From an instructional design perspective this was positive because it appeared that important stakeholders agreed on the instructional and development approaches.

2. *What are the parameters of the problem/need?* (Seels & Glasgow, 1998, p. 180)

Analysis of the SME's responses to the Content Analysis and Context Analysis questionnaires showed several parameters for instructional design and approach. First, the SME stated that "I expect that the online version should have a FUN approach. If there is audio, maybe we can incorporate something like peer-talk, and animation. Stay away from scripted type audio." Interactivity was also highly desired. Responses to the Audience Analysis and Learner Analysis questionnaires also highlighted a preference for interactivity and a use of a "fun" approach. The ages of the learners ranged between 18 and 25. Out of the 10 respondents, to the Learner Analysis questionnaire, all of them either agreed (30%) or strongly agreed (70%) that they were comfortable using the

computer as a study aid. Here, the PI (as Instructional Designer) inferred the desired tone of module and the level of interactivity (i.e. a high level of interactivity) required.

Second, there were financial constraints. Although the Director supported the conversion to a web-based module verbally, she could not support it financially. Here, the PI (as Instructional Designer) had to determine what would be cost-effective from the available group of development tools. The PI sought the advice of Programmer 1 who explained that using the development tools Authorware® 6.0 and Dreamweaver would meet the requirement of this web-based initiative.

Third, in respect to delivery of the web-based module, the SME stated that it had to be compatible with the university's standards. The PI (as Instructional Designer) determined that no proprietary applications should be used. Using Authorware® 6.0 required a player to be downloaded. Computers on-campus did not have this player downloaded in their labs. Another problem in using Authorware® 6.0 was its lack of popularity among instructional designers or instructional developers. Seeing this as a drawback to the design, the PI (as Instructional Designer) decided that the prototype would be developed using Authorware® 6.0, but the actual module would be developed using a different tool, such as Adobe® Captivate 3.0. Adobe® Captivate 3.0 creates Flash files (i.e. .flv file extension) and most computers sold today come with the Flash player pre-loaded. Most importantly, the open-use labs on the university campus either already had the free player or allowed the download. The PI (as Instructional Designer) decided that the module would be developed so that it could be executed in both Windows and Macintosh systems.

3. *What should the content be?* (Seels & Glasgow, 1998, p. 180)

The Topic Analysis and Content Analysis questionnaires delivered the pertinent data to address this question. Here the SME clearly identified the content for the web-based module. She noted that "Test Taking Strategies" for Objective tests would be ideal for conversion. From the Audience Analysis questionnaire, the SME stated that "some learners want to enhance their learning strategies and learning techniques". The Learning Strategies course is a skill-based class and from the Content Analysis the SME listed a number of things she did in her class for this particular module:

1. Learners get a sample of an objective test (e.g. a mock test – Multiple choice, true/false etc. type questions).
2. Students take the test.
3. We then engage in a discussion on the level of difficulty of the test.
4. We talk about strategies they used to overcome the difficulty they experienced.
5. Most of the time, the students tend to choose the correct strategy.
6. If they don't, then a "teaching moment" occurs and I inform them of correct strategies. I cover them either way, just to help them understand the strategies better.
7. I teach and point out keywords that they can use.

The PI (as Instructional Designer) used this list as a starting point to create the flowchart of how the content would be presented to the learners.

Beyond the three questions that guided the analysis and data reduction in this phase, an instructional design plan (IDP) was developed (see Appendix C). This

document crystallized the design information gathered from all of the Analysis phase instruments. Greer (1992) who referred to an IDP as a "blueprint" for training development believed that IDPs help to reduce time taken to develop the training as well as "produce higher quality training materials" (p. 110). While the IDP acted as a good guideline for development of the final product, it had not been completed while Programmer 1 was developing the prototype.

Instead, Programmer 1 was given guidelines from the PI (as Instructional Designer) and the SME pertaining to flow of content of the training and the need for interactions. The PI (as Instructional Designer) and Programmer 1 had several conversations verifying the content plus several design elements including feedback and interactivity. Programmer 1 was given basic information in terms of color, font and type of interaction. However, Programmer 1 was not limited to these guidelines and was free to use and did use different design elements provided by the development application. To develop the prototype using Authorware® 6.0, Programmer 1 took 40 hours. The goal of this prototype was to develop a sample of the web-based module to demonstrate to the stakeholders. The prototype encapsulated some of the SMEs ideas for flow of data and inclusion of interactivity (see Figures A-1 and A-2 in Appendix A). To show the SME the prototype, a hyperlink to the prototype was created on the PI's website. One week after receiving the link, the SME responded with her review via email to the PI. Following is a summary of her response:

1. Level of interactivity is poor;
2. Feedback to incorrect and correct response was not what was desired;
3. The look of the prototype was too bland;

4. The feel of the module was not “fun”, it was boring;
5. Overall the module was ineffective;
6. Content was correct;

Reacting to the SMEs obvious disappointment with the prototype, the PI met with the SME informally to try and gather further information as well as to assure her that the final product will be re-designed to closely meet her suggestions.

The Analysis phase of the ISD process resulted in detailed information gathered regarding purpose, audience, content, and context of creating the online module. In all, seven instruments were utilized in this phase, one interview and six questionnaires. The first interview was developed as a way to establish a relationship with the SME as well as to gain support for the initiative. The study was further enriched by the information gathered from the Learner Analysis. Learners interpreted their questions based on their own “experience, expectations and beliefs” (Rothwell & Kanzansas, 2004, p. 99; Gagné, 1977). The Learner Analysis tool provided the instructional designer with information about the characteristics of the learners. Knowing this, an instructional designer would be able to design a module for the specific skills, knowledge and attitudes of a targeted audience (Rothwell & Kanzansas, 2004).

Overall, the information derived from six of the seven instruments in the Analysis phase resulted in valuable data for the instructional designer. However, before the instructional designer sets out to modify the existing instruments used in this phase, he or she should examine carefully why one would analyze the situation and what one should be analyzing. The feasibility of conducting analysis was something that had to be considered carefully by the instructional designer. In many instances, time, cost and

resources have been limiting factors in carrying out detailed analysis. However, from the analysis of information gathered in this study, it showed that a needs analysis was necessary in order to proceed with the design and development of a module. An instructional designer could in fact design a module without knowing why a learning gap existed or who the module was intended for but the usability and effectiveness of that module would be questionable.

At the end of the Analysis phase, the research question "What is the effect of applying a systematic approach to development of a web-based module for teaching metacognitive learning strategies to students in a higher education environment?" was addressed partially. The DBR perspective has led the PI to infer that the purpose of conducting this particular phase had been met. The information gained provided an important foundation for further development. As mentioned earlier, some researchers (Rothwell & Kazansas, 2004; Dick et al., 2005) believed that the Analysis phase should provide the instructional designer with an overview of the problem, the reasons why the module is required, the nature of the content, the context surrounding the proposed development of the online module and a profile of the learner or the intended audience.

Furthermore, the review of the Analysis phase revealed the importance of establishing a rapport with the SME who had been a source of valuable information throughout the Analysis phase. Establishing a relationship with an individual like the SME provided support throughout the ISD process. Also, acquiring leadership support at the start of the ISD process had been crucial. Identifying the stakeholder(s) such as the person or persons in leadership positions i.e. directors and instructors, and the learners

themselves also helped the instructional designer to understand the context of one's environment.

Regarding the four objectives or deliverables of the study, only one was delivered at the end of the Analysis phase, a list of generalizable and provisional Lessons Learned for the Analysis phase. It was considered provisional because the rest of the ADDIE phases were not yet completed. However, all of the deliverables were met once all phases of ADDIE were completed. The effectiveness of using the ADDIE process to systematically develop a web-based module to teach metacognitive learning strategies to students in higher education was determined at the end of this study. Thus, the deliverable, a list of provisional Lessons Learned pertains only to the pilot study (i.e. the Analysis phase) of the ISD process.

Prototype Development

One outcome from the Design phase that was included as part of the pilot study was the prototype development of the web-based module. As information was being gathered in the Analysis phase, the PI (as Instructional Designer) used the information to create an instructional design plan (IDP) for the module. Given the performance of development tools, design ideas on paper can be quickly translated to a prototype. The information from the Analysis phase yielded information pertaining to preferred design elements relating to the flow of information within the module, the level of interactivity and the content of the module. Using this critical information and the design plan created by the PI (as Instructional Designer), Programmer 1 was able to create a prototype of the web-based module. The prototype was developed using the computer program

Authorware® version 6.0. In Appendix A Figures A-1 and A-2 displays two screen shots of the prototype.

The prototype was created to be delivered via a hyperlink (i.e. allows the stakeholders to navigate to the web-based module located on the web server) to some of the key stakeholders in the web-based development initiative for this study, such as the Director of the LEARN program and the SME. An informal interview occurred while showing the stakeholders the web-based module prototype. The results of this interview combined with the data extracted from the Module Design Interview provided feedback for the PI (as Instructional Designer) to refine the design principles and style guide of the IDP. The results of these interviews can be seen in Specimen B-1 in Appendix C. The use of a prototype in this instance was to generate decisions of particular design elements that needed to be retained or discarded. The prototype gave the stakeholders and the instructional designer the opportunity to formalize their thoughts on what design elements were to be considered beneficial to the learning process.

Analysis Phase: Provisional Lessons Learned

Again, please note that this is termed "Provisional Lessons Learned" because the rest of the phases of ADDIE had not yet been completed. It was only after the research on all phases had been conducted that a complete Lessons Learned list would be justified. The following is a list of Provisional Lessons Learned that was the outcome of the pilot study:

1. The instructional designer had to establish whether or not the development of the web-based module required a detailed analysis. The analysis phase of this study required a commitment of time, money and human resources. These elements are

not always available in practice due to deadline dates and marketing commitments.

2. The proposed development did not require the use of many analytical tools. Sometimes a guided interview and a needs assessment provide the necessary information to design and to develop the module. The PI learned that the Context Analysis had not really been necessary because the questions asked in this instrument had already been addressed by similar questions in the Needs Analysis, Content Analysis and Task Analysis instruments.
3. At the start of the ISD process it had been important to establish relationships with the decision makers and leaders of the initiative.
4. Informal interviews helped to establish relationships between key personnel.
5. To be flexible. The ADDIE process is a systematic process but it did not imply rigidity.
6. Within the analysis phase, it was important to limit the number of instruments to only what was necessary because filling out questionnaires and conducting surveys and interviews disrupted people's schedules.
7. There were many valid instruments available for conducting various types of analyses. It was more prudent to use an instrument that had already established validity. In other words, utilizing an instrument previously created by a reputable researcher or resource group provided reliability to the data collected. In addition it saved time and money because the instrument did not have to be developed. Modifying existing instruments rather than trying to create and to validate new ones are recommended.

Design Phase

Method

In the design phase of module development, the PI in the roles of the Instructional Designer and Programmer 2 together with the SME worked to determine what design elements should be included in the module. The design phase included one interview and one questionnaire. The name of the instrument, participants and an explanation of the instruments are as follows:

Design Module Interview.

Participants: SME, Programmer 1, PI (as Instructional Designer and Programmer2).
Through detailed research, the PI had a good grasp of what types of questions should be asked in this interview. The development of these questions were aided by the guidelines developed by Seels and Glasgow (1998) Bruning et al. (2004), Swan (2003) and Mehlenbacher (2002). The type of interview process that used is known as "interview guide approach" (Cohen et al., 2000, p. 271). The PI decided the sequence of the questions as well as what questions to use throughout the course of the interview. Also, the SME and Programmer 1 addressed design issues the PI had about content, hardware, software, interventions, style, and timeline (see Specimen B-1 in Appendix B).

Evaluate Design Decision Questionnaire.

Participants: SME, Programmer 1, PI (as Instructional Designer).
To develop the questions for this questionnaire, the PI again relied upon the four guidelines listed previously (i.e. Seels & Glasgow, 1998; Bruning et al., 2004; Swan, 2005; Mehlenbacher, 2002). The expert review process that was explained in a previous section was followed. Before the expert review there were a total of 26 questions.

However after two rounds of expert review, there were 28 questions in total. As seen in Specimen B-10 in Appendix B there are three sections in this questionnaire: (a) objectives and assessments, (b) instructional strategy, and (c) delivery system selection and prototyping.

Once the data had been gathered, including feedback from the observation of the prototype by the stakeholders (e.g. the SME and Director), the PI (as Instructional Designer) re-visited the IDP and made changes to the style guide. The procedure for administering and collecting the data were as follows: This questionnaire was placed online using the tool, http://survey.acomp.usf.edu and it was not password protected. The SME and Programmer 1 were sent an email that contained a hyperlink to the questionnaire. An email was sent to the SME who accessed and completed the questionnaire two days after receiving the email. A similar email was sent to Programmer 1 who completed the questionnaire nine days after receiving the email notification. The PI (as Instructional Designer and Programmer 2) completed the questionnaire one day after the other two participants had responded to the questionnaire.

DBR Overview: Design Phase

The design principles for web-based development at this phase were developed using the outcome from the Analysis phase, the feedback from the prototype and data from the Evaluate Design Decision questionnaire. The design principles were further refined after extracting information from the data received from administering the instruments from the Design phase. Data from the two evaluations along with the following data provided an overview of the Design phase from a researcher's perspective:

1. Logbook

2. Data from the Design Phase instruments
3. Literature review sources

The interview and the questionnaire provided the details to the PI from the perspective of the SME, ID and programmers. These perspectives contained concrete guidelines that were used to develop the web-based module. At this stage the PI used the various sources of data to document rationales for design decisions and models, strategies, and innovations used in developing the module.

Development Phase

Methods

At this phase, the PI (as Programmer 2) used the IDP and the style guide created and refined in the Design phase. The following instruments were developed and expertly reviewed:

Evaluate Usability of Module.

Participant: SME.

This questionnaire changed the most during expert review. The expert review process as detailed in a previous section was followed. The questionnaire was originally developed with 35 questions and two sections using the four guidelines (i.e. Seels & Glasgow, 1998; Bruning et al., 2004; Swan, 2005; Mehlenbacher, 2002). However, after the second round of expert review the questionnaire comprised of 42 questions, two sections with four subsections in the second section. As seen in Specimen B-2 in Appendix B the two sections are: (a) Materials Development, and (b) Evaluation of Web-based Module. The ID experts thought that more clarification was needed or more questions were needed to gather pertinent information to guide development. Following an example provided by

Seels and Glasgow (1998) the PI decided that the second section should be sub-divided into: (a) Accessibility, (b) Design Elements, (c) Graphics/Animations/Multimedia, and (d) Navigation. The ID experts approved the revisions and did not recommend any further changes. As far as the procedure for administering and gathering the data, the questionnaire was placed on the Internet using the tool, http://survey.acomp.usf.edu. An email containing a hyperlink to the web-based module and the questionnaire was sent to the SME. The SME was asked first to view the web-based module then respond to the questionnaire immediately after viewing the module. The SME responded one day after being notified that the questionnaire was available online. This questionnaire was not password protected.

Expert Review of Module.

Participants: ID Experts

Again, this questionnaire was developed by the PI using the four guidelines (i.e. Seels & Glasgow, 1998; Bruning et al., 2004; Swan, 2005; Mehlenbacher, 2002). Also, the expert review process was strictly adhered to. In this questionnaire the completion of the second iteration of expert review resulted in 29 questions and six sections. Previously, the questionnaire had 28 questions and five sections. The six sections as listed in Specimen B-3 in Appendix B are: (a) Accessibility, (b) Design Elements, (c) Graphics/Animations/Multimedia, (d) Navigation, (e) Training Module Content, and (f) Your Opinion Matters. The procedure for administering and gathering the data were as follows: This instrument was placed on the Internet by the PI using the survey tool, http://survey.acomp.usf.edu. Passwords were emailed along with a notification to the ID Experts that the questionnaire was available online. Include in this email were two

hyperlinks, one to view the web-based module and another to the questionnaire. ID Expert A and ID Expert B accessed and completed the questionnaire one week after being notified. Both ID experts were asked first to view the web-based module then respond to the questionnaire immediately after viewing the module.

Learners: Evaluate Usability of Module.

Participants: Learners enrolled in REA 2105, Critical Reading and Writing during Summer 2008.

At this juncture of the Development phase some sections and questions developed for earlier questionnaires were re-used for this instrument development. Additionally the four guidelines (i.e. Seels & Glasgow, 1998; Bruning et al., 2004; Swan, 2005; Mehlenbacher, 2002) were also used as a reference. The expert review process as described earlier was followed. The expert reviewers asked that this instrument be refined to contain seven sections instead of five sections (see Specimen B-4 in Appendix B). The two iterations of expert review further refined the instrument so that the number of questions increased from 28 to 35. The increase in questions was due to the addition of questions pertaining to the learner's background such as age and gender. The ID experts agreed that this could add another dimension to the research. The sections as seen Specimen B-4 are as follows: (a) Learner Background, (b) Accessibility, (c) Design Elements, (d) Graphics/Animations/Multimedia, (e) Navigation, (f) Training Module Content, and (g) Your Opinion Matters.

As far as administering and gathering the data, the instrument was administered via the Internet. This instrument was placed on the Internet by the PI using the survey tool, http://survey.acomp.usf.edu and it was password protected. The participants were

asked to first view the web-based module then respond to the questionnaire. The questionnaire was password protected. After viewing the web-based module, the participants were given the password to access the questionnaire. This was accomplished during one class meeting. Two participants who viewed the web-based module could not access the questionnaire. The password for the questionnaire was based on the participants' username and password to the course management system, Blackboard. However, two participants had not yet been issued Blackboard access at the time of the study therefore could not participate in the questionnaire.

Module Development Questionnaire.

Participants: PI (as Instructional Designer and Programmer 2)

This questionnaire was developed using the four guidelines (i.e. Seels & Glasgow, 1998; Bruning et al., 2004; Swan, 2005; Mehlenbacher, 2002). Specimen B-11 in Appendix B displays this instrument and a summary of the results. The questionnaire was also designed to gather information that would add to the DBR perspective. The expert review process was followed. The Development phase evaluations helped the programmer to develop and refine the web-based module at this juncture before it was implemented. The reflections of any decisions made by the PI (as Instructional Designer) and PI (as Programmer 2) at this phase were recorded in this questionnaire. This questionnaire was placed online using the survey tool, http://survey.acomp.usf.edu. To the PI, this instrument provided somewhat of a dilemma. Since the PI functioned both in the roles of Instructional Designer and Programmer 2 for the study, there was no data to collect from any other participants. However, after careful deliberation with other IDs and research experts, the PI decided to do two separate responses, one as ID and the other as the

programmer. This allowed the PI to give structure to the thought process and design decisions made by her at this juncture of the study.

DBR Overview: Development Phase

Again, the outcome of the development phase evaluation informed the study of the effectiveness of the module and included information gathered from the:

1. Logbook
2. Results from the Development phase
3. Literature review sources

The Development phase evaluations helped the programmer to develop and refine the web-based module at this juncture before it was implemented. The development of the module can be an intensive time for programmers and instructional designers. Formative evaluations were developed to clarify whether or not these evaluations could aid the programmer and the instructional designer. The Expert Review Questionnaire and the Learners: Evaluate Usability of Module questionnaire (see Tables B-3 and B-4 respectively) instigated an iteration of the "design-evaluate-refine" cycle in the Development phase before being implemented.

Implementation Phase

Method

The module was implemented on the Web by PI (as Programmer 2). The executable files of the module were placed on a server owned by the university in which the research was conducted. PI (as Programmer 2) used a feature in Adobe® Captivate 3.0 to generate an executable program that was Flash compatible. This decision was based on the fact that flash files are relatively smaller in size than other formats and can run on

most platforms today. Once the files were copied, a hyperlink to the programs was placed on a simple webpage designed for this study.

DBR Overview: Implementation Phase

At this phase of the ISD process, the PI simply used the application to generate an executable program. The process was recorded in the logbook. The instruments used to gain a DBR perspective were:

1. Logbook
2. Results from the implementation phase
3. Literature review sources

Evaluation Phase

Methods

A summative evaluation of the module was performed at this phase utilizing the Summative Usability Evaluation questionnaire (see Tables B-6 and B-8 in Appendix B).

Summative Usability Evaluation

Participants: Learners enrolled in two sections of The University Experience course in Summer 2008, ID Experts.

This questionnaire was closely based on the Learners: Evaluate Usability of Module questionnaire from the Development phase. The expert review process was followed. The Summative Usability Evaluation questionnaire, before expert review consisted of five sections and 28 questions. After the second and final round of expert review, the questionnaire consisted of seven sections and 35 questions. (a) Learner Background, (b) Accessibility, (c) Design Elements, (d) Graphics/Animations/Multimedia, (e) Navigation,

(f) Training Module Content, and (g) Your Opinion Matters. This questionnaire, like the others were placed on the Internet using the http://survey.acomp.usf.edu by the PI.

To administer and gather data, the following procedure was followed: For the first iteration of "design-evaluate-refine" in the Evaluation Phase, participants were enrolled in The University Experience course. At the beginning of the class, they were asked to view the web-based module then immediately after respond to the questionnaire. No passwords were required to access the questionnaire. A count of participants in the classroom and a count of responses to the questionnaire verified that no one took the questionnaire more than once. The time taken for them to view the web-based module was also recorded. This questionnaire was administered to the ID experts via email as well. The email contained two hyperlinks, one to the refined web-based module and the other to the online questionnaire. No passwords were required. The experts responded to the questionnaire one week after being notified. After all responses were collected, the PI analyzed several instruments to determine refinement changes (see Specimen B-7 in Appendix B). Using this list of refinements as a guideline, PI (as Programmer 2) determined which changes were feasible based on software application capability, content availability, scope of the project and time. Within one week, the PI (as Programmer 2) made the refinements changes to the web-based module.

For the second iteration of the "design-evaluate-refine" cycle, the participants were recruited from another section of The University Experience course. Again, the procedure to administer and gather data was the same as previously mentioned. At the start of a class session, the participants were asked to view the now refined web-based module online, then to immediately respond to the Summative Usability Evaluation

questionnaire (see Specimen B-8 in Appendix B). The PI had created a copy of the original questionnaire and placed it on the Internet for this second group to access so data collected would be in a separate database. The ID experts also responded to questionnaire in this iteration. After all data was collected, the PI reviewed only the data received from this questionnaire to extrapolate any suggestions for refinements of the web-based module. A second list of refinement changes was created. At this juncture the study was closed.

