Development of a Prototype Multimedia Environment to Support Hispanic English Language Learners’ Academic Learning Through Embedded Cognitive Strategy Instruction

by

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ABSTRACT

The number of English language learners continues to grow in United States’ schools and their achievement level continues to lag behind their peers. This developmental study investigated the design and development of a multimedia environment that embedded cognitive strategy instruction to assist ELL students’ academic content learning. High school ELL students face the hardship of preparing for various state mandated graduation requirements while learning the English language and learning strategies are believed to help ELL students improve their learning. The multimedia tutorial embedded rehearsal, elaboration, and compensation learning strategies to help the ELL students understand and recall information about state mandated computer competencies. Formative evaluation was used to gather data from five intermediate Hispanic ELL high school students in grades 9 through 11. Lessons learned from embedding rehearsal, elaboration, and compensation learning strategies in multimedia instruction and recommendations for future development are discussed.
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DEDICATION

With love and admiration I thank my husband Elazer who has encouraged, proofed, edited, and loved unfailingly through it all. Thanks for constantly reminding me to believe that my Lord and Savior will not leave me in my hour of need.
<table>
<thead>
<tr>
<th>Table</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Table 1</td>
<td>Limited English Proficient Students’ NCC/T Performance for 2002-2003</td>
<td>35</td>
</tr>
<tr>
<td>Table 2</td>
<td>Entry Skill Level Assessment</td>
<td>60</td>
</tr>
<tr>
<td>Table 3</td>
<td>Questions Aligned to Learning Strategies</td>
<td>77</td>
</tr>
<tr>
<td>Table 4</td>
<td>Attitude questionnaire items 1-7</td>
<td>77</td>
</tr>
<tr>
<td>Table 5</td>
<td>Attitude questionnaire item 9</td>
<td>78</td>
</tr>
<tr>
<td>Table 6</td>
<td>Attitude questionnaire item 10</td>
<td>79</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

Figure 1. Tutorial introduction screen.................................................................43
Figure 2. Activating knowledge screen...............................................................44
Figure 3. Navigation controls screen.................................................................45
Figure 4. Tutorial interaction screen.................................................................46
Figure 5. Attention-focusing screen.................................................................47
Figure 6. NCTCST Introduction Screen.............................................................62
Figure 7. Navigation buttons with descriptions...............................................63
Figure 8. Introductory matching activity...........................................................65
Figure 9. Smart guessing strategy description...............................................67
Figure 10. Review strategy description.............................................................67
Figure 11. Imagery strategy description............................................................68
Figure 12. Edit a document task........................................................................72
Figure 13. Desktop publishing vocabulary word.............................................72
Figure 14. Original and revised navigation screens........................................123
Figure 15. Original and revised what do you know screens.........................124
Figure 16. Original and revised glossary screens..........................................125
# TABLE OF CONTENTS

ABSTRACT .......................................................................................................................................... ii  
ACKNOWLEDGEMENTS .................................................................................................................... iii  
DEDICATION ......................................................................................................................................... iv  
LIST OF TABLES ............................................................................................................................... vi  
LIST OF FIGURES ............................................................................................................................... vii  
TABLE OF CONTENTS ....................................................................................................................... viii  

## Chapter One ........................................................................................................................................ 1  
Introduction ......................................................................................................................................... 1  
Problem Statement ................................................................................................................................. 1  
Need for the Study ................................................................................................................................. 1  
Purpose of the Study ............................................................................................................................... 4  
Theoretical Framework ......................................................................................................................... 5  
Project Goals ......................................................................................................................................... 6  
Significance of the Study ....................................................................................................................... 6  
Limitations of Study .............................................................................................................................. 7  

## Chapter Two ...................................................................................................................................... 8  
Review of Literature ............................................................................................................................. 8  
  
  *Cognitive Information Processing Theory* .................................................................................. 8  
  *English Language Learners (ELL)* .......................................................................................... 12  
  *Learning Strategies and English Language Learners’ Strategy Use* .................................. 15  
  *Strategy Instruction* ........................................................................................................ 18  
  *Embedding Cognitive Strategies in Computer-based Multimedia Instruction* .............. 20  
Literature Review Summary ............................................................................................................... 28  

## Chapter Three .................................................................................................................................. 31  
Prototype Design, Development, and Evaluation .............................................................................. 31  
Participants ......................................................................................................................................... 31  
Prototype Design and Development .................................................................................................... 32  
  *Analyze the Problem* ......................................................................................................... 32  
  *Analyze the Domain of the Subject Area* .......................................................................... 33  
  *Analyze Each Task and Sequence Its Major Components* .............................................. 35  
  *Analyze and Sequence Supporting Content* ........................................................................ 38  
  *Specify Learning Events and Activities* ............................................................................... 39  
  *Prototype Development* .................................................................................................. 39  
  *Perform Interactive Message Design* ............................................................................. 42  
  *Evaluate the Instruction* ..................................................................................................... 47  
Pilot Study ........................................................................................................................................... 48  
  *Data Collection Methods* .................................................................................................. 49  
  *Data Analysis* ...................................................................................................................... 54  
NCTCST Revisions and Small Group Evaluation ................................................................................ 55  
Participants ........................................................................................................................................... 55  
Small Group Evaluation ....................................................................................................................... 56  
Data Collection ..................................................................................................................................... 56  
Data Analysis ....................................................................................................................................... 57
# Chapter Four

Prototype Evaluation ............................................. 58  
Participants .......................................................... 58  
Procedures ............................................................ 58  
  *Day One* .......................................................... 59  
  *Day Two* .......................................................... 66  
  *Day Three* ........................................................ 70  
  *Day Four* .......................................................... 74  

# Chapter Five

Discussion ............................................................ 81  
Analysis ............................................................... 82  
  Revisions ........................................................... 83  
  *General Design Issues* .......................................... 84  
  *Learning Strategy Discussion* ................................. 85  
  *Imagery Strategy* .................................................. 86  
  *Review Strategy* .................................................... 88  
  *Guessing Strategy* .................................................. 90  
Future Development .................................................. 91  
  *General Design* .................................................... 92  
  *Learning Strategies* ............................................... 92  
Contributions of Study .............................................. 92  
References ............................................................. 93  

Appendix A ............................................................ 101  
Appendix B ............................................................. 102  
Appendix C ............................................................. 103  
Appendix D ............................................................. 106  
Appendix E ............................................................. 107  
Appendix F ............................................................. 108  
Appendix G ............................................................. 113  
Appendix H ............................................................. 115  
Appendix I ............................................................. 116  
Appendix J ............................................................. 117  
Appendix K ............................................................. 120  
Appendix L ............................................................. 123  
Appendix M ............................................................. 126  
Appendix N ............................................................. 130  
VITA .............................................................................. 131
Chapter One

Introduction

The stakes have risen higher for all students including English Language Learners (ELL) who are equally accountable for meeting the standards of their English-speaking peers (Abadiano & Turner, 2002). “The number of these language-minority students continues to grow exponentially, but their level of academic achievement lags significantly behind that of their language-majority peers and appears to be worsening” (Short, 1999, p. 107). It was estimated for the year 2001-2002, that there were over 3.7 million ELL students being served in United States schools (National Center for Education Statistics, 2003) and from 1990 to 2000, it was reported that the number of ELL students being served in North Carolina grew between 100-200 percent (National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs, 2004).

English language learners aspire to fulfill educational requirements, not unlike other students, in order to pursue advanced education (Kandarakis, 1996). If fulfilling educational requirements is going to be a reality for ELL students, they will need to learn how to facilitate their learning (Oxford, 1990). It is felt that instruction in an academic content environment will provide the ELL with an environment in which to learn the language of academic content as well as acquire language learning simultaneously.

Problem Statement

The problem investigated for this study was the design and development of a multimedia environment that could support ELL students’ academic learning through embedded cognitive strategy instruction in preparation for satisfying a graduation requirement.

Need for the Study

In 1995, the North Carolina State Board of Education established the ABCs of Public Education, a plan for restructuring education in North Carolina. The ABCs of Public Education focuses on (1) accountability, (2) emphasis on the basics and on high
educational standards, and (3) local control. However, prior to the ABCs of Public Education, North Carolina had already established in 1991 the K-12 Computer/Technology Skills Standard Course of Study as one approach to close achievement gaps and improve education.

Computer/Technology skills have been added to the basic skills students in North Carolina must meet. The K-12 Computer/Technology Skills Standard Course of Study identifies the essential competencies and skills that all students need to be lifelong learners in a technology environment. The curriculum is designed to improve and enhance the learning of the other basic skills—reading, mathematics, and writing and the intent is to teach it as an integral part of all content areas. The North Carolina K-12 Computer/Technology Skills Standard Course of Study is aligned with the International Society for Technology in Education (ISTE) National Educational Technology Standards for Students (North Carolina Department of Public Instruction, 2004b).

North Carolina students must pass the computer competency tests as one of their graduation requirements. The North Carolina Tests of Computer Skills (NCC/T) consists of two competency tests: a 90-minute timed multiple-choice and a 100-minute timed performance test. The test assesses students’ knowledge of societal and ethical issues, databases, spreadsheets, keyboard utilization/word processing/desktop publishing, multimedia/presentation, and telecommunications/internet.

A two-year exemption period allows ELL students time to increase their English proficiency. Although ELL students are given a two-year exemption period, high school ELL students face the extra burden of preparing for various state mandated graduation requirements while learning the English language.

The school district faces several challenges preparing students to meet the North Carolina computer competency graduation requirement. The first challenge is the number of ELL students who need to pass the NCC/T. North Carolina reported for the 2002-2003 school year 467,614 students statewide took the computer skills competency test. The number of students by grade level passing the computer skills competency test for the 2002-2003 school year were: 80.4 percent of eighth graders; 81.9 percent of ninth graders; 90.2 percent of tenth graders; 93.9 percent of eleventh graders; and 96.3 percent of twelfth graders. The number of limited English proficient students by grade level
passing the computer skills competency test for the 2002-2003 school year were: 38.6 percent of 2,860 students in grade 8; 44.7 percent of 1,216 students at grade 9; 58.5 percent of 2,089 students at grade 10; 73.7 percent of 510 students at grade 11; and 88.4 percent of 959 students at grade 12 met the computer proficiency requirements (North Carolina Department of Public Instruction, 2004a)

The second challenge is being able to adequately serve these students. In the past, students have been placed in Business Education keyboarding classes, or remediation classes taught by Technology Specialists. Students not proficient in computer use and who have language proficiency hurdles find it difficult to increase their skills to a minimal level in classes with a large student to teacher ratio. Technology Specialists reported the difficulty of remediating students in classes that exceeded 12 to 15 students. Students placed in large classes are hindered from receiving minimum help with their computer skills. In addition, there is a population of high school students, including ELL students, who need to pass the test but are not receiving any preparation for the test because they cannot fit it into their already busy schedules. The stress of poor preparation, minimal preparation, or no preparation adds to students’ anxiety. Further, the teachers and administrators’ anxiety increases because of school district’s accountability standards (i.e., North Carolina ABCs of Public Education). Finding solutions for serving ELL high school students is crucial. When Technology Specialists were assigned to high schools, there was no clear vision of how students would be served. As a result, students were served in a semester-long class, year-long class, or pulled out of elective classes (Instructional Technology Specialists, personal communication, September, 2000).

The disadvantage of the semester- and year-long classes was students wasted valuable class time remaining in a remedial class they no longer needed. For the pullout program students were pulled out of an elective class for one or two remediation sessions. Obviously an entire curriculum cannot adequately be reviewed in one or two 55-minute sessions especially for ELLs who lack an adequate foundation. State budget cuts resulted in the elimination of some or all programs that prepared students for the NCC/T (Instructional Technology Specialists, personal communication, September, 2000).
Because of the number of ELL students needing extensive computer remediation and finding an intervention that does not encroach on an already tight student schedule, the development of an instructional environment that satisfies both is the goal of this study. This study focused on the design, development, and evaluation of a multimedia environment to support Hispanic ELLs’ academic learning through embedded cognitive strategy instruction in preparation for satisfying a graduation requirement. Students can use this multimedia tool any time they can fit it in their day.

**Purpose of the Study**

This research was an effort to design and develop a multimedia environment that could support ELLs academic learning using embedded learning strategy instruction. The computer-based multimedia instruction, which is grounded in cognitive theory, introduced ELL students to the guessing, imagery, and review learning strategies that can be used in preparation for the NCC/T. Some benefits of working in a multimedia environment are: ability to control the pace of instruction, choice of sequence to explore information, and ability to start and stop program depending on their needs (Yeh & Lehman, 2001). Another benefit of multimedia is its capacity to present information through multiple ways – text, imagery, and audio, which is especially beneficial to the ELL student (North Carolina Department Public Instruction, 1999; Sparks, 2000).

The design and implementation of a prototype teaching model provides information that cannot be gathered through theory alone (Wilson & Cole, 1996). For example, teaching models can assess the effectiveness of concepts or strategies derived from direct observations applied in a classroom setting. In addition, Wilson and Cole state that prototype teaching models can make research relevant to the practice of teaching because these prototype models apply theory in real-world settings. Therefore this study provides insight into the design and development of a multimedia learning strategy instruction teaching model that benefits ELL students in an academic content learning environment and adds to the limited body of knowledge about ELLs’ learning strategy use in academic content areas. English Language Learner (ELL) characteristics, cognitive learning strategies and ELLs’ strategy use, strategy instruction, and embedding strategies in computer-based multimedia instruction were areas investigated in the literature review.
Theoretical Framework

The cognitive information processing theory was chosen for this study because this theory explains how information is received, encoded, stored, and retrieved. The cognitive information-processing model has three stages: sensory register, short-term memory, and long-term memory. In the first stage information enters the sensory register. Information must be attended to or it is lost. The information remains in the sensory register for only a brief time. Attention must be given to the stimuli in order for it to move into the second stage of information processing short-term memory.

In short-term memory, also referred to as working memory, if information is not used immediately or encoded for long-term storage it is lost. In the third stage of information processing, encoded information moves from short-term memory into long-term memory. Information is permanently stored until retrieved for further encoding or use.

Two major processes of the cognitive information processing model are encoding and retrieval. While in working memory, information can be encoded through various means of rehearsal and then stored in long-term memory. Gagné (1984) states that encoding “may be considered the central and critical event in an act of learning” (p. 82). Without rehearsal the information is lost. The type of rehearsal is crucial to retrieving the information at a later time.

It is generally accepted that often information cannot be retrieved from long-term memory because the proper retrieval cue for the encoded information is not given. When the encoding cue matches the retrieval cue, chances of retrieving the information are better. This is known as the encoding specificity principle (Thompson & Tulving, 1970; Tulving & Thompson, 1973). Anderson and Ortony (1975) investigated encoding and retrieval cue effectiveness using the sentences “The container held the apples” and “The container held the cola.” They found that “basket” served as an effective retrieval cue for “The container held the apples” but was not an effective retrieval cue for the sentence “The container held the cola.” They also found that “bottle” was an effective retrieval cue for “The container held the cola” and not effective for “The container held the apples.” Imagery has been found to be an effective encoding and retrieval strategy. Papineau and Lohr (1981) found subjects had better recall for visual imagery words (i.e., green, map,
photograph) and when words were presented visually rather than aurally. Also Levin and Kaplan (1972) found that instructing learners to use imagery to learn information was effective in facilitating their learning. A study conducted by Pressley and Levin (1980), where subjects were instructed to use imagery to retrieve word pairs at test time, found that younger students benefited from instructions to use imagery only when retrieval cues were provided during testing. However older students benefited from the instructions to use imagery with or without retrieval cues being given at test time.

In this study an examination of embedding learning strategies, specifically guessing intelligently, structured review, and imagery to facilitate effective encoding and retrieval of information at test time was investigated. Additionally this study was conducted to determine the design components needed to be an effective tool for Hispanic ELL students learning in an academic content area.

**Project Goals**

The major goal of this study was to develop a multimedia environment to support ELLs’ academic learning through embedded cognitive learning instruction. In addition, there were five secondary goals for this study:

1. Use the Leshin, Pollock, and Reigeluth’s ISD Model to design a multimedia environment.
2. Use Gagné’s Events of Instruction in the development of a multimedia environment.
3. Pilot test a prototype of the multimedia environment to determine effective design and development strategies for ELLs.
4. Develop a final multimedia environment based on pilot study results.
5. Evaluate the final multimedia tutorial that resulted from the pilot study and expert reviews, during a small group evaluation session.

**Significance of the Study**

This study provided insight into the components needed when designing and developing a computer-based multimedia instructional environment that attempts to make academic content comprehensible through the use of learning strategy training for ELL students. For beginning and low intermediate high school ELL students, in addition to
text, aural, and visual presentation of material, demonstration and a gaming atmosphere is a crucial element in helping this population of students succeed in a computer-based multimedia academic content environment. Demonstration similar to visuals will help students associate an item with the real object, but demonstration goes further by also showing the student how to perform a task. For this age group the researcher feels this is crucial for learning the information. The interactive nature of the activity will encourage this age group to get involved actively with the material as well.

**Limitations of Study**

This study was limited to the following:

1. This study was limited to Hispanic students with limited English proficiency.
2. This study was limited to a small population of ELL high school Hispanic students.
3. This study was limited to embedding guessing, imagery, and review strategies into a computer-based multimedia environment using the North Carolina K-12 Computer/Technology Standard Course of Study curriculum.
Chapter Two

Review of Literature

The literature review provides a framework for the development of a multimedia environment to support ELLs’ academic learning through embedded cognitive strategy instruction. Literature in the following areas were examined: (a) cognitive information processing theory, (b) ELL characteristics, (c) ELLs’ strategy use, (d) strategy instruction, and (e) embedding learning strategies in computer-based multimedia instruction.

Cognitive Information Processing Theory

Cognitive information processing theory plays a vital role in understanding how memory works. The encoding processes that assist retrieval of information are of particular interest. This review of the cognitive information processing theory focuses especially on encoding processes that aid the retrieval of information.

Cognitive psychology focuses on the processes of the human memory system – encoding, storing, and retrieving information during the learning process. Atkinson and Shriffin (1968) developed a model that illustrates the three stages information goes through—perception, encoding and retrieval processes.

Sensory memory. The first stage of information processing is sensory memory. Information is estimated to stay in sensory memory less than three seconds. The sensory memory is capable of detecting infinite amounts of information. Information is perceived by the sensory receptors and if not given attention it is lost (Gagne, 1984). Learners who selectively attend to some information and ignore other are practicing selective attention (Driscoll, 2000). Learners select information to attend to depending on several factors: interest in the information, previous knowledge of the information, or novelty of the information. Information the learner should focus on needs to be emphasized or it may not be attended to or it may be overlooked. The instruction must make it possible for the learner to focus on the important information and ignore extraneous information so that the information can move into short-term or working memory. Once the information is in
working memory, rehearsal and encoding processes must take place in order for information to be stored long-term.

**Short-term memory.** The second stage in information processing is the short-term memory or working memory. Information in short-term memory stays active for approximately 20 seconds unless it is rehearsed. Miller (1956) asserts that short-term memory capacity is 7 plus or minus 2 items of information. Once capacity is reached new information pushes old information out of memory. Creating larger or smaller bits or subsets of information known as chunking can increase the amount of information that can be handled at one time in short-term memory; however, the capacity of short-term memory remains 7 plus or minus 2 pieces of information (Miller, 1956). The size of the items can vary. The following examples illustrate these points: (a) a ten-letter word and a six-word sentence are considered one piece of information; and (b) a span of letters (JFKFBIAGDNASAMIT) when broken into chunks (JFK FBI AIDS NASA MIT) (Driscoll, 2000) can easily be processed because they have been chunked into meaningful subsets of information that does not exceed Miller’s 7 plus or minus 2 capacity principle. However, these letters (TAQ YXX MSE ESE LIM) lack meaning, making it difficult if not impossible to process.

For information to move from short-term memory into long-term memory it must be encoded or “transformed into a form that is semantic, or meaningful” (Gagne, 1984). The processes that learners use to move information from short-term to long-term memory are called encoding processes and processes used to access information in long-term memory are called retrieval processes (Bruning, Schraw, & Ronning, 1999). Driscoll (2000) states that in order for information to remain in working memory and for information to be moved from working memory to long-term memory, two processes are necessary: rehearsal and encoding. Rehearsal is categorized into two main types of rehearsal – maintenance and elaborative. Maintenance rehearsal or repetition is the act of circulating information by repeating it over and over (Weinstein & Hume, 1998). This information is kept in working memory as long as it is rehearsed and once the rehearsal stops the information is forgotten. Maintenance rehearsal is ideal for short term retention of information but not long-term retention of information (Bruning et al., 1999; Driscoll, 2000). Maintenance rehearsal, such as reading information over and over can be effective
when the repetition consists of retrieving the information in order to practice or review it (Gagne, 1984). When a learner uses information repeatedly, it makes the information a part of the learners’ knowledge base (Weinstein & Hume, 1998). Examples of maintenance rehearsal strategies are mnemonic devices, reading, writing, or saying material over again, repeating information aloud, using notecards, and taking verbatim notes. When long-term retention of information is the goal of learning, elaborative rehearsal is better than maintenance rehearsal (Craik, 1979; Weinstein, Ridley, Dahl, & Weber, 1988).

Elaborative rehearsal is a form of rehearsal that relates information to-be-remembered to other information (Craik & Lockhart, 1986). Elaborative rehearsal is an encoding process that makes information more memorable by relating new information to existing information in memory. Elaboration strategies are strategies that “build bridges” (Weinstein & Hume, 1998, p. 28) between existing information and new information. Information is elaborated on or added to make it meaningful and understandable in order to store and retrieve from long-term memory. An example of elaborative rehearsal is imagery (Bruning et al., 1999; Driscoll, 2000). Imagery can be used to (a) help build bridges between new concepts and existing knowledge, (b) help create connections by adding meaning to information, (c) help make information distinctive, and (d) help strengthen memory for information by combining visual cues with verbal cues making it easier to store and retrieve. Imagery used to associate foreign words with actual objects makes learning the words easier (Chun & Plass, 1996).

Long-term memory. The third stage of memory is long-term memory (LTM). LTM is the permanent storage for information. There are several characteristics of LTM that need to be discussed: capacity, retrieval, and forgetting. Long-term memory has unlimited capacity and information that is learned is never forgotten; however, it may be difficult to retrieve because the cue used to store the information is not given at the time of retrieval. Encoding specificity is critical to the retrieval of information. Encoding specificity involves the cues used to encode the information for storage such as the environment when learned, and the context in which the information was learned. The context for learning can involve the environment, mood, and state of mind.
views of how memory occurs or how we remember information, various concepts will be explored such as encoding specificity, automaticity, and state dependent learning.

