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The effects of computer-mediated reading supports on the reading comprehension and the reading behavior of beginning American learners of Arabic as a foreign language

Aweiss, Salem Issa, Ph.D.
The Ohio State University, 1993
THE EFFECTS OF COMPUTER-MEDIATED READING SUPPORTS ON THE READING COMPREHENSION AND THE READING BEHAVIOR OF BEGINNING AMERICAN LEARNERS OF ARABIC AS A FOREIGN LANGUAGE

DISSERTATION

Presented in Partial Fulfillment of the Requirements for the Degree of Doctor of Philosophy in the Graduate School of The Ohio State University

By
Salem Issa Aweiss, B.A., M.A.

* * * * *
The Ohio State University
1993

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© Copyright by
Salem Issa Aweiss
1993
To My Parents, Issa and Thurayya Aweiss

To My Wife, Samia and Daughters
Arwa, Rasha, and Yara

With Love and Gratitude
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CHAPTER I
THE PROBLEM

Introduction

During the past decade, great strides have been made in investigating new ways to structure the learning experiences of students. The ultimate goal of much research has been to help students develop the confidence, skills, and knowledge necessary to solve problems and become independent thinkers and learners (Baron and Sternberg, 1987; Bransford, et. al., 1986; Ennis, 1987; Resnick, 1987; Salomon and Perkins, 1989; Schwartz, 1987; Simon, 1980; Sternberg, 1985; The Cognition and Technology Group at Vanderbilt, 1990).

To help students take full advantage of new opportunities for learning, educators have always searched for ways to provide students with the skills and motivation that allow them to learn on their own (Nisbett, et al., 1987; Thorndike, 1906). Liberman & Linn (1991) argue that with the technological tools available, "it is time to reconsider the process of learning and how to learn and to reformulate the curriculum with computer based technology in mind" (p. 374)

In the second language (SL) context, much attention has been given to providing meaningful practice opportunities in
listening and speaking. Reading and writing, however, have suffered from what Phillips (1974) calls "benign neglect." Thus, it is not unusual to find language programs that emphasize oral skills and relegate the introduction of the reading and writing skills to later stages. This is particularly true for languages like Arabic, that have a different writing system.

The primacy of oral skills over reading and writing has been evident especially at the beginning levels of instruction. A primary reason for this imbalance is to be found in the inherently covert and private nature of reading. This characteristic makes instructional intervention aimed at insuring meaningful higher-level processing both difficult and time-consuming. In languages like Arabic, the problem is compounded with the fact that Arabic uses a writing system that is both complicated and problematic due to the absence of vocalic diacritics in the printed text.

At the intermediate level, however, a shift from spoken to written discourse becomes imperative in light of the fact that reading and writing become the primary sources of learning new information and communicating ideas. The recent years have witnessed a reappraisal of the role of the reading skill in today's classroom. This reappraisal, according to Bernhardt (1991), is a function of social-political, pedagogic, and cognitive factors. The recent shift, moreover, in curricular emphasis and instructional practice emphasizing
all four skills has led educators to rethink the role played by literacy skills.

Research on technology-related instruction in the last ten years has established that computers and computer-related technologies can be used to teach effectively, sometimes even surpassing the teacher's ability to communicate information. Research on computers and learning suggests several ways computers can be used to encourage students to be self-directed, autonomous learners (Liberman and Linn (1991). Computer-assisted instruction (CAI), if used in a properly designed curriculum, can provide coaching and other forms of scaffolding as learners begin to apply new skills. In addition, computer-mediated learning can increase a student's motivation to learn autonomously.

Although researchers in L1 have attempted to investigate how computers could be of help in reading comprehension, little L2 research, if any, addresses issues relating to the potential facilitative effects on comprehension of using the computer to expand or control readers' options for acquiring information and for creating provision for overtly interacting with the text. The present study investigates the effect of using computer-mediated reading supports on the reading comprehension of beginning American learners of Arabic as a foreign language (AFL) reading expository texts.

The learning theory espoused in this study presents an image of the learner actively collaborating with the medium
to construct knowledge. It stands in stark contrast to an image in which learning occurs as the result of instruction being "delivered" by some (or any) medium. In this theoretical framework, learning is viewed as an active, constructive process whereby the learner strategically manages the available cognitive resources to create new knowledge by extracting information from the environment and integrating it with information already stored in memory (Kozma, 1991).