DBR Overview: Evaluation Phase

Figure 8 shows how four functions of evaluation: review, needs analysis, formative and effectiveness were employed throughout the phases of the ISD process. Reeves and Hedberg (2006) recommended that the last two functions of evaluation, impact and maintenance be conducted after a module has been in use for more than a year. This timeframe was not feasible for the present study therefore these two functions of evaluation were not included. Despite this exclusion, the function evaluations included gave a full representation of a typical systematic approach to a web-based module development process.

A summary review of all data and design principles of each phase was analyzed to determine the listed objectives of the study. A major objective was to provide a list of generalizable Lessons Learned. Additionally, a report on the effectiveness of the specific instructional strategies used and an analysis of quantitative, qualitative and descriptive outcome measures of learning among field test participants was two more objectives that were clearly represented. An important objective of the study was also to create a web-based module with a known validity and effectiveness status using a systematic approach.

The next section explains how validity and effectiveness status of the module was arrived at in the study.

Evaluation Phase: Evaluation Goal.

One of the deliverables of the study was to produce a web-based module that was considered valid and effective. Again, the guidelines developed by Seels and Glasgow (1998), Bruning et al. (2004), Swan (2003) and Mehlenbacher (2002) for instructional designers, developers and educators acted as a framework for assessing the web-based module. These guidelines also provided construct validity for instrument development. The information collected in the formative stage guided the refinement process for web-based development.

Each of the formative and summative instruments of the Analysis, Design, Development, Implementation and Evaluation phases of the ADDIE process (see Table 13) provided enough information so that the validity and effectiveness of the module were determined. At the Evaluation phase the results of the questionnaire, Summative Usability Evaluation were influential in deriving the validity and effectiveness status of the web-based module. As stated previously, the participants for the Summative Usability Evaluation questionnaire (see Table 14 displayed earlier in this chapter) were learners enrolled in undergraduate courses that had metacognitive learning strategies components and two ID experts. An analysis of the outcomes provided a clear picture for interpretation of whether or not the module was considered valid and effective.

Summary

How the research question was addressed and how the research objectives were met has been discussed in this chapter. Also included here was a description of the research design and an explanation of the research methods utilized in the present study. A framework of the study which revolved around the ADDIE process, Seeto and Herington's (2006) guide, DBR research model as well as Reeves and Hedberg's (2003) evaluation functions were discussed. Seeto and Herrington's (2006) guide lent direction to the present study and was modified to a small extent.

Furthermore, this chapter included a detailed description of the pilot study which comprised of the Analysis phase of the ISD process and its outcomes. Also in this discourse was the description of the prototype, one outcome of the Design phase and how it helped to define and refine design elements for the web-based module. Consequently, conducting the Analysis phase provided guidance in regards to the method utilized in the next four phases of ADDIE. Moreover, the types of measures specifically developed for both the descriptive and quantitative measures for each phase of the ISD process have also been described. The results and discussion of the study follows in Chapters four and five.

Chapter Four

Results

The overall validity and effectiveness of the web-based module was interpreted as "valid and effective" when the respondents to the formative and summative evaluations provided a generally positive overview of the module. The end of the study was evident by the completion of the second iteration of the "design-evaluate-refine" cycle in the Evaluation phase of ADDIE. Since the pilot study and its outcomes, and the methods for the rest of the ADDIE phases was discussed in Chapter Three, in this chapter, the results of the rest of the phases of ADDIE is discussed in this chapter. The summary of data that has been analyzed and refined will be presented in the following manner: (1) design phase results, (2) development phase results, (3) implementation phase results, (4) evaluation phase results, and (5) DBR results and perspective for each phase of ADDIE. The ADDIE process provided an overall guideline for data collection.

Design Phase Results

At this phase, the IDP which was completed by the end of the prototype development was revisited and design changes were made to incorporate the SMEs suggestions. The PI (as Instructional Designer) decided to make several changes to the design. She decided to use Adobe® Captivate 3.0 as the application to develop the module for the final product. That decision was made based upon two things: (a) the level of interactivity that was required for the final product, and (b) the availability of Adobe®

Captivate 3.0. In the duration of one week, design revisions were made to the IDP. A summary of the revisions made to the IDP were:

1. Style Guide:
    a. Create a template to provide consistency;
    b. Font style: Arial; Font size: Ranges between 14pt and 16pt; Font color: (black)
    c. Place feedback in same location for each question;
    d. Place navigation buttons in same location on each screen/slide;
2. Content Flow:
    a. Introduction;
    b. First Section: 10 Questions – each question followed by quick feedback (e.g. correct/incorrect) – present one question at a time to the learner;
    c. Section Break: learner can see score then move on to the final section;
3. Final Section: each question and correct answer should be fully explained;
4. Instructional Strategy:
    a. Introduction: grab learners' attention – use a story/or set a scene – short animation (use audio);
    b. Explain sections and what to expect (use audio);
    c. Present one question at a time;
    d. Display score to the learner at the end of the first section;
    e. Second section – use audio to explain the correct answer for each question – use Adobe® Captivate 3.0 interactive built-in techniques;

Design Phase: Expert Review of Analysis Phase Instruments

Beginning from the Design phase two ID expert reviewers were recruited to review the instruments developed for the rest of the phases. At this phase an interview and a questionnaire was utilized to collect data. Of the two instruments, only the "Evaluate Design Decisions Questionnaire" instrument was expertly reviewed. The expert review process included grammar, spelling and tense changes to some questions. They also proposed clearer definitions of terms, for example for the statement "Interaction interfaces and interaction design were established in meetings at this phase," one of the ID expert asked for further clarification. The statement was later changed to "Interaction interfaces and interaction design elements were established in meetings at this phase (i.e. Design Phase of ADDIE)". Furthermore, both of them did not like the term "initiative" as it was used in some of the questions. After the final iteration the term was changes to "web-based initiative."

Design Phase: Analysis of Data

At this phase, an open-ended interview "Design Module Discussion" was planned for the SME, PI (as Instructional Designer) and Programmer 1. The interview was conducted before the IDP was completely developed and before the prototype was developed. Specimen B-1 provides a summary of the information derived from this interview. The purpose of this interview was to: (a) introduce the SME to Programmer 1, (b) confirm design approach, (c) confirm instructional strategy approach, (d) determine technical strategies, and (e) learn of any limitations present and foreseeable problems.

A combination of this information and design information from the Analysis phase led to the development of the prototype and to the refinement of the IDP. The

intention at this phase was to confirm learning objectives, to identify assessments and instructional strategies, and to design the delivery system. Prototype development was also included in this phase. The prototype and its outcomes have already been discussed in the pilot study. Following the example set in the Analysis phase of ADDIE, data reduction was again facilitated by answering three questions as put forward by Seels and Glasgow (1998). The questions and their responses were as follows:

1. *What should be assessed and how?* (Seels & Glasgow, 1998, p. 180).

This particular module was unique in the sense that it was an assessment of the learners' metacognitive ability to recognize the best strategies for answering questions for objective tests using a multiple choice format. Since the module itself was comprised of questions and is an assessment, the point of the web-based module then was to help a learner understand how to make the right choices in an objective (i.e. multiple-choice type test) test by identifying learning strategies. This information was made clear in the interview, where the SME stated that it was the Objective Test Taking Strategies module that would be the best to start developing first.

2. *How should instruction be organized?* (Seels & Glasgow, 1998, p. 180)

The interview provided clear details on how the SME visualized the web-based module. She wanted a certain amount of questions, (e.g. 10 to 15) and she wanted the questions presented first then followed by feedback for each choice. The feedback needed to be detailed and it should not be "boring". The SME, Programmer 1 and the PI (as Instructional Designer) all agreed that the module should not be very long, in fact a length of twenty minutes was considered ideal.

3. *What will the instruction look and sound like?* (Seels & Glasgow, 1998, p. 180)

The prototype was a major factor in deciding what the instruction should look and sound like. In fact, the negative responses to the prototype led to developing a web-based module that was more closely aligned to what the stakeholders, example the Director and the SME desired. The SME provided specific feedback that was presented in the description of the pilot study earlier in this chapter. The majority of the Design phase was completed in two non-consecutive weeks. However, the Design phase over-lapped with the Development and Evaluation phases of ADDIE because of the inclusion of the iterations of the "design-evaluate-refine" cycles.

Development Phase Results

The Development phase was completed in 10 non-consecutive weeks. Adobe® Captivate 3.0 was used to develop the module. At this phase the PI (as Programmer 2) used the IDP to guide the development. However, during development some changes were made because the full capability of the application provided more interactions that were not fully explored in the IDP. These opportunities provided a higher level of interaction and were not ignored since it would help to align the web-based module closer to the requirements of the SME and the Director. The Figures 10 through 14 displays several screen shots of the web-based module. Some instructional strategies used in this module development are displayed the screen shots, such as: (a) gaining the learner's attention as seen in Figure 10 (b) immediate feedback are given to the learners as seen in Figure 11 (c) overall results of the quiz is shared as seen in Figure 12 (d) audio explanation of correct choices as seen in Figure 13, and (e) inclusion of learner interaction to encourage learners to become active in learning rather than passive.

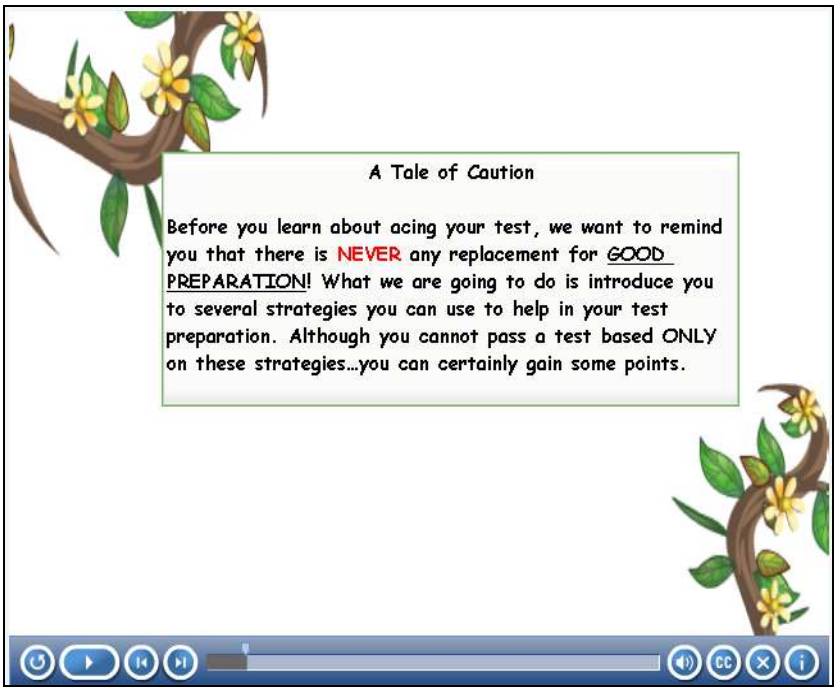


Figure 10. Screen Shot 1 of web-based module.

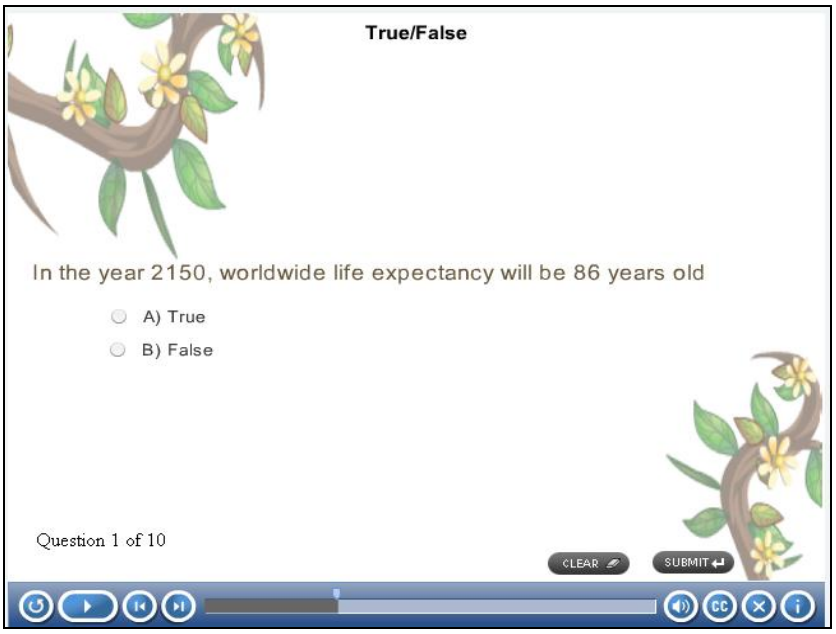


Figure 11. Screen Shot 2 of web-based module.

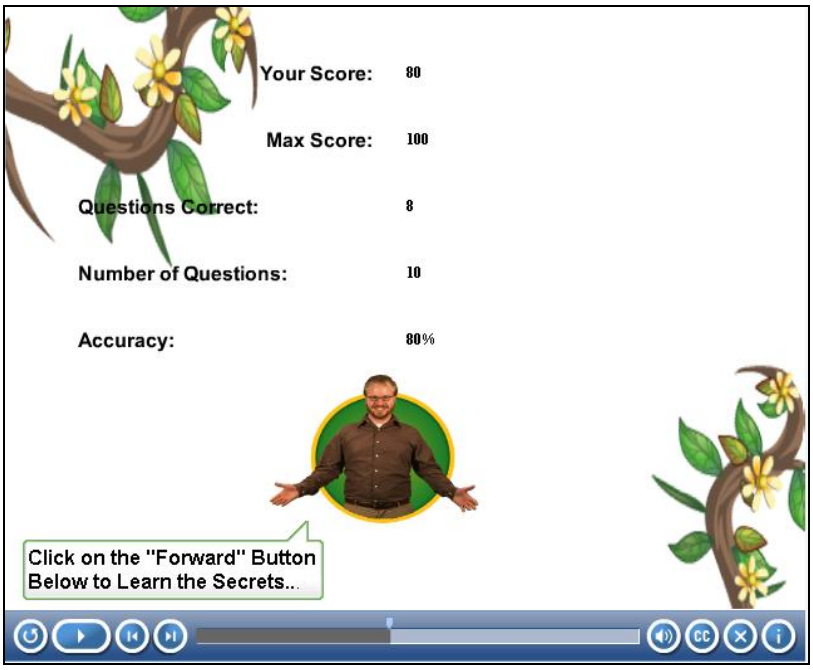


Figure 12. Screen Shot 3 of web-based module.

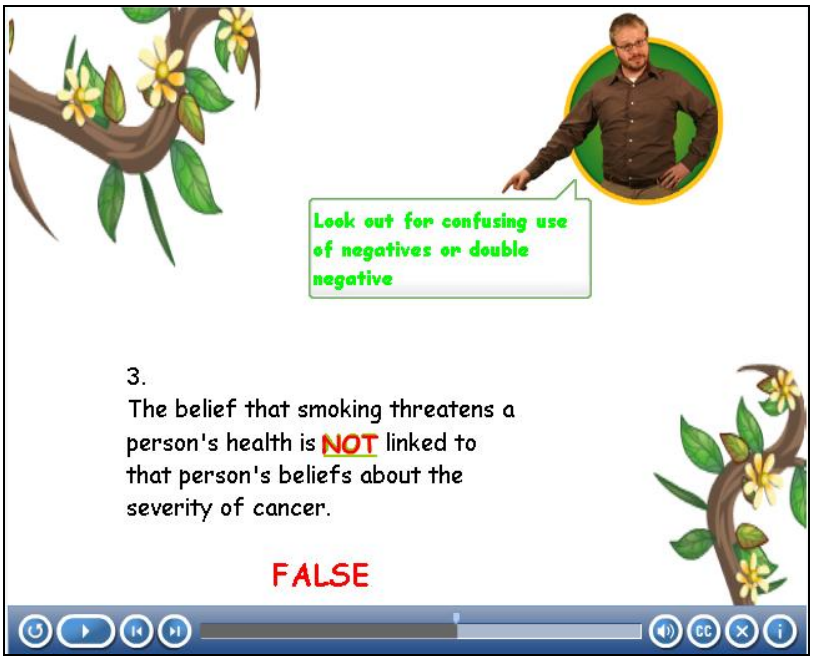


Figure 13. Screen Shot 4 of web-based module.

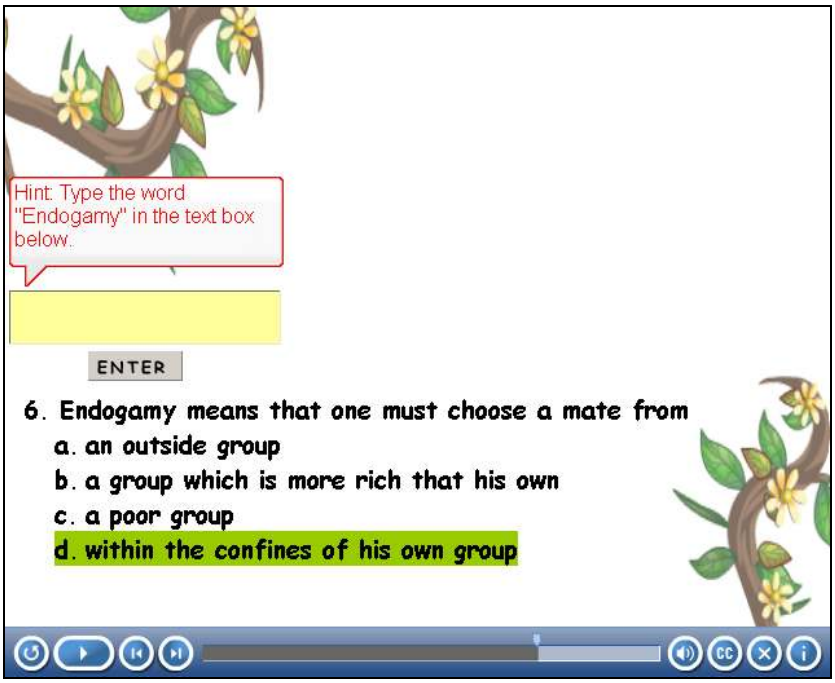


Figure 14. Screen Shot 5 of web-based module.

To view the module in its entirety on the Web, please refer to http://www.coedu.usf.edu/it/DissApps/Singh/ . The following are the changes made to the design during development:

1. Animation: Animation was used in the introductory slides as well as in the feedback and conclusion sections of the module.
2. Text animations: Text animations were used in the feedback section to highlight key words.
3. Audio: The introduction and feedback all used short audio recordings.
4. Graphics: Pictures, arrows and highlight boxes were used in the feedback portion of the module.
5. Input boxes: Input boxes were used on the basis that it provided an opportunity to ask the learner to participate and therefore increased the level of interactivity.

6. Template: A simple template was used.

The IDP (see Appendix C) was still useful as it provided information on other style elements such as content flow, font (i.e. size and color), slide background colors and hardware environment information.

Development Phase: Expert Review of Development Phase Instruments

The ID experts reviewed four questionnaires for the Development phase: Evaluate Usability of Module, Expert Review of Module and Learners: Evaluate Usability of Module and Module Development Questionnaire. Similar to the previous phase, the ID experts received the original instruments via email and responded after one week. The feedback included spelling and grammar changes. However the most important changes were associated with the "Evaluate Usability of Module" instrument. Changes in this instrument affected the other instruments in this phase and the Evaluation phase of ADDIE. After the first review of all instruments, the PI reorganized "Section II: Evaluation of a Web-Based Module" into four sub-sections: Accessibility, Design Elements, Graphics/Animations/Multimedia and Navigation. The experts agreed to this further delineation and believed that it provided clarity to the instrument.

Development Phase: Analysis of Data

At this phase, formative evaluations provided data on how the web-based module should be developed and what refinements were required before it were implemented. Feedback from the formative instruments provided the first iteration of "design-evaluate-refine" cycle at the development phase. After the web-based module was developed, the formative evaluations were conducted. The purpose was to gather data to develop and

refine the module before implementation. Again, data reduction was guided by Seels and Glasgow (1998). The questions asked at this phase were:

1. *What should be produced?* (Seels & Glasgow, 1998, p. 180)

This information was already derived from the Analysis and Design phases. All content and design information was already collected and it was clearly outlined to the PI (as Programmer 2) what needed to be developed. It should be noted here that feedback received from the SME and Director after they viewed the prototype aided in defining and clarifying what design elements were and were not acceptable.

2. *What revisions were needed?* (Seels & Glasgow, 1998, p. 180)

Specimens B-2, B-3 and B-4 provided some direction as to what revisions were needed (see Appendix B). Specimen B-2 shows the summary of results from the Evaluate Usability of Module questionnaire from the SME's perspective. In addition, the module was evaluated in the Development phase by the two ID experts and a group of learners using the Expert Review of the Module (see Specimen B-3) and the Learners: Evaluate Usability of the Module (see Specimen B-4) questionnaires respectively. To analyze the SME's responses from Specimen B-3, the researcher examined data from the two sections of the questionnaire, the Materials Development section and the Evaluation of the Web-Based Module section. From the results, the SME indicated that the content of the web-based module was correct, reading level was appropriate and content flow was what she had recommended. The SME had a clear response to question 12 which asked what changes were required when the content from a traditional format to a web-based format. Her response was "The change required the use of a theme and animations to

keep students engaged and interested. It also required a narrator to provide explanations that were needed".

In regards to data collected from the second section of the questionnaire, the SME either strongly agreed or agreed that the modules were accessible using the browser on her computer and that all links in the module worked. The SME chose to disagree with the statement that the module executed without technical delay. Moving on to the design elements such as good use of color, simple design, good directions for learners to follow, consistency in appearance of layout, feedback and error messages, engaging tone of the module, the SME consistently either strongly agreed or agreed that these elements were acceptable. Similar positive responses were also gathered from the SME when she considered the graphics, animation, multimedia and navigation aspects of the module.

When the SME was asked to state what changes she would recommend she highlighted a number of things such as: (a) the text explanation in question 6 which took too long to clear (b) in question 7 when she moved her cursor the screen disappeared (c) in question 8, the narration stopped if she moved off a particular area on the screen, and (d) for question 9, typing "grammar clues" did not add any instructional or entertaining value. Overall, the SME's feedback provided guidance to the refinement items of the web-based module that were needed and most of her suggestions were taken into account. In regards to the SME's comment on question 9, the researcher disagreed based on the premise of one of Gagné's instructional strategy which is to involve the learner and help them become active participants in the learning process.