*Encoding specificity.* For more effective retention and retrieval of information, the encoding processes should resemble the performance demands. Rafoth, Leal, and DeFabo (1993) state that the way in which information is encoded or studied determines how it will be stored and which cues will activate retrieval. This is known as the encoding specificity principle (Anderson & Ortony, 1975; Thompson & Tulving, 1970; Tulving & Thomson, 1973). The cues used to encode information can serve as the best cues for retrieving the information at time of recall. The organization of the materials and the context in which the material is learned also influences how well the material is remembered. The closer the match is between the encoding cues and the retrieval cues the search for the information in memory is more efficient and effective (Bruning et al., 1999).

*State-dependent learning and context dependent learning.* Related to the phenomenon of encoding specificity is the principal of state-dependent learning or context dependent learning. State dependent learning can involve being instructed and tested in the same situation, same state of mind, or same environment (Driscoll, 2000). In each of these conditions effective retrieval of information is dependent upon matching the situation, state of mind, and environment at encoding and retrieval. Retrieval is influenced by the context of encoding, suggesting that the more contexts or examples used for encoding information the better it is for remembering the information (Rafoth et al., 1993). Students can use these various contexts or examples to help them retrieve information later. The more contexts students use to encode information the better their chances of retrieving the information. “If new information is presented in only one context, students may not find sufficient cues in test questions to support retrieval of information that is actually in memory” (Driscoll, 2000, p. 103). Bruning et al. (1999) states that encoding specificity helps explain why some test items facilitate recall and others do not. He further states “test items . . . that reinstate cues that were present at the time of encoding facilitate students’ retrieval of the content. Test questions that do not provide cues from encoding are less able to enhance recall” (p. 112).
**Automaticity.** “When tasks are overlearned or sources of information become habitual, to the extent that their attention requirements are minimal, automaticity has occurred” (Driscoll, 2000, p. 82). Examples of automated tasks are driving a car, keyboarding, and reading. Of course performing these tasks automatically depends on certain variables; for example, whether the person is an expert or novice at the task or the conditions that exists at the time they are performing the task. When information becomes automated the learner does not have to expend many cognitive resources to carry them out thus more cognitive resources can be given to unfamiliar or difficult tasks. Extensive practice is required to make information automatic (Bruning et al., 1999; Driscoll, 2000).

**English Language Learners (ELL)**

From 1990-2000 the national school age population grew by twenty-four percent while the limited English proficient population grew by 104 percent (National Clearinghouse for English Language Acquisition and Language Instruction Educational Programs, 2002). Accommodating the education for large diverse populations is undoubtedly an overwhelming task. In a search of the literature on ELL learning in academic content areas, there is very little research that addresses developing academic language in content areas. Abadiano and Turner (2002) confirm that even though there were numerous effective practices that are aimed at helping ELL transition successfully from language learning classrooms to all English mainstream classrooms, there has been less consideration given to developing academic language in content areas. As a result, ELL are vulnerable to “academic underachievement” (Abadiano & Turner, 2002).

“Students learning English as a new language face many challenges in American schools. Not only must they learn a new culture, but they must also use the new language to learn the academic subjects of the curriculum” (Chamot, Dale, O’Malley, & Spanos, 1992, p. 2). Chamot et al. stated that investigators in Canada and United States found that students could learn enough language for social communication in about two years; however they needed from five to seven or more years to develop language skills needed in academic subjects.
Terms used to refer to English Language Learners. Other terms that are associated with ELL are (a) English as a Foreign Language (EFL), (b) English as a Second Language (ESL), (c) immigrant (d), limited English proficient (LEP), and (e) Second Language (L2). For this study the term ELL will be used when referring to learners who are learning English.

*English as a Foreign Language (EFL) defined.* English as a foreign language is an English language program in a setting or country when English is not the dominant language. It is also used in some U.S. university programs where international students study English and are likely to return to their home countries after graduation or finishing course work (TESOL, 2002).

*English as a Second Language (ESL) defined.* English as a second language refers to English language programs in English-speaking countries where students learn English as a second language (TESOL, 2002).

*English Language Learner (ELL) defined.* An English Language Learner is a person who is in the process of acquiring English and has a first language other than English (North Carolina Department Public Instruction, 1998).

*Immigrant defined.* An immigrant is a person who comes to a country to take up permanent residence (Merriam-Webster Dictionary, 1993).

*Limited English Proficient (LEP) defined.* Any student whose primary language is other than English and who is insufficiently proficient in the English language to receive instruction exclusively from regular educational programs and to function on an academic par with his/her peers (North Carolina Department Public Instruction, 1998).

*Second Language (L2) defined.* L2 is an abbreviation for a second or new language; often contrasted with a first or native language—L1 (North Carolina Department Public Instruction, 1998).

*Barriers to academic success.* Trying to characterize the ELL is difficult because there are many nationalities that make up this group. In schools today, it is not uncommon to find schools that serve as many as 15 or more nationalities in one school. Even though Calderon (1998) and Sileo and Prater (1998) caution educators not to make generalizations about ELL students, there are some generalizations that can be made about the barriers ELL students face in United States classrooms. Various factors affect
their academic success, such as mismatch between school and students’ culture and student characteristics. These factors directly relate to the need for instructional interventions for ELL students. Some areas where a mismatch between school and students’ culture and learner characteristics were noted:

1. Instructional practices and methods used in the host culture may conflict with those of the originating culture;
2. A lack of variety in programs available to address the variety of educational needs found in this population;
3. Inaccurate or inadequate services; and
4. A lack of opportunities that lead to college courses or preparation for the workplace.

Mokhtari and Sheorey (2002) investigated ELLs use of reading strategies and metacognitive awareness while reading and concluded that low ability readers are reported as having lower levels of strategy awareness and strategy use when reading academic reading materials, which affects efficient comprehension. The low ability readers were said to spend more time struggling with individual words than constructing meanings.

At the top of the list of student characteristics that affect academic success is English proficiency or language characteristics (Calderon, 1998; Kurtz-Costes & Pungello, 2000; Sileo & Prater, 1998). The level of English language proficiency can lead to depression or other psychological disorders that affect ELLs’ school adjustment (Kurtz-Costes & Pungello, 2000). Other student characteristics that affect school success are the students’ communication style, e.g. when to speak, non-verbal language, cognitive or behavioral styles (Sileo & Prater, 1998).

These factors are important in understanding the ELL student in the United States classroom; however, for this study the biggest barrier to the ELLs’ academic success is language proficiency in the academic content area. Some recommendations made for helping ELL be successful in United States classrooms were: (a) use a wide range of instructional methods, (b) use lots of modeling, (c) use of repetition and practice, and (d) use positive images of diverse groups in instructional materials (Sileo & Prater, 1998; Sparks, 2000).
In an effort to meet the challenge facing United States schools in preparing all students to become literate citizens, the ESL Standards for Pre-K-12 Students were developed by the Teachers of English to Speakers of Other Languages (TESOL) organization. The purpose for these standards are to (a) guide content teachers in the process of incorporating language skill development in their particular disciplines in order to better facilitate the academic achievement of ELL students; (b) describe the language skills necessary for ELL students to communicate appropriately and effectively in social and academic settings; and (c) help ELL students perform at an achievement level equal to native English speaking students (TESOL, 2004).

**Learning Strategies and English Language Learners’ Strategy Use**

There is enormous support for using learning strategies and learning strategy instruction evident in the literature (Brophy, 1998; Bruning et al., 1999; Chamot & El-dinary, 1999; Derry, 1990; Edmunds, 1999; Lambert, 2000; Lenz, Ellis, & Scanlon, 1996; Olgren, 2000; Oxford, 1990; Pressley & Wolsokyn, 1995; Rafoth et al., 1993; Rubin & Thompson, 1994; Weinstein & Hume, 1998; Weinstein et al., 1988; Zimmerman, 2002).

Learning strategies definitions. In general it is believed that learning strategies can help improve student achievement (Lenz et al., 1996; Rafoth et al., 1993; Weinstein & Hume, 1998). The definition might illuminate why many feel that learning strategies are crucial to improving learning. Two definitions are included. Learning strategies are specific actions taken by the learner to make learning easier, faster, more enjoyable, more self-directed, more effective, and more transferable to new situations (Oxford, 1990). Learning strategy is defined by Weinstein and Hume (1998) as any behavior, thought, or action engaged in during learning that is intended to influence the acquisition, storage, integration, or availability for future use of new knowledge and skills. No doubt successful learners have learned the benefits of using learning strategies and valuable insight can be gained from examining successful learners’ strategy use.

The two definitions explain that learning strategies are actions or behaviors that a learner engages in during learning. Not all learners engage in learning strategies during learning. Oxford’s definition has a couple of key ingredients that might make a difference
in the way students learn in the classroom. If high school students could be taught learning strategies that make learning enjoyable, easier, and faster perhaps more would actively use them to learn. The struggling students’ achievement level would probably improve considerably. An examination of the strategies of successful learners will be conducted to help understand why strategies are important and then an examination of the strategies of unsuccessful learners.

**Successful learners.** Chamot and El-dinary’s (1999) study of learning strategies used in a language immersion class found that successful learners knew and used more strategies than the unsuccessful learners. They reported that these learners used multiple cues to help determine which strategy to use, monitored and adapted their strategy use, and were flexible in their use of strategies. For example, the more effective learner (a) focused on the task as a whole, (b) were comfortable guessing information using the text context, and (c) skipped information they could not figure out. On the other hand, the less effective learners in the study clung to ineffective strategies even though they [strategies] proved not to be helpful. This ineffective strategy use was attributed to the less effective learner’s unawareness or inability to adapt strategies.

**Unsuccessful learners.** First it is important to emphasize that a learner’s failure may not always be attributed to lack of ability (Manning & Payne, 1996). More than likely it is attributable to their lack of knowledge about strategy use or how to monitor the use of strategies (Chamot & El-dinary, 1999; Derry & Murphy, 1986; Mokhtari & Sheorey, 2002). When trying to solve problems they are unfamiliar with, they may try strategies that are inappropriate for the specific learning situation. After repeated failures in the educational setting, some students begin to believe that they are incapable of achievement. Brophy (1998) calls this “failure syndrome.” Students exhibiting failure syndrome have low expectations of passing assignments or tests (Brophy, 1998; Pumtambekar, 1995). Consequently, they lack confidence in their own abilities; they give up easily when confronted with difficult problems, or attempt tasks half-heartedly. These unsuccessful learners let anxiety incapacitate them; however, cognitive learning strategies could prove to be an effective self-esteem, performance, and achievement builders (Brophy, 1998).
ELL learning strategies. Some learning strategies suggested by Rubin and Thompson (1994) for becoming a better language learner are: (a) organize or categorize vocabulary words, for example waiter, table, menu; (b) schedule regular time, and daily schedule for studying; (c) look for patterns in information and play games; (d) practice, practice, practice; (e) learn to live with uncertainty: read and underline words not understood, then reread and erase underline when information understood, continue this process several times, and avoid using a dictionary; (f) use mnemonics: use rhyming, associate words with physical world (color, size, sound, smell) or their function, context, related words; (g) use context: use phrase or sentence context to derive meaning; same for conversation context, social context; (h) learn to make intelligent guesses: memorize idioms or expressions; parts of songs, poems, commercials; and (i) learn production techniques such as, repeat more slowly and many times; use synonyms for the word; gestures, paraphrases.

The Cognitive Academic Language Learning Approach (CALLA) uses curriculum content to develop academic language and learning strategies. Learning strategies are taught explicitly to facilitate content and language learning. The CALLA instructional approach has demonstrated effectiveness in increasing achievement of limited-English-proficient (LEP) students in order that they may receive maximum benefit from their schooling (Chamot & O'Malley, 1994). Learning strategies used in the CALLA program are organized into three categories: metacognitive, cognitive, and social/affective strategies. The CALLA handbook by Chamot and O’Malley (1994) provides extensive guidance on using these strategies and activities to incorporate these strategies in the daily teaching routine. In the CALLA handbook there are chapters with sample CALLA units for science, math, social studies, and literature. Teaching activities as well as ready to use worksheets are included. Each unit also provides examples of content specific learning strategies.

Oxford’s (1990) language learning strategy system is divided into two major categories – direct and indirect strategies. Oxford points out that all strategies in the strategy system support one another. The indirect strategies consist of metacognitive, affective, and social strategies. The indirect strategies “support and manage language learning without (in many instances) directly involving the target language” (Oxford,
1990, p. 135). The direct strategies consist of strategies that “directly involve the target language” (Oxford, 1990, p. 37). Direct strategies are divided into three major categories: memory, cognitive, and compensation strategies. These three major categories are subdivided further: (a) memory strategies (i.e., applying images and sounds, and reviewing well); (b) cognitive strategies (i.e., practicing, and receiving and sending messages); and (c) compensation strategies (i.e., guessing intelligently, and overcoming limitations in speaking and writing). Strategies of particular interest for this study are structured reviewing, guessing intelligently, and imagery strategies.

It was pointed out in the literature (Mokhtari & Sheorey, 2002) that just teaching strategies did not guarantee that the students would use them because it could not be determined with absolute certainty from the instruction alone, whether the students engaged in strategy use or they just said they used strategies. To address this problem, modeling the benefits of using the strategy would be important in the instruction and also prompting and posting the strategies might be beneficial in this regard (Mokhtari & Sheorey, 2002; Sheorey & Mokhtari, 2001).

**Strategy Instruction**

Often times students’ cognitive ability is called into question when his/her academic performance is poor. In many of these instances, students’ cognitive ability is not the problem, but the problem is they do not know the skills for learning how to learn (Brophy, 1998; Manning & Payne, 1996). They are unaware of learning strategies and teachers do not teach or prompt the use of learning strategies in their instruction. In order for students to become better learners they need to know how to learn (Tsuchida, 2002). An example of a learning strategy would be learners rereading a passage of text after realizing they did not understand the passage the first time they read it, and as a result they reread it for further understanding.

Even though there is enormous support in the literature for training learning strategy use there is also literature that advises anyone interested in training learning strategies that developing learning strategy use is a gradual process that occurs over time through the natural process of schooling (Derry & Murphy, 1986; Kincannon, Gleber, & Kim, 1999); and strategies are not easily trained (Derry & Murphy, 1986; Pressley &
Wolsokyn, 1995). There are various approaches to strategy training. It should be noted that the basic characteristics of most strategy training approaches reviewed were: (a) describe the strategy, (b) model the strategy, (c) practice the strategy, and (d) generalize the strategy to other settings.

Some suggested approaches for carrying out strategy instruction are: detached strategy training, embedded strategy training, or combined strategy training (Rafoth et al., 1993), informed strategy training, uninformed training, awareness training, one-time strategy training, and long-term strategy training (Oxford, 1990) explicit training (Lambert, 2000; Lenz et al., 1996; Lin, 1994; Pumtambekar, 1995). Detached strategy training (DST) has been the traditional approach used with unsuccessful learners. The DST approach teaches strategies outside the regular curriculum while embedded strategy training (EST) embeds training within the regular curriculum. Rafoth et al. stated that neither detached nor embedded training “necessarily” (p. 41) leads to study-skill generalization across the content areas and concluded that a combined approach was the best approach. They felt the combined approach would ensure strategy transfer. In the combined approach students receive detached direct instruction, and long-term frequent practice in context with overt teacher feedback and guidance. Rafoth et al. assert this approach offers the greatest chance for strategy success.

Oxford (1990) explained that completely informed strategy training (teaching when, how, and why strategy should be used) is preferable to uninformed training because learners perform better when using informed strategy training. Oxford also states the benefits of completely informed strategy training are improved performance on tasks, maintenance of the strategy over time, and some degree of transfer to other similar tasks.

Explicit training (why, when, and how to use) of strategies is preferable because the learner acquires the knowledge about why it is important to use the strategy, the benefits of using a particular strategy, and encouragement to use the strategies. Explicit training is also advantageous to hasten strategy learning (Lambert, 2000; Lenz et al., 1996; Lin, 1994; Pumtambekar, 1995).

Oxford (1990) suggests three ways to train language learning strategies: awareness training, long-term strategy training, and one-time strategy training. Awareness training necessitates arousing the learner’s awareness of the strategy
(introduction to strategies). In long-term strategy training learners practice where and how to use strategies, in addition to monitoring and evaluating their performance after using them. One-time strategy training incorporates strategy practice during an actual learning task. This approach is suggested for learners who have a need for a particular, identifiable, and very targeted strategy that can be taught in one or just a few session(s). This approach appears applicable to situations when there is a time constraint (for example, test preparation).

Students need to know the “what, why, when, where, and how” about learning strategies if they are going to use them effectively (Clark, 1993; Lenz et al., 1996; Mokhtari & Sheorey, 2002; Pressley & Wolsokyn, 1995; Sheorey & Mokhtari, 2001; Weinstein et al., 1988). Embedding strategy instruction into the daily routine of instruction is seen as beneficial (Lenz et al., 1996; Mokhtari & Sheorey, 2002; Pressley & Wolsokyn, 1995). This needs to be done because it takes time to develop and automate strategy use. Since the use of multimedia is increasing in the daily routine of instruction, how strategy instruction can be embedded into this medium needs to be investigated. Interest in how to integrate strategy instruction into the traditional instruction has increased because the realization that learning strategies are important in improving the learning process, the next logical step is how to embed strategy instruction into computer-based instruction. The advantage of using multimedia in classrooms is multimedia can address students’ particular learning styles or preference for a particular way to process, think about, and remember new information (Dunn & Dunn, 1993; Dunn, Dunn, & Perrin, 1994; Stevenson & Dunn, 2001). However, integrating strategy instruction into computer-based multimedia is a recent occurrence.

**Embedding Cognitive Strategies in Computer-based Multimedia Instruction**

Many school districts across the country are putting computer/technology into the classroom because of the growing evidence that computer/technology enhances learning in the classroom and that achievement can be improved for students at risk of failure (Kulik & Kulik, 1991). Another reason for incorporating computer/technology in classrooms is the need for workers who possess these skills along with the skills such as problem-solving, and creative thinking that go along with using computers and
technology. From the research some advantages of multimedia use in the classroom include: (a) use of various medias – text, still or animated graphics, sound, and video to compliment various learning preferences; (b) self-paced instruction; (c) immediate feedback; (d) easy updating of materials; and (e) learner control (Paolucci, 1998; Yeh & Lehman, 2001).

Yeh and Lehman’s (2001) study investigated learner control, English learning strategies and advance organizer factors in a hypermedia environment. Yeh and Lehman hypothesized that first, English foreign language (EFL) learners in learner-controlled hypermedia instruction would recall more information than EFL learners in a program-controlled environment. Second, EFL learners using an embedded learning strategy (advance organizer) will recall more information than EFL learners learning without an advance organizer. Third, the advance organizer would be more effective in the learner-controlled hypermedia environment than in the program-controlled hypermedia environment. Fourth, EFL learners’ language learning strategy use would interact with the instructional treatments (learner control vs. program control) in a hypermedia environment that would influence their recall. Last, EFL learners in the learner control environment would have better attitudes towards the instruction than the program control EFL learners’ attitude.

The study participants were 111 EFL students. For the study, one pre-instructional computer-based videodisc was created and four computer-based videodiscs, one for each of the four treatment groups was created: (a) learner control with advance organizer; (b) learner control without advance organizer; (c) program control with advance organizer; and (d) program control without advance organizer. Oxford’s (1990) Strategy Inventory for Language Learning (SILL) instrument was used to measure the levels of English learning strategy use and an advance organizer strategy was used to develop the advance organizer.

Yeh and Lehman (2001) found that students in the learner-controlled environment out performed the program-controlled group on a recall test. They concluded that a learner-controlled environment is better for EFL learners and their findings were consistent with EFL language learning theory that states EFL learners need to actively interact with their external environment and they should be allowed a degree of control.
over their learning. Yeh and Lehman showed the advantages of a learner-controlled environment that makes it ideal for EFL learners are: self-pacing, choosing learning sequence, ability to explore assistants embedded in lesson, revisit sections if needed, start and stop program depending on their needs, and availability of just-in-time aids.

Properly constructed advance organizers are felt to be an effective scaffold for EFL learners learning from interactive hypermedia and they are effective in improving comprehension for high and low ability level students and reported to have a significant effect on recall scores. In fact the interactive hypermedia lesson helped all the learners in this study be more effective and efficient learners.

The final conclusions of Yeh and Lehman’s (2001) study were interactive hypermedia provided an ideal environment to do language learning strategy training for students with lower levels of language learning strategy use; however, they cautioned more research was needed to confirm this finding because of the mixed findings reported in the literature on the effectiveness of advance organizers. Reasons given for these mixed findings on the effectiveness of advance organizers may be attributable to the construction of the advance organizers; failure to teach students how to use advance organizers; ignoring learner characteristics; and lack of objective methods for qualifying and quantifying learning results. Finally navigational concerns especially with beginning level students should not be overlooked; but these concerns should not negate the advantages (flexibility, interactivity, and network of multimedia resources) of using hypermedia instruction.

Hartley (2001) recognized that the characteristics that are reported to enhance learning with multimedia and hypermedia (i.e., novelty, multiple modes of presentation, non-linear paths, and learner control) may also impede learning and that its probable that only strategic learners will benefit from hypermedia. Hartley reviewed research done by Dehn (1997), Derry and Murphy (1986), and Cardinale and Smith (1994), and he asserted, as a whole the research indicated that incorporating strategy instruction into content learning is promising. Hartley investigated the idea of whether learning strategies can be taught in a hypermedia environment and what impact will teaching learning strategies have on students’ achievement? Hartley adapted Graham and Harris’ (1993) model for strategy instruction for this study as seen below:
1. Initial presentation of strategy – discuss current strategies and benefits of the new strategy;
2. Explain the use of the strategy, how and when;
3. Provide an example of the strategy being used;
4. Memorize the strategy; and
5. Perform strategy independently.