The theoretical framework advocated in this study is also consonant with the current models of reading in both L1 and L2. These models emphasize the interactive nature of reading (Bernhardt, 1991; Rumelhart and Ortony, 1977) and the constructive nature of comprehension (Anderson & Pearson, 1984; Anderson et al., 1977; Bernhardt, 1991; Bloome & Greene, 1984; Spiro, 1980; Rumelhart, 1980; among others). Specifically, the research literature suggests that reading comprehension is a function of many factors including (1) text characteristics such as vocabulary, structure, and text density (Amiran and Jones, 1982); (2) reader characteristics such as reading competence and prior knowledge (Paris et al., 1983; Spiro, 1980); learning strategies available (Pressely et al., 1989), and motivation, etc. (Kennedy, 1984); (3) human-factors considerations such as the lighting and legibility of the display in a microtext—text displayed on a computer screen—(Daniel & Reinking, 1989; Fish and Feldman,
1987); and (4) stability of the text (Just and Carpenter, 1987). All of these factors interact to make the reading act easy or difficult for a particular reader with a particular text.

Recent work comparing comprehension of text on printed pages and texts on computer screens, while not unequivocal, provides evidence that comprehending microtexts is no more difficult than comprehending printed text (Feldman and Fish, 1987; Feldman, 1988; Hansen, 1978). Feldman and Fish (1987, 1991) have noted that, like traditional instruction, microcomputer programs may be individualized and interactive, but with added options of giving greater independence from teacher directions to the learner.

Reinking and Schreiner (1985) argue that as an alternative medium for presenting text, the computer encompasses a unique set of techno-logical attributes. These attributes may combine in a unique fashion to influence cognitive processing during reading. Technological tools usually relieve the learner of tedious tasks such as those required for information retrieval and management and thus permit more time to be spent on complex problem solving and higher-order intellectual skills.

In summary, although research has documented that computer-mediated reading supports may enhance reading comprehension of first language readers, little is known about how such supports impact on the comprehension
capabilities of foreign language readers. The present study is an attempt to provide insight into how American beginning readers of AFL process and comprehend expository texts displayed on the computer and the extent to which computer-mediated reading supports facilitate the process of comprehension. It is hypothesized that computer technology will lead to important new options for enhancing learning during reading. Computers may be a potentially important tool for aiding comprehension during independent reading and may enhance comprehension when they are used purposefully to effect more active processing of text. Continued research is needed to understand more fully the potential impact of computer-mediated texts on reading comprehension and to discover their potential uses.

**Statement of the Problem**

Reading is a cognitive skill of tremendous complexity and importance to daily life. Learning to read is a multifaceted task that requires the integration of an entirely new type of information, contained in the orthographic system, into a pre-existing system for understanding and producing speech. The problem solving activities associated with constructing meaning from a text require, like other complex cognitive tasks, the use of cognitive resources. Processing that is not automatic engages the limited resources for processing of the working memory
and may ultimately affect the overall quality of text processing and comprehension (Baddeley & Hitch, 1974; Britton, Glyn, & Smith, 1985; Perfetti, 1988, 1991).

The implications of the cognitive load for foreign and second language readers are perhaps more profound than for first language readers. Beginning SL readers usually lack sufficient knowledge of the target language (TL) that enable them to construct an accurate discourse model of the SL. L2 reading, first of all, entails learning a second encoding system. It is important, therefore, to consider readers who learn to read another language based on a different orthographic system. Robertson (1990) notes that in the teaching of Arabic as a foreign/second language, one essential consideration pondered by many elementary level teachers of the language is the impact of Arabic orthography on the reader. An imperfect orthography and deficient writing system appear to be the principal problems facing both beginning and proficient readers of Arabic. The reader of Arabic faces a problem uncommon to most alphabetic scripts, namely the inclusion or absence of the short vowels in the text. Arabic, unlike the majority of alphabetic orthographies, makes extensive use of vocalic and diacritical markings to indicate short vowels, case markings, doubling of consonants, among other functions. These diacritics are usually absent in the printed text.
Mahmoud (1979) notes that decoding unvocalized Arabic script requires careful attention by even a skilled reader. Moreover, reading unvoweled orthography requires attention to form at the expense of content. The inclusion of the vowel markings, on the other hand, requires the reader to "simultaneously process three bands of information: the central band consisting of the consonantantal features, and the top and bottom bands composed of the diacritical markings for the short vowels" (Robertson, 1990, p.4).