Moving on to Specimen B-3, here a summary of results from the Experts Review of Module questionnaire is displayed. The two ID experts reviewed the module first and

then responded to the questionnaire. The ID experts were asked to share their opinions of the web-based module in regards to accessibility, design elements, graphics, animation, multimedia, navigation and content. From their perspective, they generally strongly agreed or agreed that the module was acceptable in the areas of accessibility, design elements, graphics, animations, multimedia, navigation and training module content. However, one expert did disagree and found that the ends of the sections within the module were not clearly delineated. Navigation appeared to be an issue for one expert as well, for example although there was 100% agreement that navigation was consistent, one expert found that she could neither navigate to the beginning of the module easily nor did she think that the navigation buttons were clearly marked. Also, one expert did experience problems downloading and viewing the module and that was reflected in her disagreement with the statement "I did not experience any technical delays while going through this training module". As noted previously, the SME had a similar response because she also experienced a technical delay when trying to view the module on her computer (see Specimen B-2).

In regards to content, there was 100% agreement by the two experts that the examples of questions in the module made learning the concepts easier. Similarly, the SME strongly agreed to a similar question that was posed to her. There was also 100% agreement by the experts that the feedback given to the learners will help the learners understand the concepts of the lesson. When if the sequencing of the information made it easy for the learners to learn, 50% strongly agreed and 50 % agreed. Comparable results were found when the experts were asked whether the information was relevant to the learner.

Like the SME, the two experts liked the simplicity of the design and thought that the module was engaging. As one expert wrote, "It was very engaging. I enjoyed the motif of going on a jungle mission. The audio narration and graphics helped to carry this through and keep me interested in what was coming up next." On the other hand, to list one thing they did not like, one expert mentioned that for future changes perhaps hyperlinks should be created to give learners access to resources about test-taking strategies and allow the learner to download these resources.

Next, Specimen B-4 shows the summary of results from the Learners: Evaluate Usability of Module questionnaire, the responses of a group of learners (*n*=7). All learners were enrolled in the Reading Course. It was comprised of 71% female and 29 % male. Juniors dominated the class with 71%, while 14% were of senior standing and 14% chose "Other". The ages ranged between 19 and 29. It was interesting to note that most (71%) learners preferred to attend traditional (i.e. face-to-face) courses. Again, here, the PI found that most learners either strongly agreed or agreed in areas of accessibility, design elements, graphics, animations, multimedia, navigation and training module content.

As far as accessibility was concerned, according to the learners, all of them strongly agreed that the module executed on their computers without problems. Additionally, 100% of the participants also strongly agreed that all links worked within their browser. However, when it came to technical delays, the PI discovered that one learner did experience a technical delay when he/she tried to view the module. When considering some of the design elements, 86% strongly agreed and 14% agreed that the design was simple and uncluttered. A similar percentage breakdown was found when

participants stated that they either strongly agreed or agreed that the directions given to the learner was easy to understand. In the statements concerning the start and end of the sections within the module, two learners (14% each) disagreed and strongly disagreed respectively about the sections being marked within the module. Like the ID experts and SME, the participants also indicated that the tone of the module was engaging, that is, 57% strongly agreed and 43 % agreed with the statement.

Most of the learners participants, 29% strongly agreed and 43% agreed that the graphics used in the module helped to enhance their learning. One participant disagreed and one chose not to respond to that statement. Participants appeared to react positively to the audio, text animations and interactions. For instance, 86% strongly agreed and 14% agreed with the statement that audio provided useful information that enhanced their learning. Participants, that is 57% strongly agreed and 29% agreed that the text animations helped them to focus on what they should be learning but one participant disagreed. The same distribution of responses was received for the statement "the interactions make the training interesting."

When considering navigation within the module, in terms of navigation buttons being clearly marked, 57% of participants strongly agreed and 29% agreed with that statement. Again, one participant disagreed. A parallel distribution of responses was received when participants were asked about the availability of tracking information to track their progress within the module. As far as the ease of navigating to various parts of the module, 43% of participants strongly agreed and 57% agreed that it was easy. Regarding the content of the module, similar to the ID experts and the SME responses, data from learner participants signified a positive outlook. Particularly, 43% and 57% of

learner participants strongly agreed respectively that the information in the module was useful. Also, feedback given in the module was placed to help the students learn, and it appeared to be a positive aspect of the module as 71% of participants strongly agreed as well as 29% agreed with that statement.

There were a total of 33 statements in this questionnaire and two additional open-ended questions. In analyzing the overall learner participant responses, it appeared that one respondent in particular disagreed with 7 statements. In the participant's open-ended response to being asked what they liked about the module, the participant stated that it was "informative." The participant was also asked what was one thing they would change about the web-based module. In response, the participant stated that "Some things seem to be bad examples, like the last question. When an answer doesn't flow with the question it seems to be more of an error than a giveaway." In reflecting on this participants' responses, the PI believed that it could be the case where the content was not to his/her liking or the module did not meet his/her particular design and content preferences. The PI did investigate all of the negative responses received. Although all responses were carefully considered for refinement purposes, especially negative responses, the PI considered that the majority of responses generated a positive view of the module.

Overall, when asked to list one thing they liked about the module, the learners generally thought it was informative, and the module gave them relevant information. As expressed by a learner, "I liked the way that the module showed how to break down the questions to better help the students learn. I also like how they showed key words to look at to help decide which answer was best for me to choose." What the learners did not like

ranged from “bad examples”, “distracting” graphics, “guy that pops on the screen is annoying”, “no clear statement to let me know that I was finished” to “the narrator’s voice was a little boring at times.”

A full list of the refinements derived from the formative review at the Development phase before moving on to the Implementation phase can be seen in Specimen B-5 in Appendix B. Please note that the first four refinement suggestions were derived from an informal meeting with the SME and Director of the LEARN program. The rest of the refinement suggestions in Specimen B-5 were derived from the responses to the Development phase instruments. Also, the average time it took the learners to complete the module was 9.1 minutes. In Specimen B-5, of the twenty-six refinements listed, seventeen were addressed and nine were not addressed for two reasons: they were either a personal stance or opinion of the participant and had either no relevance to the design (e.g. Refinement nos. 9, 10, 15, 23, 24, 26) or they were already addressed (e.g. Refinement nos. 6, 12, 25).

Implementation Phase Results

This phase was small in scope. Referring to Seels and Glasgow (1998), the question to be addressed was:

1. *What preparation is needed*? (Seels & Glasgow, 1998, p. 180)

This phase was completed in one week, non-consecutive days. The length of time included updating the module and copying the files to the web server after each of the refinement iterations. It was simply a matter of the PI (as Programmer 2) copying the module files over to the university’s web server. A web page was developed and a hyperlink was added to give access to participants of this study.

Evaluation Phase Results

The Evaluation phase was completed in two non-consecutive weeks. Here the evaluations were considered summative evaluations for the study. In this phase, two iterations of the "design-evaluate-refine" cycle were conducted. At the end of the second iteration, the study was closed.

Evaluation Phase: Expert Review of Evaluation Phase Instruments

The Learners: Evaluate Usability of Module provided the premise on which the Summative Usability Evaluation instrument was based upon. The ID experts received the instrument via email and gave their feedback after one week. After the recommended changes were completed, the updated instrument was sent via email for the second and final review of the instrument. The Summative Usability Evaluation comprised of seven sections: (a) Learner Background, (b) Accessibility, (c) Design Elements, (d) Graphics/Animation/Multimedia, (e) Navigation, (f) Training Module Content, and (g) Your Opinion Matters. The ID experts pointed out spelling and grammar errors. Since they were already familiar with this organization, they did not request further changes.

Evaluation Phase: Analysis of Data

Recall that there were two iterations of the "design-evaluate-refine" cycle in this phase. The summative evaluation instrument, called the Summative Usability Evaluation, was first administered to a group of learners enrolled in a University Experience course as well as to the ID experts. Similarly, at the second cycle of the iteration "design-evaluate-refine" the instrument was administered to a different group of learners enrolled in a different section of the University Experience course as well as to the two ID experts. Overall, the average time the learners took to view the module in the first and second

iteration was 9.61 minutes and 9.85 minutes respectively. In contrast, according to information the SME provided, it takes approximately 60 minutes to cover the same material in a traditional class. This indicates a considerable amount of time saving for students using the web-based module. A full summary of responses is displayed in Specimen B-6 in Appendix B. Additionally, a list of refinement changes were derived from their responses as well, and is shown in Specimen B-7.

Again, data reduction was guided by Seels and Glasgow (1998) questions:

1. *Are the objectives achieved?* (Seels & Glasgow, 1998, p. 180)

The majority of the objectives pertaining to requirements first listed by the SME, PI (as Instructional Designer) and Programmer 1 were met as seen in Table 15. Table 15 shows the list of objectives derived from Design Module Discussion and whether the objectives were met. As can be seen two objectives could not be met because it was no longer applicable after the module was developed. To meet the majority of the objectives, two iterations of "design-evaluate-refine" occurred. The objectives that could not be met were: (a) hyperlink from course website, and (b) using Authorware® 6.0 to create web-based module. The Summative Usability Evaluation questionnaire yielded a number of refinements that needed to be addressed in order to meet the objectives of the development of the module. A summary of the data is displayed in Specimens B-6 and B-8 in Appendix B respectively.

As seen in Specimen B-6, data gathered from the questionnaire (n=15) yielded information so that 5 refinements to the web-based module were identified. These participants comprised of 33% male and 67% female. The learner participants, 87%, were freshmen at college. Of all the participants, if given a choice between traditional and

Table 15

Meeting objectives derived from "Design Module Discussion"

Design Information	Source of Information	Was Objective Met?
1) No test bank required for module. Preferably a generic test of about 10 to 15 questions should be developed.	SME	**Yes**: 10 questions were used.
2) The module should last no more than 15 to 20 minutes (no more than ½ hour online).		**Yes**: Learners Overall Average Time to view module was 9.85 minutes
3) The module should have info on: how to prep for a test --> should present the questions --> ask the students to answer question --> highlight different parts of the questions.		**Yes**: During refinement cycles, slides were added to inform learners on how to prep for the test. Students were first asked all questions, they were scored and then feedback on each question was shared.
4) For each module, there are about 6-8 strategies per module.		**Yes**: There were 8 strategies
5) The first module to be developed should be Objective Test Taking Strategies		**Yes**
6) May need to store answers and score person. This way they can get immediate feedback.		**Yes**: The application had a built-in mechanism to track answers, score and give feedback.
7) The module should contain animation, it should not be boring. Avoid boring.		**Yes**: There is animation. According to comments, most participants found the module engaging and interesting.
8) Audience – all high school graduate students.		**N/A**
Delivery Information		
9) Should it be web-based (as opposed Internet)? Web-based was decided.	Programmer 1 & PI (as Instructional Designer)	**Yes**: Web-based
10) Multimedia – containing audio as well as text		**Yes**: There is audio and text animation.
11) Broadband		**Yes**
12) Link from the SVC site		**No**: Site not yet available
13) Maybe Authorware® 6.0 was the best solution however everyone was concerned about scalability/ compatibility/flexibility		**No**: Captivate 3.0 student version was used to develop module.
14) The module should be delivered via the web. The university's web server can support Dreamweaver/Flash.	SME	**Yes**: It is web-based and uses Flash Player 9.0.

web-based courses, 73% would prefer traditional and 27% would prefer web-based course. When asked to respond to various statements concerning accessibility, 80% strongly agreed and 13% agreed that the modules was able to run on their computer without any problems. However one participant disagreed. The PI discovered that this participants' computer was not updated with the correct Flash player.

Review of the participants' responses to the design elements of the web-based module, all of the participants, that is 80% strongly agreed and 20% agreed that the module was simple and uncluttered, the directions were easy to follow, the start and end of each section were clearly understood and the fonts and colors used promoted legibility within the module. However, when attention was drawn to layout consistency of feedback messages, help messages and error messages, one participant consistently chose to disagree with these statements. Although, it should be noted that the majority of participants (93%) responded positively to these same design elements by strongly agreeing or agreeing with the statements.

Within the group of statements regarding graphics, animation and multimedia, analysis of the data showed that 60% strongly agreed and 40 % agreed respectively that the layout of graphics was consistent and the various text animations used in the module allowed them to focus on what needed to be learned. Furthermore, although 93% of the participants either strongly agreed or agreed that the graphics used helped to enhance their learning, there was one participant who strongly disagreed with this statement. The PI considered that it could be the participant's personal opinion as there was no other indication that he/she experienced any technical difficulties with the module. According to data results, 67% of participants strongly agreed and 33% agreed that navigation

buttons were clearly marked. Other navigation statements elicited positive responses of strongly agreed and agree among participants as well. Content of the module was found to be useful and relevant as 47% participants strongly agreed and 54% of participants agreed. Similarly, all participants (i.e. 53% strongly agreed and 47% agreed) were of the view that feedback and the way the information was presented in the module facilitated learning.

In the open-ended questions in the Summative Usability Evaluation the participants were asked to state what they liked most about the module. One participants' response was "I liked that after I was finished testing, it didn't just give me a score. It came back and told me where I messed up and what ways I could have looked at each question differently." Of the 14 participants who commented on the module, six of them mentioned that they found the feedback helpful. Another participant mentioned that they liked the "audio and how it broke down some simple tips that I tend to look over it was very helpful." The simplicity and ease of navigating the module was also mentioned as aspects of the module that participants liked.

Responses pertaining to what participants would like to change about the module varied from three participants stating that they would change "nothing" to the module being "too short." Time appeared to be an issue for two participants. For example one of them stated "The thing that I would change would be, during the learning part, after the quiz, it should give more time in between the questions to take in all of the useful information." Unfortunately the two participants did not realize that they could pause or go navigate forward or back through the program. One of the ID experts did experience technical delays when trying to download the module. Upon investigation, the PI

discovered later that the expert was using a computer that was over five years old from a public library and had limited memory.

Certainly the number of refinements was reduced from twenty-six to five at the end of the first iteration of the "design-evaluate-refine" cycle of the Evaluation phase. At the end of second iteration there was seven refinements identified. The refinement lists are shown in Specimens B-5 and B-9 respectively. At the end of the second iteration, the data from the Summative Usability Evaluation (n=22) showed that technical issues were resolved since 100% of participants either strongly agreed or agreed that they did not experience technical delays while downloading or viewing the module (see Specimen B-8). Overview of the data indicates a general positive opinion of the modules. Results were positive and similar to that found from the first iterative cycle. Furthermore, when participants were asked to comment on what they liked most about the module, many of them referred to the simplicity of design and the relevance of the content. As one participant points out, "It was short, sweet, and to the point. There wasn't any fluff or unnecessary information." In contrast, when participants were asked if they could change one thing about the module, some participants thought that the narrator's tone could be changed, that more questions and explanations should be included and learners could be given a practice test as well. One participant thought that relevancy was a problem and stated that he/she "would change the into to make it more relevant to college level learning."

Referring to Specimen B-9, the list of refinements garnered the second time the Summative Usability Evaluation questionnaire (see Specimen B-8) was administered showed that generally one or two learners at the most having problems discerning the end

of each section within the module or disagreeing about the consistency of the position of the error message. One participant also strongly disagreed and another disagreed that they found the module engaging. In addition, as seen in at the end of the first and second iterations, some of the changes could not be accomplished either due to time constraints or due to lack of available content. To explain, Specimen B-9 shows that one respondent each requested more explanations or another test. This did not prompt a third round iteration of the "design-evaluate-refine" cycle since the suggestions by the respondents did not align with objectives set for the module.

2. *Has the innovation been disseminated and adopted?* (Seels & Glasgow, 1998, p. 180)

Time constraints prevented this question from being answered. As Reeves and Hedberg (2003) pointed out, for this to be measured and to understand the impact of this web-based module on the learners would require an evaluation after one to two years. Unfortunately this could not be realized in this study; however it is certainly something to consider for future recommendations.

Design Based Research (DBR) Results

The analysis of the DBR perspective was directed by Seeto and Herrington's (2006) guideline which is comprised of the ADDIE phases, the four phases of DBR as presented by Reeves (2000), and Reeves and Hedberg's (2003) six functions of evaluation. The four phases of DBR as well as the evaluation functions enhanced construct validity within this study. Following is a description of the DBR perspective of each phase of the ISD process, ADDIE.

DBR Overview: Analysis Phase

The first phase of the goals of DBR as defined by Reeves (2000) is to analyze practical problems by researchers and practitioners (see Figure 2). The problem summarized here and as described fully in Chapter One was that considering the increase in the number of web-based training modules, quality among them has been inconsistent and generally poor. In this study, the research analyzed the use of a systematic process, ADDIE, to develop a web-based module to determine whether quality was incorporated due to a systematic development approach. This research effort had several objectives also listed in Chapter One.

Seeto and Herrington (2006) pointed out that both the SME and instructional designer should be involved in the needs assessment. The instructional designer should perform the needs assessment and seek the aid of the SME to help clarify and analyze the data in the Analysis phase of ADDIE. Concurring with this viewpoint, to evaluate the Analysis phase of ADDIE with respect to DBR the PI incorporated the evaluation functions presented by Reeves and Hedberg (2003). In the first phase of DBR, two evaluative functions, review and needs analysis (Reeves & Hedberg, 2003) were used to guide data reduction. According to Reeves and Hedberg (2003) the review function should help to answer "why" develop a web-based module and the "needs assessment" should clearly list the objectives of the web-based development initiative as well as provide instructional design guidelines.

The PI discovered that both evaluation functions were encompassed in the needs analysis (note: needs analysis is referred to by Reeves and Hedberg (2003) as "needs assessment") conducted in the Analysis phase of ADDIE. For instance, the initial

interview “Analyze the Problem” with the SME, Director of the LEARN Program and the PI yielded the “why” information for developing the web-based module. Typically this is one of the objectives of the review function. Essentially, the stakeholders wanted to reach “out to more students or to new student populations” and “to seek new opportunities to diversify current academic support services available to the students”. The needs analysis also provided the objectives for the web-based module as well as detailed design guidelines both of which were presented earlier in this chapter.

Another item of note would be the element of time involved to complete the Analysis phase of ADDIE versus the time involved to complete the Design and Development phases of ADDIE. Referring to Figure 6 in Chapter Three, it shows that the Analysis phase was completed in 16 non-consecutive weeks, the Design phase was completed in two non-consecutive weeks and the Development phase was completed in 10 non-consecutive weeks to complete. Lee and Owens (2004) pointed out that the “time taken to complete a thorough analysis at the beginning invariably more than made up for time savings later” (p. 16). Upon reflection, the PI discovered that this opinion held true in this study. The PI had originally scheduled three weeks for the Design phase and 12 weeks for the Development phase.

DBR Overview: Design Phase

Next, insight of the DBR perspective of the Design phase was gathered from the Evaluate Design Decisions Questionnaire as well as the Design Module Discussion of the ADDIE process. Reeves (2000) stated that the second phase of DBR is to develop solutions to the problem with a theoretical framework. The theoretical framework which provided a possible solution to the problem was the ISD process, ADDIE. ADDIE was

used as it is a popular generic process that most instructional designers claim to use to guide the development of their training modules. The point of using ADDIE was to investigate the systematic process and to determine whether it was still relevant in designing a web-based module that incorporated computer interactions. What was also being investigated was whether a systematic approach such as ADDIE would also produce a web-based module that was considered high in quality. Having computer interactions and being web-based are two elements that were not fully conceptualized when ADDIE came into popularity in the late 1980's (Molenda, 2003).

Feedback in response to the prototype occurred early in the Design phase of ADDIE and was used to refine the IDP. From a DBR perspective, Specimen B-10 in Appendix B shows a summary of results derived from the Evaluate Design Decision Questionnaire which provided details about the decision-making process that occurred in the Design Phase of ADDIE. The participants (n=3) were the SME, Programmer 1, and the PI (as Instructional Designer). Regarding the results, data was gathered in three specific areas, "Objectives and Assessments", "Instructional Strategy" and "Delivery Selection System and Prototyping." The results clarified how the design decisions were made and how each participant's ideas resonated throughout the rest of the ISD process.

Specimen B-10 shows that all three participants believed that they knew the purpose of the web-based initiative. More importantly they all agreed that the most important stakeholder were the learners. The SME disagreed that the learners needed a knowledge assessment prior to using the web-based module. Additionally, the SME together with the PI (as Instructional Designer) both made the choice to "disagree" in

regards to giving learners feedback after the assessment; they did not believe further feedback was necessary in this module.

When considering the responses to the questions asked in the "Instructional Strategy" section, there was a consensus among the participants that the SME was the primary source of content for module development. Furthermore, all agreed that the design decisions had been made very early in the Design phase but the SME could not distinguish at what phase or at what point within a phase of ADDIE that the meetings were held. Moreover, it was not surprising to see that when asked who was most influential in choosing an instructional strategy for the initiative, both Programmer 1 and PI (as Instructional Designer) believed it was the SME, however, the SME believed it was the PI (as Instructional Designer). Also, there was general agreement, that is, 67% strongly agree (PI (as Instructional Designer) and Programmer 1) and 33% agree (SME) that an IDP was essential in guiding the development of the web-based module. Moreover, the SME did not know if an IDP had been developed for this web-based initiative.

Further analysis of data from the "Instructional Strategy" section of the questionnaire related how the participants viewed the decisions made about the design elements utilized in the web-based module. On an interesting note, both the Programmer 1 and the PI (as Instructional Designer) believed that the person who was most influential in setting design elements for the initiative was the instructional designer. On the other hand, the SME believed that the programmer was most influential in setting design elements for the initiative. Here it is important to point out that Instructional Designers need to understand clearly who makes the design decisions.

Hardware and software decisions according to the PI (as Instructional Designer) were a collaborative decision made by the Programmer 1 and the PI (as Instructional Designer). Interestingly, the SME was of the opinion that the programmer and instructional designer were equally influential regarding hardware and software decisions. As far as decisions made about interaction interfaces and interaction design elements, navigation and how the information would be presented to the learners, there was agreement among the participants that they had been made in the Design phase of ADDIE. However, all participants either strongly agreed or agreed that the use of media elements such as audio, video, animation and graphics was guided by the information derived from the Analysis phase of ADDIE.