Lesson topics used in this study, summarization, goals, objectives, monitoring learning, concept mapping and questions, were adapted from the work of Pressley and Wolsokyn’s (1995). Hartley addressed two research questions (a) can learning strategies be effectively taught in a hypermedia environment, and (b) can learning strategy instruction improve achievement? His assumptions were: (a) if students have prior knowledge of strategies, extensive strategy instruction is not needed, (b) students’ lack of strategy use was not because they were not aware of strategies but because strategies took too much effort to implement; and (c) tying strategy instruction closely to the content would not require extensive training of each strategy. Hartley concluded from his findings that first, strategy instruction did not have a positive impact on students’ knowledge of cognition; however, it did appear to have a substantial positive impact on the students’ regulation of cognition. His conclusion was that “student’s use of strategies ultimately depended upon the decision to use a strategy” (p. 301) and with this age group (11th and 12th graders) emphasis might need to be placed on regulation of cognition. Second, students did not exhibit superior performance on a post-test. He attributed this to the discrepancy between students’ knowledge and regulation of strategy use. Hartley recommends tighter integration of strategy instruction within the content while encouraging learners to use learning strategies. It was pointed out that the students’ desire to succeed is an important factor in the success of any learning intervention. It was realized students’ possessing knowledge of strategies does not ensure they will use them.

Hartley proposed three possible reasons for the lack of strategy use: cognitive load, metacognitive development, and theory of settings. Cognitive load refers to the mental requirements of a task the students are required to complete. In the case of this study, the researcher felt the technical level might have prevented students from implementing strategies. In the case of metacognitive development, Hartley (2001)
conjectured that the learners possessed sufficient amounts of declarative and conditional knowledge before the intervention and the problem they faced was integrating this knowledge with existing knowledge causing the knowledge of cognition items (students understanding of strategies) to be minimal. Students reported they had been taught some of the strategies previously.

The theory of settings (why strategies were not used appropriately) was the reason given for their failure to use strategies. Five reasons were cited for not using strategies: poor monitoring, ineffective routines, limited knowledge base, attributions that are not conducive to strategy use and minimal transfer of strategic activity. To alleviate some of the problems in his study, the researcher suggests the following: (a) tighter integration of the strategy instruction with the content instruction (make strategy examples specific to content); and (b) an integrated approach to strategy instruction that includes tools that are easy to access and use, and tools that facilitate deeper processing while causing minimal deviation from content. Hartley concludes that strategy instruction is “more complex than originally believed” (p. 303).

Ulitsky’s (2000) study examined strategies used by successful language learners in a multimedia environment. The research questions being examined were: (a) What learning strategies do good language learners use in a multimedia environment? (b) Can a task designed to promote awareness of individual learning strategies be effective in enhancing the learning process and impact teaching? The study involved 27 pre-service and in-service teachers in a language education master’s program. This was an on-line language-learning course. The participants were reported as having extensive experience with language learning and teaching in both the United States and overseas and an understanding of language acquisition principles and learning strategies. The majority of the participants reported they were comfortable using computers. Students were asked to identify specific strategies they used and to utilize strategies they had used in the past or use the strategies provided in the Learning How to Learn with Technology Menu that were created for use with the laserdisc programs being studied. The Learning How to Learn with Technology Menu was created using Oxford’s Strategy Classification System and O’Malley’s Learning Strategies as the framework.
The conclusions drawn from the findings were that multimedia alone was “not enough, no matter how stimulating and authentic the visual and auditory input” (Ulitsky, 2000, p. 308) for effective language acquisition. The participants were acquainted beforehand with many of the general learning strategies, such as metacognitive and affective strategies: organizing and planning for conditions that aid in one’s learning, regulating, and fine tuning learning, and dealing with frustrations and challenges. They attributed knowing these strategies kept them focused on the task and motivated to continue when overwhelmed. This conclusion implies that it is important that ELL students learn strategies because strategies can aid them in their learning process especially when tasks may be difficult.

In her summary, Ulitsky (2000) also stated that it is important to make tasks relevant to learners, which will help learners feel good about the learning. The participants reported using visual cues in combination with textual and aural cues, which they found invaluable in developing comprehension and enhancing motivation and learning; however, the students reported these cues lacked authenticity and lacked interaction with native speakers, which the language learners believed was needed. She emphasized that the computer environment could not answer the “why” question. “Why” questions answered by native-speakers is crucial in language learning. Another thing to emphasize about the learning strategies in the multimedia environment is the learning strategy employed in traditional settings may need some modification, for use in the multimedia environment. In the discussion of her findings, Ulitsky believed that the learner needs adequate and appropriate training in the areas of general and medium-specific learning strategies. Training in self-reflection will better prepare them for this environment and providing the tools to assist them in problem solving and information processing is crucial to their success with multimedia instruction.

The study by Jones, Farquhar, and Surry (1995) examined how metacognitive theory can be integrated into computer-based learning environments through the user interface. This research is intended to inform designers on how to design effective user interfaces for educational software. Jones et al. recommended that designers consider learners’ cognitive strategy preferences, the user’s ability to engage in a particular cognitive strategy, and the appropriateness of the cognitive strategy selected. These
cognitive strategies include rehearsal strategies, elaboration strategies, organization strategies, affective strategies, and comprehension monitoring strategies.

Jones et al. (1995) believed the user interface should help the user manage the large amount of information presented in a program and as such, the interface “should provide users with relevant data about the program, how to use the program, where they are in the program, and how well they are doing” (p. 14). The information Jones et al. provided for developing the user interface is organized around three questions: (a) What is it? (b) How do I use it? (c) What do I know?

The types of scaffolds “tools, strategies and guides which support students in attaining a higher level of understanding, one which would be impossible if students worked on their own” (Brush & Saye, 2001, p. 335) support student-centered learning were investigated in a hypermedia program called Decision Point (DP).

Brush and Saye (2001) conducted research on embedding scaffolds in hypermedia supported student-centered learning to promote higher-order skills such as problem-solving and critical thinking. They investigated the types of scaffolds needed in student-centered learning and how students use these scaffolds to complete tasks. Brush and Saye’s definition of scaffolds are “tools, strategies and guides which support students in attaining a higher level of understanding, This study used 36 students in a United States History class.”

Two types of scaffolds used in DP were conceptual scaffolds (i.e., scaffolds to determine what data to consider when solving a problem), and metacognitive scaffolds (i.e., scaffolds to assist with self-monitoring and self-regulation). The actual scaffolds provided in DP included interactive essays that provided an overview of the events provided in the database, links to supporting documents for each event, highlighted menus to assist students in choosing key documents, student guides to assist in the analyses, and syntheses of information, and student journals to assist in monitoring progress. Brush and Saye (2001) found all student groups used the hyper-linked interactive essays and list of recommended documents the most. The recommended documents were used more than any other document in the database.

Embedded hyperlinks within the interactive essay may have been the reason students used these documents more, suggesting that visual cueing of links and
summarizing documents may be effective methods for focusing student’s attention on important nodes of information. They also concluded that the use of hyperlinks within the essay might have been used more as opposed to the menu because the students could see the relationship between documents. Recommendations researchers made for future research on this topic are:

1. Use hyper-linked summarizing essays or documents for navigation as opposed to linear indexes to aide in greater chances of seeing links or relationships between information.
2. Since one of the complaints by the students was they did not have enough time to complete assignments, more tools for scaffolding progress are needed.
3. The student journal feature was found not be an effective scaffold for self-regulation and progress monitoring because not enough time was allowed at end of class to complete the journal entries. Brush and Saye recommend placing more emphasis on the purpose of the journal and giving structured time to complete in order to increase their effectiveness.
4. The guides were not utilized for summarizing information. Brush and Saye realized that students were not instructed in analysis skills which might have resulted in lack of effective use of the guides.

The goal of this study was to provide designers’ guidelines for creating scaffolds that would assist users attempting to collect, analyze, synthesize, and evaluate information from large databases.

Olgren (2000) makes a good point when she stated one of the greatest challenges of teaching with technology is to focus on the learner and not the technology. “…I continually remind myself to begin with the learner. For one, doing that keeps me grounded in the learner’s shoes or what it would be like to be a learner in my course. For another, it helps me to cast a critical eye on what is likely to work and not work to foster effective outcomes” (p. 7).

Some of the challenges that affect learning with technology are physical separation between learner and instructor, learner autonomy and responsibility, ability to use technology, difficulty in determining expectations and remaining motivated in this technology environment. If the learner is the focus, how can metacognitive strategies that
enhance learning be facilitated in this environment? Olgren (2000) offers the following as guidelines that can be used to embed learning strategies within the course materials:

1. Include orientation materials that explain how to approach the course (planning strategy);
2. Have students articulate their intrinsic goals in order to make a connection between materials, their needs, interests, and applications of materials;
3. Divide course materials into chunks (content overview, examples, application guidelines, activities, directions of what to do);
4. Include interactive activities that require learner synthesis, analysis, application, and evaluation in real and/or simulated settings;
5. Self-evaluation activities where students reflect on their learning, they compare the outcomes of their learning to the goals set in the beginning; and
6. Make technology transparent (the learners’ energies are focused on learning and not on operating equipment) (p. 11).

**Literature Review Summary**

This literature review focused on cognitive information processing theory, ELL characteristics, cognitive learning strategies and ELLs’ strategy use, strategy instruction, and embedding cognitive learning strategies in multimedia. First, the cognitive information processing theory describes how the memory system works. This theory has several implications for the development of instruction (a) the short duration and limited capacity of the sensory and short-term memory means that the learner’s attention needs to be focused on the important aspects of the content; (b) methods of rehearsal and encoding are necessary if information is going to be stored in long-term memory; (c) matching encoding cues to retrieval cues aids learners in better recall; and (d) extensive practice is needed to automate knowledge so learners can focus attention on unfamiliar and difficult tasks.

Second, the literature on ELLs revealed that their academic achievement lags behind language-majority peers and as such they are at risk of educational failure. At-riskness as defined by Gansneder and Frymier is “a function of the bad things that happen to a child, how severe it is and how often it happens, along with what else happens in the child’s immediate environment” (1989, p. 142). Characteristics that put them in academic
jeopardy are: language, delayed education for various reasons, fewer years of education than their English-speaking peers, and being served in ELL programs that do not integrate language learning and academic content. Strategy training has been shown to help increase all learners’ academic performance, and has been shown to benefit ELL students.

Third, from the literature on cognitive learning strategies of successful learners and ELLs’ strategy use, it was found that cognitive learning strategies are crucial to ELL students becoming successful language learners. It was found that successful learners have a repertoire of strategies that they use to actively involve themselves in the learning process. They know when, why, and where to deploy these strategies. The research showed that training unsuccessful learners in strategy use would benefit this group of learners.

Fourth, even though there is literature that asserts that training strategies is not easy, and developing metacognitive awareness and cognitive strategies is a gradual process, strategy instruction is supported in the literature. The literature on strategy instruction showed that ELL students benefited from strategy training, which resulted in improved academic performance. Informed strategy training is thought to hasten strategy learning. There are various models of strategy instruction (detached or embedded, explicit or implicit, informed or uninformed) available to educators desiring to integrate strategy learning into their content lessons. The following four characteristics were found basic to most strategy instruction approaches reviewed. Strategies should be (a) described, (b) modeled, (c) practiced, and (d) generalized to other settings.

The research suggested that embedding strategies in the content area would be more beneficial if strategies were closely tied to the content (content specific strategies), further it was felt that student motivation is crucial to students using strategies. Students need extensive use of strategies to help them determine how, when, where, and why they should use them. One strategy to help encourage strategy use is prompting the use of strategies often until learners become autonomous users of strategies. In order to help students learn, teachers must give them the strategies and skills to become effective learners. The lack of knowledge about strategy use results in inefficient learning or no
learning for students. This is an excellent reason for embedding strategy instruction into the content.

Most of the available literature on ELLs’ learning strategies focused on strategies used for language acquisition in reading, writing, listening, and speaking. Strategies for language learning and for other content subjects are often the same and these strategies can help prepare ELLs to move into mainstream classes. Very little literature addressed learning strategies used by ELLs in an academic content area. In an effort to remedy this lack of strategy use in academic content areas, the ESL Standards for Pre-K-12 Students were established to help content teachers integrate language in content areas in order to make ELL students skillful and effective learners and better facilitate their academic learning (TESOL, 2004). Therefore, this study will focus on embedding cognitive learning strategy instruction in a multimedia environment to support academic learning. This study can contribute to the body of knowledge related to English language learning by further expanding English language learning beyond strategies used for language acquisition and toward strategies related to academic content. It is also believed more research related to academic content could help ELLs become better prepared to meet graduation requirements.

It can be concluded from the research on using multimedia to support cognitive thinking that multimedia is a feasible approach for English language learning instruction; even so, as many of the research studies examined cautions, caution must be taken when designing instruction to ensure that the instruction is beneficial to the learner. The limited amount of research in this area makes this area suitable for further research.
Chapter Three

Prototype Design, Development, and Evaluation

This developmental project was initiated to explore embedding learning strategies in a computer-based multimedia tutorial in order to support English language learners’ academic content learning. A prototype of the North Carolina Tests of Computer Skills was designed, developed, and pilot tested. For this study North Carolina Tests of Computer Skills will be referred to as NCC/T and the North Carolina Tests of Computer Skills tutorial will be referred to as NCTCST. The findings from the formative evaluation completed during the pilot test were the framework for conducting this developmental study. Included in this chapter is a description of the study’s participants, the design and development of the NCC/T multimedia prototype, the pilot study, revisions and further development phase (Phase II of the proposal).

Participants

Phase I of this study consisted of the design and development, and pilot testing of the NCTCST prototype. Participants for Phase I were three ESL students, four ELL and two Business Education teachers. During Phase II of this study, an outside instructional design expert reviewed the NCTCST and five ELL students participated in a small group formative evaluation of the NCTCST.

Phase I of the study was conducted in a North Carolina high school that has approximately 1500 students and one third are classified ELL. The ELL students come from 43 different cultural and language backgrounds. These ELL students are in the ninth through twelfth grades. The ELL students selected to participate in this study had not taken, or had not passed one or both parts of the NCC/T. These students participated in an after school ELL tutorial class four days a week. This class provides extra assistance in content area subjects especially vocabulary. The majority of the students are beginning English language learners.

The second group of participants consisted of two Business Education and four ESL teachers. The ESL keyboarding teacher and a second Business Education teacher conducted expert reviews of the prototype. The ESL keyboarding teacher works with a
large majority of ELL students who take the keyboarding class. The keyboarding teacher is a 30-year veteran with approximately 10 years teaching the ESL keyboarding class. The keyboarding teacher provided insight into design aspects that were relevant to the ELL learner and the K-12 Computer/Technology Skills Standard Course of Study content.

The District ESL supervisor chose the ESL teachers because they utilized technology in their ESL classrooms. Because the researcher has experience teaching in the content area and preparing students for the NCC/T, the researcher conducted a self-evaluation of the tutorial prior to the teachers’ reviews. An outside instructional design expert reviewed the tutorial prior to full implementation in Phase II.

Phase I

Prototype Design and Development

To aid in the design and development of a prototype of the NCC/T computer-based multimedia tutorial, the Leshin, Pollock, and Reigeluth (1992) Instructional Systems Design (ISD) Model and Gagné’s Theory of Instruction were chosen. Gustafson and Branch (1997) categorizes the Leshin et al. (1992) model as a product oriented model because its assumed that a product will be produced. This ISD model consists of seven steps: (a) analyze the problem, (b) analyze the domains, (c) analyze each task and sequence its major components, (d) analyze and sequence supporting content, (e) design and write each lesson, (f) perform interactive message design, and (g) evaluate the instruction. A description of how these steps were used in this design and development process follows.

Analyze the Problem

The first step in this development process was to analyze the instructional problem. The problem for this study is ELL students have difficulty passing the NCC/T, which is a state mandated graduation requirement. Some ELL students have failed one or both tests multiple times.

In an effort to improve achievement levels of all students in North Carolina, the State Board of Education in 1991, established this computer proficiency graduation
requirement. This computer proficiency has been integrated into the states ABCs of
Public Education plan. Hispanic students’ test scores on the NCC/T falls below those of
the majority students (North Carolina Department of Public Instruction, 1999).
Additionally, Hispanic students’ test scores fall below those of majority students
nationally in reading, math, and writing (National Center for Education Statistics, 2003).

This graduation requirement involves the development of computer proficiency
over time and is a collaborative effort by all K-12 teachers. Students take the NCC/T
beginning their eighth grade year. Teachers are to integrate the K-12 Computer/
Technology Skills Standard Course of Study curriculum into the daily teaching and
learning process (North Carolina Department Public Instruction, 1999). The NCC/T
consists of two tests – a multiple-choice test and a performance test. The multiple-choice
test is a timed 70-question test. The test covers the following areas societal issues (such
as, ethics, societal impact, terms/operations/care), databases, spreadsheet, keyboard
utilization/word processing/desktop publishing, multimedia presentation, and
telecommunications topics. The performance test is a series of timed sections that
demonstrates student knowledge of computer/technology. Students are required to solve
problems using desktop publishing, database, and spreadsheet software and a computer.

English language learning students, entering North Carolina schools at the high
school level, are given a two-year exemption period while they become English
proficient before taking the test. They may receive accommodations, if these
accommodations are a routine part of their instruction and testing. Any student not
passing one or both parts of the NCC/T are given opportunities to retake the test each
time it is administered up until graduation. Seniors are given three test attempts. To help
ELLs meet graduation requirements, they are provided additional assistance (i.e.,
supplemental instruction that includes English language learning) until they can meet
graduation requirements up to the age of 21.

**Analyze the Domain of the Subject Area**

In analyzing the subject domain there are four major sub-steps: (a) identify the
tasks comprising each domain, (b) identify performance deficiencies associated with each
task, (c) write performance objective for each task, and (d) develop the performance measures for each task.

Identify the tasks comprising each domain. The tasks of the NCC/T have been defined by the K-12 Computer/Technology Skills Standard Course of Study. The goals and objectives of the NCC/T have been established in the K-12 Computer/Technology Skills Standard Course of Study and these goals and objectives vary according to grade levels.

Desktop publishing was chosen from the six strands of the NCC/T. An objective taken from the goals and objectives of the K-12 Computer/Technology Skills Standard Course of Study (use word processing/desktop publishing for assignments/projects) in conjunction with a state released sample activity were analyzed to determine competencies needed for the desktop publishing portion of the performance test. For the desktop publishing performance test, students are asked to modify a document. From the results of this analysis, the following tasks were identified: open an existing word processing document, set margins, set tabs, set line spacing, center a title, edit font style and size, apply text alignment, indent paragraphs, spell check a document, save and name a document, print a document, use correct keyboarding techniques.

Identify performance deficiencies associated with each task. Leshin et al. (1992) model suggests that performance deficiencies can be detected by observing the target learner working at the task or interviewing teachers. Through interviews with the Business Education and ESL teachers it was learned that the majority of the students in the ESL program have limited computer skills, if they have any at all, and have limited English language proficiency. Table 1 shows the performance of LEP students in the state on the NCC/T for the 2002-2003 school year. Based on this information the assumption was made that the ELL students had limited background knowledge of the computer/technology competency skills needed to pass the NCC/T.
Table 1
Limited English Proficient Students’ NCC/T Performance for 2002-2003 (North Carolina Department of Public Instruction, 2004a)

<table>
<thead>
<tr>
<th>Grade Level</th>
<th>Number Students Identified as LEP</th>
<th>Percent Met Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>2,860</td>
<td>38.6</td>
</tr>
<tr>
<td>9</td>
<td>1,216</td>
<td>44.7</td>
</tr>
<tr>
<td>10</td>
<td>2,089</td>
<td>58.5</td>
</tr>
<tr>
<td>11</td>
<td>510</td>
<td>73.7</td>
</tr>
<tr>
<td>12</td>
<td>959</td>
<td>88.4</td>
</tr>
</tbody>
</table>

*Write performance objective(s).* The performance objectives used for this tutorial were taken from the K-12 Computer/Technology Standard Course of Study. The following is an example of an objective from the K-12 Computer/Technology Standard Course of Study curriculum and the objective used for the NCC/T: *Use word processing/desktop publishing for assignments/projects.* For this study the students would be able to complete the five objectives for the NCTCST: (a) navigate the tutorial, (b) learn when, why, and how to use imagery, review, and guessing strategies; (c) match desktop publishing vocabulary words to definitions; (d) identify keyboard key types and key functions; and (e) edit a document according to instructions.

*Develop performance measures for each task.* The performance measures used for the tutorial were chosen to resemble the performance measures (multiple-choice and performance test) used for the NCC/T. Using similar performance measures is expected to aid the learner in encoding and retrieving the information better. This is referred to as state dependent learning (Bower, 1981; Driscoll, 2000; Overton, 1985; Smith, 1986). Building a context for remembering or retrieval of information makes remembering easier and retention better (Bruning et al., 1999). These tutorial performance assessments were a self-check for the students to help them determine how well they had studied the information and if they needed more review.

**Analyze Each Task and Sequence Its Major Components**

The steps in analyzing each task and sequencing its major components are: (a) determine if each task is procedural or a transfer task, (b) analyze the objects and tools of
the task, (c) identify and sequence the main components of the task, (d) analyze the target learner, (e) analyze existing courses (f) narrow down media choices, and (g) plan the project.

*Determine if procedural or transfer task.* Procedural tasks are defined as tasks that can be broken down into sequential steps and vary little from one performance to another, for example writing a business letter (Leshin et al., 1992). Transfer tasks are defined as tasks that are “best learned by learning underlying principles that are used to generate the best procedure for any given situation” (p. 49), and varies a great deal from one performance to another, for example supervising employees. Based on these definitions, it was determined that the tasks students were asked to perform such as setting a margin, setting a tab, or changing a font were procedural tasks because they are performed basically the same way each time its done and its usually the same from one software application to another.

*Analyze objects and tools of the tasks.* The objects of a task were defined as events, things, or what is being changed by the task. The objects for the NCTCST were determined by analyzing the NCC/T curriculum. It was determined that a desktop publishing document was needed to practice the performance test skills for this prototype. It was also determined that practice multiple-choice test questions were needed.

Leshin et al. (1992) defined tools as what is being used to make the changes to the object(s). Tools needed for the NCTCST are a computer connected to a printer, sound, and CD-ROM drive. In addition Microsoft Word software is needed to edit the document.

*Identify and sequence the main components of the task.* The main components of the tasks were identified and sequenced based on the K-12 Computer/Technology Skills Standard Course of Study curriculum and an analysis conducted on a state released desktop publishing sample activity from the NCC/T. From the results of this analysis, the following ten tasks were identified and sequenced: open an existing word processing document, set margins, set tabs, set line spacing, center a title, edit font style and size, apply text alignment, indent paragraphs, spell check a document, save and name a document, print a document, use correct keyboarding techniques.

*Analyze the target learner.* The targeted learners were high school Hispanic ELL students who had not taken or had not passed one or both parts of the NCC/T. These
students participated in an after school tutorial class four days a week. This class provided extra assistance in content area subjects especially vocabulary learning. The students in this tutorial class were beginning English language learners.