In particular, American readers of Arabic have to switch to an orthographic systems that is principally a phonetic representation. Arabic and English, moreover, lack any amount of overlapping orthographic regularity. In fact, those readers must first develop a sense of the orthography and only after these distinctions can be made can learners begin developing their sensitivity to spelling patterns (Bernhardt, 1991).

The differences, moreover, between Arabic and English with respect to direction (right versus left), letters (Roman versus non-Roman), and shape of letters (Arabic is variant, English is invariant), are potential sources of difficulty for native speakers of English reading AFL. Most of the Arabic letters have basically four different shapes according to whether they stand alone, or in initial, medial, or final position of a word. This is most problematic for beginning and even advanced learners in terms of word recognition. This
characteristic of cursivity in Arabic is clarified in Figures 1 and 2 for the letters /h/ (ه) and /x/ (خ) respectively.
Figure 1. The Characteristic of Cursivity in Arabic.
The Letter /h/ (ح)

Figure 2. The Characteristic of Cursivity in Arabic.
The letter /x/ (خ)
The sound system, in addition, poses another potential difficulty for American readers of AFL. Khaldieh (1990) notes that phonology and script of L2 play important roles in word recognition. L2 readers may misidentify words while reading an L2 because of a deficiency in the phonology/script system or because of phonological interference from L1.

Orthography and the sound system of Arabic are but the first components that American readers must learn and acquire. Linguistic differences between Arabic and English, for example, at the morpho-syntactic and discourse levels are also likely to have an influence on readers’ comprehension. Word order variation, relative clause formation, noun and verb phrase structures, and other complex structural differences between the two languages can mislead second language readers, particularly at the beginning stages.

American readers of Arabic, like all second language readers, also encounter comprehension difficulties because they must utilize underdeveloped and/or inaccurate foreign language reading skills or inappropriate first language reading strategies (Alderson, 1984, Anderson, 1989; Barnett, 1988; Bernhardt, 1986; Koda, 1988). American readers of AFL are likely to be influenced by their knowledge of English when interpreting Arabic texts. By inappropriately applying first language reading skills to Arabic texts, native readers of English may construct an incomplete and/or inaccurate representation of the text. In other words, "native readers
of English risk creating a discourse model that is radically
different from the one intended by the writer. In so doing,
they greatly jeopardize their capacity to comprehend the text
accurately" (Berkemeyer, 1991, p.6).

Thus, American learners of AFL—like other second and
foreign language learners—being constrained syntactically,
lexically phonologically, semantically, and strategically,
have a tougher task at hand than their L1 counterparts. The
implication is that cognitively demanding processes in
reading—both identification and interpretation processes—
may strain the limited resources of the reader's information
processing system, specifically, the reader's working memory.
Put differently, the time and cognitive effort required to
carry out the comprehension task may interfere with readers'
processing of information in the text. Thus, it becomes
imperative to explore ways to alleviate the cognitive
overload and facilitate the reading task by enhancing the
integration of the text-driven and knowledge-driven facets of
reading. Computer-mediated texts may represent a viable means
of addressing the limitations inherent in the processing
capacity of the working memory and traditional printed texts.
Computer technology provides new options for acquiring
information from written texts thus prompting a richer, more
overt and more active interaction between the reader and the
text (Daniel & Reinking, 1987; Duchastel, 1986).
Significance of the Problem

Although interest in using computers as a supplemental medium for classroom learning and instruction is not recent, investigations of the theoretical connections between computer technology and current understanding of reading comprehension dates back only to the early 1980s. Researchers in L1 reading comprehension have made claims recently that computer-mediated reading supports may enhance readers' overt interaction with the written text in ways which are normally available only during oral communication.

Computer-mediated reading supports, however, is an area of study virtually ignored in SL research, and when studied in L1 context, it is limited to grade school students. Data-based studies on the effect of computer-mediated supports on reading comprehension to date, have been first language studies that have employed English as the language of instruction (Feldman & Fish, 1987; McKonki & Zola, 1988; Reinking, 1983; Reinking & Schreiner, 1985; among others). These L1 studies have already linked computer-mediated reading supports with enhanced reading comprehension of expository texts. The question of whether or not this effect is present in foreign language reading has not yet been investigated. In particular, no studies have investigated whether or not American learners of AFL benefit from being provided with alternate options to regulate their access to reading supports and with expanding or controlling their
options for acquiring information. In other words, can additional evidence for this hypothesis be generated in foreign language reading? It is worth noting in this context that findings from research with first language students cannot always be applied directly to L2 contexts (Bernhardt, 1991). Because second language readers are distinct from L1 students (and from each other), research on second language students is essential. No studies, however, have investigated how computer-mediated reading supports may enhance reading comprehension in a foreign language.