Data from the third section of the questionnaire "Delivery System Selection and Prototyping" conveyed that the SME, PI (as Instructional Designer), and Programmer1 all either strongly agreed (67%) or agreed (33%) that a prototype is always recommended when developing a web-based module. Similarly, the same agreement was arrived at when participants considered the statement that the "feedback from the prototype is expected to refine the design and development of the web-based module". Considering that a prototype would help to reduce costly design changes, the SME disagreed with that statement but Programmer 1 and the PI (as Instructional Designer) both agreed and strongly agreed respectively with the statement.

However, all participants strongly agreed that a prototype helped to show what the final web-based module could potentially "look, sound and feel" like. When participants were asked who they thought influenced the delivery system (e.g. whether via Internet or Face-to-Face or Blended) choice, both Programmer 1 and the PI (as

Instructional Designer) stated it was the SME but the SME believed that the Instructional Designer was most influential in making the delivery method choice. From additional comments, Programmer 1 stated that "Proper testing of desired design deliverable content was initially over-shadowed by incapacitates of delivery method. This was quickly resolved with the Instructional Designer, the SME and the programmer."

Additionally to underscore the SME's dilemma to some of the questions asked of her in this questionnaire, she stated "I did not know if a formal IDP was created or when it was created. Additionally, I did not know if the meetings that were conducted fell before or after the design or analysis phases." Finally, the PI (as Instructional Designer) commented that "The prototype helped tremendously in refining design elements. In this case, especially what design elements that was desired and not desired. A simple IDP was developed but not formally presented to the SME. The programmer was given information on how the content should be presented (questions first, followed by feedback) details about colors/fonts was mentioned."

DBR Overview: Development Phase

Although the analysis presented here occurred at the Development phase of ADDIE, when viewed from a DBR perspective and using Seeto and Herrington's (2006) guide (see Figure 3), the analysis was still at the second phase of the Reeves (2000) DBR model (see Figure 2) , that was, development of solutions with a theoretical framework. Working within the Seeto and Herrington (2006) guide, they expressed the importance of using formative evaluations while developing the learning environment. In the earlier research by Reeves and Hedberg (2003), they also agree with the use of formative evaluations when developing any learning module. Reeves and Hedberg (2003) believed

that formative evaluations would help to improve the product as it is being developed as well as check the usability and relevance of the product.

In the present study, the formative evaluations were conducted at the Development phase of ADDIE and discussed previously in this chapter were: (a) the "Evaluate Usability of Module" questionnaire and the participant was the SME, (b) the "Expert Review of Module" questionnaire and the participants were the two ID experts, and (c) the "Learners: Evaluate Usability of Module" and the participants were the learners enrolled in a Reading Experience course. To satisfy the requirement as suggested by Seeto and Herrington (2006) that from a DBR perspective some record of reflection should occur at this phase, another questionnaire, the "Module Development Questionnaire" was administered to the instructional designer and the programmer.

A note to the readers: it should be understood that at this juncture, the PI was functioning in the roles of the Instructional Designer and Programmer 2. Programmer 1 could no longer be a part of the study. Therefore the PI faced a dilemma, whether to respond to the "Module Development Questionnaire" once, combining the roles of instructional designer and programmer or to respond twice to the questionnaire in separate roles of instructional designer and programmer. The PI decided to keep the roles separate and respond twice to the questionnaire. In making this decision the PI believed that by keeping the two roles separate it would support the integrity of the study.

The participants were the PI (as Instructional Designer) and the PI (as Programmer 2). A full summary of responses to questions in the Module Development Questionnaire are shown in Specimen B-11 in Appendix B. In this questionnaire there are four sections: (a) "Content Development", (b) "Hardware and Software Elements" (c)

"Design Elements" and (d) "Your Opinion Matters". Consistency in responses in regards to accuracy of the content, the appropriateness of the content for the target audience branching of the content and the modularization of the content. It was apparent that all content criteria were met that was set out in the Analysis and Design phases of ADDIE respectively. It took approximately ten days to integrate the content to the module design. It was agreed that the sequencing of the content followed the design criteria set in the IDP and there was strong agreement that the SME helped to maintain accuracy of the content throughout the development.

DBR Overview: Implementation Phase

The implementation of the web-based module did not occur to the degree where it warranted detailed analysis from a DBR perspective. The PI simply copied the files for the web-based module to a web server for deployment. The SME was not involved in this process.

DBR Overview: Evaluation Phase

It was at the Evaluation phase of ADDIE where two iterations of the "design-evaluate-refine" cycle occurred. Also, from the DBR perspective it was at this juncture where the third and fourth phase of Reeves' (2000) DBR model culminated. This can be seen in Seeto and Herrington's (2006) guide, (see Figure 3). The third phase of DBR states that the solution to the problem should be evaluated and tested in practice. The output of the fourth and the final phase of DBR should be "design principles" produced from the documentation and reflection of the study. In the third and fourth phases of DBR the analysis was guided by the evaluation function. Reeves and Hedberg (2003) explained that this function was a means to appraise strategies of the web-based module

in the environment it is meant to be used. In essence, they recommend a usability study at the Evaluation phase of ADDIE. The final two evaluation functions, impact and maintenance according the Reeves and Hedberg (2003) are best studied after the web-based module has been in the intended environment for a year (Seeto & Herrington, 2006). Therefore as stated previously these two functions were not included in the present study but could be something to be considered in a future study.

First, in regards to the third phase of Reeves' DBR model, the questionnaire Summative Usability Evaluation was administered in two cycles to the ID experts as well as to the learners and this helped to evaluate the web-based module in practice. The results from the iterations of "design-evaluate-refine" cycles have been discussed previously in this chapter. As noted, the number of refinement changes decreased after each iteration of the "design-evaluate-refine" cycle (see Specimens B-5 and B-9). The results from the questionnaire and after each iteration highlighted what was working as well as what needed to be re-designed. Although at each cycle the group of learners was different, the number of refinement changes continued to decrease dramatically. Based on the refinement changes identified via the summative evaluation questionnaire, the PI noted that it was an important tool that helped to create a web-based module that was generally acceptable to the majority of the learners and met the requirements of the other stakeholders such as the SME and the Director of the program.

Second, the outcome of the fourth phase of Reeves' DBR model was based upon the PI's logbook as well as data collected from all twelve questionnaires and two interviews to produce a set of design principles. This outcome was part of the deliverables as stated in Chapter One, that was, to produce a list of "Lessons Learned"

and to report on the effectiveness of specific instructional strategies used in the present study.

Summary

In this chapter, the discussion presented the outcomes from the Design, Development, Implementation and Evaluation phases of ADDIE. The iterative cycle of "design-evaluate-refine" occurred once in the Development phase and twice in the Evaluation phase of ADDIE. Results of the study highlighted the importance of formative evaluations and iterative cycles to develop a valid and effective web-based module. Additionally, participants agreed that development of a prototype early in the ISD process is an important guide for instructional designers and developers. Furthermore, the DBR overview lent further insight into the ISD process that provided relevant information to Instructional Designers. Next, Chapter Five concludes the study by discussing the results and what the results indicate. Chapter Five also presents the list of deliverables, implications of the study and directions for future research.

Chapter Five

Summary

There were two purposes of this study: (a) to examine the use of a systematic ISD process, ADDIE, to develop a web-based module that would be considered valid and effective, and (b) to employ the DBR methodology to create relevant outcomes for practitioners in the field of IT while adding to the body of IT research. In this chapter, the outcomes of the integration of the ADDIE process and DBR methodology will be used to discuss the research objectives, the research question, limitations and threats to the study, direction for future research and implications of the study.

Discussion of the Research Question and the Theoretical Implications

What is the effect of applying a systematic approach to the development of a web-based module for teaching metacognitive learning strategies to students in a higher education environment?

As stated earlier in Chapter One, one of the purposes of the present study was to study the development of a web-based module using a systematic ISD approach: ADDIE. Some critics of ADDIE believe that it is an obsolete process. ADDIE, they think is too rigid and cannot be used to accommodate the development of web-based modules that involves interactivity (Allen, 2006). In contrast, in the present study, it was found that ADDIE provided construct validity for the research as well as a flexible

guideline for developing an interactive web-based module. Although caution is necessary in defining levels of interactivity, the web-based module did contain interactions that encouraged the learner to change from passive to active. As seen in the results in Chapter Four, when asked if they found the module engaging, of the 22 respondents to the final summative evaluation (see Specimen B-8), 55% strongly agreed and 32% agreed respectively that they found the module engaging.

Moreover, the results of the present study indicated that using a systematic approach such as ADDIE to develop a web-based module that included interactivity was still a valid approach. Regardless of technological advancements and levels of interactivity, in the present study ADDIE was found to still provide a serviceable approach. Additionally, there were a number of activities that were included within the systematic process that also contributed to creating a valid and effective web-based module. To summarize the activities:

1. Conducting a detailed front-end analysis.
2. Developing a prototype early in the process.
3. Integrating formative and summative evaluations.
4. Assimilating iterations of "design-evaluate-refine" cycles throughout the process.
5. Accommodating flexibility within the process.

The PI believes that these five elements were critical in using the systematic approach successfully. Figure 15 displays the five activities and how it related to ADDIE in the study. Each activity shown in Figure 15 contributed to developing a valid and effective web-based module using a systematic ISD approach.

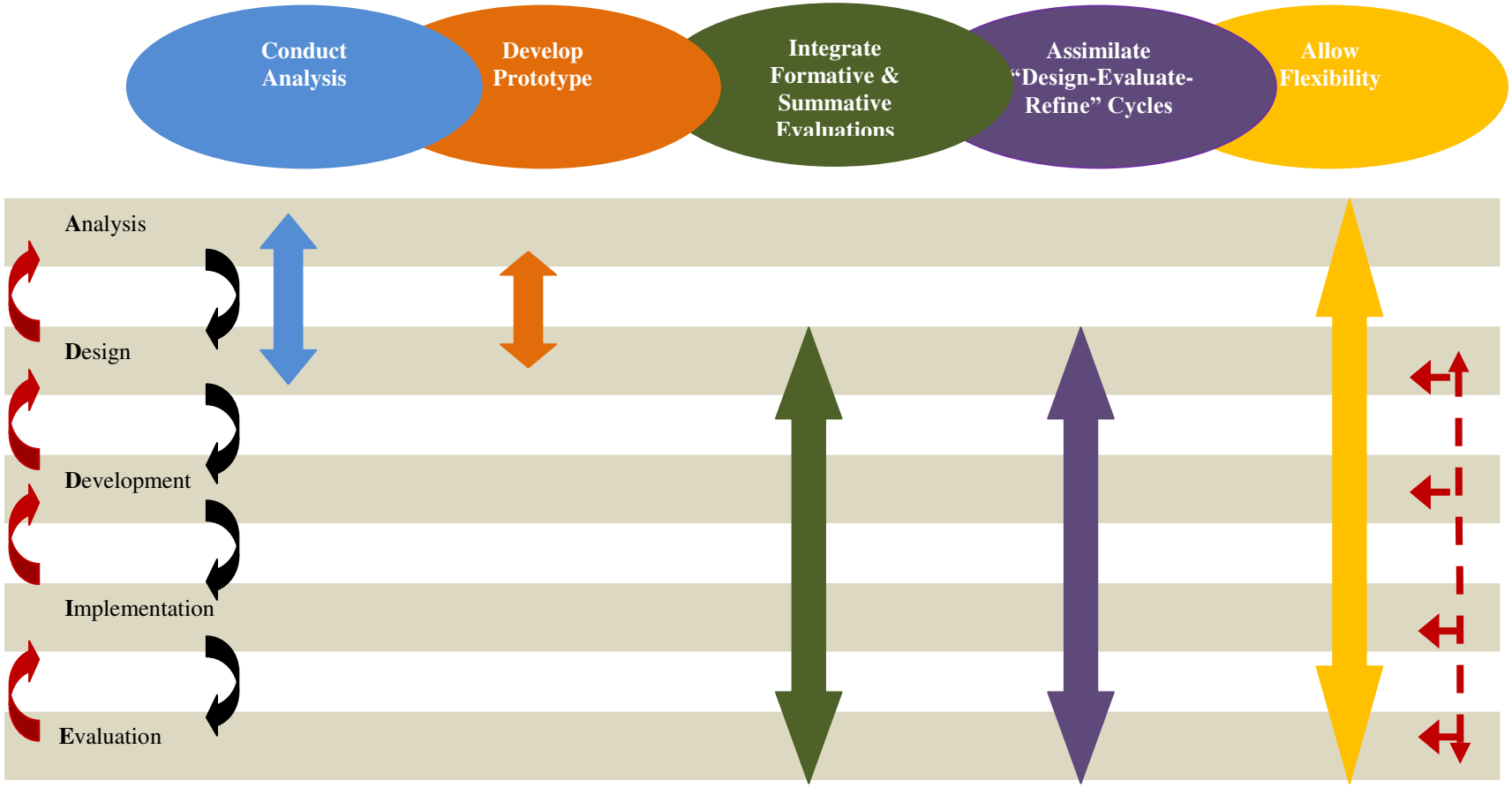


Figure 15. Five activities and how they related to ADDIE.

Dick et al. (2005) as well as Gustafson and Branch (2002) pointed out that the systematic approach naturally lends itself to iterative cycles. Specifically, Dick et al. (2005) mentioned that instructional designers are continuously refining their designs throughout the ISD process. As explained in Chapter Four, the present study had three iterations of "design-evaluate-refine" cycles and the results lend support to the perspective held by Dick et al. (2005) and Gustafson and Branch (2002). Another important aspect the study also confirmed was the importance of formative and summative evaluations throughout the ADDIE process. Dick et al. (2005) states that "Formative evaluation is the process designers use to obtain data that can be used to revise their instruction to make it more efficient and effective." (p. 278).

Also, Dick et al. (2005) believe instructional designers should be able to conduct formative evaluations with confidence. Moreover, formative evaluations they conclude are of fundamental value for the "effective use of the systematic design process…" (p. 340). Regarding summative evaluations, Dick et al. are also strong advocates. They state that conducting summative evaluations can help to "…verify the effectiveness of instructional material with target learners" (p. 340). According to Dick et al. summative evaluations provide two things: (a) expert judgment to determine whether the instruction met the needs of the organization, and (b) field trial to determine the effectiveness of the instruction with the target audience. In the present study, expert judgment showed that the instruction did meet the original goals (see Table 15 in Chapter 4). Additionally, the feedback from the target audience also revealed that the instruction was effective.

Additionally, the results of the study highlighted the importance of conducting a front-end analysis. Without some analysis, clarification of the purpose of the

development and why it is needed will be unknown. This can obviously lead to a poorly designed product. Furthermore, the results showed that development of a prototype was an efficient method utilized to truly grasp the actual design elements that were desired by the stakeholders. Finally, flexibility, as shown in Figure 15 must be incorporated throughout the process.

Flexibility appeared to be an inherent characteristic of ADDIE since it is generic in its approach and open to the interpretation of the instructional designer. From this perspective, the flexibility of ADDIE can be interpreted as a positive aspect of the process. However, upon close investigation, one of the problems encountered in the study very early in the process was that ADDIE was found to be too generic and did not provide enough details. For example, at the start of the Analysis phase, a front-end analysis was determined to be beneficial to developing a quality web-based module. How to accomplish the analysis was not readily available and this added a level of complexity to the process. The PI conducted research and found guidelines by noted researchers (for e.g. Dick et. al., 2007; Seels and Glasgow, 1998) in the IT field that provided details to create several instruments for the front-end analysis (see Appendix A). Other instructional designers are encouraged to use similar references to overcome the lack of specificity in the ADDIE process. Therefore, in reflecting on the ADDIE process, although its generic nature gave rise to adaptability to develop an effective and valid web-based module, it did not provide sufficient detailed guidelines for instructional designers.

Discussion of Research Objectives

Research Objective 1: To create a systematically and rigorously designed product intended to meet research design goals.

As the results in Chapter Four indicated, the ADDIE phases not only provided a systematic approach to developing the web-based module but also provided a rigorous approach as well. ADDIE provided a guideline that ensured certain elements such as a front-end analysis, prototype development and evaluations are included in the process (see Figure 15). Some critics of the ADDIE process claim that it is a static model and therefore inadequate to create interactive web-based modules. However in this study that was not the case. The PI discovered and as mentioned previously by researchers Gustafson & Branch (2002) that if ADDIE was used as a flexible guideline and not as a static step-by-step process, it would allow production of an interactive web-based module. It may be one of the reasons why ADDIE is still taught to Instructional Designers and why it still persists in the field of Instructional Technology.

As seen in Table 15 the design goals set out in the Analysis phase of ADDIE were met. Some changes occurred during the development process and this was also reflected in Table 15. In the Analysis phase, the instruments utilized provided the information necessary to answer "Why" the product was desired (Dick et. al, 2005). However, design goals were discussed in the "Analyze the Problem' interview among the SME, Director of the LEARN program and the PI (as Instructional Designer). Furthermore design goals were crystallized in the "Design Module Discussion" among the SME, the Programmer 1 and the PI (as Instructional Designer) early in the Design phase.

Research Objective 2: To produce data that indicates the validity and effectiveness of the product.

There are several reasons that support the validity and effectiveness of the final product. As noted, there were a total of twelve questionnaires in this study. Although all twelve instruments helped to determine the validity and the effectiveness of the web-based module, there were four instruments in particular that provided more detailed data regarding validity and effectiveness. The instruments in the Development phase were: Evaluate Usability of Module, Expert Review of Module and Learners: Evaluate Usability of Module. The instrument at the Evaluation phase was: Summative Usability Evaluation. These four instruments altogether showed through a majority of positive responses from the learners, ID experts, programmers, instructional designer and SME that the web-based module could be viewed as valid and effective.

In addition, another indicator that offered confirmation that the web-based module should be considered valid and effective were the results of the iterations of "develop-evaluate-refine" cycles that occurred once in the Development phase and twice in the Evaluation phase. As mentioned in Chapter Four, Specimens B-5, B-7 and B-9 shows that the number of refinements decreased from twenty-six to seven. Notably, these seven refinements listed in Specimen B-9 were not part of the original design goals nor were they part of a majority opinion and therefore it was not feasible to prompt further development. The reduction in the number of refinements indicated that the product had evolved and had been refined to a level acceptable to the majority of the learners.

Research Objective 3: Deliverable A: A list of generalized "Lessons Learned".

An integration of the data from the Provisional Lessons Learned listed as an outcome in the pilot study in Chapter Three, the DBR perspective and the ADDIE process was used to determine a list of generalized Lessons Learned. Upon reflection, it was found that the Provisional Lessons Learned still held true by the close of the study. The Provisional Lessons Learned lent itself to some organizational categories that are included in the final report on the "Lessons Learned". Following is the list of Lessons Learned:

General Lessons Learned

1. Establishing relationships: At the start of the process it had been important to establish relationships with the decision makers and leaders of the initiative.
2. Interviewing: Informal interviews helped to establish relationships between key personnel.
3. Identifying stakeholders: In this study the stakeholders were the learners, the SME and the Director of the program. Identifying stakeholders early will help the instructional designer when making design and development decisions.
4. Making decisions early in the process: The instructional designer had to establish whether or not the development of the web-based module required a detailed analysis. The Analysis phase of this study required a commitment of time, money and human resources. These elements are not

always available in practice due to deadline dates and marketing commitments. However, making decisions early cannot be overstated.

5. Documenting the process: It is important not only from a research perspective but from a design perspective as well that the entire process is documented. This type of documentation provided a detailed and useful audit trail. Documentation will help instructional designers reflect on methods used and aid in refinement of the process.
6. Determining project goals and timelines: A critical part of a successful project is to develop the product within the expected timeframe and budget. Although this project did not use expansive project management tools, simple timelines and goals were set.

ADDIE Lessons Learned

1. Conducting front-end analysis: conducting in-depth analysis at the start of the process led to defining many of the design elements necessary to make a product that met the requirements set out by the stakeholders. Analysis was found to be a critical part of creating a product that met the requirements of the stakeholders. Another important aspect of conducting detailed front-end analysis was that it was found to save on design and development time.
2. Relying on expert knowledge and research: Since ADDIE provided a generic and flexible process, it lacked specificity on “how to” accomplish each phase. To overcome this, the instructional designer can rely on

research conducted by noted researchers in the field as was done in this study, or if possible, employ an expert for guidance.

3. Ensuring content validity: Content validity was not an issue in this study however it was still something that had to be considered. Recall that in this study the SME was also an instructor of the targeted course for conversion. The SME provided content for conversion that was based on a strong theoretical foundation. The PI did not have to conduct further research for content material. There was not any concern about the validity of the content. However, in a different situation, where content is being newly developed rather than being converted, content validity measures should be integrated into the process. Some steps to ensure validity of content is to get expert advice (e.g. employ a SME) and to conduct research.
4. Being flexible: The ADDIE process is a systematic process but it does not imply rigidity. ADDIE was used as a flexible guideline and as the outcome of the study displayed, it can be utilized to develop a valid and effective web-based module that includes interactivity.
5. Developing a prototype: This was a critical part of the ISD process. It helped to determine what design elements were desirable and what were not. It provided information to narrow or expand the design scope.
6. Integrating formative evaluations: Integrating formative evaluations throughout the process provided critical information that improved the product within the development life cycle. The formative evaluations

provided useful and timely feedback from the ID experts as well as the learners.

7. Establishing "design-evaluate-refine" iterations: Including iterations of "design-evaluate-refine" cycles were a very powerful element in the ISD process. This element helped to establish the effectiveness of the module throughout development. It also helped to establish effectiveness and validity of the web-based module.

Design and Development Process Lessons Learned

1. Determining what is critical and what is not: The development did not require the use of many analytical tools. Sometimes a guided interview and a needs assessment provided the necessary information to design and to develop the module. As learned in this study for example, the Context Analysis was not really necessary because the questions asked in this instrument had already been addressed by similar questions in the Needs Analysis, Content Analysis and Task Analysis instruments.
2. Being cognizant of participants' schedules: Within the Analysis phase, it was important to limit the number of instruments to only what was necessary because filling out questionnaires and conducting surveys and interviews disrupted people's schedules.
3. Utilizing existing instruments and expertise: There were many valid instruments available for conducting various types of analyses. It was more prudent to use an instrument that had already established validity. In other words, utilizing an instrument previously created by a reputable

researcher or resource group provided reliability to the data collected. In addition it saved time and money because the instrument did not have to be developed. Modifying existing instruments rather than trying to create and to validate new ones are recommended. Also using guides and questions created by noted researchers in the ID field provided cost effective expertise.