*Analyze existing courses.* There are various Business Education classes whose content aligns with the NCC/T curriculum. Although these classes are available, the keyboarding class, in which many students who have not passed the NCC/T are automatically enrolled, focuses mostly on keyboarding, leaving a gap in the competencies students need for the NCC/T. The topics covered for the NCC/T are keyboarding, desktop publishing, databases, spreadsheets, telecommunication, societal issues, and multimedia/presentations.

*Narrow down media choices.* Because this study is investigating embedding learning strategy instruction in a multimedia environment, development of a computer-based multimedia tutorial was planned. A multimedia environment was chosen for several reasons. First, multimedia has the capability to present text, visual, and auditory information that can address a learners’ preference for learning through visual, auditory, or tactile/kinesthetic methods. Second, providing the tutorial on CD-ROM will make it easy for students who have computer resources at home to use it when it is convenient for them. Finally, since the NCC/T is an assessment of students’ competencies in computer/technology, the computer-based multimedia environment provides the ELL student with more opportunities to practice these skills in a simulated environment.

*Plan the project.* The project plan was based on four factors—human and material resources, time, and costs (Leshin et al., 1992). For this project several subject-matter experts (two Business Education and four ESL teachers), and an instructional designer examined the materials during the design and development process. Additionally, three ELL students pilot tested the prototype during one-on-one and two-on-one evaluations and five ELL students evaluated the final prototype during a small group evaluation.

Material resources that were required for the design and development of the prototype tutorial were the NCC/T curriculum materials and practice activities, images, audio scripts, Word software, and Trainer8 authoring software. Computers with a CD-ROM drive and Word software were required to conduct the pilot test. These resources were available at the school. An instruction sheet was created that provided students...
information on how to use the tutorial. A list of the tutorial screens is included in Appendix A.

**Analyze and Sequence Supporting Content**

The next step, analyze and sequence supporting content, involved three sub-steps: (a) identify and sequence supporting content for procedural tasks, (b) sequence supporting content with major content, and (c) allocate content to modules.

*Identify and sequence supporting content for procedural tasks.* The supporting content used for this tutorial is learning strategy instruction. Three learning strategies were chosen. Guessing, imagery, and structured review were chosen because ELL students with language difficulties need strategies that can help them learn new information. During the course of learning English especially in an academic content area, ELL students will encounter many words they do not recognize and understand. Guessing intelligently can help them compensate for this lack of knowledge. Studies conducted by Chun and Plass (1996) and Jones and Plass (2002) found that associating foreign words with real objects or images made learning words easier. Multiple review sessions are usually needed to be able to remember information easily because for most people looking at new information once is not enough to remember it (Chamot & O'Malley, 1994; Oxford, 1990). Also guessing, imagery, and reviewing strategies can be used by ELL students in a variety of other academic content areas, such as, language arts and social studies (Chamot & O'Malley, 1994; Oxford, 1990; Rubin & Thompson, 1994; TESOL, 2004).

*Sequence supporting content with major content.* The learning strategies were embedded into the NCTCST prior to the DTP content since they were intended to help the ELL student process the information for better recall. First, the strategy was introduced. Next, procedures for using the strategy while completing the task were explained. Finally, the learner had the opportunity to practice the information using the strategy.

*Allocate content to modules.* For this tutorial the desktop publishing (DTP) strand was prototyped. The DTP strand requires students to demonstrate knowledge of word processing, keyboarding, and DTP skills. Since students are required to demonstrate their
knowledge on a multiple-choice test and a performance test, the DTP module included vocabulary terms and practice activities for word processing, keyboarding, and DTP skills (such as, centering text, inserting text, or changing font style and size).

**Specify Learning Events and Activities**

The four steps prior to developing the tutorial dealt with analyzing and sequencing tasks and supporting content using the Leshin, et al. (1992) ISD Model; however, during this phase of the design and development process, Gagné’s (1984) Theory of Instruction (Nine Events of Instruction) was used to guide prototype development. This theory is based on cognitive information processing theory and on 20 years of research in the area of effective classroom practices. The Nine Events of Instruction model supported the prototype development.

**Prototype Development**

One goal of the tutorial prototype was to embed learning strategy instruction in order to help learners to improve their encoding and retrieval of information at test time. Learners who acquire and use learning strategies are better able to selectively attend to information, encode information into long-term memory, retrieve information from long-term memory, and use information to solve problems (Gagné, 1984). Learning strategies undoubtedly affect how easily one learns, recalls, uses and thinks about information (Gagné, Briggs, & Wager, 1992).

Gagné (1984) proposed nine events of instruction that should take place for effective instruction to occur. These nine events are (1) gaining attention, (2) informing learner of the objective, (3) stimulating recall of prior learning, (4) presenting the stimulus, (5) providing learning guidance, (6) eliciting performance, (7) providing feedback, (8) assessing performance, and (9) enhancing retention and transfer.

*Gaining attention.* The cognitive information-processing model asserts that if attention is not given to a stimulus the information is lost. Information enters the sensory registry and registers for a very brief time after which the information is lost. Gagné (1984) asserts that any information that persists longer than a brief moment is due to the attention given to it. Attention focusing devices that Leshin et al. (1992) suggest are
change in sound, change in brightness of a display, use of visuals or inclusion of verbal information, use of arrows, blinking items, or asking a question. These are a few techniques that serve to gain the learners’ attention. The introductory screen of the NCC/T is intended to get the learners’ attention. Several techniques were used including a computer image that indicated theme of the tutorial. Upbeat music was used to grab students’ attention. Immediately following the first screen is an image of graduates and an animated image asking students if they are prepared for the NCC/T. In addition to gaining the learner’s attention, it is intended to stimulate motivation to complete the tutorial.

**Informing learner of objective.** Informing the learner of the objective is intended to create “expectancy” (Gagne, 1984). Learners will know what they can expect to accomplish by the end of the instruction. This also can help to motivate the learner to participate in the instruction. Driscoll (2000) states this can be achieved by stating what the learner will be able to do once the instruction is over. The tutorial objectives were based on the K-12 Computer/Technology Skills Standard Course of Study curriculum and the skills students need when they take the NCC/T. Expectancy for what will be learned helps learners to maintain attention so further processing of information takes place (Gagne, 1984). In addition to what learning outcome is expected, learners know what is required during performance assessments.

**Stimulate recall of prior learning.** To stimulate recall of prior learning the learner must recall prerequisite information about the topic. If the learner has limited or no knowledge about a topic then their knowledge must be developed. Since it was determined through teacher interviews that the ELL students’ knowledge of the computer competencies was limited and in order to build their knowledge of computer skills, an activity that listed several standard word processing icons that are prerequisite knowledge of the software application were presented to be matched to their function. They got the opportunity to learn the icons later in the tutorial if the learners did not know the icons.

**Present the stimulus.** When presenting the stimulus the distinctive features of the desired learning outcome should be emphasized. Pointing out features through the use of highlighting, underlining, bolding, and arrows are ways to emphasize the important
content. In the NCTCST, colored arrows were used to draw attention to tasks/features of the document students were required to manipulate during the tutorial.

Provide learning guidance. During this step encoding information for long-term storage is the primary objective. The activities students engage in depend on the type of learning outcomes desired. For the NCTCS the desired outcome is development of intellectual skill and cognitive strategy skills. Intellectual skills are the procedural knowledge (Driscoll, 2000) students need to complete the NCC/T tasks. Cognitive strategies, such as encoding and retrieval strategies will help the ELL students encode and retrieve content learned in the NCTCST.

Eliciting performance. The prior steps have been intended to help the learner encode information for long-term storage. This step is for the learners to demonstrate their learning. Leshin et al. (1992) suggested the use of matching items, multiple-choice, and T/F as practice activities for performance that requires only recognition. The activities used for eliciting performance were: matching activities, multiple-choice questions, and performing actual tasks on a document. Multiple-choice practice questions are used because the written component of the NCC/T is a multiple-choice test. Practice documents were used to give students practice completing a similar task they may find on the NCC/T performance section. These performance tasks were intended to help the learner assess how well they knew the information and as a result they could determine if they needed to continue reviewing or move on.

Providing feedback. Feedback is given to learners to help the learners determine the correctness of their performance. Leshin et al. (1992) model provides a variety of ways feedback can be achieved, such as give feedback immediately after every response or be concise and as brief as possible. These two suggestions seemed to work best for the practice activities in the NCTCST (brief responses to the correctness of the answer were given immediately after each response). For the multiple-choice test, it was decided to give feedback only at the end of the test; this saved time and decreased tutorial file size.

Assessing performance. Assessing performance verifies that learning took place. At the end of the tutorial the learner has an opportunity to take a practice performance test. They can judge from their performance how effective their study sessions were and if they need to review the tutorial again.
Enhancing retention and transfer. Driscoll (2000) suggests a couple of ways to build retention and transfer into instruction: (1) during learning guidance use a variety of examples and contexts, and (2) during eliciting performance and assessing performance phases, spaced reviews should be planned. Gagné (1984) suggested that a (1) variety of practice, (2) spaced reviews, and (3) commonality of cues between the learning situation and the new situation could be used. Multiple practice activities (i.e., multiple-choice and matching questions) spaced throughout the tutorial were used to aid in retention of the information. In addition tutorial screens were designed to be used as flashcards that students could use when they are away from the computer.

Perform Interactive Message Design

During the interactive message design step the type of media that was used for the prototype was chosen. The Leshin, et al. (1992) model includes directions for choosing and designing the five types of media: (a) human-based, (b) print-based, (c) visual-based, (d) audiovisual-based, and (e) computer-based systems.

The NCC/T tests students’ knowledge of computer/technology skills, consequently, computer-based instruction was chosen. This study is interested in investigating the development of a multimedia environment that can support ELLs’ academic learning through embedded strategy instruction. Using the Leshin et al. (1992) ISD Model the following interactive message design techniques were suggested:

1. An overview of the instructional program should be given at the beginning. This should include why the information is important, and how the user will use the information. The introduction screen included an audio clip emphasizing the importance of this tutorial as a preparation tool for the NCC/T. An image of a computer with upbeat music is used as attention getter. This screen moves to an image of a pair of graduates and an animated image to focus their attention on the connection between the NCC/T and graduation, which the tutorial will help prepare them. The next screen introduces the tutorial’s objectives and what the learner will be learning.
2. In an instance where a learner does not have the prerequisite knowledge, their knowledge must be built. Consequently, the Getting Started matching activity introduced the learner to information in the tutorial they would have an opportunity to learn if they did not already possess the knowledge.
3. Include in the directions how to begin program, how to exit program, and how to get additional help. At the beginning of the tutorial students are provided a lesson on how to navigate the program.
4. User interactions can be in the form of questions or practice activities. These interactions can occur prior (inductive) to the content, or can occur after deductive) the content. Content was presented first followed by a practice activity with immediate feedback.

Figure 3. Navigation controls screen.
5. Use attention-focusing devices. Use these devices in moderation to avoid over stimulation or distraction from the instructional content. An animated image was included to focus the learner’s attention on the reason they needed to study the NCTCST.
The final step in the Leshin, Pollock, and Reigeluth (1992) model is evaluate the instruction through formative and/or summative evaluation. In Phase I of this study, formative evaluation was carried out using expert reviews and one-on-one evaluations during a pilot study of the NCC/T prototype. During Phase II, an outside instructional design expert review and small group evaluation were conducted.

Formative evaluation was used to detect weaknesses in the instructional design of the prototype and to improve the tutorial before the final small group evaluation. The Leshin et al. (1992) model states that expert-review is the first stage in formative evaluation. The responsibility of the expert-reviewer was to verify the technical accuracy of the prototype. The following experts, Business Education and ESL teachers were utilized in Phase I. In addition, one-on-one evaluations were conducted with ELL students.

Participants selected. The ELL tutorial teacher selected three ELL students from the after school tutorial class to participate in the formative evaluation of the prototype. The Leshin et al. (1992) model recommended that three different ability levels (high,
medium, low), from the targeted population, rate the instruction. The Leshin et al. (1992) model suggest the following as possible data collection tools: pretest, posttest, performance assessment measures, student attitude questionnaires, instructor attitude questionnaires, and subject matter expert assessments.

**Pilot Study**

The intention of the pilot study was to gain insight into the design and development of an effective multimedia tutorial that could support ELLs’ academic learning. The areas of navigation, visual appeal, learning strategies, language appropriateness, and computer/technology content were the areas investigated. Data were gathered through self-evaluation, expert reviews, and one-on-one evaluations.

After the design and development of the NCTCST prototype, two Business Education teachers and four ESL teachers evaluated the prototype. Three ELL students pilot tested the prototype. The researcher conducted a self-evaluation of the tutorial prior to Business Education and ESL teachers’ reviews.

*Self-evaluation.* Tessmer (1993) suggests that the researcher treat herself/himself as an expert and review the materials prior to having an outside expert review the instruction. Before beginning this study, the researcher had three years experience preparing students for the NCC/T. The researcher completed the self-evaluation of the NCTCST prior to having the content experts and instructional designer review the tutorial.

*Content experts.* The content experts consisted of two Business Education teachers, and four ESL teachers. The Business Education teachers were chosen because they are credentialed Business Education teachers. Also they have experience with the North Carolina Computer/Technology curriculum, and more than 15 years combined experience teaching ELL students in the Business Education classes. One keyboarding teacher works with the majority of the ELL students taking a keyboarding class. The ESL keyboarding teacher is a North Carolina certified Business Education teacher and has taught keyboarding for 30 years. For at least ten of these years, she was designated as the ESL keyboarding teacher, which involved teaching keyboarding classes specifically for ELL students. The second keyboarding teacher is also a North Carolina certified Business Education teacher and has taught for 25 years. Both teachers provided insight into design
aspects that were relevant to the ELL student and the North Carolina Computer/Technology content. The ESL Program Director chose four ESL teachers because of their experience integrating computers in their teaching. The four ESL teachers are North Carolina certified ESL teachers with a total of 29 combined years of experience teaching ELL students.

One-on-one and two-on-one evaluations. These evaluations were carried out with three ELL students who participated in the after school ESL tutorial class. Tessmer (1993) recommends that evaluations be done individually so students can be asked questions as they progress through the instruction. For this study one-on-one and two-on-one evaluations were conducted.

Data Collection Methods

Self-evaluation. The self-evaluation conducted by the researcher was useful because it detected audio file quality, problems with navigation, visual appeal, learning strategies, content, language appropriateness or other technical problems, such as grammatical and spelling errors.

Content Experts. Tessmer (1993) was used as a guide in determining the types of information needed about the tutorial prototype and preparing evaluation questions prior to the teachers’ review. He suggests that evaluation questions be based on the kind of information the researcher wants to obtain from the evaluation, such as, learner appeal, material implementation, or design expertise. See the prepared evaluation questions in Appendix E.

Two Business Education and four ESL teachers reviewed the tutorial prototype. The teachers and the researcher reviewed the prototype screen by screen. The teachers were asked to look at the screens and talk aloud about their perceptions especially in the areas of navigation, visual appeal, learning strategies, language appropriateness, and computer/technology content. During the review process teachers were asked additional questions about the tutorial prototype (Appendix E). A discussion of the results from the content experts follows. Additional comments are included in Appendix F.

Navigation. Graham (1999) defines navigation as “the process by which a user explores all the levels of interactivity, moving forward, backward, and through the
content and interface screens” (p. 51). Making the navigation clear and obvious to the user through the consistent placement of the navigation buttons will help orient the user quickly on how to use the instruction (Lynch & Horton, 2001). Navigation for this tutorial included a navigation bar made up of icons representing forward, back, menu, and audio. The navigation icons were placed at the top right corner of the screen. Two additional navigation icons represented glossary and quit were located at the bottom right corner of the screen.

Since navigating the program is critical for student success using the tutorial, information was needed to determine if students would understand how to navigate through the tutorial. The screen after the title screen explains the tutorial navigation. The teachers were asked if they thought the ELL students would understand the navigation. Various suggestions were made as to how the screen could be improved. One teacher expressed confusion over the navigation even though she explained that after replaying the audio clip she realized it had stated click the forward button. This in itself made the researcher question whether the navigation was as clear as it could be. See Appendix F to review the teachers’ comments for improving the navigation screen.

Visual appeal. Couch, Caropreso, and Miller (1994) states that the use of color stimulates interest and curiosity. Harrell (1999) states that color may not affect the overall performance of a student, but its presence is pleasant and may make learning more enjoyable. Creating a desire to use the instruction is important to the use of the instruction. Visual appeal or an aesthetically pleasing look is important in this regard. Overall the color scheme was not an issue with the teachers. However, in the area of icons, one teacher suggested that by making the icons more ‘cartoony’ and by using a “less formal font – Comic Sans” the tutorial can be made more interesting and fun to the students. In contrast to the first teacher’s suggestion of using a less formal font, another teacher suggested not using a casual font. The teacher stated, “I wouldn’t go to a casual look. Make it much like you see in the books. What is this [Tahoma]? That looks fine to me. For American students who are born with it for a quick review its fine, but if you’re trying to learn it you don’t need any more impediments.”

The font style was also a concern of the other teachers because some letters of some fonts can confuse the students. “They get confused with that [lower case i and l].”
They suggested using Times New Roman because the letters have tails [serifs] that help distinguish them. Typography is definitely a concern because of legibility. In a study that examined onscreen typefaces, it was suggested that practitioners use their own judgment when selecting a font because the study found no significance between the selection of the font and the effect on comprehension. In fact Chandler (2001) states, “The field is still immature with only a few experiments revealing often-conflicting findings” (p. 103). Graham (1999) suggests that any font used should be tested to determine how it looks when displayed on screen. Serif fonts are fonts with small tails on the ends of letters and San Serif fonts do not have these tails. She cautions that small Serif fonts can interfere with readability because they tend to blur together on screen, and as one ESL teacher stated, ELL students “…don’t need any more impediments.” See Appendix F for other comments.

*Learning strategies.* The three strategies chosen for the tutorial were selected from literature on ELLs’ learning strategy use (Chamot et al., 1992; Chamot & El-dinary, 1999; Oxford, 1990). Imagery and structured review were chosen because the goal of the tutorial was to help make learning computer/technology skills easier and make recall of the information easier. Imagery is a highly useful strategy in that it allows the learner to understand and recall information, which Oxford (1990) states aids them in becoming competent at using the new language. Imagery can be used to (a) help build bridges between new concepts and existing knowledge, (b) help create connections by adding meaning to information, (c) help make information distinctive, and (d) help strengthen memory for information by combining visual cues with verbal cues making it easier to store and retrieve. Imagery can be used to associate foreign words with actual objects to make learning the words easier (Chun & Plass, 1996). Both imagery and structured review were chosen because they are memory strategies that aid the learner in recalling the information during testing.

The strategy guessing intelligently was chosen to help ELL students compensate in the learning environment when they do not know the information. This would be especially beneficial for ELL students who are learning a new language and academic content simultaneously. Guessing intelligently is classified as a compensation strategy that helps learners overcome gaps in their knowledge (Oxford, 1990). When they do not
know information they have a strategy to fall back on rather than giving up. Rubin and Thompson (1994) recommended that language learners determine meaning from context rather than use a dictionary.

The structured review strategy was chosen because it is generally accepted that multiple practice sessions over time is needed for information to be retained in long-term memory. Research studies that examined the spacing effect showed that spacing practice sessions over time promoted higher levels of learning and retention than massed practice (Caple, 1996; Dempster, 1987)

The researcher was interested in determining if the strategies were explained clearly, was appropriate for the content, and was helpful for learning and recalling the content. Most of the feedback received about the learning strategies dealt with making the information understandable and improving the screens for the learning strategies. To the question if there were other strategies that would be better suited for the content in this tutorial, they did not suggest any alternative or additional strategies. A couple of teachers suggested that all screens be made printable. The students would then be able to use the screens as flashcards. One teacher suggested, “Use flashcards as third strategy. Practice is not something you do during [the] test. Imagery and guessing can be used during test to help remember.” Teachers felt there was too much text explaining the strategy on one screen. See Appendix F for other teacher comments.

Language appropriateness. Two sources were used to determine the appropriateness of the language level for the ELL students: (a) teacher evaluations, and (b) student observations. From the teacher evaluations it was determined that the language needed to be made more comprehensible by “simplify[ing] text.” Teacher comments included: “Change the wording to a lower readability level for ELL students.” “Explain what indent means – ESOL students do not know that word.” “Change ‘check’ like an idiom, they will visualize ‘✓’, use ‘Pretest’.”

The literature on serving ELL students in content area classrooms offers several suggestions for making the language comprehensible: (a) choosing only the essential vocabulary, which reduces the amount of text and avoids overwhelming the ELL student; (b) define or demonstrate the words, which can be done by using images that are closely related to the written words; (c) use words they may already know to help them
understand meanings; (d) introduce the vocabulary words first before starting the remainder of the lesson (e) using words students already know, (f) use simple sentence structure, such as, verb-subject-object; and (g) avoid the use of compound or complex sentences (Echevarria, Vogt, & Short, 2000; Haynes & O'Loughlin, 1999; North Carolina Department of Public Instruction, 1995).

**Content.** The Business Education teachers and two of the ESL teachers have experience preparing the ELL students for the NCTCST; therefore, their input was needed to verify if there were sufficient practice activities and feedback, if it was clear how to complete the activities, and if the activities were helpful in achieving tutorial objectives. For the practice activities the teachers inquired if the students would get more than one chance to answer questions. The teachers believed that students should get multiple attempts at answering a question and feedback should be immediate. “Feedback needed immediately so know when get right or wrong, with explanation like the matching activity.” Teachers also suggested that all multiple-choice questions and answer choices be read to the students, because the test is multiple-choice and the ELL students get read aloud. Providing audio that reads the questions and answer choices can serve as a retrieval cue during the actual test (Driscoll, 2000; Thompson & Tulving, 1970) and it will address the learning style of the auditory learners. See other comments in Appendix F.

**One-on-one and Two-on-one Evaluations.** Since participants in the after school tutorial class are beginning level English proficient students, it was not possible to choose three different ability levels. Throughout the evaluation process the researcher was interested in identifying problems with the tutorial (such as, clear directions, useful and understandable strategies, appropriate language level, understandable and easy navigation, and visual appeal). Three ELL students, in the after school tutorial class, evaluated the NCTCST. However, the after school time constraints prevented each student from doing a complete review of the tutorial.

Since time constraints due to student English proficiency level and after school tutorial program time limit prevented the students from doing a complete review, the students were prompted to visit particular components, in order to allow the researcher to get feedback on multiple aspects of the tutorial especially navigation and learning.
strategies. The researcher observed students’ facial expressions or the time they spent on any one item looking for indications that items might be confusing. Observing these behaviors were important because students commented only when asked questions or when responding to questions. To encourage students’ comments about the tutorial, the researcher asked questions at different points in the tutorial.