The significance of the present study is that it investigates readers' abilities to comprehend expository texts delivered through a computer medium in a language other than English. This line of research holds a promising potential for the identification of the textual manipulations that have greater facilitative effect on comprehending expository texts in a foreign language. Put differently, a significant dimension of the present study is that it will reveal what, if any types of reading supports have a facilitative effect on the reading comprehension of beginning readers. Moreover, this study will make significant contributions to the existing knowledge base in second language reading and second language acquisition research, in general. In addition, several pedagogical purposes will be served.
Previous L1 studies have also attempted to shed light on the contribution of individual reading supports in isolation (Feldman & Fish, 1987; 1991; Fish & Feldman, 1988). No study in L1 or L2, however, has investigated the relative and collective contribution of the different textual manipulations and the nature of their interaction, if there is any. In the present study, the researcher is interested in achieving a greater understanding of expository text comprehension by disentangling the individual and interactive effects of reading supports. Information concerning which, and the extent to which readers of AFL rely on computer-mediated reading supports would help expand our knowledge of the extent and nature of the relationship between such supports and reading comprehension. Information gleaned from this study may provide the foreign language profession with much needed research evidence concerning some pedagogical decisions, especially in instructional and curriculum design and materials preparation. Knowing which reading supports have more facilitating effects on the comprehension of beginning foreign language readers will allow foreign language educators to adjust instruction so that enhanced comprehension can be achieved. In other words, this line of research is needed because of its potential to guide material preparers as well as instructional and curriculum designers to reflect critically on ways to help learners become independent readers in a foreign language. There is a need,
therefore, to explore more fully the comprehension processes available to foreign language learners and to generate a foreign language specific database from which to make enlightened decisions on selection and construction of instructional reading texts. Hence, this study should have a significant impact on the field of literacy in a foreign language.

In summary, using the computer to mediate text may affect reading comprehension because the technological attributes of the computer enable unique textual manipulations. Comprehension can be increased if the computer can be used to relieve the processing burden placed on the reader and stimulate more active processing on the part of the reader.

**Purpose of the Study**

The major purpose of the present study is to discover, in a foreign language context, whether reading comprehension increases when computer-mediated texts are used to expand or control readers' options for acquiring information from the text. The results of first language reading studies predict that providing computer-mediated reading supports during independent reading results in greater and enhanced comprehension. The question of whether or not this effect is present in foreign language reading has not yet been answered
or even investigated. This study is intended to investigate thus, whether such claims can be extended to L2 reading.

A second purpose of the present study is to investigate readers' perceptions of the reading task, their selection of reading supports (when applicable), the effectiveness of the type of text manipulations selected by the researcher, and finally to prove the effectiveness of the computer in providing opportunities to manage a reader's interaction with text during independent reading. A secondary purpose of this study is to assess the feasibility of using the computer to gather data concerning the reading behavior of beginning American reader of AFL during the reading of expository text.

This study will provide a framework within which the issue of the facilitative effect of computer-mediated reading support on the comprehension of beginning American readers of AFL will be investigated. It is hoped that this study will provide a baseline data for further quantitative and qualitative research into initial reading in a foreign language.