4. Employing objective evaluators: Having used two independent ID experts who were not stakeholders in the product ensured that a valid quality control measure was included in the ISD process. There assessment of the product and the process provided an unbiased and objective perspective.
5. Developing and using the IDP: Developing an IDP plan was helpful but again, it was considered a guideline. Like the ADDIE process, the IDP should be considered flexible but also be specific. It should allow for innovative ideas that may arise during the development process.

Research Objective 3: Deliverable B: Report on the effectiveness of the specific instructional strategies utilized.

There were a variety of instructional strategies that were employed in the present study. Some of the strategies were derived from Gagné's (1977) nine events of instructions, which are known effective learning strategies. All of Gagné's (1977) nine events were utilized to some extent. Explanations on how they were utilized in the web-based module are as follows:

1. *Gain the learner's attention*: A concerted effort was made to develop the web-based module as a "fun" way to learn. This was one of the requests made by the

SME. The results indicated that this request had been met. During formative evaluation, both ID experts strongly agreed that the web-based module had been engaging. Similarly, in Specimen B-4, 57% and 43% (n=7) of the learners strongly agreed or agreed respectively that they found the module engaging. Furthermore, in the summative evaluation, the overall majority of respondents found the web-based module to be engaging.

2. *State the instructional objective*: The objective, stated clearly in the beginning of the web-based module was to teach the learner metacognitive learning strategies for objective test-taking.
3. *Stimulate memory of relevant information*: The content of the web-based module was developed to help the learner recall relevant terms that they were already familiar with. For example to help the learner distinguish between absolute and relative qualifiers, the learner was given the words "all" and "likely" respectively. These are words that all learners were already familiar with but probably could not categorize them in the context of a metacognitive learning strategy.
4. *Present the stimulus, information, or distinctive features to be learned*: This was another strategy employed in the web-based module. The design of the web-based module presented test questions to the learners. The learners had the opportunity to answer each question and this was followed by the explanations of the correct answer. The explanation for each correct choice taught learners how to recognize a particular objective test-taking strategy.
5. *Guide the learning*: In the web-based module the learner was guided through the process. First the questions were presented. Next, the learners were presented with

their results. Following this, the learners were prompted to go the final section of the module where they could gather more in-depth knowledge about each correct answer.

6. *Elicit performance – retrieval, active participation, practice*: The learners had to be active participants to complete the web-based module. Questions were posed to the learners and by choosing an answer the learners received feedback (i.e. correct, incorrect). Moreover, after the learners received their scores, the next section of the module gave them more detailed information about the correct choice. It also prompted them in certain cases to click on different areas of the screen or to type a particular word. These actions helped to encourage the learners' mode to change from passive to active.
7. *Provide feedback – correction of errors, reinforcement*: Feedback and reinforcement strategies were used in the web-based modules. For example, in the section where the questions were asked, immediate feedback (i.e. correct, incorrect) was used. Following the breakdown of the learners' score, the new information was reinforced by having the learners go through the final section of the web-based module where the explanation of each correct choice was presented.
8. *Assess performance – metacognition, retention*: Assessment of the learners' performance was conducted in a limited sense. To clarify, the learner was assessed on their initial knowledge of test-taking strategies. However, after the learner gained new knowledge, no further assessment of the learner occurred within the web-based module.

9. *Provide for retention and transfer – overlearning, distributed practice, generalization*: It was expected of the learners that they would use the knowledge gained from using the web-based module to improve their general test-taking strategies skills.

Another learning strategy employed in the web-based module was the element of time as mentioned by Carroll (1963, 1973, 1981, 1989). To reiterate, Carroll (1963, 1973, 1981, 1989) believed that giving learners time to learn any new concept was a factor that affected learning. In this study when learners accessed the module they were not given any time limits. Learners were free to go through the module as quickly or as slowly as they chose. At the last iteration of the "design-evaluate-refine" cycle, data collected revealed that the average time the learners took to complete the module was 9.85 minutes. The analysis of the data did reveal that one respondent (n=22) had a problem concerning time. The learner felt that more pause time should have been placed between the question and the explanation sections of the web-based module. This respondent was unaware that they had the capability to pause the module as they wished.

The average times recorded for learners to complete the module at each iteration of the "design-evaluate-refine" cycles were 9.11 minutes, 9.61 minutes and 9.85 minutes respectively. As analysis of the data shows, in general learners took little less than 10 minutes to complete the web-based module. In contrast, according to the SME, in a traditional classroom, it takes approximately six times that time (i.e. 60 minutes) to cover the same concept. In this case, this indicates that the time it takes the learner to learn the same concept has been reduced considerable.

Research Objective 3: Deliverable C: An analysis of quantitative, qualitative and descriptive outcome measures of learning among field test participants.

The data gathered in this study was generally qualitative. Data reduction was accomplished by using questions developed by researchers Seels and Glasgow (1998) for each ADDIE phase. The intent of the data gathering was primarily to evaluate the systematic design process using ADDIE to develop a web-based module. In addition, the data also helped to determine the validity and effectiveness of the web-based module. Among the various field test participants in this study, the learners were considered the most important stakeholders.

From the perspective of the learners, the data gathered from both the formative and summative evaluations indicated a positive outcome regarding the validity and effectiveness of the web-based module. As explained earlier in Chapter Four, data revealed that the majority of the learners either strongly agreed or agreed that the key aspects of the web-based module such as: accessibility, design, graphics/animations/multimedia, navigation and content were effective. In the third and final iterative cycle "design-evaluate-refine" of the study, from the summative evaluation when asked to state what they would change about the module, one learner thought that there should be more explanations and another thought that it should be more relevant to college level learning.

In contrast, when asked to state what they liked most about the module, one learners' response encapsulated the point of the web-based module. The learner stated "I like the main goal which will help me to focus more on the wording the next time I take a quiz or test". Questions regarding content of the module indicated that it was relevant to

the learners. When learners, including the ID experts were asked in the final iteration of the "design-evaluate-refine" cycle about the content, all of the respondents (n=22) either strongly agreed or agreed that the examples used in the module made learning the concepts easy, the feedback helped them to learn and having the questions presented first followed by the feedback also accommodated learning (see Specimen B-8). More revealing was the response received to the question asking whether the information in the web-based module was considered useful and relevant, 68% strongly agreed and 32% agreed it was useful and relevant. Generally, data collected from the learners consistently showed that the majority of them, that is, over 80%, either agreed or strongly agreed with various statements concerning the validity and effectiveness of the web-based module.

Research Objective 3: Deliverable D: A module that is considered valid and effective at the juncture where the study completes a second iteration of the "design-evaluate-refine" cycle. Consideration of the modules' validity and effectiveness will be derived using data collected via formative and summative evaluations guided by the ADDIE process.

As previously stated, results indicated that the web-based module should be considered valid and effective at the juncture where the study completed the final iteration of the "design-evaluate-refine" cycle. Validity and effectiveness of the web-based module was derived from two perspectives. First, the information derived from the participants of the study was an obvious source of information to indicate that the module was valid and effective. As mentioned earlier in this chapter, overall, the majority of learners, 80% and over along with the ID experts had a positive view of the module's relevance (see Specimen B-8).

A second indicator that the web-based module was valid and effective was that the number of refinements was reduced from twenty-six (Specimen B-5) at the Development phase of ADDIE to seven (see Specimen B-9) by the end of the second iteration of the Evaluation phase of ADDIE. At the Development phase, the first iteration of the "design-evaluate-refine" cycle occurred. From the formative evaluations 26 refinement suggestions were gathered from the learners, SME, ID experts and the Director of the LEARN program. Seventeen of the 26 refinements were completed. The ones that were not completed were either due to their incompatibility with the scope of the project or was a minority opinion, that is, one or two respondents' opinion.

Two more iterations of the "design-evaluate-refine" cycle occurred at the Evaluation phase of ADDIE. At the end of the second iteration in this phase, the number of refinements was reduced to seven. Again, no further changes were made either due to their incompatibility with the scope of the project or were a minority opinion, that is, one or two respondents' opinion. Overall, the reduction in the number of refinement requests was significant to the study. The objective here was to reduce elements within the web-based module that could have inhibited learning. Additionally, reduction of refinements was viewed as a positive outcome that indicated a better quality product and a valid and effective product.

Implications Concerning Quality of the Web-Based Module

The quality of web-based modules or lack thereof as stated in Chapter One is an issue that educators should address presently. Due to the rise in demand for web-based courses, many IHEs have been sharply increasing the number of web-based courses in their curriculum. In regards to web-based courses, Kilby (2008) believes that, "quality is

an expectation" (para. 1). Although measurement of quality was not within the scope of the present study, producing a quality web-based module was an expectation. In the present study, the PI sought to develop a web-based module that was valid and effective using a systematic process. For the PI, validity and effectiveness implied a product that was also high in quality. To support this notion, the NEA's (2000) list of twenty-four measures of quality implies that effectiveness is an aspect of quality measurement. Admittedly, to some researchers, this is debatable but within the confines of the study, the results did provide evidence that the key stakeholders, the learners, as well as the ID experts found the web-based module to be effective.

Overview of DBR Methods for Instructional Design Research and Theoretical Implications

Another purpose of the study was to utilize the DBR approach. Some advocates of DBR (for e.g. Dawson & Ferdig, 2006; Reeves et al., 2005, 2000; Robyler , 2005; Schrum, et al., 2005; Barab & Squire, 2004; Bell, 2004; Collins et. al, 2004; Cobb et al., 2003) regard DBR itself as a means for instructional technology researchers to provide practical, timely and relevant research. Inclusion of Seeto and Herrington's (2006) guide as well as Reeves and Hedberg's (2003) evaluation functions provided substantial support as well as construct validity for the study. Without Seeto and Herrington's (2006) guide, designing the research study would have been more challenging than what it turned out to be. Moreover, some of the challenges mentioned by the @Peer Group (2006) were not experienced to any great extent in the present study. For example, obtaining IRB approval did not pose a problem. IRB approval was sought in two parts, first for the pilot study that included the Analysis phase of ADDIE and second for the rest

of study that included the four other phases of ADDIE that is, Design, Development, Implementation and Evaluation. IRB approval was granted with an exemption status. Collaboration among peers from different disciplines, and length of time for the study also did not provide any extenuating challenges in the study. Publishing was not attempted therefore no comment can be made on it being a challenge.

Another challenge mentioned by Levin and O'Donnell (1999) is the credibility gap as explained earlier in Chapter Two. Since credibility in research is dependent on certain factors such as validity, objectivity and reliability tests (@Peer Group, 2006), this is a challenge to overcome in all studies including DBR studies. As an example, in the present study, there was interaction, rather than separation, between context and intervention. This is typical of DBR. However as O'Donnell (2004) pointed out because of the iterative nature of a DBR study, some level of credibility can be provided. Iterations of the "design-evaluate-refine" cycles provided a level of consistency that gave rise to evidence that established the validity and effectiveness of the web-based module and support the use of a systematic approach to develop a web-based module.

Generalizabilty of the study was another challenge to address when using the DBR approach. Typically, to claim that the outcomes of a study are generalizable, if the study is replicated in various contexts then it should provide the same outcomes. However, as critics to the DBR approach claim, there are various factors that affect learning that are not measured such as interaction with other factors, for example, the environment, instructors, learners or numerous other elements. In this study, to help overcome this challenge, advocates of the DBR approach proposed that the intervention be viewed "holistically" (DBRC, 2003, p. 5). To clarify, the DBRC (2003) group believes

that the educational intervention is in itself an outcome of the context. Therefore, in reference to the formative and summative results of the study, it suggested that utilizing a systematic approach such as ADDIE and incorporating the five activities mentioned earlier will produce a valid and effective interactive web-based module.

It is not yet known whether sustainability will be a challenge in this study. A characteristic of DBR is its iterative nature. To maintain sustainability, the PI would have to actively continue the iterations of the "design-refine-evaluate" cycles. Beyond the challenges, the DBR approach did produce practical design principles for practitioners in the instructional technology field as seen in the Lessons Learned section listed earlier in this chapter. Another outcome of the DBR approach was that it provided a current and in-depth examination of a systematic approach using ADDIE to develop a web-based module. For example, one of the key things that were highlighted was that the stakeholders like the SME, programmers and instructional designers had to establish relationships early in the process to make effective decisions.

Also, not surprising, the primary source of content information was the SME. What was interesting was that the programmer and instructional designer both thought that the SME was most influential as far as decisions made for instructional strategies used in the module. In contrast the SME felt it was the instructional designer who was most influential. Results indicated it was a combination of the SME's requests, the Instructional Designer's interpretation of the SME's requests, and the capabilities of the development application used. The dynamics of the decision-making process was highlighted in this reporting. It is important for an instructional designer to know what

their role is in the design decision-making process. It is important to delineate who should be making the decisions and how to go about making informed decisions.

These types of details mentioned above and reported in Chapter Four are representative of the type of data a PI can receive in a DBR study. As Reeves (2000) pointed out there is a need for relevant research in the field of instructional technology. In the present study the DBR approach provided insights into the decision-making process for developing a web-based module. This was a critical aspect of the study captured with a DBR approach.

On different note, the PI did experience some problems using the DBR methodology. The PI believes that some of these problems resulted from the combination of a lack of financial support and available resources. For instance, in this study the PI acted as the Instructional Designer and also as one of the programmers. Given the opportunity and the financial support, the PI would have preferred to employ another programmer to complete the study rather than act in this role. The PI discovered that holding three roles in a study was somewhat cumbersome and time-consuming. It also became awkward when responding to the particular questionnaires.

Another issue with using DBR for this study was the difficulty experienced by the PI in trying to begin the study. To elaborate, the PI learned that a very difficult aspect of a DBR study is "getting started." However, the PI overcame this problem by seeking the advice of a mentor who was familiar with DBR and who offered strategic information when required. Also, by clearly defining the research question the PI was able to develop the objectives of the study and this helped to guide the study in the early phase. Furthermore, by focusing on one objective of the study at a time the PI was also able to

slowly design the framework of the study. In addition, a device that worked well for this PI was the use of flowcharts to map out the design of the study. The flowcharts helped the PI to visualize how the study could best be designed to gather the necessary data. Also, it pointed out any missing features.

Moreover, for researchers or practitioners contemplating using DBR, the length of time involved may also be a daunting aspect. Analyzing the logbook, the PI notes that entries from the logbook began at June 2006 and ended in March 2009, approximately 138 weeks (i.e. a little more than two and a half years). Of those weeks approximately 32 weeks could be deducted since the PI did not complete any tasks in those weeks. Next, the PI could only "guess" at the number of hours that were dedicated to the study per week since this was not recorded. Approximately an average of 25 hours per week was dedicated to the study. Therefore the study comprised of research hours plus development hours is estimated to be 2650 hours (i.e. (138 weeks -32 weeks) multiplied by 25 hours). As Champion (1999) points out, estimating time may help instructional designers develop better training. In Chapter Three, as shown in Figure 6, the ADDIE process lasted 31 non-consecutive weeks. Again, using the estimate of 25 hours per week, the total hours estimated to develop the 10-minute web-based module is 776 hours (i.e. 31 weeks multiplied by 25 hours).

In retrospect, the element of time is important to developers and this should have been recorded. The PI would recommend that other DBR researchers should plan to record time dedicated to their study or product development in terms of hours, days and weeks. Despite some of these challenges the PI recommends using DBR for instructional design research studies. Since instructional designers have been seeking timely and

relevant guidance, the outcomes of this study did provide some evidence that the DBR approach is a valid method for the field of instructional technology. The outcomes of the present study showed that practitioners and researchers alike in the field of instructional technology can find more in-depth information that can inform their design decision-making process and development process using a DBR approach.

Limitations and Threats

A large amount of the data collected was descriptive and the PI had to continuously guard against researcher bias. The PI was cognizant of any bias and removed them from the narration. In addition, an independent ID researcher and an editor were asked to read the narration frequently in order to point out any bias.

Furthermore, there were some instances where the ADDIE process and the DBR approach were abstract and this added a level of complexity to the measurement methodology. For example, the ADDIE process was not rigid, meaning that sometimes phases overlapped (e.g. some parts of the Design and Development phases occurred simultaneously). In order to measure each phase as they occurred, they had to be distinctive and operationalizing the study in its entirety was difficult.

Another threat that was encountered was that of instrumentation. There were twelve questionnaires and two interviews that were used in this study. To guard against this threat, each instrument was derived from established researchers in the ID field and their sample questions they provided. Additionally, each instrument went through two cycles of expert reviews. To guide the expert reviewers, the PI gave both of them four specific guidelines that were also derived from credible sources. Modifications to the questionnaires were based on these guidelines and the IDs' expert knowledge.

Directions for Further Research

There are several directions to recommend for further research. First, two of the six evaluation functions (Reeves & Hedberg, 2003), impact and maintenance, could not be accomplished within the time frame set out to complete the study. Reeves and Hedberg (2003) advised that these functions should be conducted a year or two after the product has been in the environment. On an interesting note, these functions may also work to overcome the challenge of sustainability thus continuing to utilize the DBR methodology.

A second direction for future research could be the consideration of the instruments used for the study. As noted, all instruments were based on existing and valid research work. The process described in the study was intended to show instructional designers how to use existing research and instruments to gather data as well as how to analyze the data to help guide design decisions. IT researchers may want to conduct further statistical analysis on the instruments themselves.

Lastly, a third direction for future research could be to further analyze the element of quality in a web-based module. Quality measurement is a detailed process and this could be the basis of another study entirely from a different perspective. Currently, there are few rigorous studies concerning the quality of web-based modules. Moreover, there are even fewer studies that utilize DBR and quality measurement of web-based modules.

Summary

A holistic view of the completed research yielded valuable and practical insights for instructional designers and added to the body of existing design-based research. To re-iterate there were two purposes in conducting this study: (a) to examine the utilization

of a systematic ISD process, that is, ADDIE, to develop a web-based module that would be considered valid and effective, and (b) to use the DBR methodology to create relevant outcomes based on ISD theories for practitioners in the field of IT and to add to the body of IT research. The outcomes of the study provided evidence that using a systematic approach such as ADDIE to develop a valid and effective interactive web-based module was still viable. Additionally, although the outcomes from this study did not form a basis to propose a new ISD model, it highlighted five key activities that could be added to the ADDIE process to accommodate development of a quality interactive web-based product. The five activities are as follows:

1. To conduct a detailed front-end analysis.
2. To develop a prototype early in the process.
3. To integrate formative and summative evaluations.
4. To assimilate iterations of "design-evaluate-refine" cycles throughout the process.
5. To accommodate flexibility within the process.

Furthermore, using the DBR methodology yielded results that added to the body of IT research. Moreover, it provided support of the use of this methodology within the instructional technology discipline. The "Lessons Learned" outcome in this study was one example of the usefulness of the DBR methodology for practitioners within the IT discipline. Many instructional designers seek guidance and relevant information with strong theoretical support. Results from DBR studies appear to meet that need.

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APPENDICES

Appendix A: Results: Pilot Study (Analysis Phase & Prototype)

Needs Analysis

1. Is the LEARN program seeking to enhance its current instruction method?

Answer: Yes.

2. Can you identify the need/s of the LEARN programs?

Answer: We would like to implement an online/web-based course that has the possibility of reaching out to more students or to new student populations. The LEARN Program needs to seek new opportunities to diversify current academic support services available to the students. Two specific areas that maintain the program's presence around campus are study-skills workshops and credited courses in critical reading skills and learning strategies. Courses and workshops are currently facilitated using "traditional" face-to-face instructional methods.

3. What do you believe will address the need/s that currently exists?

Answer: Cognizant of the advancement of technology in instructional settings, and interested in broadening services to remote students, the LEARN Program director has decided to implement changes that will allow web-based delivery of at least one of the courses taught in the program. A consecutive step will be the design and development of stand-alone instructional modules that can be implemented as part of the course or taught separate as one of the workshops offered in the program. Online/web-based modules will help us to reach out to students not currently served.

4. Describe what changes (you) the administrators of the LEARN program would like to implement?

Answer: Currently the course is "web-enhanced" BlackBoard. Some course material is online and certain aspect of the course (e.g. discussions) occurs online. Currently none of the modules that are taught in class is accessible online. We would like make these modules available online.

5. What need/needs are you trying to meet by implementing the proposed changes to the LEARN program now?

Answer:

1. Provides flexibility to access information and content
2. Decrease barriers to distance learning – e.g. help commuter students
3. Increase the possibility of reaching students in regional campuses

6. Why do you think the changes are important to implement now?

Answer: Maybe we are losing potential students that could be served if we had online accessibility. This is just an observation and you should know that no formal needs analysis has been conducted, no statistics have been collected. However we believe that this is an opportune time to move the modules online.

7. If any instructional changes are implemented, what benefits do you expect?

Answer:

1. Greater number of students will be served
2. Course will be more accessible
3. Flexibility of online modules will help develop workshop
4. Will help us to diversify instructional capabilities
5. Will help us to adapt to future changes (easier to integrate changes in online modules)

8. Have there been any other interventions implemented previously? If "yes" please describe what the intervention was and what the actual outcome versus the expected outcome was.

Answer: No.

Audience Analysis (For SME)

1. What is the age range of the learners?

Answer: Between 18 and 25

2. What are the general computer capabilities of the learners?

Answer: In general, most of our students can be considered computer literate. They possibly use the computers on a daily basis and are comfortable using them.

3. In particular, are they comfortable using an email application?

Answer: Yes.

4. Can the learners attach and send files via email?

Answer: Yes.

5. Do all the learners have access to computers? (Either on-campus or at home or in-class)

Answer: Yes.

6. What does the learner want to learn?

Answer: Our classes are not content-based but skill-based. Therefore, we use their own interest in any subject matter to make our teaching and their learning relevant. For instance, if the topic to discuss is *lecture note-taking* in a procedural class, students need to come up with one of the classes they are taking that meets the definition of procedural. Based on that class we will work with that subject matter to facilitate the strategy to be learned.
Sometimes the learner is in class because it is a "required" class because they could be on academic probation. However, some learners want to enhance their learning strategies and learning techniques. Some may want to understand how they learn so they can raise their GPAs.

7. What does the learner already know about the subject matter?

Answer: They know a little about time management, general knowledge of note-taking and how to read a textbook. These are general knowledge also discussed in class.