While observing the students, it was evident that two of the three students seemed to have problems understanding what to do. One student asked the other student questions in their native tongue. The researcher offered to help the student who was having difficulty in order for the other student to continue working. When the two students were asked about using the guessing strategy, one student had a concern about using the guessing strategy because as she explained it, “we are taught not to guess. If all wrong answers cannot be eliminated you skip the question.” In relaying this information to her teacher, the teacher related a similar incident where a student missed passing a state test by two points and she told the student “next time guess honey.” So it seems necessary to emphasize to the students they will learn how to use the guessing strategy to help make good guesses on tests where they are not penalized for guessing. Towards the end of the tutorial class period, the students were given an evaluation sheet to complete. See Appendix C for students’ comments.

Data Analysis

Data analysis was conducted using a comparison process which compared the comments of expert reviewers and students for areas of agreement or disagreement (Tessmer, 1993). The comparison process involves organizing all comments and performances on a datasheet or a copy of the instrument in the case of the attitude questionnaire (Tessmer, 1996). From the comparison of expert reviewers’ comments and student observations, which were examined for areas of agreement or disagreement, a list of suggested revisions were compiled. In determining which revisions should be made, Tessmer (1993) suggests making high impact revisions first. These high impact revisions are the ones that will have the most impact on ELL students learning in the multimedia environment. The following areas were the areas considered high impact:

1. Clarify navigation by making icons more representative of their functions.
2. Make language more comprehensible for the ELL by aiding word meaning through the use of images and synonyms. Use a font that will make the text legible for the students thus eliminating a possible impediment for ELL students, but at the same time adding interest.

3. Reduce visual clutter and enhance understanding by using more imagery and reducing the amount of text on a screen. This process may involve splitting information over several screens.

4. Allow multiple attempts and provide immediate feedback for each question.

In summary, the NCTCST prototype developed to help ELL students prepare for a state mandated graduation requirement was shown though the pilot study that this tool after revisions and further development can serve as a valuable tool for this purpose. Several samples of revised screens can be found in Appendix L.

**Phase II**

**NCTCST Revisions and Small Group Evaluation**

Following the outside design expert’s review, final testing of the NCTCST prototype was conducted using small group evaluation. Five Hispanic ELL students participated in the evaluation to determine if the earlier suggested revisions improved the design of the tutorial. This section describes the participants, procedures, data analysis, and summary of the NCTCST study.

**Participants**

*Outside Instructional Design Expert.* The suggested revisions based on the pilot study recommendations were used as guidelines for further development of the NCTCST. An instructional designer at a large research institution in the southeastern part of the United States evaluated the tutorial. The outside instructional designer evaluated the NCTCST for design soundness as it related to Gagné’s (1984) Theory of Instruction. The following recommendations from this review were incorporated into the NCTCST design (Appendix G):

1. Orient the user by dividing the tutorial into sections so learner knows where they are in the tutorial;
2. Include the objective at the beginning of each section to remind and help learner know what they are expected to do;
3. Provide directions on every screen to guide learning; and
4. Standardize pop-up screens, button locations, and the interface to avoid confusing the learner.

The school principal and guidance counselor selected the five Hispanic ELL students who participated in the after school small group evaluation. None of the participants had passed or taken the NCC/T. The selected ELL students reviewed the NCTCST over a four-day period.

**Small Group Evaluation**

Tessmer (1993) describes small group evaluation as “... evaluation that occurs when a group of learners evaluate an unfinished version of instruction” (p. 101). The purpose of small group evaluation is to (a) confirm if previous revisions improved the effectiveness, efficiency, and appeal of the instruction through the use of a larger number and diverse ability group, (b) determine weaknesses that were not apparent earlier, and (c) help debug the instruction in any area that causes the students problems. During the small group evaluation data was collected using five Hispanic ELL students from the after school tutorial class.

The data collected from the small group evaluation was used to determine whether (a) the design of the embedded learning strategies in this computer-based multimedia program enabled the learners to learn the content, and (b) the design of the embedded learning strategy instruction in the computer-based multimedia program supported the English language learners’ academic content learning.

**Data Collection**

An outside instructional design expert conducted an evaluation of the tutorial prototype prior to the small group evaluation. Small group observations, debriefing interviews, attitude questionnaire, performance and multiple-choice assessments were used to collect data. During the small group session the researcher observed students utilizing the NCTCST in a computer lab setting. At the end of each day the researcher conducted debriefing interviews with the participants to get immediate feedback. The
group setting for the interview is intended to make the students feel comfortable about expressing their opinions about the NCTCST. The researcher believes that the students may express more openly if they hear others expressing their opinions. The attitude questionnaire was completed at the end of the four-day session to obtain additional feedback about the participants’ experiences using the tutorial. The attitude questionnaire focused on overall appeal and implementation of the tutorial. Attitude questions can be found in Appendix H.

**Data Analysis**

Data gathered from entry skills and computer skills questionnaire, observations, debriefing interviews, attitude questionnaire, and performance assessments were analyzed using a datasheet to catalog observed behaviors, debriefing comments, questionnaire responses, and assessment results (Tessmer, 1993, p. 89). This datasheet tool allowed information to be organized into categories (learner comments, observations, questionnaire answers) in order to compare and contrast the data collected from these data collection tools. This analysis method allowed the researcher to see where there was agreement or disagreement on various aspects of the tutorial design, benefits of embedded learning strategies, and appeal and implementation of the tutorial. From the gathered data, it was determined whether the pilot study’s feedback in the areas of improving navigation, practice activities, vocabulary words, instructional language supported the ELL students’ academic learning through the embedded learning strategies—imagery, review, and guessing into these areas were confirmed. SGE data were also used to determine if the prototype had additional weaknesses or program bugs. The researcher sought to determine if the learners perceived the learning strategy instruction as beneficial and if it supported their learning while studying the tutorial content.
Chapter Four

Prototype Evaluation

The prototype evaluation sought to determine whether the embedded learning strategies aided the learners studying the content in this multimedia environment, if the revisions based on the pilot study improved the design of the tutorial, and determine any additional problem areas the students encountered using the NCTCST. This chapter describes the participants, observations, small group debriefing interviews, performance assessments, and attitude questionnaire procedures used to collect data over four days during an after school tutorial time.

Participants

A small group evaluation (SGE) was conducted with five Hispanic high school students in grades nine through eleven. The SGE participants have been in the United States ranging from ten months to two years. The principal and guidance counselor of the participating high school selected the five Hispanic ELL participants. The criteria for selection were: (a) Hispanic student and (b) had not taken NCC/T or had not passed the NCC/T. The researcher learned from the school’s ESL teacher that these students are classified as intermediate English language learners, although he considered them to be low-intermediate ELL students. An ESL teacher served as an interpreter for the ELL students. The ESL teacher is currently participating in the Visiting International Faculty Program. The Visiting International Faculty Program invites teachers from other countries such as Spain, France, and Great Britain to teach in North Carolina schools. This ESL teacher is from Spain and has taught in the ESL program at the school for three years.

Procedures

The small group evaluation (SGE) extended over a four-day period during the 50-minute after school tutorial time. Five Hispanic students met with the researcher and interpreter. The SGE was conducted in the ESL classroom because the regular school computer lab was not available. The ESL classroom had one computer; therefore, the
researcher setup a mobile computer lab using five PC laptop computers and one networked printer. The laptop computers were configured with Windows XP, Microsoft Word, and the NCTCST. The NCTCST was authored with Trainersoft software. Headphones were used which allowed students to listen without disturbing other students.

**Day One**

*Overview.* The ELL students arrived in the ESL classroom approximately five minutes after the bell rang. The students selected a computer workstation. The researcher was introduced to the students. The researcher informed the students that the ESL teacher would serve as an interpreter. Participants were given an overview of the research activity. They were told on Day One that they would complete an entry skill assessment and a short questionnaire to determine the learners’ entry skill level and learning strategy and computer use prior to starting the tutorial activities. The ELL students were also told that they would examine the tutorial for 15-minutes, and end with a debriefing session for 15-minutes. On Day Two they would examine the tutorial for 30-minutes and participate in the debriefing session for 20-minutes and on Day Three they would follow the format for Day Two. On the fourth day they would complete the performance and multiple-choice assessments included in the tutorial and complete a paper and pencil attitude questionnaire.

The students were asked to provide the researcher with information to determine if the tutorial strategies—imagery, review, and guessing would help them while studying the information in the NCTCST. Because the researcher needed to understand what problems the students experienced in the tutorial and because the researcher did not understand Spanish, the students were asked to speak in English as much as possible. However, they were instructed to speak in Spanish if needed, and the interpreter would translate for the researcher. Using the interpreter was to ensure that the most accurate data was obtained during the sessions. Further students were told they would be observed while they were working through the tutorial and at the end of each day there would be a debriefing session to discuss their opinions about the NCTCST. The interpreter was asked to repeat the instructions in Spanish to ensure the students understood the instructions. The ELL students were given headphones to use during the session.
Instructions. The students were asked if they had used laptop computers prior to Day One of the small group session. None of the students had used a laptop computer; therefore, prior to beginning the tutorial students were shown how to use the laptops’ pointing system (glide pad and mouse buttons) and how to adjust the volume on the computer. Students spent approximately five minutes practicing how to use the glide pad and mouse before beginning the tutorial session.

Entry-level skill assessment. Next the five ELL students were given a five-question entry skill multiple-choice assessment to determine their level of prior knowledge of the NCC/T content. The students were instructed on how to access the entry skill assessment on the computer desktop. The students were given five minutes to complete the five questions. To determine the five ELL students’ entry skill level, they answered five multiple-choice questions. See the entry skill assessment in Table 2. The results of the entry skill assessment indicated that four of the five students had limited knowledge of the NCC/T content prior to examining the tutorial.

Table 2
Entry Skill Level Assessment

<table>
<thead>
<tr>
<th>Learner</th>
<th>Number Questions Answered Correctly (questions = 5)</th>
<th>Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>L2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L3</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>L4</td>
<td>3</td>
<td>60</td>
</tr>
<tr>
<td>L5</td>
<td>1</td>
<td>20</td>
</tr>
</tbody>
</table>

Note: L1 = Learner 1; L2 = Learner 2; L3 = Learner 3; L4 = Learner 4; L5 = Learner 5

Because the researcher needed to determine if the ELL students would be able to use the tutorial without assistance, the students were asked to work independently as much as possible. They were told if they encountered words they did not know they should guess at the meaning using the words they did know and that they would learn a strategy to help them guess wisely. The students were told they could print any computer
screens they wished to use as a study tool and these pages would have a printer icon on them. The researcher gave the short questionnaire to the ELL students. The researcher read the questions aloud and asked the interpreter to read the questions in Spanish.

Observations. The students were observed reading the questionnaire then three students raised their hands speaking in Spanish. The interpreter informed the researcher the three students asked what the words ‘learning strategies’ meant. The researcher gave examples of learning strategies then the interpreter translated the information in Spanish to the students giving them examples of learning strategies (such as, repeating information over and over, and writing in the margins). On the learning strategy and computer use questionnaire, the five ELL students indicated they used some form of a practice strategy prior to participating in the study—copy examples, write notes, or repetition. Four of the five students rated their computer skill level as good or fair, while one did not use a computer. The four students who reported using a computer used it to surf web, play games, e-mail, play music, and do class assignments.

After all ELL students completed the questionnaire, instructions were given on how to launch the NCTCST program, which was on the computer desktop. The ELL students reviewed the introduction and the navigation sections of the NCTCST. The students were given 15 minutes to review the tutorial. One student started to talk with another student; so all the students were reminded that it was important to review the tutorial independently. This would allow the researcher to determine if the embedded learning strategies helped them use the tutorial with no assistance. They were further instructed if they encountered words they did not know they should guess at the meaning using words in the sentences they did know and they would learn a strategy in the tutorial to help them guess wisely.

During the earlier evaluations of the NCTCST, several recommendations were made to improve the design of the NCTCST: (a) clarify navigation by using icons that represent their function more closely, (b) standardize screen layout, (c) provide section markers that orient the user to where they are in the tutorial with the objective repeated for each section, (d) make language comprehensible by using images and synonyms, and (e) provide practice activities that allow multiple attempts and feedback. These suggested
design improvements were monitored to determine if the imagery, review, and guessing strategies supported the ELL students in learning the NCC/T content.

The researcher observed the five students to see if the revised navigation screens, which used images and immediate practice of the navigation supported learning the navigation lesson easily and quickly. The five students started the tutorial and were able to proceed through the introduction. The introduction informed the learner about the importance of the tutorial (Figure 8). Next all students viewed the tutorial objectives screen and advanced to the next section of the tutorial containing the navigation objective, navigation buttons, narration and textual button descriptions, and an activity to practice the navigation content (Figure 9). The researcher observed that all the students were able to navigate the screens until they got to the first matching activity. This activity was used as an introduction to the several matching activities included in the tutorial.

![Figure 6. NCTCST Introduction Screen.](image)
Prior to the student practice of the navigation controls, they were given a short matching activity to introduce the matching game. Students raised their hands and called the teacher’s name repeatedly to indicate that they were experiencing a problem understanding the matching activity (Figure 10). The researcher directed two students by pointing out the words Column 1 and Column 2 above the columns of buttons and in the instructions and asked the students to reread the instructions. After pointing this out the students proceeded on their own. When they went to the next screen where they were given the opportunity to practice the navigation icons using the same matching format, they were able to do the matching without further assistance. Three of the students’ navigation matching screens showed all green lines indicating all items were matched correctly.

By the end of Day One, all the students had completed the navigation section and were able to use the navigation controls without assistance. Four of the students were observed asking the interpreter what they were supposed to do on the first matching activity. This indicated that additional help understanding how to complete this activity was needed.

Navigating the earlier screens (introduction, tutorial objective and navigation) in the tutorial did not appear to be a problem for any of the ELL students. However,
comprehension of the instructions on the matching activity was a barrier for four of the
five ELL students. Even though the screen had been revised in an attempt to make the
words easier to comprehend and by including accompanying audio, which read the
instructions that were on screen for completing the activity, four of the five students still
asked what they were supposed to do.

Observing the students working through the tutorial revealed that even though this
group of ELL students was classified as intermediate, they were low intermediate as
verified by the ESL teacher. When compared to the beginning English language learners
used in the pilot study, the five intermediate ELL students’ proficiency level appeared to
be similar to the beginning students. The five ELL students relied heavily on their native
language and four of the five students depended heavily on the interpreter for assistance.

The interpreter was available to ensure that the data collected would be as
complete and accurate as possible since the students were low-intermediate English
language learners. The positive aspect of using an interpreter was obtaining all data
spoken in Spanish that was pertinent to the study. However, the negative aspect of using
an interpreter was it allowed the ELL students to rely on their native language and to rely
on the interpreter to explain information rather than them making a guess when they were
not sure.

To leave enough time for the debriefing session, the researcher stopped the
students after all students completed the navigation section of the tutorial. The students
recorded their stopping point on a sheet of paper and turned in to the researcher. Students
would start at this point the next day.
Section 1
Learn How to Play the Matching Game

Practice playing the matching game. You will use it again in the tutorial.
1. Match items in Column 1 to banks in Column 2.
2. Click a button in Column 1.
3. Find and click the matching answer in Column 2.
4. When done, correct answers will show green lines.

Column 1

- Which column button is clicked first?
- Which column button is clicked second?
- Correct answers show what color?

Column 2

- Click button in Column 2
- Green lines
- Click button in Column 1

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Figure 8. Introductory matching activity.

Debriefing interview. The students were asked if the icon images, icon descriptions, or the combination of icons and descriptions were the most helpful in learning to navigate the tutorial. One student indicated “just icons helped” understand what to do. The other four students agreed. The students were asked what they thought about the navigation lesson, which included animated icon descriptions, icon images, and a navigation matching game. One student commented, “First one [matching activity] was hard and did not understand.” The researcher repeated the question and two students agreed that the first matching activity was hard and two did not respond. When students were asked what they would change about the navigation lesson, one commented, “They are okay” and another said, “They are clear.” No other students commented. Students were asked how the researcher could make the screens look better. A student responded, “Looks okay.” The other four students agreed with the student that the screens looked okay. At the end of the 15 minutes the session was ended and the students were dismissed for the day.
Day Two

The five ELL students came in immediately after the bell rang and took their places at the computer they worked on the previous day. The computers were already turned on and displaying the desktop. The researcher reminded the students to speak in English so the researcher would know what problems they were experiencing with the program. It was explained they would work through the tutorial the first 30 minutes of the session and the last 20 minutes they would participate in the debriefing session.

Instructions. Students were given the slips of paper that had their stopping point from the previous day. Students were directed to start the program and go back to the screen where they left off by skipping over screens they had completed. The researcher shortly realized from the puzzled looks that none of the students understood the instructions. The researcher showed the students how to skip over screens by using the forward arrow until they got to the screen where they stopped the previous day. The interpreter explained in Spanish how to skip through the screens using the forward arrow to get back to where they stopped. With the exception of understanding the instructions to skip through the screens to navigate back to the place where they left off the previous day, all the students were able to navigate the tutorial without assistance.

Observations. The students examined the tutorial for the first 30 minutes of the session. The students were observed to determine if they had problems comprehending the learning strategy section. None of the ELL students asked questions as they proceeded through the guessing strategy (Figure 11). They moved on to the second learning strategy, which was the review strategy (Figure 12). After reviewing the screen with the description of the review strategy, the next screen directed the user to print the page and fill in a review schedule. One student asked if they were to print the screen and once it was understood they were to print this screen, all the students printed the screen without further assistance. From the instructions on completing the review schedule, the student was instructed to fill-in the hours from the example on the previous screen. It had been observed that the students did not review the sample review schedule on the previous screen so they were directed to return to the previous screen and scroll down to the example schedule. All the students returned to the previous screen but did not attempt...
Section 2
Smart Guessing Strategy

Learn to use the smart guessing strategy.

Name of the strategy: Smart Guessing strategy

Why use the strategy: Guessing can help you figure out meanings of information you do not know.

When to use the strategy: Use when you do not understand a word or do not know an answer to a question.

How to use the strategy: Gather clues from other words or sentences. Use words you already know to help guess the meaning of words. If available, look at pictures or diagrams.

Figure 9. Smart guessing strategy description.

Section 2
Review Strategy

Learn to use the review strategy.

Name of strategy: Review Strategy

Why use the strategy: You remember better the more times you study and when you space out your study sessions. For example, it is better to study 3 times for 1 hour each than study for 3 hours all at once.

When to use the strategy: Use it to make sure you do not forget to study often.

How to use the strategy: Setup a study schedule for this tutorial. Use the example below to make your own schedule. Print the blank schedule form on the next page.

Figure 10. Review strategy description.
to scroll down the screen. They waited. The researcher directed the students to the scroll bar handout beside their computer. The students did not respond. The students were directed to use the scroll bar to scroll down the page to the review schedule. The students did not respond. The researcher realized they were having a problem scrolling down the page. The researcher and the interpreter showed each student how to click, hold, and drag the scroll bar using both hands to move down the screen. Once the students could scroll down the page the students were directed to copy the schedule onto their copy of the review schedule. After the review schedule was completed, the students continued to the imagery strategy. The students did not ask questions about the imagery strategy (Figure 13).

The students’ raised hands and calling the interpreter’s name erupted when the students got to the Menu Page. Four of the five students experienced difficulty with the Menu Page. The interpreter explained that the students said they were confused about what to do on this screen. The researcher explained that the underlined words were hyperlinks and by clicking the hyperlink they would go to another page. The researcher directed them to read the suggestion, which stated, “On the first time through this tutorial

Figure 11. Imagery strategy description.
start with the first topic and continue practicing each topic in the order given” at the top of the Menu Page screen. The students continued by clicking on the Getting Started link.

Four of the five students had all green lines on their Getting Started screens indicating they had responded accurately to all questions. One student was observed going back to the Getting Started screen several times to attempt the icon matching activity. All the students were able to complete the matching activity without assistance. After students completed the Getting Started matching activity, time was called and students were instructed to close the program and turn off the computer so the debriefing session could start.

Debriefing interview. The next 20 minutes were spent asking questions about the tutorial. Images of the three learning strategies and the menu page were shown to the students to aid their recall of what they had examined during the observation session. The students were advised that everyone would be asked for their suggestions during the interview session. Students were asked if the navigation was easier to use the second day and if it was easier, what made the navigation easier to use. One student commented she had done it yesterday and when the other students were asked their opinion they agreed with the first student.

The students were shown the menu page and reminded that four of them had asked for help when they got to the Menu Page. They were asked how the page could be made easier to understand. One student answered speaking rapidly in Spanish. It was indicated that the researcher did not understand what was said. Since the interpreter had to go to the office briefly, the student whose English proficiency level was higher than the other students’ started translating what the first student said. The student translating relayed that each topic needed a number beside it to tell them which one to do first, second, and third. In the middle of the student translating the comment, the interpreter returned and the student who was interpreting stopped and would not continue even when encouraged by the researcher and the interpreter to do so. Students were asked in turn for their suggestions for making the menu page better; however, they did not offer any other suggestions. They were encouraged to speak in Spanish if they needed to. There were no comments. The ELL students were asked what they thought about the first students’ suggestion. They all agreed that the numbers would help. From the day’s debriefing...
session all the ELL students indicated that the Menu Page needed to be revised to include
more structure to help them know how to approach using the information on the page

The students were shown images of the three learning strategies. They were asked
which strategy or strategies did they think were helpful and how was it helpful. A student
commented, ‘the picture of the scissors was helpful” leading the researcher to conclude
that the images were helpful in comprehending the information. The debriefing session
time was up and the ELL students were reminded that the next day was the last day to
examine the tutorial. It was explained because the 30-minute session would not be
enough time to examine the desktop publishing vocabulary, keyboard keys, and editing a
document they would be assigned to examine only one of these topics. The session was
ended and the students were dismissed for the day.

Day Three

The five ELL students came and took their places at the computer they worked on
the previous day. The computers were turned on and the desktop was displayed. The
researcher reminded the students to speak in English so the researcher would know what
problems they were experiencing with the program. It was explained that the first 30
minutes would be spent examining the assigned section of the tutorial and the last 20
minutes giving feedback on using the tutorial.

Instructions. Because this was the last day to examine the tutorial content before
taking the multiple-choice and performance tests they would be assigned a specific topic
of the tutorial in order for the researcher to get feedback on all the sections of the tutorial.
Two students were assigned to review the desktop publishing vocabulary words section,
one student was assigned the keyboard keys section, and two students were assigned the
edit a document section. The students were instructed to go to the menu page and click on
the assigned section.