Two characteristics of reading comprehension and the computer will guide this investigation. First, direct instruction in reading comprehension is both difficult and time consuming because of the inherently complex cognitive skills involved in comprehending text especially for beginning readers for whom comprehension parameters may not be intuitively clear. Various theoretical perspectives and
the empirical evidence which supports them point to the importance of readers' awareness of a number of textual features and the successful application of several complex cognitive skills required to carry out and interpret them (Anderson, Reynolds, Schallert, and Goetz, 1977; Bransford & Johnson, 1972; Meyer, 1975; Rumelhart, 1980; Schank & Abelson, 1977). Brown (1980) and Flavell & Wellman (1977) argue that beginning and younger readers are less aware of the parameters which encompass reading comprehension. As a consequence, such readers are normally not successful in their application of strategies to acquire meaning from text. Secondly, the technological attributes of the computer enable the readers to interact with the text in a manner not possible in the traditional text. Reinking (1983) argues that the technological capabilities of the computer permit "an expanded manipulation of texts which is both more sensitive to variations in readers, texts, or tasks and which models and demands practice of comprehension skills. Offering a reader several options for interacting with the meaning of the text may increase comprehension for that text" (p.5). Moreover, it is believed that requiring readers to make decisions about their own comprehension relevant to specified comprehension variables may encourage the development of skills which could transfer to other texts and could also increase sensitivity to relevant task variables.
The need for this and similar studies has arisen from two realities, one pragmatic and one theoretical. Williams and Brown (1990) argue that the agenda for technology-related classroom research emanates from the reality of computers in the classrooms of America. Several researchers (Norman, 1989; Pea, 1989, 1990; Perkins, 1990; Salomon et al., 1991; Williams & Brown, 1990) have argued that despite the difficulties of assessing the impact of computers on teaching and learning, there is no doubt that computers are now an important part of the schools and universities of America. There is a need, therefore, to find ways to most effectively utilize these valuable instructional resources. A second factor that has prompted the need for studies as this one relates to the fact that for computer-assisted language learning (CALL) research to be meaningful, it has to be grounded in a theoretical framework. Earlier studies of computer-related technologies for instruction were often based upon the behavioral paradigm of stimulus-response learning. Although certain principles from early learning theory, such as reinforcement, still underpin much learning, the research community is beginning to grasp complex aspects of human learning that cannot be explained by a strict behavioral view. Learning and instructional designs need to be investigated and evaluated in terms of more complex theoretical models. Cognitive science provides one such avenue for theory and research.
This study will use computer-mediated text to provide college students reading AFL with assistance when they experience difficulty in comprehending relatively short expository texts. In the present study, the computer will be used to mediate text in an individualized fashion. Several educators and reading researchers have hypothesized that such mediation facilitates comprehension and provides options for readers, especially poor ones, to interact overtly with the text (Brown et. al., 1979; Paris et. al., 1986; Reinking and Schreiner 1985). It is expected that the use of reading support will facilitate comprehension of the text and that poor readers will have higher comprehension scores when using supports than when not.

It is hypothesized that the expected increases in comprehension under the conditions of this study are more likely to be due to deeper or more efficient cognitive processing than prolonged exposure to the text. It is also hypothesized that both poor and good students will make use of the textual manipulations provided during independent reading of microtexts.

Based on the theoretical connections between the technological attributes of the computer and informative texts, the following research questions will guide the present study:
Question I- Can the reading comprehension of beginning readers of Arabic as a foreign language (AFL) be influenced by using the computer to mediate reading aids? In other words, will the comprehension of beginning AFL readers reading informative microtexts be significantly enhanced by having access to three types of reading supports/textual manipulations mediated by the computer?

Question II- Which of the reading supports appear to be most beneficial for beginning AFL readers? That is, is the effect greater for one type of reading support than for another?

Question III- What combination of reading supports, if any, seems to be more conducive to reading comprehension? In other words, is there any interaction between the different reading supports and if so, what is the extent and nature of such interaction(s)?

Question IV- Do beginning American readers of AFL make use of the reading supports provided via the computer, and if so, will some options be selected more often than others?
V- Is American beginning AFL readers' perception of the reading task affected by their reading ability as measured by the number of propositions recalled?

Readers' perception will be investigated with regard to the following: a) the perceived effects on comprehension of the reading supports, (b) subjects' perceptions of the computer program and the reading supports in general, and (c) procedures specific to reading from the microcomputer.

Theoretical Bases

Reading as a Cognitive and Social Process/Activity

In their attempts to discover and describe what it means to be a competent reader, scholars in reading have made different assumptions about meaning-making processes. Hynds (1990), for example, notes that reading research since the 1960s has looked into the reader, the text, and the social context in order to explain the reading process. Bernhardt (1991) also observes that insights and data generated about reading are generally cognitive or social in nature, "implying in essence, that reading is a meaning-extracting or a meaning-constructing process" (p. 5).

A cognitive perspective often views the reading process as an intrapersonal problems solving task that takes place within the brain's knowledge structures. Cognitive models of reading (LaBerge & Samuels, 1975; Just & Carpenter, 1980) are
text-based and non-linear in nature. The critical element in any cognitive view, according to Bernhardt (1991), is that it is an individualistic act that consists of "processing steps that are separate and measurable, although interdependent" (p. 8). In a cognitive view, readers are thought to have processors that act on information in rule-governed ways like a computer program. The internal representation of a text is thus, not a duplicate of the input text, but rather an individual's intrapersonal conceptualization (Bernhardt, 1991).