8. How motivated is the learner?

Answer: Generally speaking, they are all motivated. Yet, some students take the class only to get a couple of extra credits they need to fulfill administrative requirements. So it sometimes depends on why they are taking the class (highly motivated tend to be better students).

9. How much time is the learner willing to spend studying?

Answer: No more than the time they need to complete assignments, the class does not require more than 2 hours worth of work per week. Requirements are considered "light". Because our class is not content-based, there are no tests. Hence, student progress is evaluated based on the successful completion of assignments that will reinforce strategies discussed in class.

10. What does the learner think of distance-learning classes?

Answer: Although I could not tell for sure, I'd venture to say that students are comfortable with the idea. Currently, all our classes have an asynchronous discussion board where students independently react to readings. Overall, students enjoy this activity. However, I could not answer for sure how they would like a complete online interaction.

11. What is the reading level (in English) of the learners?

Answer: Comprehension is 8^{th} grade and above. Average rate of reading is 250 words per minute. These are national average for this level.

12. How do learners apply the knowledge from this class?

Answer: By incorporating the learning/study strategies and metacognitive awareness on the work they do for their other classes. They go back to their classes and change some of their study practices. At least, I hope so. We address their study concerns in class…sometimes I get verbal feedback. I also get written feedback because they write a reflection paper at the end my class. In this reflection paper, the students explain where and how they implemented learning concepts and systems.

Task Analysis

Topic Analysis (for SME)

1. What is the information that needs to be taught?

Answer: The module [tentative] is "Test Taking Strategies"

2. How is this information presented to the learners (lecture, homework, reading assignments, class discussions etc.)?

Answer: Through "hands-on"/traditional method. They take debriefing analysis of test items and the different types of tests.

3. Is there any pre-requisite knowledge required for this course?

Answer: Nothing beyond the baseline knowledge of a college freshman.

4. Is there any pre-requisite knowledge required before learning this information?

Answer: Nothing beyond the baseline knowledge of a college freshman.

5. Is there any pre-requisite skill(s) required?

Answer: Nothing beyond the baseline skills of a college freshman.

Content Analysis

1. What procedures/skills are presented to the learners?

Answer: In general, they are introduced to a number of concepts:

1. Intentional learning
2. Knowledge of self regulation
3. Memory and concentration
4. Autonomy and motivation
5. Objective and subjective test taking strategies
6. Time management

For the "Test-Taking" module, they learn about:

- Subjective tests
- Objective tests
- Levels of intellectual performance
- Levels for test questions
- Essay test vs. multiple choice/true-false/mix-match etc.

2. Describe in detail the sequence of steps in which the procedure/skill (procedural knowledge) is presented to the learners

Answer: This relates in particular to the "Test taking" module – for the Objective tests:

a. Learners get a sample of an objective test (a mock test – Multiple choice, true/false etc. type questions
b. Students take the test
c. We then engage in a discussion on the level of difficulty of the test?
d. We talk about strategies they used to overcome the difficulty they experienced?
e. Most of the time, the students tend to choose the correct strategy
f. If they don't, then a "teaching moment" occurs and I inform them of correct strategies. I cover them either way, just to help them understand the strategies better.
g. I teach and point out keywords that they can use. ?

For Subjective (essay type) tests:

a. I use PowerPoint slides and SmartBoard to provide prompts for students
b. Students read the prompt and attempt to answer the question (they have 10 minutes to write an answer)

c. We follow this by a discussion as to why they found the question difficult
d. I point out “Topic” words, “Keywords” and “Limiting” words
e. I discuss Levels of knowledge which is similar to Blooms Taxonomy
f. Discuss “thesis” statement
g. How to structure paragraphs
h. I also cover test anxiety

3. Describe in detail how you would like the procedure/skill to be taught in an online environment.

Answer:
I would:

a. Like it to be highly interactive
b. Example – have a test bank for objective test – randomize questions – have easy to hard questions etc.
c. Audio, video – if it is pertinent and will add value to the learning
d. Scenarios presented to learners
e. Fun approach – fresh voice (no Mom and Dad voiceovers giving advise…)

4. What conceptual facts/rules/principles (declarative knowledge) are presented to the learners?

Answer: For the “Test taking module”:

a. Levels of knowledge
b. Levels of intellectual ability
c. Characteristics of objective and subjective tests
d. Commonly used test-taking strategies
e. General rules of test taking strategies

5. What attitudes and values (affective knowledge) are presented to the learners?

Answer: I cover a lot, for example:

a. Being responsible for studying
b. Being self-regulated
c. Being self-motivated
d. Being committed to their studies

6. Describe in detail how you would like the attitudes and values to be taught in an online environment.

   Answer: I expect that the online version should have a FUN approach. If there is audio, maybe we can incorporate something like “peer talk”, and animation. Stay away from “scripted” type audio.

Context Analysis

Environment for:	**Learner Characteristics**	**Instructional Setting**	**Organizational Support**
Planning	What behaviors, prior knowledge, ability and attitudes (e.g., towards content, delivery, and the organization) will the learner bring to the situation? Answer: Previously answered	What constraints exists that will affect this online intervention? Answer: Limits human interaction (face to face) but I do not think it will affect the learning outcomes. There may be financial limitations. What resources will affect the selection and preparation of this online intervention? Answer: Don't know	What resources will be available for planning and development? Answer: Don't know What purpose will the online intervention serve for the organization? Answer: previously answered.
Learning	What are characteristics of the learners and how will it affect individual learning? Answer : Students are responsible to know and understand their own learning style .Are individual learning preferences met? Answer: Students are responsible to know and understand their own learning style. We can equip them with knowledge to self-regulate.	What characteristics of the social and physical setting affect learning? Answer: Not applicable. Are the instructors well versed on the subject matter? Answer: Yes	How will instruction be monitored? Answer: Assignments, reflection papers, discussions. How will its relevance be established? Answer: Already established in traditional class. Not an issue.
Performance	What support is needed? Answer: Website, on-site, IT support	What social and physical constraints can hamper use of the new learning or skills? Answer: Lack of access to PCs. How can they be eliminated? Answer: Open-use labs on campus	How will diffusion (adoption and maintenance) of the learning be encouraged? Answer: Through in-class instruction. Instructors will encourage learners to use the online module

Source: Seels & Glasgow, 1998

Specimen A-1

Analysis Phase: Instrument and summary of results from the "Learner Analysis" questionnaire

n = 10		
A. STUDENT INFORMATION		
Item	**Category**	**% in Category**
1. I am a	Full-time	90
	Part-time	10
B. COMPUTER USAGE		
2. I feel comfortable using computers to aid in my studies.	Strongly Agree	70
	Agree	30
3. I regularly use the computer to read emails and send information.	Strongly Agree	60
	Agree	40
4. I am comfortable attaching files to emails to send to my instructors family	Strongly Agree	60
	Agree	30
	Disagree	10
5. I am comfortable using the computer to do real time chats or online discussions.	Strongly Agree	50
	Agree	20
	Disagree	10
	Strongly Disagree	20
6. I have access to the Internet all the time.	Strongly Agree	60
	Agree	30
	Disagree	10
C. ONLINE/DISTANCE LEARNING COURSE INFORMATION		
7. I have taken a distance learning course in the past.	Yes	60
	No	40
8. I am currently enrolled in a distance learning course.	Yes	20
	No	80
9. I think distance learning courses are easy in comparison to traditional (or instructor led) courses.	Agree	60
	Disagree	40
10. I think distance learning courses are difficult in comparison to traditional (or instructor led) courses.	Agree	20
	Disagree	80
11. If this course (Learning Strategies) was online, I would take the online course instead of the traditional (instructor-led classroom) course.	Strongly Agree	30
	Agree	50
	Disagree	20
12. I am taking this course because it was recommended to me by my advisor.	Strongly Agree	30
	Agree	10
	Disagree	30
	Strongly Disagree	30
13. I am taking this course because I want to improve my learning strategies and skills.	Strongly Agree	50
	Agree	30
	Disagree	10
	Strongly Disagree	10
14. I am a motivated learner.	Strongly Agree	10

	Agree	70
	Disagree	20
15. I already know a lot about the subject matter covered in this Learning Strategies course.	Strongly Agree	20
	Agree	50
	Disagree	30
16. I know very little about the subject matter covered in this Learning Strategies course.	Strongly Agree	10
	Agree	20
	Disagree	50
	Strongly Disagree	20
17. I am willing to spend 1 or more hours per week studying the information from my Learning Strategies course.	Strongly Agree	20
	Agree	60
	Disagree	20
18. I will apply the knowledge gained from this class to help improve my grades in my other classes.	Strongly Agree	50
	Agree	50
19. I heard about this course from my friend.	Strongly Agree	10
	Agree	10
	Disagree	30
	Strongly Disagree	50
20. I heard about this course from my advisor.	Strongly Agree	20
	Agree	30
	Disagree	30
	Strongly Disagree	20
21. I saw this course advertised in the course schedule/flyer/department.	Strongly Agree	40
	Agree	30
	Disagree	10
	Strongly Disagree	20
D. YOUR OPINION IS IMPORTANT TO US. YOU CAN HELP US CREATE AN EFFECTIVE ONLINE COURSE. WE WOULD APPRECIATE IT IF YOU TAKE A MOMENT TO SHARE YOUR OPINIONS WITH US.		
22. If you had the opportunity to create an online version of your Learning Strategies course, what are some of the features would you include(e.g. would you include animation, more online discussion, interactions, scenarios etc.)? Remember you want to keep it educationally sound and you do not just want to add technology because it is “cool”.		Open ended
Response 1. Quizzes to build understanding surrounding our learning types. More examples of our learning types and ways we can succeed in numerous courses.		
Response 2. I think that PowerPoints should be available with each chapter. Online discussions should be there, but not interactions. I think we should have other discussions besides just the "Hope" discussions.		
Response 3.I would keep the same model of the class as the traditional class but I would just instead of the discussion involve more group problem solving.		
Response 4. I would use the PowerPoint presentations a lot because they give a lot of useful information. Most of the learning material could be taught by PowerPoint .		
Response 5. I think that you should have more online discussion assignments.		
Response 6. Weekly live meetings to introduce material. Online discussion and assignment could all be done via the web course.		
Response 7. I personally don't have a problem coming to class every week, and prefer that way better. If it were online though, I would say add more scenarios and discussions. Discussions help everyone understand everyone has problems too and they can help each other out. Animation might be nice to add, for the visual learners.		

Response 8. No animations that's just silly. The graphs shown in class that used our (the students) input was a very good use of technology and something along those lines, semi-interactive, would be a good addition to an on-line version of this class. Realtime discussions don't seem to work to well in some of the other online classes that I've take. A select few students are the ones asking the questions and voicing their opinions. The "Hope" discussion board I thought was very good. The way Ms. Ruiz set it up allowed for the comfortable exchange of ideas by all students. MORE; DISCUSSION BOARDS, weekly postings
Response 9. If I had the choice to create this as an online course, I would make more online discussions to find out what the students are thinking. I would also make discussions for the students to interact with each other. I would have role playing activities so the students can ask each other questions and answer the questions. I would not have timed tests so the students can feel pressured and fail, but I would have practice time tests so the students can practice, and enhance their timed test taking skills.

Note: A 4-point Likert scale is used: Strongly Agree/Agree/Disagree/Strongly Disagree

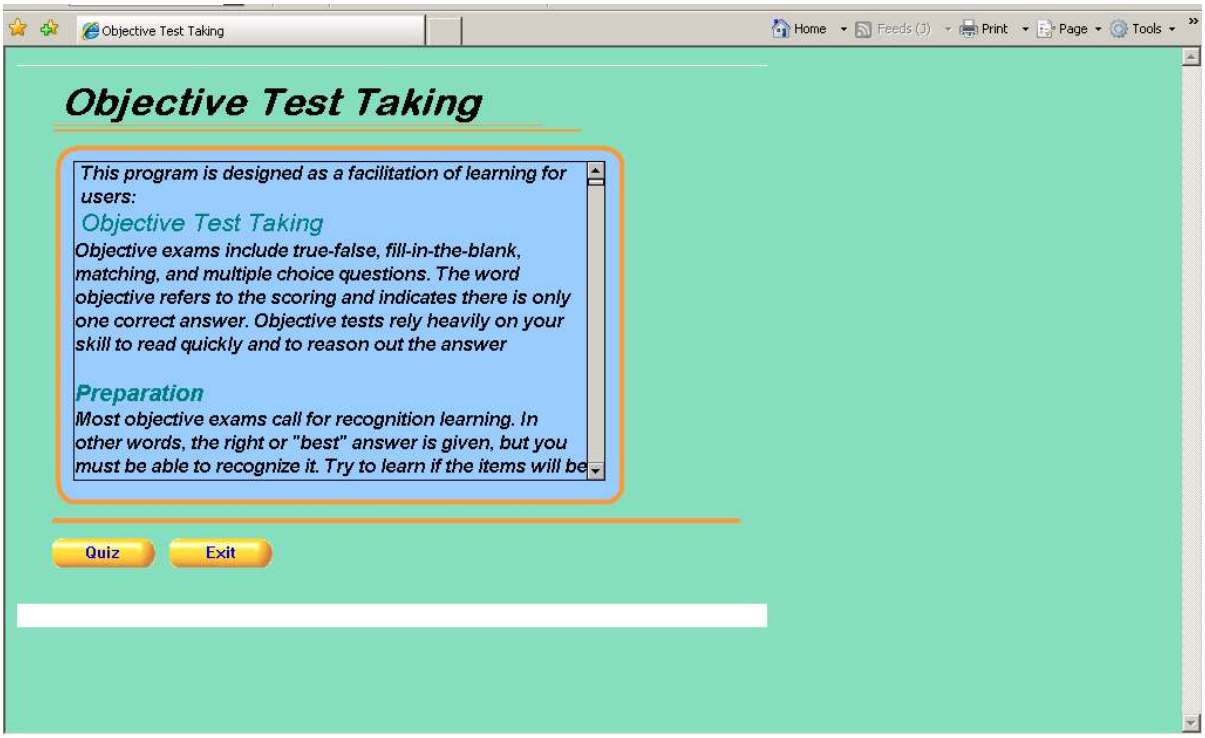


Figure A-1.Screen Shot #1 of prototype of web-based module

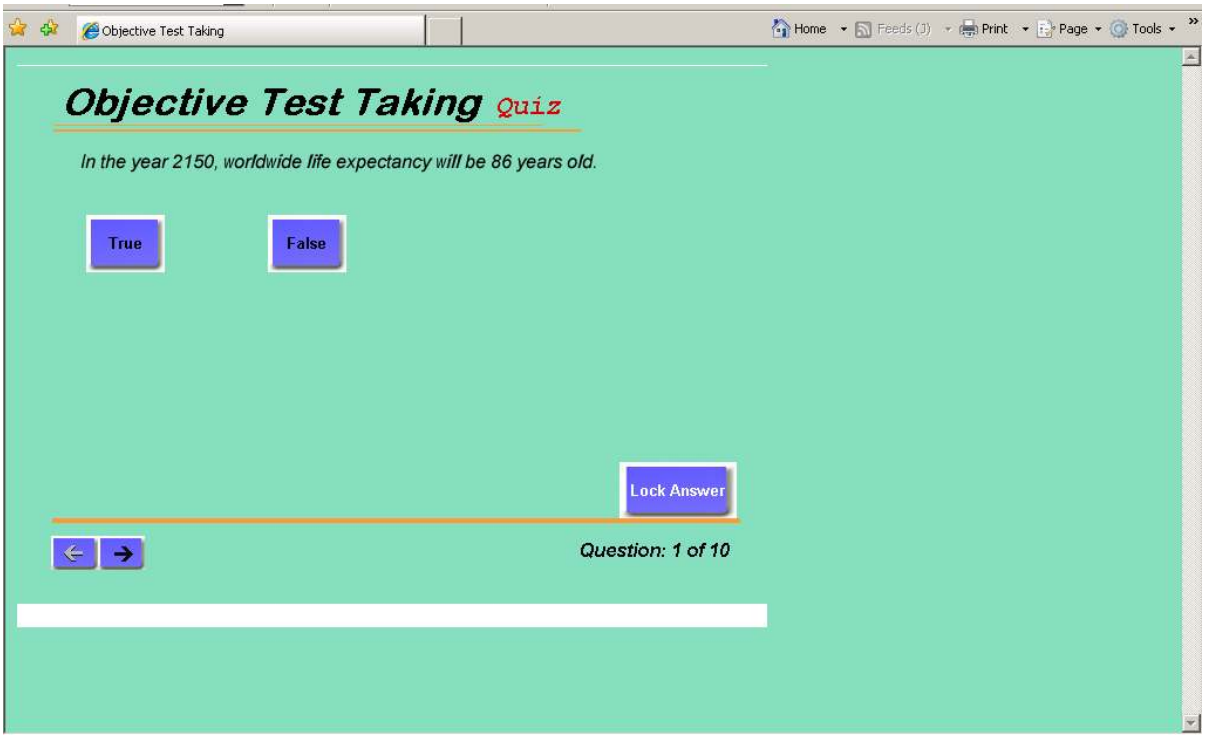


Figure A-2. Screen Shot #2 of prototype of web-based module.

Appendix B. Results: Design through Evaluation Phases of ADDIE

Specimen B-1

Summary of information derived from "Design Module Discussion"

n=3

Design Information	Source of Information
1) No test bank required for module. Preferably a generic test of about 10 to 15 questions should be developed. 2) The module should last no more than 15 to 20 minutes (no more than ½ hour online). 3) The module should have info on: (a) how to prep for a test (b) should present the questions (c) ask the students to answer question, and (d) highlight different parts of the questions. 4) For each module, there are about 6-8 strategies per module. 5) The first module to be developed should be Objective Test Taking Strategies 6) May need to store answers and score person. This way they can get immediate feedback. 7) The module should contain animation, it should not be boring. Avoid boring. 8) Audience – all high school graduate students.	SME
Delivery Information	
9) Should it be web-based (as opposed Internet)? Web-based was decided. 10) Multimedia – containing audio as well as text 11) Broadband 12) Link from the SVC site 13) Maybe Authorware® 6.0 was the best solution however everyone was concerned about scalability/ compatibility/flexibility	Programmer 1 and Instructional Designer/Researcher
14) The module should be delivered via the web. The university's web server can support Dreamweaver/Flash.	SME

Specimen B-2

Development Phase: Instrument and summary of results from the "Evaluate Usability of Module" questionnaire

n=1		
Section 1: Materials Development		
Questions	**Category**	**% in Categories**
1. Most or all of the content for the web-based module was based on information provided by the Subject Matter Expert/s (SME/s).	Strongly Agree	100
2. The choice of content to be used for instructional development was made by (choose all that apply):	SME	100
3. The organization of the content for the instruction was influenced by (choose all that apply):	SME	100
4. The terminology and wording of the content is based on what is currently being used in the traditional classroom.	Strongly Agree	100
5. The terminology and wording of the content is based on material that has a theoretical foundation.	Strongly Agree	100
6. The terminology and wording of the content is familiar to the target audience.	Strongly Agree	100
7. Do you believe that the readability (i.e. reading level) of the content is appropriate for web-based delivery?	Yes	100
8. Do you believe that the quality of the content is appropriate for web-based delivery?	Yes	100
9. The text/audio is written in an active voice.	Agree	100
10. Highlighting and other animation techniques are used appropriately to bring attention to key phrases and words.	Agree	100
11. Did moving the traditional content matter to a web-based format require changes?	Yes	100
If you responded "Yes" to the above question please go to Question 12 else if you responded "No" please go to Question 13. 12. Please state some of the changes that occurred when moving the content from a traditional format to a web-based format. (For example, for the learners to understand the concepts in a web-based format, were there instructional strategies such as games, animation etc. used?)	Open ended	100
Response 1. The change required the use of a theme and animations to keep students engaged and interested. It also required a narrator to provide explanations that were needed.		
13. Moving the traditional content to a web-based format required changes in how the information was sequenced (whether linear, branching etc.).	Agree	100
14. The content in the web-based module will produce the same learning outcomes as the traditional format for the learner.	Strongly Agree	100
15. Learners can easily understand the content presented in the module.	Strongly Agree	100
Section II: Evaluation of the Web-Based Module **A. Accessibility**		
16. The module is accessible from my browser.	Strongly Agree	100
17. The module executed without technical delays.	Disagree	100

18. All the links that I clicked within the module worked on my browser.	Agree	100
B. Design Elements		
19. The module design is simple and uncluttered.	Strongly Agree	100
20. The graphics and colors employed are aesthetically pleasing.	Strongly Agree	100
21. The fonts and colors promote legibility within the module.	Strongly Agree	100
22. All links, icons and navigation buttons work as expected.	Agree	100
23. The information is structured in a meaningful manner in the module and facilitates learning.	Strongly Agree	100
24. The directions given for the user to follow are easy to understand.	Strongly Agree	100
25. The ends of sections within the module are clearly understood.	Agree	100
26. There is tracking information available to the users so they can see where they are within the modules at all times.	Agree	100
27. The question examples used in the module facilitate learning.	Strongly Agree	100
28. The feedback used in the module facilitates learning.	Strongly Agree	100
29. Feedback messages appear in a consistent layout on each page.	Strongly Agree	100
30. Help messages appear in a consistent layout on each page.	Strongly Agree	100
31. Error messages appear in a consistent layout on each page.	Strongly Agree	100
32. The explanations of concepts (i.e. strategies) used in the module facilitate learning.	Strongly Agree	100
33. The way (i.e. linear or branching etc.) the content information is presented in the module facilitates learning.	Strongly Agree	100
34. The overall tone of the module is engaging.	Strongly Agree	100
35. The module provides a suitable learning environment for all users.	Strongly Agree	100
C. Graphics/Animations/Multimedia		
36. There is consistency in layout of graphics, fonts, color, and positioning of icons.	Agree	100
37. The various text animations (e.g. text highlight, text movement etc.) help to emphasize what learners should be learning.	Agree	100
38. The audio provide useful information to enhance learning.	Strongly Agree	100
39. The interactions made the training interesting.	Strongly Agree	100
D. Navigation		
40. The user can navigate to various parts of the module as desired.	Agree	100
41. The learner can navigate to the beginning of the module easily.	Agree	100
42. Navigation is consistent within the module.	Strongly Agree	100
43. State what you liked most about the module.	Open ended	100
Response 1. Feedback is consistent and clear. Tutorial is simple and well organized. Students get a summary of their results after completing the test. Good job emphasizing important concepts with visual and auditory clues.		