Observations. All the students were observed navigating to the menu page and
clicking on the assigned section. The researcher observed to see if the students spent time
examining and practicing the information in the section of the tutorial they were assigned.
The first student observed was the student assigned to review the keyboarding section.
The student was observed looking at the keyboard screens. Next the student clicked the
keyboard and the pop-up window opened; however, the student continued to click the keyboard and nothing happened. The student overlooked the instructions or did not understand to click the OK button to close the pop-up window even though there was an auditory signal every time the student pressed the keyboard alerting the student that some action was needed before the student could continue. After the OK button was pointed out the student was observed clicking many of the keys on the keyboard to see the key descriptions. While examining the different keys, the student asked the interpreter what ‘toggle’ and ‘overwrite’ meant. The interpreter relayed to the researcher that the student wanted to know what toggle meant but he was not familiar with the term. The researcher illustrated a toggle key on the student’s keyboard and the student continued. When the student got to the keyboard matching activity, the student attempted this activity several times. The student was even observed writing down information on a piece of paper. Time was called while the student was writing down the information and the student did not have a chance to repeat the activity using the notes.

Second the two ELL students assigned to examine the edit a document were observed. When the researcher started observing the two students they had opened the editing practice Word document. The students were observed looking at the page and then scrolling down the page to the next task, spending a little time looking at the next task and scrolling down the page. They continued through the remainder of the tasks in this manner. Neither student attempted to complete the practice activities (i.e., center text, set line spacing, set margins, set tabs) that followed each set of instructions (Figure 14).

The last two students observed were the two assigned to examine the desktop publishing vocabulary words. Both students were observed looking at the vocabulary word screens (Figure 15). One student asked the interpreter for help. The interpreter explained to the researcher the student asked what the word ‘paste’ meant. The researcher directed the student to try and guess the meaning from the words they already knew in the sentence. The student continued. After reviewing several more words the same student asked the meaning of ‘store’. The researcher reminded the student again to try and guess the meaning from the words they already knew in the sentence. The student continued through the remaining words without assistance. The second student (who appeared to be at a higher English proficiency level) did not request help with any of the desktop
publishing vocabulary words. Although printer icons were included on all the vocabulary screens to allow the student to print the screen and use as a flashcard, neither student attempted to print the screens. Both students working on the desktop publishing vocabulary section printed the crossword puzzle. At the end of the 30 minutes, the session was ended to start the debriefing session.
Debriefing interview. Examples of keyboarding pop-up windows, edit a document, desktop publishing vocabulary words, and matching activity screens were shown to the students to help them remember what they had examined in the tutorial. To determine which activities the ELL students preferred in the tutorial, the students were asked which activities they liked or disliked. All students indicated they liked the matching activity. One student indicated she liked the keyboard pop-up windows. Students were also asked which activity/activities were the most helpful while studying the NCTCS. All students indicated that the audio and matching activities were very helpful; one student indicated the keyboard pop-up windows were helpful.

The researcher was interested in finding out if the students perceived that the words were at an appropriate level to help them understand the tutorial information. Students were asked to rate the word level as easy, hard, or in-between. Four of the five students felt the words were in between and one student felt the words were easy.

The students were shown the images representing the three learning strategies. The ELL students were asked the next time they did not know a word which strategy would they use. All the students pointed to the image representing the imagery strategy. When asked why they would use imagery, all five students indicated the imagery strategy was the easiest to use. When they were asked why they thought the imagery strategy was the easiest to use, one student commented she did not understand the doors (representing the guessing strategy). There were no comments from the other students. The researcher concluded from this statement that the students did not understand how to use the guessing strategy. Another reason the students may not have understood the guessing strategy was possibly that the students did not make the connection between guessing they already use and the guessing strategy in the tutorial. The tutorial provided additional hints for using the guessing strategy to increase the likelihood they would guess correct.

When asked which strategies they used while studying the tutorial, the five students said they used them all. Students were asked if they had used the guessing strategy while completing the icon matching activity. Four of the five students said they had guessed and one said she knew the icons already. One student said she guessed because she knew that scissors were used to cut and another said she knew the disk meant to save. The debriefing session time ended and the students were dismissed for the day.
Day Four

The five ELL students came in immediately after the bell rang and took their places at the computer they previously worked on. The computers were ready at the desktop. The researcher reminded the students that this would be the last day they would meet with the researcher. Additionally they were reminded that speaking in English would help the researcher understand any problems they experience with the tutorial. It was explained they would complete the performance test first, next the multiple-choice test, and last complete the attitude questionnaire.

The performance and multiple-choice tests included in the tutorial were intended to help the students judge their own study progress. The researcher informed students that in order to find out if the objectives for developing the tutorial had been met they would complete a performance test and a multiple-choice test to determine how well the learning strategies helped them recall the tutorial content. In order to allow time to complete all activities for the day, they would be given 15 minutes to complete the performance test, 20 minutes to complete the multiple-choice test, and 15 minutes to complete the attitude questionnaire. It was also explained that the actual NCC/T test times were longer. Students were directed to go to the menu page and stop. Once all the students were at the menu page directions for assessing the Test Your Knowledge section of the tutorial were given. Students were instructed to read the instructions on the screen and start the performance test.

Performance assessment observations. The performance and multiple-choice tests included in the tutorial were intended to help the students judge their own study progress. For the performance section of the test students were given three tasks to complete: center and bold a title, change font style and size, and double space between paragraphs.

The desktop publishing performance test instructions and tasks were setup to resemble the NCC/T test format. On the instructions page of the performance document, the student was directed to make the three edits to the sample document. After looking at the page all the students raised their hands for assistance. The researcher asked the two students closest to the researcher what was the problem. The students asked what they should do. The researcher encouraged all the ELL students to reread the instructions and scroll down to the document and make the changes. One student was attempting to edit
the directions instead of scrolling down to the actual document. The student was directed to scroll down to page two. The student was able to change the font color of the title to red, even though this was not one of the tasks. All the students were observed attempting to make the edits to the document. Time was called before they could complete the tasks. The ELL students were directed to close the Word document and save the document to return to the tutorial. For the NCTCST the student would be taken to a correct copy of the edited document and there they could compare their document to the corrected copy. Included with the document would be instructions that stated if they could not perform the tasks they needed to practice the “edit a document” section again.

Once the ELL students were back at the tutorial screen, they were directed to go to the next screen, which was the multiple-choice test. The students were reminded they had 20 minutes to complete the multiple-choice section. Upon completing the multiple-choice test, a scoring page would display the student’s score. Based on the score <80% the students were instructed to review the tutorial information again. If they scored ≥80% they were congratulated but reminded to study the information often to help remember it.

The researcher instructed the students on how to access the multiple-choice test. The ELL students were informed that the actual multiple-choice portion of the NCC/T is given with paper and pencil and not on the computer. The researcher informed the students they would have 20 minutes to complete this section and that the questions and answer choices would be read and this was being done because on the actual test they would have someone read the test questions to them. They were also instructed that if they did not want to wait on the researcher reading the questions and answer choices they could continue on their own. Three of the five students chose to wait as the researcher read the questions and answer choices aloud and two continued on their own. At the end of the multiple-choice assessment, a score page was displayed that informed the learner of their score and whether they needed further review.

Since all the learners did not examine all the NCTCST topics it is hard to determine if the imagery, practice, and guessing strategies were helpful based on the results of the performance and multiple-choice assessments. However, from the ELL students’ comments on the learning strategies, they agreed that the strategies were helpful and indicated they used images to comprehend the tutorial content (i.e., navigation icons.
helped). Learner four and five (L4 and L5) examined the edit a document section of the tutorial. During the observations neither student attempted to practice the editing tasks. From the results of the performance assessment neither student assigned to examine the editing a document tasks did well on these tasks.

The tutorial multiple-choice assessment consisted of 15 questions. The intent of the multiple-choice assessment was to provide students with a self-evaluation in order to determine the progress of their studying, whether further study was needed, and provide experience with the multiple-choice test format. Of the 15 questions on the multiple-choice assessment 10 questions were related to desktop publishing vocabulary terms, 9 questions were related to keyboarding terms or tasks, and 8 questions were related to edit a document concepts. Nine questions covered more than one of the three areas of the NCTCST content. For example, the answer “enter/return” to the question “Which key moves the cursor to the beginning of the next line of text?” was covered in desktop publishing vocabulary and keyboarding.

Performance assessments were planned and implemented as a part of this study. However, the evaluation of the NCTCST took longer than originally planned and as a result students were unable to evaluate the complete tutorial. Because of insufficient time for students to review all sections of the tutorial the assessment results were not valid. Further study and more time to review the tutorial are needed in order to evaluate if the guessing, imagery, and review learning strategies were beneficial to the students.

**Attitude Questionnaire.** The ELL students spent the last 15 minutes completing the attitude questionnaire. The attitude questionnaire assessed the ELL students’ perceptions of the NCTCST and was an additional tool to collect data not obtained during the debriefing sessions. When the 15 minutes were up the session ended and the students were thanked for participating in the study and dismissed. Table 3 shows the learning strategies aligned to the attitude questionnaire questions. Tables 4, 5, and 6 show the results of the attitude questionnaire.
### Table 3

*Questions Aligned to Learning Strategies*

<table>
<thead>
<tr>
<th>Learning Strategy</th>
<th>Attitude Questions (See Tables 7, 8, 9 for the actual questions)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Guessing</td>
<td>3, 7, 8, 9</td>
</tr>
<tr>
<td>Imagery</td>
<td>1, 3, 6, 8, 9</td>
</tr>
<tr>
<td>Practice</td>
<td>1, 5, 8, 9, 10</td>
</tr>
</tbody>
</table>

Students’ responses to items one through seven from the attitude questionnaire are shown in Table 4 and items 9 and 10 respectively are shown in Table 5 and Table 6. On the attitude questionnaire students used a scale of Strongly Disagree, Disagree, Agree, Strongly Agree to rate their opinion for questions one through seven.

For question eight the students were asked to rank first, second, and third the learning strategy they would use most while studying, all students ranked imagery as first, review as second, and guessing as third.

### Table 4

*Attitude questionnaire items 1-7*

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. The navigation lesson (images, description, and matching game) helped me learn to navigate the</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. The instructions were easy to understand and follow.</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>3. I understood the words used in the tutorial.</td>
<td>1</td>
<td></td>
<td>4</td>
<td></td>
</tr>
<tr>
<td>4. Audio should be on all screens.</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>5. Reviewing (practicing) the tutorial over three days made learning the information easier.</td>
<td></td>
<td></td>
<td></td>
<td>5</td>
</tr>
<tr>
<td>6. The imagery strategy is helpful when studying for a test and during the test it helped me remember information I studied.</td>
<td>2</td>
<td></td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>
7. The guessing strategy is helpful to find meanings of words you do not know and answer questions you do not know.

<table>
<thead>
<tr>
<th>Questions</th>
<th>Strongly Disagree</th>
<th>Disagree</th>
<th>Agree</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>7. The guessing strategy is helpful to find meanings of words you do not know and answer questions you do not know.</td>
<td>1</td>
<td>4</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 5

*Attitude questionnaire item 9*

Now that you have used the tutorial for 3 days would you change:

<table>
<thead>
<tr>
<th>Would change</th>
<th>Yes</th>
<th>No</th>
<th>Why/How?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigation</td>
<td>1</td>
<td>4</td>
<td>Because everything was fine. Because everything was ok. For ‘learnd diferents’ forms.</td>
</tr>
<tr>
<td>Look of screen</td>
<td></td>
<td>4</td>
<td>It was ok too. Because all was fine. For have more ideas.</td>
</tr>
<tr>
<td>(1 no response)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Words</td>
<td>3</td>
<td>2</td>
<td>Because they are a little hard to understand. More easy to understand. I would use easier words. Because everything was ok. For learned ‘diferents’ words.</td>
</tr>
<tr>
<td>Activities</td>
<td>2</td>
<td>3</td>
<td>Because it is ok. Because I didn’t understand. For learned ‘diferents’ activities</td>
</tr>
<tr>
<td>Learning strategies</td>
<td>2</td>
<td>3</td>
<td>Because the vocabulary was a little hard too. More easy. For learned ‘diferent’ forms of strategies.</td>
</tr>
</tbody>
</table>

From students’ responses to changes they would make in the tutorial, language headed the list of items they wanted to see changed in the tutorial. The language was “…a little hard to understand” and “I would use easier words” were the reasons given for
changing the language. The challenge here is to determine which words were hard for the ELL students to understand and how to change the wording without altering the learning goals.

Table 6
*Attitude questionnaire item 10*

<table>
<thead>
<tr>
<th>Activities</th>
<th>L1</th>
<th>L2</th>
<th>L3</th>
<th>L4</th>
<th>L5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vocabulary Words</td>
<td>5</td>
<td>1</td>
<td>3</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>Matching Activities</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Review Schedule</td>
<td>3</td>
<td>7</td>
<td>2</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Crossword Puzzle</td>
<td>4</td>
<td>5</td>
<td>6</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Flashcards</td>
<td>7</td>
<td>3</td>
<td>5</td>
<td>7</td>
<td>5</td>
</tr>
<tr>
<td>Edit Document</td>
<td>2</td>
<td>6</td>
<td>4</td>
<td>5</td>
<td>7</td>
</tr>
<tr>
<td>Keyboard Pop-up screens</td>
<td>6</td>
<td>4</td>
<td>7</td>
<td>6</td>
<td>6</td>
</tr>
</tbody>
</table>

The results of the students ranking the activities according to activities liked most to activities liked least, the matching activities were clearly the most favored activity by the ELL students. Other favored activities included the vocabulary word activity followed by the review schedule. It should be noted that these activities were activities where the students participated actively with the tutorial content and included a large number of images that associated the words to their meanings.

In summary, it was found that consideration of ELL students’ language proficiency level was a key factor in beginning to low intermediate English proficient students using this computer-based multimedia instruction. Wherever the ELL students experienced problems with the tutorial (such as in the first navigation matching activity, Menu Page) they asked the interpreter for help, rather than using the guessing strategy to help find meanings on their own. Because language proficiency influenced how useful the learning strategies were in supporting ELL students learning in this environment, it was concluded that additional scaffolding of the tutorial instructions is needed. Using other forms of imagery (such as demonstration or animation) and additional practice
activities (such as Fill-in-Blank, True and False or activities supported by the software) especially for the desktop publishing vocabulary and edit a document is needed to support ELL students learning in a computer-based multimedia environment. Other than making the words easier to understand, overall the five ELL students indicated satisfaction with the tutorial.
Chapter Five

Discussion

This chapter provides an overview of the problem studied, the development of the NCTCST prototype, the evaluation process, and finally an analysis of the prototype evaluation with future development recommendations for designing instruction that embeds learning strategies in a multimedia environment to support ELL students’ academic learning.

This study was motivated by the need for an intervention that would help prepare ELL students to meet the computer technology requirements. Computer/Technology skills have been added to the basic skills students in North Carolina must meet. The K-12 Computer/Technology Skills Standard Course of Study identifies the essential competencies and skills that all students need to be lifelong learners in a technology environment. The curriculum is designed to be an integral part of the reading, mathematics, and writing content areas (North Carolina Department of Public Instruction, 2004b). English language learning students moving to North Carolina have a two-year exemption period before being required to take state mandated tests. The two-year exemption period allows them time to increase their English proficiency level. Although ELL students are given a two-year exemption period, high school ELL students face the challenge of preparing for state mandated graduation requirements while learning the English language.

The major goal of this study was to develop a multimedia environment to support ELLs’ academic learning through embedded cognitive strategy instruction. There were five sub-goals for the project (a) use the Leshin, Pollock, and Reigeluth (1992) ISD Model to design a multimedia environment; (b) use Gagné’s (1984) Events of Instruction in the development of a multimedia environment; (c) pilot test a prototype of the multimedia environment to determine effective design and development strategies for ELLs; (d) develop a final multimedia environment based on pilot study results; and (e) evaluate the final multimedia tutorial, that resulted from the pilot study and expert reviews, during a four-day small group evaluation session.
Analysis

Phase I of this study consisted of the first three sub-goals—the design, development, and pilot testing of the NCTCST. Sub-goals one and two of this study involved the use the Leshin, Pollock, and Reigeluth’s (1992) ISD Model and Gagné’s (1984) Events of Instruction Model to design and develop the NCC/T multimedia tutorial. The Leshin et al. model uses a seven-step process to guide the designer through the design of a product from analysis to evaluation. Gagné’s Events of Instruction Model was used to develop the NCTCST topics using the North Carolina K-12 Computer/Technology Skills Standard Course of Study as the content. In addition, the literature on learning strategy instruction was used to develop the NCTCST section on learning strategies. Sub-goal three of this study was to pilot test the NCTCST prototype using content experts, ELL students, and an instructional design expert to improve the instructional design of the NCTCST. During the expert reviews, two Business Education teachers and four ESL teachers reviewed the tutorial. Using think alouds, data were gathered on how to improve the NCTCST. Three high school beginning level English language students were observed using the NCTCST. They were asked questions as they examined the tutorial. An outside instructional designer also reviewed the tutorial and gave feedback. The following is a synthesis of the input from those reviews. These suggestions were used to make revisions to the prototype before the small group evaluation was conducted.

1. Clarify navigation by making icons more representative of their functions; standardize pop-up screens, button locations, and the interface to avoid confusing the learner; and orient the user so they know where they are in the tutorial by dividing the tutorial into sections and include the objective at the beginning of each section.

2. Make the tutorial instructional language more comprehensible for the ELL students by using imagery and reducing the amount of text on a screen, and using words found in everyday conversation that they might be familiar.

3. During practice activities allow multiple attempts and provide immediate feedback.
Phase II of this study consisted of the last two sub-goals—revise and evaluate a final version of the NCTCST. Sub-goal four consisted of making revisions to the tutorial based on pilot test recommendations. In determining which revisions should be made, Tessmer (1993) suggests making high impact revisions first. These high impact revisions were the ones that the researcher believed would have the most impact on ELL students learning in the multimedia environment (such as navigation and instructional language).

**Revisions**

To clarify the navigation, a section on navigation was included to explain the navigation buttons to the ELL students. Animated text descriptions were included to emphasize each button’s function and a narration of the same information to make it easy for the ELL students to decode words they were not familiar. This screen was followed by an activity to allow the student to assess their recall of the navigation buttons. The interface information, as suggested by the review experts, was standardized whenever possible (i.e., font style, size, and color, pop-up screen size and position on screen, and button placement on the screen).

The tutorial was divided into six sections: navigation, learning strategies, keyboarding, desktop publishing vocabulary, edit a document, and web resources to orient the learner to which section of the tutorial they were studying.

The instructional language was simplified by using short sentences or phrases, and using words the ELLs might already know (Haynes & O'Loughlin, 1999). This was done in an effort to help the ELLs comprehend the non-content language (language for instructions). The content language (computer terminology) remained unchanged. In addition, when there were steps to be followed, sentences were numbered to guide the learner through the process.

The practice activities were setup to allow the student to practice the activities as often as they wished and receive immediate feedback. For example the matching activity used green or red lines to indicate correct or incorrect answers. The keyboard popup screens provided feedback as to whether the choice made was correct or incorrect, and if it was incorrect, what was incorrect about the response. See samples of revised screens in Appendix I.
After the revisions were made, the tutorial prototype was evaluated. Sub-goal five involved evaluating the revised NCTCST using five Hispanic ELL students. A discussion of the evaluation outcomes will be presented in terms of general design and learning strategy issues with the tutorial prototype. Because the focus of the study was on developing a prototype that embeds learning strategies the general design issues will be presented in the first section followed by an elaborated discussion of embedding the learning strategies, which will incorporate the discussion of the learning strategy issues.

**General Design Issues**

Some general design issues that were revealed, as the ELL students worked through the NCTCST, were problems understanding the non-content tutorial instructional language and non-participation on some activities. Since it was observed that the students asked questions concerning what they were to do, the tutorial instructional language should be made more user friendly for beginning and intermediate English language learners. These learners may be reluctant to attempt activities initially on their own because the task appears daunting by the amount of language presented at one time. For example, students had problems comprehending how to use the matching activity even though instructions were simplified through numbering the steps using a list format, using short sentences or phrases, and including narration that read the list of steps. In addition to the list above, to make the instructional language more user friendly, using animated images or text, highlighting or other visual cueing, and short demonstration clips can help cue the learner even more. Using animated text similar to that used in the navigation section of the tutorial can be used to control the amount of information the student receives at one time. The use of demonstration clips can clarify the instructions by allowing the learner to see a task being accomplished. It was observed that students asked for assistance frequently to understand what something meant but once they were directed they were able to continue on their own.

Another design problem was the presentation of the 20 desktop publishing vocabulary words before providing an opportunity to rehearse the information. To make remembering the words easier, chunking the words into subsets of five with varied practice activities in between will allow the students to rehearse the words multiple times.
to improve recall. Rehearsal has been found to be an effective way of learning (Gagné, 1984; Weinstein & Hume, 1998) and extended practice is needed to automate retention of the information and make recall easier (Bruning et al., 1999; Gagné, 1984).

From the list of general design issues, the researcher considered comprehension of non-content tutorial language to be the biggest problem students had with the tutorial. The non-content language of multimedia instruction needs to be more user friendly and obvious to support beginning to intermediate ELL learning academic content. The use of more visual cueing (i.e., highlighting, pointing, animating, and demonstration) can help the ELL students use the NCTCST better.

**Learning Strategy Discussion**

The focus of the tutorial was to support the students’ English language learning by embedding learning strategies that would assist them in studying the NCC/T content. This small group evaluation helped the researcher determine if the embedded learning strategies were helpful to the ELL students while studying the NCC/T content and how best to embed these learning strategies. The following will be a discussion of the imagery, practice, and guessing learning strategies, how the strategies were embedded, evaluated, and outcomes of the evaluation.

These strategies were chosen from the literature on ELLs’ learning strategy use (Chamot et al., 1992; Chamot & El-dinary, 1999; Oxford, 1990). Imagery and structured review are memory strategies that aid the learner in recalling information. Imagery helps the ELL learner create connections by adding meaning to information and by associating words to actual objects to make learning the words easier (Chun & Plass, 1996). The structured review strategy was chosen because research has shown that spacing practice sessions over time promoted higher levels of learning and retention than massed practice (Caple, 1996; Dempster, 1987). The review strategy was embedded to facilitate learning the NCC/T content and emphasize that multiple rather than single review sessions were better for remembering. The compensation strategy, guessing intelligently was included to help the ELL students overcome gaps in their knowledge (Oxford, 1990) about the tutorial content. This compensation strategy was embedded to assist the learner in constructing meaning from content that was unfamiliar or not understood.
Embedding learning strategies. From the literature on learning strategy training, it was found that students performed better using an informed or explicit strategy training approach teaching when, how, and why strategies should be used (Chamot & O'Malley, 1994; Lenz et al., 1996; Lin, 1994; Oxford, 1990). A separate section of the NCTCST tutorial introduced the three strategies prior to having the students use the three learning strategies in the NCTCST. Each strategy included a description of when, why, and how the strategy should be used. Additionally, the research on strategy training asserts that strategy learning takes a long time, thus learners should be prompted often to use strategies (Babkie & Provost, 2002; Gagné, 1984; Lenz et al., 1996). To prompt the ELL students to use the strategies in this tutorial, learning strategy icons were created using images to represent each strategy. These buttons were included on specific pages to remind the user to use the particular strategy. When the student pressed the button it would take them back to the learning strategy section and specifically to that strategy.

Imagery Strategy

Strategy embedded. In the literature on adapting content materials for ELL students various suggestions made use of imagery: choose materials that contain many pictures that closely relate to written text; use charts and graphs; bold text to emphasize points; and highlight main points with color (Echevarria et al., 2000; McFarland, 1996; North Carolina Department of Public Instruction, 1995; TESOL, 2004). Multiple suggestions from the list above were incorporated into the NCTCST in order to help the ELL students develop academic content language while studying computer skills. Imagery undergirds all aspects of the tutorial (i.e., navigation, desktop publishing vocabulary, keyboarding, and editing a document) and its importance is supported in the ESL literature (Chun & Plass, 1996; North Carolina Department of Public Instruction, 1995; Oxford, 1990; TESOL, 2004; Ulitsky, 2000).

The navigation section included images of the navigation buttons, animated text descriptions, and narration explaining the function of the buttons. Making the navigation clear and obvious (Lynch & Horton, 2001) orient the user quickly to how to use the instruction. Doing so will help the learner focus on the tutorial content rather than focus on how to get around in the tutorial. The majority of the ELL students strongly agreed
that the navigation lesson helped them learn to navigate the tutorial quickly. One student commented, “Just icons helped” understand the navigation. This suggested that the images influenced the student’s understanding of the navigation controls. Observations also confirmed that the students learned quickly and easily how to use the prototype.

In the keyboarding section imagery was embedded using the hotspot feature of the software to create a keyboard. The different types of keys found on the keyboard were color coded to make it easy to distinguish the different types of keys. After the key types were explained the ELL student was able to practice identifying the various key types by clicking keys on the keyboard. When the keyboard was pressed a pop-up window opened indicating if the choice was correct or incorrect and why it was incorrect.

For the desktop publishing section, images were used to illustrate the desktop publishing words. Imagery can help the ELL student create connections by adding meaning to words and make words distinctive, easier to encode, and retrieve. Text descriptions and audio were included with the images to help the students connect the vocabulary word with the object visually and verbally. A combination of text, audio, and visual content were found valuable in developing student comprehension, and enhancing motivation and learning (Ulitsky, 2000). The desktop publishing vocabulary screen layout was arranged so it could be printed as a flashcard. Images were also used in the edit a document section to show examples of the completed task (i.e., image of a centered title).

**Strategy evaluated.** To evaluate whether the imagery strategy was beneficial, the ELL students were asked their opinions during small group debriefing interviews, on an attitude questionnaire, and on performance assessments. In order to determine adequately if the learning strategies influenced their learning, more time for the students to spend reviewing the tutorial would be needed.

**Evaluation outcomes.** In response to the question of whether the learning strategies were helpful during learning, the ELL students indicated all the strategies were helpful. When students were asked to rank the three learning strategies based on which they would use most while studying, all students ranked imagery first, review second, and guessing third. All the students strongly agreed or agreed that the imagery strategy was helpful when studying for a test and during the test it helped them remember the
information. These findings confirmed that images play an important role in ELL students’ comprehension of new information (Chun & Plass, 1996; Levin & Kaplan, 1972; North Carolina Department Public Instruction, 1998; Oxford, 1990; Papineau & Lohr, 1981; Pressley & Wolsokyn, 1995; Velayo & Quirk, 2000). Student comments also validated that images were helpful during learning. All the students indicated they would use the imagery strategy to help them learn a word they did not know. They also indicated that the imagery strategy was the easiest to use. The students stating that the imagery strategy was easy to use suggests that they might continue to use this strategy.

**Review Strategy**

*Strategy embedded.* The review strategy included in the learning strategy section, described why, when, and how to use the strategy (Chamot & O'Malley, 1994; Lenz et al., 1996; Lin, 1994; Oxford, 1990). A sample schedule and a schedule form were provided in the tutorial. The students printed out the blank form to fill out as a study schedule for the three days they examined the tutorial. In addition, review activities were embedded in the navigation, keyboarding, desktop publishing vocabulary, and editing a document sections.

Various practice activities to assist the ELL students in encoding the content for long-term storage were included. The matching feature of the authoring software provided the students with immediate visual feedback. Green lines connected correct answers and red lines connected incorrect answers. The randomization feature of the software made it possible for the answers to appear differently each time students attempted the activity so the students would have to rely on recall of the correct answer rather than remembering the order or location of the answer.

Another important feature of the software was the ability to create hotspot images. This feature was used to create an image of a keyboard which students could identify keys by clicking on the keyboard image. The hotspot feature also allowed instant feedback through pop-up windows that provided feedback on the correctness of their response and the student could attempt the activity multiple times.

*Strategy evaluated.* Observations, debriefing interview questions, performance assessments, and attitude questionnaire were used to determine students’ strategy use.
The visual nature of the matching activity and keyboard popup screens made it possible to determine if the students completed the activities while working through the tutorial. It was also possible to determine through observation if the students completed the edit a document and crossword puzzle activities.

The debriefing interviews and attitude questionnaire asked about the student’s strategy use. The performance activities that were an integral part of each section allowed students to assess their comprehension of the content. The performance and multiple-choice assessments at the end of the tutorial allowed assessment of the tutorial content and determine if the learning strategies had been helpful in learning the information.

*Evaluation outcomes.* It was observed that the students completed the matching activities enthusiastically, more so than any other activity in the tutorial. The student who completed the keyboarding section of the tutorial was observed completing many of the practice activities. The two students assigned to complete the desktop publishing vocabulary section printed out the crossword puzzle but did not have time to complete during the session. The last two students observed reviewing the edit-a-document section did not attempt any of the editing tasks. When asked if they needed help with the activity they responded “no.” However, adding additional activities (such as, matching, multiple-choice, or fill-in-blank) to assess whether they comprehended the edit-a-document tasks might encourage more participation completing these tasks.

From the debriefing interview questions, four students strongly agreed and one student agreed that the navigation lesson that included a matching activity along with the navigation images and descriptions helped them learn to navigate the tutorial quickly. On the attitude questionnaire, all the students agreed that reviewing the tutorial over three days made learning the tutorial content easier. It was observed that the ELL students did not require assistance usually the second time they used the navigation, matching activities, or the scroll bar.

All the ELL students indicated that the matching activities were their favorite type of activity. These activities kept the students actively involved in the tutorial and provided an opportunity for students to assess their recall of the information through immediate feedback. Because the students enjoyed the matching activities, this suggests that similar activities that encourage their continued practice of the content will be
beneficial. Multiple review sessions have been found to be more beneficial than single review sessions. As a result, this repeated practice of the information will eventually help the learner store the information in long term memory and will result in better retention and recall of the information (Gagné, 1984; Weinstein & Hume, 1998).

The results of the post assessments conducted were not beneficial in determining whether their learning strategy use benefited the students while studying the tutorial content since the students only had the opportunity to review one section of the tutorial. Therefore, the researcher believes more time is needed for the ELL students to study the entire tutorial before students’ learning strategies use can be assessed. Nevertheless, research studies conducted by Dempster (1987) and Caple (1996) support that spaced review sessions result in better performance than single review sessions.

**Guessing Strategy**

*Strategy embedded.* The guessing strategy was described in the learning strategy section. The guessing strategy icon button was placed on all NCTCST topic screens to remind the students to guess when they came across words they did not know or had difficulty understanding what something meant. The guessing strategy was incorporated to help ELL students compensate for words they did not recognize or meanings they did not understand. This strategy was thought to be beneficial for the ELL learner because they are learning a new language, which takes time and this would be a technique that would help them compensate for what they did not know (Oxford, 1990).

*Strategy evaluated.* Observations, debriefing interviews, attitude questionnaire, and performance assessments were used to evaluate the benefits of the guessing strategy. During observations over the three days it was observed that the students often asked for assistance. Once they were provided additional prompting in most cases they were able to continue. During the debriefing interviews students were asked about strategies they had used. The attitude questionnaire asked questions about the learner’s strategy use while using the tutorial. Finally, the performance assessment was used to determine if the learning strategies had been helpful in learning the information. In order to adequately determine the impact of the learning strategies, more time is needed for the students to review the entire tutorial.

90
Evaluation outcomes. During the debriefing session, the majority of the students agreed with the statement, “The guessing strategy is helpful to find meanings of words you do not know and answer questions you do not know.” On the attitude questionnaire, the students ranked the three strategies in order of preference in helping them study, the guessing strategy was ranked third by all the ELL students. The comment “I did not understand the doors” (image representing the guessing strategy). This comment along with the fact all the students ranked the guessing strategy third indicated to the researcher that the students had difficulty understanding the guessing strategy. Even though the majority of the students agreed that the guessing strategy was helpful in finding meanings of words they did not know, it was observed that the ELL students asked for help often rather than attempting to understand the information using clues from surrounding text. This contradiction in the students’ responses and what was observed indicated to the researcher that further revisions to the guessing strategy should be considered.

There are two possible reasons for the limited student use of the guessing strategy. The ESL literature on making language comprehensible recommends adapting academic language in content materials by reducing the amount of language (McFarland, 1996; North Carolina Department of Public Instruction, 1995; TESOL, 2004). During the review of the NCTCST, the ESL and Business teachers recommended eliminating unnecessary words on the tutorial screens. Reducing the amount of language in a multimedia environment can also reduce the amount of language available to draw clues for constructing meaning.

A second reason for student’s limited use of the guessing strategy can be attributed to the students’ dependency on the interpreter to explain in English what they did not understand instead of constructing their own interpretations. Even though this strategy is believed to be an important ELL strategy, it was determined that it was not suitable in this context. This fact confirms that the context in which the strategy is used is crucial to the student’s use of the strategy.

Future Development

Future prototype development of the NCTCST are based on the results of the prototype evaluation and should include the following:
General Design

1. When including narration with text, the narration should match the words as presented on screen to avoid confusing the ELL learner.

Learning Strategies

1. Use additional imagery to cue the ELL learner’s knowledge of how to approach tutorial tasks.
2. Provide ample time for ELL learners to evaluate the complete tutorial before assessing performance.
3. Use an advance ELL and beginning or intermediate ELL student in a collaborative pair to evaluate the tutorial and make recommendations for improvement. After suggested revisions are made, the process is repeated using a different collaborative pair. Several two-on-one collaborative pair evaluations are suggested before conducting a final evaluation with a small group of ELL students.

Contributions of Study

The primary contribution of this study is the creation of a theory-based prototype to assist ELL students in their academic content learning efforts. This theory-based prototype, which embedded rehearsal, elaboration, and compensation cognitive strategy instruction to facilitate students’ encoding and retrieval processes, was based on the instructional design framework of Leshin, Pollock, and Reigeluth (1992), and Gagné (1984).

This study also highlights the need for careful planning and the importance of stakeholder input into the design of products for ELL learners. The feedback from teachers and students provided information about instructional implementation and learner characteristics that were not revealed in the literature; however, it was pertinent to the development of this product.

Finally, this study adds to the instructional technology literature base by offering guidelines for the integration of learning strategies into multimedia design for ELL learners.
References


Yeh, S. W., & Lehman, J. D. (2001). Effects of learner control and learning strategies on English as a foreign language (EFL) learning from interactive hypermedia lessons. *Journal of Educational Multimedia and Hypermedia, 10,* 141-159.

Appendix A

NCTCST Screens

1. Overview of program
2. Objectives
3. Navigation objective
4. Navigation icons introduced
5. Matching game introduction
6. Practice navigation icon information
7. End of navigation
8. Learning strategies objective
9. Smart guessing strategy introduced
10. Smart guessing strategy explained
11. Smart guessing practice
12. Review strategy introduced
13. Review strategy explained
14. Review strategy practice
15. Imagery strategy introduced
16. Imagery strategy explained
17. Imagery strategy practice
18. End of learning strategies
19. Menu page
20. Getting Started activity
21. Desktop publishing (DTP) vocabulary objective
22. Desktop publishing vocabulary words
23. Desktop publishing vocabulary word practice
24. End of DTP
25. Keyboard keys objective
26. Keyboard keys introduced
27. Keyboard keys practice
28. End of keyboard keys
29. Edit a document objective
30. Edit a document tasks introduced
31. Edit a document practice
32. End of edit a document
33. DTP assessment
34. Multiple-choice assessment
## Appendix B

### Student Evaluation Questions

<table>
<thead>
<tr>
<th>Categories</th>
<th>Questions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Navigation</td>
<td>• What would make the navigation easier or better?</td>
</tr>
<tr>
<td></td>
<td>• If you could change one thing about the navigation, what would you change?</td>
</tr>
<tr>
<td>Visual appeal</td>
<td>• How can the screen be made more attractive?</td>
</tr>
<tr>
<td></td>
<td>• If you could make changes, what would you change about the colors, fonts/text and images?</td>
</tr>
<tr>
<td>Learning strategies</td>
<td>• What strategies do you use regularly?</td>
</tr>
<tr>
<td></td>
<td>• What are your feelings about using the imagery, guessing, and reviewing strategies?</td>
</tr>
<tr>
<td></td>
<td>• When you saw the learning strategy prompts, what did you do?</td>
</tr>
<tr>
<td></td>
<td>• How can you use imagery in other classes?</td>
</tr>
<tr>
<td></td>
<td>• How can you use the guessing strategy in other classes?</td>
</tr>
<tr>
<td></td>
<td>• How can you use reviewing strategy in other classes?</td>
</tr>
<tr>
<td></td>
<td>• What are your feelings about using learning strategies now?</td>
</tr>
<tr>
<td></td>
<td>• If you could make changes to the way the strategies: imagery, guessing, and reviewing were presented what would you change?</td>
</tr>
<tr>
<td>Language appropriateness</td>
<td>• How easy was it to understand the words in the tutorial?</td>
</tr>
<tr>
<td></td>
<td>• What can be done to make the words easier to understand?</td>
</tr>
<tr>
<td>Content</td>
<td>• What tutorial practice activities did you like or dislike?</td>
</tr>
<tr>
<td></td>
<td>• What affect did the images and audio have on understanding the information?</td>
</tr>
<tr>
<td></td>
<td>• Which activities were helpful or not helpful and why?</td>
</tr>
<tr>
<td></td>
<td>• What changes would you make to the activities?</td>
</tr>
<tr>
<td>Technical</td>
<td>• Describe any problems you had navigating through tutorial?</td>
</tr>
<tr>
<td></td>
<td>• Describe any problem you had with the buttons or links?</td>
</tr>
<tr>
<td></td>
<td>• Describe any problem you had opening or closing Word documents?</td>
</tr>
<tr>
<td>Perceptions about tutorial</td>
<td>• Tell me what you enjoyed about the tutorial?</td>
</tr>
<tr>
<td></td>
<td>• How did you study for the NCC/T before using this tutorial?</td>
</tr>
<tr>
<td></td>
<td>• Which do you like better: studying using the NCTCST or your old way of studying for the NCC/T? Why?</td>
</tr>
<tr>
<td></td>
<td>• What was helpful or not helpful about using this tutorial when studying for the NCC/T?</td>
</tr>
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</table>
## Appendix C

### Pilot Study Student Evaluation Data Analysis

<table>
<thead>
<tr>
<th>Category</th>
<th>Learner 1</th>
<th>Learner 2</th>
<th>Learner 3</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Observations</strong> –</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Did students understand how to start the tutorial or how to navigate the tutorial?</td>
<td>Needed help</td>
<td>Needed help</td>
<td></td>
</tr>
<tr>
<td>Was language at an appropriate level for a beginning English Language Learner?</td>
<td>Asked often what to do next.</td>
<td>Asked the other student questions in native tongue. Asked researcher questions about meanings of words.</td>
<td>Moved through screens independently most of the time. Was able to assist the other student.</td>
</tr>
<tr>
<td>Did students understand how to complete the different activities without further explanation?</td>
<td>Did not seem to understand the language used or what to do, which hindered from doing much reviewing of tutorial. Puzzled look throughout the session.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Were images and audio helpful? (audio was not working on Business lab computers)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Learning Strategies understandable</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Questionnaire comments</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Were any strategies (images, practicing, guessing) more helpful than others?</td>
<td>Practicing because if you practing you are already know what you doing.</td>
<td>Practicing is more helpful because it prepares before doing some activities or tests.</td>
<td></td>
</tr>
<tr>
<td>2. List strategies you use often when studying.</td>
<td>Practice</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Evaluator questions –</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. Have you taken the ELL keyboarding class?</td>
<td>No</td>
<td>Yes</td>
<td></td>
</tr>
<tr>
<td>2. Are the instructions</td>
<td></td>
<td></td>
<td>Yes</td>
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<tr>
<td>Category</td>
<td>Learner 1</td>
<td>Learner 2</td>
<td>Learner 3</td>
</tr>
<tr>
<td>------------------------------------------------------------------------</td>
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<tr>
<td>for learning strategies clear?</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Take a look at flashcards. Do you know how to use? Do you understand how to get out of screen?</td>
<td>Had to be shown how to bring up in PowerPoint and shut down PowerPoint when done</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. Have you ever used guessing strategy?</td>
<td></td>
<td></td>
<td>“We are taught not to guess. If all wrong answers cannot be eliminated you skip the question.”</td>
</tr>
<tr>
<td>6. Go to the “matching” activity. Do you understand what to do?</td>
<td></td>
<td></td>
<td>No</td>
</tr>
</tbody>
</table>

Rating Scale: Strongly Disagree    Disagree    Somewhat Agree    Agree    Strongly Agree

Evaluation questionnaire categories –

1. Directions easy to follow

2. Navigation is clear

3. Activities easy to follow

4. Visually appealing

5. Learning strategies

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104
### Category

<table>
<thead>
<tr>
<th>Category</th>
<th>Learner 1</th>
<th>Learner 2</th>
<th>Learner 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>helpful</td>
<td></td>
<td>X</td>
<td>X</td>
</tr>
<tr>
<td>6. Knew most of language or words</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>7. Overall tutorial beneficial</td>
<td>X</td>
<td></td>
<td>X</td>
</tr>
</tbody>
</table>

One-to-one datasheet analysis sheet (adapted from Tessmer, 1993).
Appendix D

Observation Log

<table>
<thead>
<tr>
<th>Place: ____________________________</th>
<th>Time: ____________________________</th>
<th>Date: ____________________________</th>
</tr>
</thead>
<tbody>
<tr>
<td>Behaviors observed</td>
<td>Reflections on what was observed</td>
<td></td>
</tr>
<tr>
<td>-----------------------------------</td>
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<td></td>
<td></td>
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</tbody>
</table>
## Appendix E

### Content Expert Review Evaluation Questions

<table>
<thead>
<tr>
<th>Categories</th>
<th>Questions</th>
</tr>
</thead>
</table>
| Navigation                  | • Do you think the students will understand how to navigate the tutorial and how can it be made better?  
                               • Will students understand the button “Click to Continue?”  
                               • How can the navigation screen be simplified?  
                               • What do you think about the program’s navigation buttons? Suggestions for making them better? |
| Visual appeal               | • Will the images and audio help the learner understand the information?  
                               • Were program colors, text, and images appealing, appropriate? What changes would you make?  
                               • Is screen layout uncluttered and appealing? What changes would you make?  
                               • What do you think about the font style? |
| Learning strategies         | • Are there other strategies that would be better suited for this tutorial than the ones used? Which ones?  
                               • Describe circumstances when students learn well in your class.  
                               • Describe circumstances when students do not learn well in your class.  
                               • What strategies do you use to help your students perform well in your class? |
| Language appropriateness    | • What words would learners have problems with?  
                               • How can the language be made more understandable?  
                               • How can the glossary be made better?  
                               • What do you think about using translations in the tutorial? |
| Content                     | • What changes would you make to the content?  
                               • What other topics would you suggest adding?  
                               • What affect do you think images and audio has on helping to understand the information?  
                               • What changes would you make to the images, audio, or activities? |
| Technical                   | • Describe any problem you had with the buttons or links?  
                               • What spelling or grammatical errors did you find?  
                               • What problems did you have understanding the directions?  
                               • What problems did you have navigating through tutorial?  
                               • Describe any problems you found with the tutorial activities? |
# Appendix F

## Pilot Study Expert Review Evaluation Responses

<table>
<thead>
<tr>
<th>Evaluation Category</th>
<th>Responses</th>
<th>Suggested Revisions</th>
<th>Sample of Revisions</th>
<th>Screen Titles</th>
</tr>
</thead>
</table>
| Navigation          | “Not explained clearly; screen too cluttered so may make it confusing as to what to do.”
“I had a little trouble figuring out at the beginning but when I went back and listened again – you did say to click forward.”
“Don’t use roll over to see what they do. Line navigation buttons in list with labels beside each.”
“Friendlier looking icons (cartoony).”
“Represent words with pictures to strengthen connections.”
“Would probably do better with ‘NEXT’.”
“On navigation screen have buttons at top or in middle but not both.”
“That’s confusing because you have buttons here [buttons in middle of page] and buttons here [buttons at top of page].” | • Make navigation clearer
  o Eliminate unnecessary words
  o Simplify words by using icons that are more of a representation of their function | X | How to Navigate |
| Visual appeal       | “Cluttered; too much text on some screens.”
“Color scheme find.”
“Add visuals to represent words.” | • Eliminate unnecessary text and split screens to eliminate clutter | |