44. State what changes you would recommend to the module.	Open ended	100
Response 1. Feedback section: Question 6 When explanation is over, screen takes too long to clear Question 7 I moved the cursor and the screen disappeared Question 8 If cursor is not left on the nm square, the narration stops Question 9 Typing “grammar clues” does not add any instructional or entertaining value. This screen takes too long to fade out.		

Specimen B-3

Development Phase: Instrument and summary of results from the "Expert Review of Module" questionnaire

n=2		
Section I. Accessibility		
Questions	**Category**	**% in Category**
1. The training module ran on my computer without any problems.	Strongly Agree	50
	Disagree	50
2. All the links within the module worked in my browser.	Strongly Agree	50
	Agree	50
3. I did not experience any technical delays while going through this training module.	Strongly Agree	50
	Disagree	50
Section II. Design Elements		
4. The module design was simple and uncluttered.	Strongly Agree	100
5. The organization of the training module was easy to follow.	Strongly Agree	50
	Agree	50
6. The directions given for the learner to follow were easy to understand.	Strongly Agree	50
	Agree	50
7. The ends of sections within the module were clearly understood.	Agree	50
	Disagree	50
8. The fonts and colors promoted legibility within the module.	Strongly Agree	50
	Agree	50
9. Feedback messages appeared in a consistent layout on each page.	Strongly Agree	50
	Agree	50
10. Help messages appeared in a consistent layout on each page.	Agree	100
11. Error messages appeared in a consistent layout on each page.	Strongly Agree	100
12. All links, icons and navigation buttons worked as expected.	Strongly Agree	50
	Disagree	50
13. The overall tone of the module was engaging.	Strongly Agree	100
Section III. Graphics/Animation/Multimedia		
14. The graphics complemented the learning.	Agree	100
15. Layout of graphics, fonts, font colors, font size, and positioning of icons were all consistent.	Strongly Agree	50
	Agree	50
16. The various text animations (e.g. text highlight, text movement etc.) helped the learner to focus on the learning objectives.	Strongly Agree	50

	Agree	50
17. The audio provided useful information and enhanced learning.	Strongly Agree	50
	Agree	50
18. The interactions made the training interesting.	Strongly Agree	100
Section IV. Navigation		
19. Within the module, navigation buttons were clearly marked.	Agree	50
	Disagree	50
20. I navigated to various parts of the module as desired.	Agree	100
21. I could navigate to the beginning of the module easily.	Strongly Agree	50
	Disagree	50
22. Navigation was consistent within the module.	Agree	100
23. Tracking information was available to the learners so they could see where they were within the modules at all times.	Agree	50
	Disagree	50
Section V. Training Module Content		
24. I think that the question examples used in the module made learning the concepts/learning strategies easier**.**	Agree	100
25. I think that the feedback given in the module will help the learner to understand the concept/learning strategies.	Agree	100
26. The way the information is sequenced (all the questions first followed by feedback) in the module will help the learner to understand the material.	Strongly Agree	50
	Agree	50
27. The information provided was relevant information to the learner.	Strongly Agree	50
	Agree	50
Section VI. Your Opinion Matters		
28. Please state what you liked most about this training module:	Open ended	100
Response 1. It was very engaging. I enjoyed the motif of going on a jungle mission. The audio narration and graphics helped to carry this through and keep me interested in what was coming up next.		
Response 2. The simplicity and clarity of expectations.		
29. Please state one thing you would change in this module:	Open ended	100
Response 1. Just an addition, maybe for a future version - a PDF I could print out with the tips as a review sheet later and may be some other resources, websites I could go to for study/test taking skills.		
Response 2. The nav buttons at the bottom were unclear at first. I had to roll over the "forward" button to be sure I was on the right one. I made the assumption that it was "forward", but it might be helpful for the buttons to be labeled.		

Specimen B-4

Development Phase: Instrument and summary of results from the "Learners: Evaluate Usability of Module" questionnaire.

n=7		
Section I. Learner Background		
Questions	**Category**	**% in Category**
1. What is your gender?	Male	29
	Female	71
2. In college, I am a (choose one)	Freshman	14
	Sophomore	0
	Junior	71
	Senior	0
	Other	14
3. What is your age?	Open ended	100
4. I attend college (choose one)	Full-time	71
	Part-time	29
5. If given a choice between a traditional (i.e. classroom/face-to-face class) version of a course and a web-based version, where both are available at convenient times, I would take the:	Traditional (classroom version)	71
	Web-based version	29
Section II. Accessibility		
6. The training module runs on my computer without any problems.	Strongly Agree	100
7. All the links within the module work in my browser.	Strongly Agree	100
8. I did not experience any technical delays while going through this training module.	Strongly Agree	71
	Agree	14
	Disagree	14
Section III. Design Elements		
9. The module design is simple and uncluttered.	Strongly Agree	86
	Agree	14
10. The organization of the training module is easy to follow.	Strongly Agree	71
	Agree	29
11. The directions given for the learner to follow are easy to understand.	Strongly Agree	86
	Agree	14
12. The start of each section within the module is clearly understood.	Strongly Agree	43
	Agree	43
	Disagree	14
13. The end of each section within the module is clearly understood.	Strongly Agree	43
	Agree	29
	Disagree	14
	Strongly Disagree	14
14. The fonts and colors promote legibility within the module.	Strongly Agree	43
	Agree	57
15. Feedback messages appear in a consistent layout on each page.	Strongly Agree	57
	Agree	29
	No Answer	14
16. Help messages appear in a consistent layout on each page.	Strongly Agree	57

	Agree	29
	No Answer	14
17. Error messages appear in a consistent layout on each page.	Strongly Agree	57
	Agree	29
	Disagree	14
18. All links, icons and navigation buttons work as expected.	Strongly Agree	57
	Agree	43
19. The overall tone of the module is engaging.	Strongly Agree	57
	Agree	43
Section IV. Graphics/Animations/Multimedia		
20. The graphics used in the module help to enhance my learning.	Strongly Agree	29
	Agree	43
	Disagree	14
	No Answer	14
21. Layout of graphics, fonts, font size, font color, and positioning of icons were all consistent.	Strongly Agree	43
	Agree	43
	No Answer	14
22. The various text animations (e.g. text highlight, text movement etc.) helped me to focus on what I should be learning.	Strongly Agree	57
	Agree	29
	Disagree	14
23. The audio provides useful information and enhances my learning.	Strongly Agree	86
	Agree	14
24. The interactions make the training interesting.	Strongly Agree	57
	Agree	29
	Disagree	14
Section V. Navigation		
25. Within the module, navigation buttons are clearly marked.	Strongly Agree	57
	Agree	29
	Disagree	14
26. I can navigate to various parts of the module as desired.	Strongly Agree	43
	Agree	57
27. I can navigate to the beginning of the module easily.	Strongly Agree	43
	Agree	43
	Disagree	14
28. Navigation is consistent within the module.	Strongly Agree	43
	Agree	57
29. There is tracking information available so that I can see where I am within the module at all times.	Strongly Agree	57
	Agree	29
	Disagree	14
Section VI. Training Module Content		
30. I think that the question examples used in the module made learning the concepts easy.	Strongly Agree	57
	Agree	43
31. The feedback given in the module helped me to learn.	Strongly Agree	71
	Agree	29
32. The way the information (all the questions first followed by feedback) is presented in the module helps me to learn.	Strongly Agree	43
	Agree	43
	Disagree	14
33. I find the information in the module to be useful and relevant to me.	Strongly Agree	43
	Agree	57
Section VII. Your Opinion Matters		
34. Please state what you like most about this training module:	Open ended	100
Response 1. It was informative		

Response 2. Interesting tips			
Response 3. The interaction kept me focused, which I really liked.			
Response 4. I really enjoyed the training module very much, and hope for the success of it because I would like to have this module as a course here at [name of school].			
Response 5. How to break down the question that I didn't understand.			
Response 6. I liked the way that the module showed how to break down the questions to better help the students learn. I also like how they showed key words to look at to help decide which answer was best for me to choose.			
Response 7. What I liked most about this training module is how each unfamiliar word was explained in different parts which made finding the answer very easy.			
35. Please state one thing you would change in this module:		Open ended	100
Response 1. Some things seem to be bad examples, like the last question. When an answer doesn’t flow with the question it seems to be more of an error than a giveaway			
Response 2. For certain facts, checking "will" or "likely" is not very helpful.			
Response 3. The guy that pops up on the screen is annoying.			
Response 4. Nothing.			
Response 5. There was no clear statement to let me know that I was finish.			
Response 6. Sometimes, during the answer session, the graphics would get distracting, instead of focusing on what was being taught to me, I started watching the falling letters.			
Response 7. The narrator's voice was a little boring at times.			

Specimen B-5

Development Phase: List of refinements from formative evaluations

Participant/s	Number	Description	Changed?	Comment
SME, Director of LEARN Program	1	Number each question.	YES	Numbered each question.
	2	In narration at the beginning, add" Go through the 10 questions first. At the end you will find an explanation for each choice.	YES	Updated narration.
	3	In introduction narration add "Remember, there is never any replacement for good preparation. We are going to introduce you several strategies you can use to aid in your test preparation. You cannot pass a test based only on these strategies but you can certainly gain some points."	YES	Updated narration.
	4	In evaluation find out whether "instant feedback helped".	YES	Conduct summative evaluation.
SME, ID, Programmer1	NULL	No refinement information	N/A	
SME	5	Technical delays - investigate	YES	Found out that the Flash Player needed to be updated to the current version.
	6	Check navigation links	NO	Buttons work as they should. A feature in Captivate using a 'skin' - which is a pre-made navigation menu and color scheme, was used. "Closed Caption" button was not utilized but appeared on the module.
	7	End of sections - not defined	YES	Added slides to explain end of each section
	8	Question 6. When explanation is over, screen takes too long to clear	YES	Decreased it by approx. 15 seconds.
	9	Question 7. I moved the cursor and the screen disappeared	NO	Problem did not re-occur during re-testing
	10	Question 8. If cursor is not left on the nm square, the narration stops	NO	This is how it is meant to work.
	11	Question 9. Typing "grammar clues" does not add any instructional or entertaining value. This screen takes too long to fade out.	YES	Focused on technical issue - slow fade out. Left "grammar clues". From an instructional perspective it is useful. Reinforces that the learner needs to look for

				"grammar clues". Also change from a passive learner to an active learner.
ID, Programmer #2	NULL	No refinement information	**N/A**	
2 ID Experts	12	Check navigation links	**NO**	No change (1 respondent)
	13	Technical delays - investigate	**YES**	Did not download Flash player.
	14	Change "Ace My Test" to "Ace Your Test"	**YES**	Changed.
	15	For a future version - a PDF I could print out with the tips as a review sheet later and may be some other resources, websites I could go to for study/test taking skills.	**NO**	No change (1 respondent)
	16	The navigation buttons at the bottom were unclear at first. I had to roll over the "forward" button to be sure I was on the right one. I made the assumption that it was "forward", but it might be helpful for the buttons to be labeled.	**YES**	To a great extent, the “skin” which dictates the navigation buttons appearance, is part of the design template. In between sections, a prompt appears to tell the student what button to use next to move forward.
7 Learners – Reading Class	17	Technical delays - investigate	**YES**	Old PCs - Speed and memory -
	18	Organization? (2 respondents)	**YES**	Added more narration and a new slide.
	19	Directions (1 respondent)	**YES**	Added more narration and a new slide.
	20	Start and end of sections not clearly understood	**YES**	Added more narration and a new slide.
	21	Layout of error message consistency problem	**YES**	Consistent
	22	Navigation clearly marked?	**YES**	Added more narration and a new slide.
	23	Question examples bad	**NO**	No change (1 respondent)
	24	Guy that pops up onscreen - annoying	**NO**	No change (1 respondent)
	25	No clear statement that it was completed	**NO**	This is clearly marked and stated in the narration
	26	Graphics distracting	**NO**	No change (1 respondent)

Specimen B-6

Iteration 1- Evaluation Phase: Instrument and summary of results from "Summative Usability Evaluation" questionnaire

n=15		
Section I. Learner Background		
Questions	**Category**	**% in Category**
1. What is your gender?	Male	33
	Female	67
2. In college, I am a (choose one)	Freshman	87
	Sophomore	0
	Junior	0
	Senior	0
	Other	7
	No answer	7
3. What is your age?	Open ended	100
4. I attend college (choose one)	Full-time	80
	Part-time	7
	No answer	7
5. If given a choice between a traditional (i.e. classroom/face-to-face class) version of a course and a web-based version, where both are available at convenient times, I would take the:	Traditional (classroom version)	73
	Web-based version	27
Section II. Accessibility		
6. The training module runs on my computer without any problems.	Strongly Agree	80
	Agree	13
	Disagree	7
7. All the links within the module work in my browser.	Strongly Agree	87
	Agree	13
8. I did not experience any technical delays while going through this training module.	Strongly Agree	67
	Agree	33
Section III. Design Elements		
9. The module design is simple and uncluttered.	Strongly Agree	80
	Agree	20
10. The organization of the training module is easy to follow.	Strongly Agree	93
	Agree	7
11. The directions given for the learner to follow are easy to understand.	Strongly Agree	80
	Agree	20
12. The start of each section within the module is clearly understood.	Strongly Agree	80
	Agree	20
13. The end of each section within the module is clearly understood.	Strongly Agree	80
	Agree	20
14. The fonts and colors promote legibility within the module.	Strongly Agree	80
	Agree	20
15. Feedback messages appear in a consistent layout on each page.	Strongly Agree	20
	Agree	67
	Disagree	7

16. Help messages appear in a consistent layout on each page.	Strongly Agree	20
	Agree	67
	Disagree	7
17. Error messages appear in a consistent layout on each page.	Strongly Agree	20
	Agree	53
	Disagree	20
	Strongly Disagree	7
18. All links, icons and navigation buttons work as expected.	Strongly Agree	47
	Agree	47
	Disagree	7
19. The overall tone of the module is engaging.	Strongly Agree	60
	Agree	40
Section IV. Graphics/Animations/Multimedia		
20. The graphics used in the module help to enhance my learning.	Strongly Agree	53
	Agree	40
	Strongly Disagree	7
21. Layout of graphics, fonts, font size, font color, and positioning of icons were all consistent.	Strongly Agree	60
	Agree	40
22. The various text animations (e.g. text highlight, text movement etc.) helped me to focus on what I should be learning.	Strongly Agree	60
	Agree	40
23. The audio provides useful information and enhances my learning.	Strongly Agree	73
	Agree	27
24. The interactions make the training interesting.	Strongly Agree	67
	Agree	33
Section V. Navigation		
25. Within the module, navigation buttons are clearly marked.	Strongly Agree	67
	Agree	33
26. I can navigate to various parts of the module as desired.	Strongly Agree	47
	Agree	53
27. I can navigate to the beginning of the module easily.	Strongly Agree	47
	Agree	53
28. Navigation is consistent within the module.	Strongly Agree	47
	Agree	47
	Disagree	7
29. There is tracking information available so that I can see where I am within the module at all times.	Strongly Agree	40
	Agree	60
Section VI. Training Module Content		
30. I think that the question examples used in the module made learning the concepts easy.	Strongly Agree	53
	Agree	40
	Disagree	7
31. The feedback given in the module helped me to learn.	Strongly Agree	53
	Agree	47
32. The way the information (all the questions first followed by feedback) is presented in the module helps me to learn.	Strongly Agree	53
	Agree	47
33. I find the information in the module to be useful and relevant to me.	Strongly Agree	47
	Agree	53
Section VII. Your Opinion Matters		
34. Please state what you like most about this training module:	Open ended	93
Response 1. It was real easy, very understanding, and very helpful		
Response 2. It gave me test taking tips that I would have never thought of.		
Response 3. Although I only had two answers wrong the training module gave me tips on all ten questions		
Response 4. I like the graphic design of the tutorial because it would emphasize certain words that I needed		

to know.		
Response 5. IT HAS GREAT EXAMPLES USED TO HELP ON TEST-TAKING SKILLS!!		
Response 6. I liked that after I was finished testing, it didn't just give me a score. I came back and told me where I messed up and what ways I could have looked at each question differently.		
Response 7. What I like most about this training module is that the questions were clear and enhanced my learning.		
Response 8. I like the audio and how it broke down some simple tips that I tend to look over it was very helpful		
Response 9. What I liked the most in the module was the questions that were asked. Though the questions were challenging, they were interesting to think about.		
Response 10. I liked the audio that went along with this module, because it made it alot easier to take in the information.		
Response 11. What I liked the most about the training was how after I finished the test, the module showed me what to look for in a question, whether I got the question right or wrong.		
Response 12. What I liked most about the training module was the fact that it was very helpful when the feedback was given.		
Response 13. What I liked most of the module is it explained how they got the answers to the questions at the end of the test.		
Response 14. From the ID perspective, it was engaging in nature - the "mission" theme/motif was carried through the whole module.		
35. Please state one thing you would change in this module:	Open ended	100
Response 1. Nothing at all		
Response 2. There isn’t much I would change about it.		
Response 3. The voice is a bit monotone		
Response 4. I honestly can't think of anything to change about this tutorial. It covered every detail and question I would have had.		
Response 5. I WOULD EXTEND THE TIME AND ADD MORE QUESTIONS AND EXAMPLES!		
Response 6. Nothing, it was an excellent tutorial for me.		
Response 7. One thing I would change in this module is adding more questions related to the subject.		
Response 8. Honestly nothing it was all good		
Response 9. What I would change about this module is to provide more feedback on the answers given and to explain why a person might have chosen that answer.		
Response 10. The thing that I would change would be, during the learning part, after the quiz, it should give more time in between the questions to take in all of the useful information.		
Response 11. I would change the voice of the speaker, some people would prefer a softer voice.		
Response 12. I would change the amount of question. It was short but it hit the important ones but adding a few more would be good.		
Response 13. I would have more questions and make them more of a challenge.		
Response 14. Decrease the time to download - It took me approx: 5 minutes (which seemed like longer) using the Internet connection and computer at a public library.		
Response 15. One of the last questions asked the user to "roll over" the text in blue. The user actually needs to "click" on the blue text to see the statement.		

Specimen B-7

Iteration 1- Evaluation Phase: List of refinements derived from summative review after iteration 1 of the "design-evaluate-refine" cycle

Participant/s	Number	Description	Changed?	Comment
Learners - UE class	1	Error message layout - not consistent (1 respondent)	**YES**	Checked - all messages and re-set to appear at top right hand corner.
	2	The voice is a bit monotone (2 respondents)	**NO**	Not a feasible option
	3	Extend time and add more questions	**NO**	No more content at this point in time.
	4	Provide more feedback on the answers given and explain why a person might have chosen that answer.	**NO**	Unfortunately, the content does not provide the "psychology" as to why a person would choose an particular response
ID Experts	5	Decrease the time to download - It took one user approx: 5 minutes using the Internet connection and computer at a public library.	**NO**	Unfortunately - this is an attribute that cannot be easily corrected - there are no jpegs files - there are a number of audio that may be causing delays - I recompiled program but there are no options given in Captivate to reduce download - also there is an option for audio quality - but adjusting this resulted in a degraded quality.

Specimen B-8

Iteration 2 - Evaluation Phase: Instrument and summary of results from "Summative Usability Evaluation" questionnaire

n=22		
Section I. Learner Background		
Questions	**Category**	**% in Category**
1. What is your gender?	Male	36
	Female	64
2. In college, I am a (choose one)	Freshman	91
	Sophomore	0
	Junior	0
	Senior	0
	Other	5
	No answer	5
3. What is your age?	Open ended	100
4. I attend college (choose one)	Full-time	86
	Part-time	5
	No answer	9
5. If given a choice between a traditional (i.e. classroom/face-to-face class) version of a course and a web-based version, where both are available at convenient times, I would take the:	Traditional (classroom version)	77
	Web-based version	18
	No answer	5
Section II. Accessibility		
6. The training module runs on my computer without any problems.	Strongly Agree	82
	Agree	14
	No answer	5
7. All the links within the module work in my browser.	Strongly Agree	91
	Agree	9
8. I did not experience any technical delays while going through this training module.	Strongly Agree	82
	Agree	18
Section III. Design Elements		
9. The module design is simple and uncluttered.	Strongly Agree	64
	Agree	36
10. The organization of the training module is easy to follow.	Strongly Agree	77
	Agree	23
11. The directions given for the learner to follow are easy to understand.	Strongly Agree	82
	Agree	18
12. The start of each section within the module is clearly understood.	Strongly Agree	77
	Agree	23
13. The end of each section within the module is clearly understood.	Strongly Agree	73
	Agree	14
	Disagree	9
	Strongly Disagree	5
14. The fonts and colors promote legibility within the module.	Strongly Agree	68
	Agree	32

15. Feedback messages appear in a consistent layout on each page.	Strongly Agree	59
	Agree	41
16. Help messages appear in a consistent layout on each page.	Strongly Agree	50
	Agree	45
	Disagree	5
17. Error messages appear in a consistent layout on each page.	Strongly Agree	41
	Agree	55
	Disagree	5
18. All links, icons and navigation buttons work as expected.	Strongly Agree	59
	Agree	41
19. The overall tone of the module is engaging.	Strongly Agree	55
	Agree	32
	Disagree	5
	Strongly Disagree	5
Section IV. Graphics/Animations/Multimedia		
20. The graphics used in the module help to enhance my learning.	Strongly Agree	55
	Agree	45
21. Layout of graphics, fonts, font size, font color, and positioning of icons were all consistent.	Strongly Agree	55
	Agree	45
22. The various text animations (e.g. text highlight, text movement etc.) helped me to focus on what I should be learning.	Strongly Agree	68
	Agree	27
	Disagree	5
23. The audio provides useful information and enhances my learning.	Strongly Agree	68
	Agree	27
	Disagree	5
24. The interactions make the training interesting.	Strongly Agree	59
	Agree	41
Section V. Navigation		
25. Within the module, navigation buttons are clearly marked.	Strongly Agree	73
	Agree	23
	Disagree	5
26. I can navigate to various parts of the module as desired.	Strongly Agree	68
	Agree	27
	Disagree	5
27. I can navigate to the beginning of the module easily.	Strongly Agree	59
	Agree	36
	Disagree	5
28. Navigation is consistent within the module.	Strongly Agree	64
	Agree	32
	Disagree	5
29. There is tracking information available so that I can see where I am within the module at all times.	Strongly Agree	68
	Agree	27
	Disagree	5
Section VI. Training Module Content		
30. I think that the question examples used in the module made learning the concepts easy.	Strongly Agree	73
	Agree	23
	Disagree	5
31. The feedback given in the module helped me to learn.	Strongly Agree	59
	Agree	41
32. The way the information (all the questions first followed by feedback) is presented in the module helps me to learn.	Strongly Agree	64
	Agree	36
33. I find the information in the module to be useful and relevant to	Strongly Agree	68

me.	Agree	32
Section VII. Your Opinion Matters		
34. Please state what you like most about this training module:	Open ended	100
Response 1. It helps you to focus on keywords in the question that may be there to trick you.		
Response 2. I like the main goal which will help me to focus more on the wording the next time I take a quiz or test.		
Response 3. I thought the questions were interesting		
Response 4. Fun an easy to learn.		
Response 5. The thing that I liked most about this module was the animation. it wasn't too much so as to get me distracted, yet it was enough to keep me interested.		
Response 6. The interactive questions.		
Response 7. I like the whole concept of the module. I learn something new today so thank you		
Response 8. What I liked most is that it was helpful and easy to do.		
Response 9. I liked that there was audio with the module because although I like reading the material, it is easier to understand for me when I hear what I'm being taught.		
Response 10. It taught me useful tricks to taking a test.		
Response 11. I liked the color and the way everything is clearly pointed out in the module.		
Response 12. The most interesting part is the way the examples are explained at the end, I liked how specific and helpful certain words are in a sentence.		
Response 13. It was interesting.		
Response 14. It was interesting and made answering the questions fun and interactive.		
Response 15. I liked the way the learning concepts were broken down. They seem to be presented in an intelligent way.		
Response 16. I like that the words and tips were highlighted in specifics so that I could better understand how to answer each different kind of question		
Response 17. I liked how the module actually went over the test with you and picked out different things in the questions and pointed them out		
Response 18. It was short, sweet, and to the point. There wasn't any fluff or unnecessary information.		
Response 19. It was interesting and fun. The questions were also good questions based on really life situations which made it fun.		
Response 20. I liked the pictures that were in the test review section. They made listening to the explanation interesting.		
Response 21. The module is very engaging visually.		
Response 22. The module was interesting and I think would keep the attention of an elementary or middle school student.		
35. Please state one thing you would change in this module:	Open ended	82
Response 1. I would make the questions more objective.		
Response 2. Explain some things more.		
Response 3. The one thing that I would change about this module is in the section where you have to type the word in the yellow box it should say now "click the forward button" when you are finished.		
Response 4. I would just change the audio on the one part where the narrator says "Micro".		
Response 5. I really wouldn’t change anything about it I thought that it was good.		
Response 6. I think that the module was sufficiently put together, but if I was to change something about it, I would put more time in between the questions during the teaching part because they go by kind of fast.		
Response 7. I would change the intro to make it more relevant to college level learning.		
Response 8. I did not like the voice so much ,but it isn't too bad		
Response 9. Make the person speaking a little bit more lively, although he is very good at explaining and has very good pronunciation, he is very monotone, and it can make the module a bit boring, and because there is so much info to be learned, you don't want the student to get bored. But besides that, it was great :) Thank you		
Response 10. It would've been nice to take another test after learning to put the information to good use.		
Response 11. Nothing.		