108
<table>
<thead>
<tr>
<th>Evaluation Category</th>
<th>Responses</th>
<th>Suggested Revisions</th>
<th>Sample of Revisions</th>
<th>Screen Titles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>“I like the pictures, makes interesting to look at. Just wouldn’t use little children.”</td>
<td>• Choose font(s) that eliminate readability issues while making interesting looking</td>
<td>X</td>
<td>How to navigate..</td>
</tr>
<tr>
<td></td>
<td>“Too much text on screens. If too much text don’t want to read.”</td>
<td></td>
<td></td>
<td>Arrow keys</td>
</tr>
<tr>
<td></td>
<td>“The color is good. One thing is if color blind they want see red and green. Yellow they’ll see find but red and green will look more like this [gray].”</td>
<td></td>
<td></td>
<td>What do you know...</td>
</tr>
<tr>
<td></td>
<td>“They get confused with that [font that doesn’t distinguish [i] from [l]. Use something like Times New Roman.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Make more interesting or fun, less formal font – Comic Sans.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“I wouldn’t go to a casual look. Make it much like you see in the books. What is this [Tahoma]? That looks fine to me. For American students who are born with it for a quick review its fine but if you’re trying to learn it you don’t need any more impediments.”</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Learning strategies</td>
<td>“The strategies are okay.”</td>
<td>• Use flashcards (which was included as part of the imagery strategy) as the 3rd strategy.</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“Simplify words “project or task” for ‘assignment’. Leave word – ‘assignment’ because this is a strategy in itself. Because they turn to someone in class and ask what’s this word?”</td>
<td>o  Make screens printable</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>“For ‘personal experiences’ use ‘tap prior knowledge’.”</td>
<td></td>
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<tr>
<td>Evaluation Category</td>
<td>Responses</td>
<td>Suggested Revisions</td>
<td>Sample of Revisions</td>
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</tbody>
</table>
| Sample of Revisions | “Visual connections with content materials.” “Hands-on experiences, not just seeing picture but making or doing.” “Participate actively – talk, read, write.” “Visuals to back up information.” “Repetition – re-teach, in another method, use different words, friends translate.” “Try to incorporate a variety of modalities, listen, see do, all at the same time, have extensive set of props and books to show and demo…” “Use flashcards as third strategy. Practice is not something you do during test. Imagery and guessing can be used during test to help remember.” “One student said she missed passing on a test by two points and I said to her guess honey.” | - Use synonyms to clarify word meanings  
- Connect the words to images to make meanings concrete and use image and text annotations for computer vocabulary | X X | How to navigate…  
What do you know…  
Arrow keys |
<p>| Language Appropriateness | “Change the wording to a lower readability level for ESOL students. On the Learning Strategy Review screen for example the wording is too hard for ESOL students to understand. Ex. visualize, particular, associations, similar, elaborate, analogies.” “Explain what indent means – ESOL students do not know that word.” “Change ‘check’ like an idiom, they will | | | |</p>
<table>
<thead>
<tr>
<th>Evaluation Category</th>
<th>Responses</th>
<th>Suggested Revisions</th>
<th>Sample of Revisions</th>
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<tr>
<td></td>
<td>visualize ✓, use Pretest.” “Simplify text.” “Too much text on one screen.” “Check thesaurus for other words they may know, put in ( ), use content word and synonym in ( ). “Translate some words not everything.” “I disagree with translating because you can’t do for all students, I come from the old school where they must use English.” “What you could do is translate into Spanish but that doesn’t help the student who speaks Arabic. We have 43 languages here. You could underline words that are like vocabulary “image” or “imagery” then say ‘you may want to use a dictionary to look up these words – to translate these words…’ I would not try and translate it – no. Just vocabulary words. Because they can use a dictionary when they take the test so it makes sense to get them in the practice of using. They’re better off if they learn to use the dictionary.” “Make the vocabulary words a link to a page that shows image and definition.” “Read text word for word so not to confuse.” “Read all the questions and answer choices. They get read aloud.”</td>
<td>Include audio on all screens and match the audio to the text</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Evaluation Category</td>
<td>Responses</td>
<td>Suggested Revisions</td>
<td>Sample of Revisions</td>
<td>Screen Titles</td>
</tr>
<tr>
<td>---------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>---------------------</td>
<td>---------------</td>
</tr>
</tbody>
</table>
| Content             | “Audio on all screens. Except glossary.”  
“The test covers more than this. Put in pictures of database and spreadsheet.”  
“See if you can delete some of the words. Put in pictures of most used information.”  
“Do they get more than one try?”  
“Feedback should be immediate and explanation of correct answers.”  
“Feedback needed immediately so know when get right or wrong with explanation like that matching activity.”  
“They can get two guesses and then it’s told to them right then so its reinforced immediately.”  
“Read all questions and answer choices, they get read aloud.”  
“Use multiple-choice format because test is multiple-choice.”  
“May want to include an activity for right and left aligning tabs.”  
“Make all screens printable.” | • Include immediate feedback with explanation of why answers are wrong  
• Give multiple chances to answer correctly  
• Make screens printable                                                                 |                                                                  |                |
| Technical           | Increase time for hand cursor descriptions. Pretest completed but can’t go to main menu.                                                                                                                                                                                                                                                    | All technical errors corrected                |                |                |
## Appendix G

### Outside Instructional Design Review Responses

<table>
<thead>
<tr>
<th>Screen</th>
<th>Instructional Designers Recommendations</th>
<th>Action Taken</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>• Create a menu page</td>
<td>• Menu page added at beginning of DTP section</td>
</tr>
<tr>
<td></td>
<td>• Indicate which section user currently in</td>
<td>• Objectives added to each section</td>
</tr>
<tr>
<td></td>
<td>• Include menu at beginning of each section that indicates user has visited the section</td>
<td></td>
</tr>
<tr>
<td></td>
<td>• Include goal(s)/objective(s) for each section</td>
<td></td>
</tr>
<tr>
<td>All</td>
<td>Directions on every screen that tells what user will do or learn</td>
<td>Directions added to all pages</td>
</tr>
<tr>
<td>Some</td>
<td>The forward and back buttons do not work as expected.</td>
<td>Buttons fixed</td>
</tr>
<tr>
<td>All</td>
<td>Move all icons together (bottom of page) Make interface consistent Sometimes things are underlined in block, sometimes in green Pop ups are not the same Sometimes pop ups, sometimes new pages</td>
<td>Icons grouped at bottom of pages</td>
</tr>
<tr>
<td>What Do You Know</td>
<td>Add to instructions… “If not, that is o.k.” Unclear instructions. What is the purpose of this screen?</td>
<td>Screen revised</td>
</tr>
<tr>
<td>Imagery Strategy</td>
<td>Include a task which user can contextualize the use of the strategy (specific task they would do in tutorial) Information for when to use strategy is same for all 3 strategies. “Are there not times when one strategy would be more effective than another?”</td>
<td>None taken</td>
</tr>
<tr>
<td>Screen</td>
<td>Instructional Designers Recommendations</td>
<td>Action Taken</td>
</tr>
<tr>
<td>------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
<td>----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Practice Strategy</td>
<td>Suggested a calendar page be created Make schedule applicable to when they would actually study. Indicate user should have multiple study sessions Change “Practice” title to resemble imagery and guessing strategy.</td>
<td>Form created</td>
</tr>
<tr>
<td>Keyboarding</td>
<td>Number keys, special keys pop-ups are different than the letter keys pop-ups These buttons force a “go, then back” sequence, but that sequence is made clear.</td>
<td>• Standardized pop-up windows • Buttons fixed</td>
</tr>
<tr>
<td>Keyboarding</td>
<td>“Move the mouse over the keyboard…” Questions whether users will know what is meant by …you see the hand…</td>
<td>None taken</td>
</tr>
<tr>
<td>Vocabulary Words</td>
<td>Provide more directions as to what the user is to do</td>
<td>Directions added to all screens</td>
</tr>
<tr>
<td>Number keys [vocabulary word]</td>
<td>Needs a “back” or “continue” button. Why not use a pop-up?</td>
<td>Pop-up window added</td>
</tr>
<tr>
<td>Question 1</td>
<td>Problem with navigation button In a new section, but the user doesn’t know that, no way to return to previous screen</td>
<td>Buttons fixed</td>
</tr>
</tbody>
</table>
Appendix H

Entry Skill Level Assessment

1. The part of the computer that indicates your place on the screen is called?
   Icon
   Glide pad
   Mouse
   Cursor

2. Which key should be pressed to indent the first line of a paragraph?
   Tab key
   Space bar
   Enter/return key
   Arrow key

3. One blank line between lines of text is called?
   Triple space
   Single space
   Word wrap
   Double space

4. Sally wants to indent each paragraph in her document, which key would she use to indent?
   Space bar
   End key
   Tab key
   Home key

5. A computerized program that uses graphics and text to produce a professional looking document is?
   Spreadsheet
   Database
   Desktop publishing
   Word processing
Appendix I

Learning Strategies and Computer Use Questionnaire

1. What are some of your favorite learning strategies to use?

2. Check the number of years you have used a computer:
   Less than 6 months
   1 year
   More than 1 year
   Do not use

3. Rate your computer skills:
   Excellent
   Good
   Fair
   Do not use

4. For what activities do you use the computer (check all that apply to you)?
   Surf the web
   Play games
   Send e-mail
   Listen to music
   Class assignments
Appendix J

Multiple-Choice Assessment

1. Which key moves the cursor to the beginning of the next line of text?
   - Backspace/delete
   - Shift
   - Enter/return
   - Tab

2. For keys that have two characters, you must do which of the following to type the upper character?
   - Hold down Space bar and press the key you wish to type
   - Press Caps Lock key and press key you wish to type
   - Hold down Shift key and press key you wish to type
   - Press Option key and press key you wish to type

3. Lindsay typed a three-page social studies paper on the computer using a word processor. If she wants to save it, she must do which of the following?
   - Go to File Menu/choose Quit
   - Go to Edit Menu/choose Close
   - Go to File Menu/choose Save As/name document
   - Go to Edit Menu/choose Cut

4. In order to type a “$” sign, you will need to use the Shift key. The Shift key is known as a:
   - Letter key
   - Symbol key
   - Special function key
   - Character key

5. One blank line between lines of text is called
   - Single space
   - Double space
   - Word wrap
   - Triple space

6. Sarah is using a word processing program to enter a paragraph in her report for the science fair. When will she need to press the return/enter key again?
   - To start a new sentence
   - To start a new document
   - To start a new line of text
   - To start a new paragraph
7. If Barbara didn’t have time to draw her pictures for her document, the best alternative source would be:
   To insert pictures from clip art
   Cut out and use pictures from a magazine
   To use the clipboard
   To use a drawing that someone else did

8. In her creative writing assignment, Barbara has used the word “friend” ten times. In which word processing utility could she find a synonym?
   Thesaurus
   Spell checker
   Grammar checker
   Outliner

9. Which key should be pressed to indent the first line of a paragraph?
   Arrow key
   Tab key
   Return key
   Space bar

10. Which of the following keys are found on homerow?
    l t b d e n
    a v e b h l
    s f k h d j
    r k s u v t

11. Which of the following processes are most useful in entering a paragraph?
    Keyboarding
    Telecomputing
    Word processing
    Sort/searching

12. A computerized program that uses graphics and text to produce a professional looking document is:
    Database
    Spreadsheet
    Word processing
    Desktop publishing

13. When you make changes to the text of a document you are:
    Moving
    Centering
    Editing
    Tabbing
14. To place text horizontally in the middle of a page is:
   Sorting
   Centering
   Tabbing
   Spacing

15. Sue is typing a song on her word processor. The song has three verses, and the chorus is repeated after each verse. What would be the most efficient way to enter the song, making sure the chorus is repeated after each verse?
   Copy chorus on copy machine then cut and paste it into document
   Type the chorus three times
   Highlight the text and change it to bold
   Use the copy and paste commands on word processor
Appendix K

SGE Attitude Questionnaire

Directions: Circle your answer.

1. The navigation lesson (images, descriptions, and matching game) helped me learn to navigate the tutorial quickly.

   |--------------------------|---------------------|--------------------------|
   Strongly                  Disagree  Agree                        Strongly
   Disagree        Agree

2. The instructions were easy to understand and follow.

   |--------------------------|---------------------|--------------------------|
   Strongly                  Disagree  Agree                        Strongly
   Disagree        Agree

3. I understood the words used in the tutorial.

   |--------------------------|---------------------|--------------------------|
   Strongly                  Disagree  Agree                        Strongly
   Disagree        Agree

4. Audio should be on all screens.

   |--------------------------|---------------------|--------------------------|
   Strongly                  Disagree  Agree                        Strongly
   Disagree        Agree

5. Reviewing (practicing) the tutorial over three days made learning the information easier.

   |--------------------------|---------------------|--------------------------|
   Strongly                  Disagree  Agree                        Strongly
   Disagree        Agree

6. The imagery strategy is helpful when studying for a test and during the test it helped me remember information I studied.

   |--------------------------|---------------------|--------------------------|
   Strongly                  Disagree  Agree                        Strongly
   Disagree        Agree

120
7. The guessing strategy is helpful to find meanings of words you do not know and answer questions you do not know.

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Strongly</td>
<td>Disagree</td>
<td>Agree</td>
</tr>
<tr>
<td>Disagree</td>
<td>Agree</td>
<td>Strongly</td>
</tr>
</tbody>
</table>

8. Rank each strategy 1, 2, or 3. 1 is the learning strategy you would use the most when studying. Rank all three strategies.

____   _____   _____

9. Now that you have used the tutorial for 3 days would you change:

**Circle One**

(1) Navigation  **Yes**  **No**  Why/How? _____________________________

(2) Look of screen  **Yes**  **No**  Why/How? _____________________________

(3) Words  **Yes**  **No**  Why/How? _____________________________

(4) Activities  **Yes**  **No**  Why/How? _____________________________

(5) Learning Strategies  **Yes**  **No**  Why/How? _____________________________

121
10. Rank each activity 1, 2, 3, 4, 5, 6, or 7 where 1 is the activity you liked most and 7 is the activity you liked least.

Vocabulary Words

Matching

Making Study Schedules

Crossword Puzzle

Flashcards

Perform edit document tasks

Pop-up Windows
Appendix L

Revised Prototype Screens

Figure 14. Original and revised navigation screens.
Figure 15. Original and revised what do you know screens.
Figure 16. Original and revised glossary screens.
## Appendix M

### Design and Development Constructs and Indicators

<table>
<thead>
<tr>
<th>Constructs</th>
<th>Indicators</th>
<th>Document Page(s) or Screen Title(s)</th>
</tr>
</thead>
</table>
| **Leshin, Pollock, and Reigeluth ISD Model** | • Problem identified  
• Tasks comprising the subject area identified | PP. 37-39 |
| **Selected and sequenced content—** | • North Carolina Computer/Technology Skills Curriculum  
  o Competency Goal 2: The learner will demonstrate knowledge and skills in the use of computer and other technologies  
    • Using word processing/desktop publishing for classroom assignments/projects (prototyped one strand)  
• Learning strategies: guessing, review, imagery | PP. 40-43 |
| **Developed lessons—**  
• North Carolina Computer/Technology Skills Curriculum | (Gagné’s Instructional Events Model)  
Gain learner’s attention | Computer graphic, graduation graphic, animated graphic, and audio script provides introduction of program | P.44  
NCTCST screens #1, 2  
Inform learner of objective | Tutorial objectives | P. 44  
NCTCST screens #3, 4, 9, 15, 18, 24, 50, 61 |
<table>
<thead>
<tr>
<th>Constructs</th>
<th>Indicators</th>
<th>Document Page(s) or Screen Title(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Activate prior knowledge</td>
<td>Getting Started with NCTCST</td>
<td>P. 45 NCTCST screen #23</td>
</tr>
<tr>
<td>Present content</td>
<td>Learn to use the tutorial section (navigation)</td>
<td>P. 45 NCTCST screens 5, 9, 25, 51, 62</td>
</tr>
<tr>
<td>Provide learning guidance</td>
<td>Strategy examples</td>
<td>P. 45 NCTCST screens 13, 14, 16, 26-46, 51, edit document images</td>
</tr>
<tr>
<td>Elicit learner performance</td>
<td>NCTCST uses multiple-choice and application of skills test formats</td>
<td>P. 45 NCTCST screens 7, 13, 14, 17, 26, 52-54, 57-59, 63</td>
</tr>
<tr>
<td>Provide feedback</td>
<td>Visual cueing of correct/incorrect answers on matching activities.</td>
<td>P. 46 Score pages</td>
</tr>
</tbody>
</table>

Score page at end of assessment to indicate performance score.
<table>
<thead>
<tr>
<th>Constructs</th>
<th>Indicators</th>
<th>Document Page(s) or Screen Title(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Assess performance</td>
<td>Performance and multiple-choice assessments</td>
<td>P. 46</td>
</tr>
<tr>
<td>Enhance retention and transfer</td>
<td>Multiple practice activities: multiple-choice assessment, performance assessment, matching activities, click keyboard (hotspot), vocabulary flashcards</td>
<td>P. 46</td>
</tr>
<tr>
<td>Model the strategies</td>
<td>Strategy used with the content</td>
<td>NCTCST screens</td>
</tr>
<tr>
<td>Practice the strategies</td>
<td>Guessing Structured Review Practice Imagery</td>
<td>NCTCST screens</td>
</tr>
<tr>
<td>Generalize the strategies</td>
<td>Questionnaire Questions and Comments Learning strategy prompts</td>
<td>Appendix K</td>
</tr>
<tr>
<td>Evaluated instruction—</td>
<td>Self-evaluation (Phase I) Comments and Analysis</td>
<td>P. 52</td>
</tr>
<tr>
<td>Business Education and ELL teachers (Phase I)</td>
<td>Comments and Analysis</td>
<td>Appendix F</td>
</tr>
</tbody>
</table>

- Learning strategies (imagery, guessing, structured review practice)
<table>
<thead>
<tr>
<th>Constructs</th>
<th>Indicators</th>
<th>Document Page(s) or Screen Title(s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>One-on-one and two-on-one evaluations (Phase I)</td>
<td>Comments and Analysis</td>
<td>Appendix C P. 110</td>
</tr>
<tr>
<td>Instructional design expert evaluation (Phase II)</td>
<td>Comments and Analysis</td>
<td>Appendix G P. 120</td>
</tr>
<tr>
<td>Small group evaluation (Phase II)</td>
<td>Observations, debriefing, attitude questionnaire responses and comments, and analysis</td>
<td>P. 62-85</td>
</tr>
</tbody>
</table>
Appendix N

Institutional Review Board Approval

November 12, 2003

MEMORANDUM

TO: Barbara B. Lockee Teaching and Learning 0313
    Jackie Manning T&L 0313

FROM: David M. Moore  


This memo is regarding the above-mentioned protocol. The proposed research is eligible for expedited review according to the specifications authorized by 45 CFR 46.110 and 21 CFR 56.110. As Chair of the Virginia Tech Institutional Review Board, I have granted approval to the study for a period of 12 months, effective November 10, 2003.

Approval of your research by the IRB provides the appropriate review as required by federal and state laws regarding human subject research. It is your responsibility to report to the IRB any adverse reactions that can be attributed to this study.

To continue the project past the 12 month approval period, a continuing review application must be submitted (30) days prior to the anniversary of the original approval date and a summary of the project to date must be provided. My office will send you a reminder of this (60) days prior to the anniversary date.

Cc: File
VITA

Jackie B. Manning
Email: jamannin@vt.edu

EDUCATION

Ph.D. Candidate, Instructional Technology, Department of Teaching and Learning, Virginia Polytechnic and State University, Blacksburg, VA. Dissertation: *Development of a Prototype Multimedia Environment to Support Hispanic English Language Learners’ Academic Learning Through Embedded Cognitive Strategy Instruction.* Chair: Dr. Barbara Lockee, February 2005.

Master of Education, Instructional Technology, North Carolina A&T State University, Greensboro, NC. Special Project Title: *Technology Staff Development Plan: Eastern Guilford Middle School, May 1999.*

Bachelor of Science, Family and Consumer Science, Meredith College, Raleigh, NC, May 1993.

COLLEGE TEACHING EXPERIENCE

Spring 2004  Introduction to Computers (CIS 110), Davidson County Community College, Lexington, NC, Instructor.

2002-2003  Educational Applications of Microcomputers (EDCI-5314), Virginia Tech, Blacksburg, VA, Graduate Teaching Assistant.

PREVIOUS TEACHING EXPERIENCE

2003-2004  North Carolina A&T State University, Academy for Teaching and Learning Blackboard Training Sessions: Coordinated and conducted basic and advance Blackboard workshops for faculty.

Summer 2003  Virginia Tech, Faculty Development Institute Lab Assistant: Supported participants as they worked on integrating web design with Dreamweaver, PDF file creation, scanning images and documents, creating assessments, using the on-line gradebook, and utilizing discussion board in their Blackboard courses.

2001-2002  Virginia Tech, Social Studies University Mentor: Supervised pre-service teachers during their field observations and experience. Provided candidates assistance and technical support during the creation of their electronic portfolios.

1998-2001  Guilford County Schools, Greensboro, NC, Instructional Technology Specialist: Served on the technology team that brought the school district’s first high tech facility—Eastern Guilford Middle School—on line. This facility is used as the prototype for other middle schools in the county.
1997-1998  North Carolina A&T State University, Greensboro, NC, Computer Lab Manager: Provided technical support and one-to-one training for faculty, staff, and students. Recorded and disseminated weekly staff minutes.


**Related Teaching Experiences**

**Summer 2000**  ITECH Summer Technology Program, Greensboro, NC, Instructor: Taught desktop publishing, spreadsheet, and database skills to second through eighth grade students.

**Summer 1995/1998**  Summer Technology Institute, North Carolina A&T State University, Greensboro, NC: Students were taught basic web page design over the course of six weeks. This summer program was designed to expose female high school students to the technology field.

**PROFESSIONAL DEVELOPMENT AND SERVICE**

**Affiliations**
Association of Education and Communication Technology (AECT), 2002-Present
North Carolina Teaching Certification, 2003-2008

**Professional Development**
Understanding Networking Fundamentals, CompuMaster, Greensboro, NC, 1998

**Professional Conferences**

**Service**
Excellence in Education Review Panel, Teaching and Learning, Virginia Tech, 2002

**Computer Software Skills**
Microsoft Office, Blackboard, EndNotes, Dreamweaver, Adobe Acrobat, Paint, PrintMaster
**Publication**

**Presentations**

Manning, J. B. (January, 2004). *Utilizing Technology to Support Pedagogy*. Invited presentation as a part of Teaching Effectiveness Training Institute, North Carolina A&T State University, Greensboro, NC.

Manning, J. B. (January, 2004). *Utilizing Blackboard*. Invited presentation to the Graduate Teaching Assistant Training Program, North Carolina A&T State University, Greensboro, NC.