Response 12. The voice within the program needs to be altered. It is a little creepy.
Response 13. I think the learner section went a little fast
Response 14. I don't think there is anything to change
Response 15. Nothing that I can think of. Whoever made this module did a good job!!!
Response 16. I would add a little more color.
Response 17. Printable notes, tips, or something to save to my own computer for quick reference later.
Response 18. IF the audience is higher than elementary or middle school, I would suggest changing the narrator.

Specimen B-9

Iteration 2 - Evaluation Phase: List of refinements derived from summative review after iteration 2 of the "design-evaluate-refine" cycle

Participant/s	Number	Description	Changed?	Comment
UE Experience Class	1	End of section – somewhat unclear	**NO**	Acceptable – majority – 87% either strongly agreed or agreed that the sections were clearly marked
	2	Error messages are not consistent on page	**NO**	Acceptable – majority – 95% either strongly agreed or agreed that error messages were consistent in the layout
	3	Navigation buttons are not clearly marked, consistent and cannot navigate easily	**NO**	Acceptable – majority – 95% either strongly agreed or agreed that the navigation buttons are clearly marked, consistent and that you can navigate module easily
	4	More explanations needed (1 respondent)	**NO**	Content provides no further details.
	5	Narrator could be more lively or different	**NO**	Not feasible due to a time constraint
	6	Printable notes (1 respondent)	**NO**	Not feasible due to a time constraint
	7	Add another test to practice what was learned	**NO**	Not feasible due to a time constraint

Specimen B-10

DBR Perspective: Instrument and summary of results from "Evaluate Design Decisions Questionnaire"

n=3		
Section I: Objectives and Assessments		
Questions	**Choices**	**% in Categories**
1. My role in this web-based initiative is:	Programmer	33
	Instructional Designer	33
	Subject Matter Expert	33
2. The purpose of this initiative, to develop a web-based training module, is clear to me.	Strongly Agree	100
3. Please state what you believe to be the purpose of developing this web-based training module.	Open-ended	
4. I know the stakeholders who are involved in this initiative to develop a web-based training module.	Strongly Agree	67
	Agree	33
5. Who are the most important stakeholders in this initiative to develop a web-based training module?	Administrators	0
	Faculty	
	Learners	100
	Other	0
6. To develop the web-based training module, it was important to assess learner's knowledge or each learner's previous knowledge.	Strongly Agree	33
	Agree	33
	Disagree	33
7. For this module development initiative it is important to provide feedback to the learners after assessment.	Strongly Agree	33
	Agree	
	Disagree	67
8. Learner analysis information gathered from the "Analysis" phase was used to guide instructional strategies proposed for the module.	Strongly Agree	67
	Agree	33
Section II. Instructional Strategy		
9. The instructional strategy was decided (i.e. moving from traditional to online and providing interaction and instant feedback for learners) early in the "design phase".	Strongly Agree	100
10. Was an Instructional Design Plan (IDP) developed by the instructional designer?	Yes	67
	No	0
	I Don't Know	33
If you answered "Yes" to the previous question please go to Question 11 else please go to Question 12.		
11. How many meetings did you have before an IDP was created?	0	0
	1	0
	2	0
	3	67
	No Answer	33
12. I think an IDP is essential in guiding development.	Strongly Agree	67
	Agree	33
13. Who do you think was most influential in choosing an instructional	SME	67

strategy for the initiative?	Programmer	0
	Instructional Designer	33
	Other	0
14. Who do you think was most influential in setting design elements for the initiative?	SME	0
	Programmer	33
	Instructional Designer	67
	Other	0
15. Design elements such as font (size and color), background color, animations, graphics and audio were discussed in detail in meetings.	Agree	67
	Disagree	33
16. Who do you think was most influential in choosing hardware and software for the initiative?	SME	0
	Programmer	0
	Instructional Designer	67
	Other	33
17. Interaction interfaces and interaction design elements were established in meetings at this phase (i.e. Design Phase of ADDIE).	Strongly Agree	33
	Agree	67
18. Use of media elements such as audio, video, animation and graphics was guided by the information derived from the Analysis phase.	Strongly Agree	33
	Agree	33
	No Answer	33
19. Navigation issues were discussed in meetings in this phase (i.e. Design Phase of ADDIE).	Strongly Agree	33
	Agree	33
	No Answer	33
20. How the information would be presented to the learner (whether one concept one question at a time followed by feedback or a group of concepts/questions followed by feedback) was discussed in meetings at this phase (i.e. Design Phase of ADDIE).	Strongly Agree	33
	Agree	67
21. There were quality control guidelines that addressed clarity and consistency issues (e.g. using an IDP to guide development).	Strongly Agree	67
	No Answer	33
22. The source of the content for the initiative was derived mainly from:	SME	100
	Programmer	0
	Instructional Designer	0
	Other	0
Section III: Delivery Selection System and Prototyping		
23. The delivery system (e.g. whether via Internet or Face-to-Face or Blended) choice was influenced most by:	SME	67
	Programmer	0
	Instructional Designer	33
	Other	0
24. A prototype was developed in this phase (i.e. Design Phase of ADDIE).	Strongly Agree	67
	Agree	33
25. If a prototype was developed, it helped to show what the final web-based module would potentially "look, sound and feel" like.	Strongly Agree	100
26. A prototype would help to reduce costly design changes.	Strongly Agree	33
	Agree	33
	Disagree	33
27. The feedback from the prototype is expected to refine the design and development of the web-based module.	Strongly Agree	67
	Agree	33
28. Given the opportunity, I will always recommend developing a prototype when developing web-based instruction.	Strongly Agree	67
	Agree	33

29. If you have additional comments, please add it here:	Open ended	100
Response 1. Proper testing of desired design deliverable content was initially over-shadowed by incapacitates of delivery method. This was quickly resolved with the Instructional Designer, the SME and the programmer.		
Response 2. In section II, I could not answer questions 11, 18, 19, and 21 because I did not have that information. An "I don't know" choice is needed. I did not know if a formal IDP was created or when it was created. Additionally, I did not know if the meetings that were conducted fell before or after the design or analysis phases.		
Response 3. The prototype helped tremendously in refining design elements. In this case, especially what design elements that was desired and not desired. A simple IDP was developed but not formally presented to the SME. The programmer was given information on how the content should be presented (questions first, followed by feedback). Details about colors/fonts were mentioned.		

Specimen B-11

DBR Perspective: Instrument and summary of results of the "Module Development Questionnaire"

n=2		
Section I. Content Development		
Questions	**Categories**	**% on Categories**
1. In this module development initiative, I was a:	Programmer	50
	Instructional Designer	50
2. Content sequencing (i.e. linear or branching) meets the requirement determined in the design phase.	Strongly Agree	100
3. Content is modularized and can be easily changed and customized.	Strongly Agree	50
	Agree	50
4. Content is appropriate for the target audience as determined from the analysis phase.	Strongly Agree	100
5. The content is accurate as determined from the analysis phase.	Strongly Agree	100
6. How much time (in days) did it take to integrate the content to module design?	Open ended	100
Response 1. 10 days		
Response 2. 10 days		
7. The sequencing of the content followed the design criteria set in the Instructional Design Plan (IDP).	Yes	100
If you responded "No", go to Question 8, otherwise go on to Question 9.		
8. Explain why the sequencing was different than what was requested in the IDP.	Open ended	0
9. The Subject Matter Expert (SME) helped to maintain accuracy of content throughout development.	Strongly Agree	100
Section II. Hardware and Software Elements		
10. The software application used to develop the training module can be easily deployed in any platform (e.g. Windows or Mac environment).	Strongly Agree	100
11. The software application used to develop the training module is the same as the one requested in the IDP (Instructional Design Plan).	No	100
If you responded "No", go to Question 12, otherwise go on to Question 13.		
12. Please explain why a software application other than the one defined in the IDP was used to develop the training module.	Open ended	100
Response 1. The first programmers suggested and used Authorware® 6.0. However, the design called for questions presented first, followed by detailed feedback of each question. The first programmer could not accomplish this using Authorware® 6.0 . The Captivate application was used for module development.		
Response 2. Captivate was used instead of Authorware® 6.0. Change in programmers. Captivate offered an easier way to accomplish animations, include audio etc. It was also easy to deploy and use. It required a download of the Flash 9 player.		
13. No downloads are required to run the module.	Yes	50
	No	50
14. No special hardware is required to run the module.	Yes	50

	No	50
15. How much time (in days) did it take to decide on hardware and software elements?	Open ended	100
Response 1. 1		
Response 2. 1		
Section III. Design Elements		
16. The prototype helped to define desired design elements.	Strongly Agree	100
17. Interactions that were developed followed the specifications defined in the IDP.	No	100
If you responded "No", go to Question 18, otherwise go on to Question 19.		
18. Please explain why interactions were not developed as defined in the IDP plan.	Open ended	100
Response 1. During development, some minor changes occurred. Some of the highlight text and text animations features were decided upon during development.		
Response 2. Captivate afforded different types of animations to be used. Flash and other text animations were used. This is different from what could have been created using Authorware.		
19. Interactions complemented the learning.	Strongly Agree	100
20. Colors of fonts and background work well in various browsers.	Strongly Agree	100
21. Text animations are used to complement the learning.	Strongly Agree	100
22. All navigation buttons are consistent throughout the module.	Strongly Agree	100
23. How much time (in days) did it take to develop the design elements?	Open ended	100
Response 1. 10		
Response 2. 10		
Section IV. Your Opinion Matters		
24. State any problems you encountered in developing the module:	Open ended	100
Response 1. As stated previously. The initial decision was to use Authorware 6. However, later, a change in programmers prompted the use of Captivate 3.0.		
Response 2. Captivate has some limitations, such as no drawing features (cannot draw lines). Also some timing issues between audio and slide animations took some time to resolve.		
25. State what assisted you in the development of the training module:	Open ended	100
Response 1. IDP plan was used as a guideline throughout development. Also, the SME was available when questions about content arose.		
Response 2. Although Captivate has limitations, it is relatively very easy to use in comparison to Authorware.		

Appendix C: Instructional Development Plan (IDP)

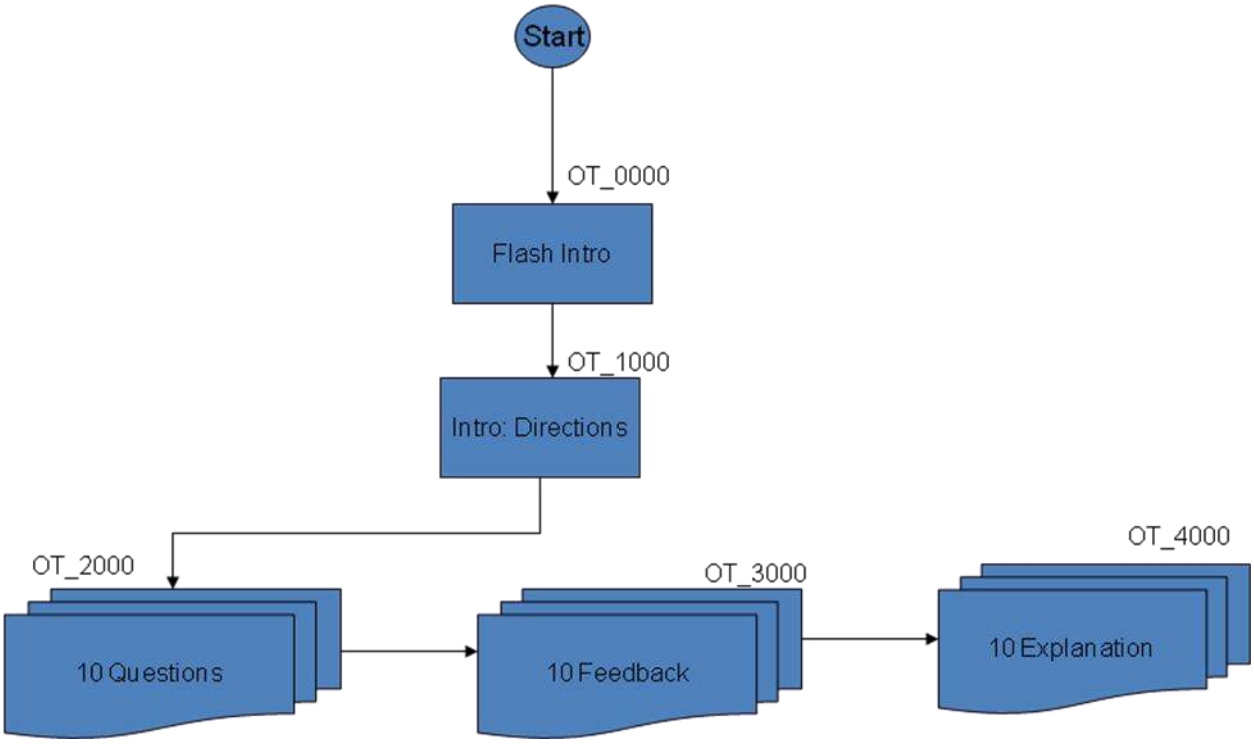
IDP: Test taking Strategies -Objective Test Module

- Hardware – PC – Audio/Graphics card
- Software – Authorware® 6.0 (possibility: Captivate 3.0)
- Target Audience – College students enrolled in Learning Strategies course (18-25)
- Accessibility – Internet
- Environment – delivered via Internet – run on PC/Mac
- Interactivity Level - High

IDP: Style Guide

- Font: Arial (size will change depending on length of question)
- Background: White/Graphic
- Navigation – Template (bottom right) – find an existing template (if using Adobe Captivate)
- Animation graphics – text graphics (highlights, rollovers).
- Audio – only for Intro, explanation and conclusion

IDP: Flowchart: Objective Test Module



Appendix D: Excerpt from Logbook

Week1 Wednesday 21st June, 2006 I have gathered several pieces of information for the first phase of this project. The analysis phase involves many types of analyses such as Audience, Technical, Goals, Content and Context. Within each of these areas, there is a refined breakdown of information. The literature on the Analysis portion is immense, yet trying to pinpoint examples is rather difficult. There are many books and journal article on "How To" do an analysis but no strongly structured examples are given, or if there are examples I have not found them. Anyway, it looks like I will have to take bits and pieces of the examples I have found and add my own information. I have also spoken to Claudia and Dr. White, trying to gather as much information as possible. Claudia will be the SME. I don't have a clear idea of what type of measures can be done. I am hoping that grey area will be cleared up soon.
Week 2 Wednesday 28th June, 2006 The process of actually writing the interview questions for all of the analysis artifacts is very difficult. Trying to get the theories behind the needs analysis, task analysis, context and content analysis is also difficult. The literature on each part is a bit ambiguous. I have created a flowchart of how the phases will occur and what is going to occur in each phase. I have made changes to this after doing some reading on the analysis portion. I have to meet with Dr. White on Friday so he can go over the Analysis artifacts. I have not completed these artifacts. I have also emailed Claudia to let her know where I am at and also to ask her for any enrollment data she has over the past years. I think this will prove useful when trying to justify why the course is moving to online.
Week 3 Wednesday 5th July, 2006 The IRB process has begun. Met with Brenda Kuska (974-6433) and Dr. White. Since this is only the Analysis phase that I have to complete. The IRB approval will only cover this first phase. All the interview questions are attached to the IRB application. Scientific reviewer is Dr. Kealy. At this point I am awaiting approval.
Week 4 Wednesday 12th July, 2006 I had to renew my IRB certification and submit that to Brenda. The application has to be reviewed again today. Claudia asked if the questions can be emailed to her once IRB approval has been awarded. She thinks that she can put more details if she spends more

time on her own answering the questions as opposed to an interview situation.
Week 5 Wednesday 19th July, 2006 Received IRB approval for Analysis phase. Emailed questions to Claudia.
Week 6 Wednesday 26th July, 2006 Claudia has class and work conflicts so she will not be able to respond to the questions until next week. She also will not have access to any of her students to answer some of the questions written for the users. Claudia also wants me to meet with her boss. Currently her boss is on vacation and will return in late August, but then Claudia will go on vacation then. It appears that my Analysis phase will be delayed a couple of weeks.
Week 7 Wednesday 2nd August, 2006 Research continues for literature review.
Week 8 Wednesday 9th August, 2006 Reviewing answers provided by Claudia. Some of Claudia comments suggested the questions themselves were incorrectly worded. She did not think that the word "problem" in the analysis section should be used, since they really are not addressing a problem, they are addressing a "need". I have to discuss with Dr. White on Friday.
Week 9 Wednesday 16th August, 2006 Preparing draft for pre-proposal. I did not make much progress. Dr. White mentioned that I should try to find information that deals with web-based initiatives. Also, after reviewing Claudia's responses with Dr. White, he suggested that it brought up an interesting topic…how to word the questions correctly when doing an analysis. Claudia pointed out that it was a "need" not a "problem". I should mention this in my dissertation. Careful consideration must be placed when wording the each question in the analysis phase. In the version in which I had "problem" Claudia were not able to relate to those questions, therefore the responses were not what I was looking for. The next step is to reword the questions and have a face to face interview with her. There were a number of questions that she did not respond to at all, this also need to be clarified. Dr. White

suggests that it is bet to request a face to face meeting with Claudia. It will alleviate some of the frustration of trying to deal with this via email. Also, if Claudia has any questions about the questions, I will be able to address the issue immediately, rather than having to wait a week for a response.
Week 30 Wednesday 10th January, 2007 Research on DBR. Contacted Claudia for meeting.
Week 31 Wednesday 17th January, 2007 Meeting is set with Claudia for next 2 weeks. Have to think about design issues – look over responses to open-ended questions. Also thinks about hardware/software issue that may be of concern,
Week 32 Wednesday 24th January, 2007 From analyzing the responses some students are concerned with animations (1 person commented that it was silly) and they like the interactivity (online chat etc.).
Week 33 Wednesday 31st January, 2007 Meeting with Claudia cancelled to 02/09/07
Week 34 Wednesday 7th February, 2007 Meeting with Claudia yielded some design information/issues. First it will be a standalone website, maintained by Claudia. There is an assigned programmer but for my module I will be getting my own programmer. The links to the course will be delivered through BB – but will link to outside website. Module will be on test-taking strategies. Some design issues: think of style, use Dreamweaver/Flash, not sure if tracking is required, no login requirement, animation and must be meaningful. No more than 20 minutes of online. Not boring. Should convey "BEST PRACTICES IN TEST TAKING STRATEGIES". Think about loading time etc.

ABOUT THE AUTHOR

Oma B. Singh is currently working as an Instructional Designer at a private liberal arts not-for-profit university. Prior to her doctoral pursuit of a degree in Instructional Technology at the College of Education at the University of South Florida, Oma was a computer programmer analyst at a multi-national magazine distribution company. After having gained six years of expert computer programming experience, she decided to pursue a Master of Science degree in Management Information Systems (MIS) with an emphasis in database systems analysis, design and programming. Oma holds both a Bachelor and Master of Science degree in MIS.

While pursuing her doctoral degree, she had the opportunity to work as the Director of Training and Instructional Designer at a small private company that specialized in providing systems engineering as well as computer-based and instructor-led training development for clientele that included various branches of the U.S Department of Defense. Oma is looking forward to teaching and conducting further research to help practitioners in the field of Instructional Technology.