From a text-oriented framework, reading researchers have looked at the underlying structures of prose that influence recall and inferential processes (Fredrikson, 1975, 1977; Graesser, 1981; Kintsch, 1974; Kintsch & van Dijk, 1978; Meyer, 1975). Bernhardt (1991) argues that "the reading process is clearly multidimensional and multivariate, and it is critical, at all times, to keep that fundamental concept in mind" (p. 72). Thus, text driven elements and operations in second language reading, namely words (word recognition, and lexical entries), syntax, and the structure of the text, are as important and as essential to the comprehension process as are the knowledge-driven facets and operations.

Models of Reading Comprehension

Cognitive theoretical perspectives and the empirical evidence that supports them suggest that reading
comprehension entails the awareness of a variety of textual features and the reader's application of complex cognitive skills by which they may be interpreted (Anderson et al., 1977; Kintsch & van Dijk, 1978; Meyer, 1975; Rumelhart, 1980; Rumelhart & Ortony, 1977; Schank & Abelson, 1977).

Cognitive psychologists and educators have advanced different models of how some mental processes work. Models, according to Carr (1982) represent a description of the major working parts of a real-life process (such as reading). The description, adds Carr (1982), captures the most important characteristics of each part's operation, though it might leave out larger amounts of detail. According to Rayner & Pollastek (1989), there are a number of models of the reading process that vary in the extent to which they capture important aspects of the skill.

Cognitive psychologists have characterized three models as being primarily (1) "bottom-up" (2) "top-down," or "interactive." Bottom-up models (Gough, 1972) stress that most information flows in a passive manner through the human information-processing system. The major idea is that this flow of information is very fast and that knowledge we have stored in memory has little impact on how the processing takes place. In contrast, proponents of top-down models (Goodman, 1970; Smith, 1971) feel that the passive flow of information through the processing system is relatively slow because there are numerous bottlenecks (places where the
architecture of the system forces us to slow down). Accordingly, to short-circuit the bottlenecks, these models stress that readers rely heavily on information stored in memory (general information that readers have about the world) to help speed up our processing. The primary way in which readers short-circuit the information-processing bottlenecks is to formulate hypotheses about what they will read next. This view of reading, often referred to as the "hypothesis-testing model," was once very popular. Evidence now suggests, however, that the visual processing of text is very fast and that the extent to which readers engage in hypothesis testing or guessing behaviors seems to play a minimal role in the process of reading.

Interactive models (Just & Carpenter, 1980; McClelland, 1986; Rumelhart, 1977) allow for all sorts of communications between top-down and bottom-up processes. Reading is interactive in the sense that the reader makes use of information from his background knowledge as well as information from the printed page. Reading is also interactive in the sense that many skills work together simultaneously in the process.

Although several different interactive models have been proposed, Swaffer (1988) notes that they share the same processing components. They all "account for feedback between features and agrees that, to comprehend, the mind: (1) "selects" input (monitor or executive function); (2)
"processes" familiar letter and words automatically
(automatic function); (3) "recognizes" linguistically marked
relationships (surface language processing); (4) "infers"
relationships not tagged by language; and (5) "synthesizes"
the text’s discourse with the reader’s logical and affective
judgments" (Swaffer, 1988, p.125).

Interactive approaches to reading suggest that reading
comprehension is a combination of identification and
interpretation skills. Reading theorists and researchers have
identified two conceptually distinct but highly interrelated
aspects of reading: (1) decoding the visual print (perceptual
or identification processes) and (2) comprehending the
message it represents (interpretation or comprehension
processes). In Just and Carpenter’s (1987) conceptualization,
perceptual processes visually register written language,
transforming from printed symbols to language, whereas the
comprehension processes interpret language, transforming it
from linguistic symbols to a more symbolic representation—
that is, from language to thought. Obviously, both perception
and comprehension are crucial to reading, and they operate
together. In other words, as the end product of reading,
comprehension can be affected by all its component processes,
ranging from the lower level processes that recognize the
printed words and encode contextually appropriate meanings
for them to higher level processes that assemble and
integrate the underlying propositions and relate them to
previously acquired knowledge.

In L2 reading, Bernhardt (1991) argues that in fluent
reading, the two "systems [knowledge-driven and text-driven
facets] work together influencing, supplementing, and
supporting each other" (p. 119). This image according to
Bernhardt (1991) serves to underscore the notion of the
dynamic nature of comprehension. The second language reader
(as any reader) employs both a perceptual and comprehension
systems. Bernhardt (1991) adds that meaning construction in
the second language essentially entails making inferences
fill in the gaps in texts.

Reading and Computers

Interest in the theoretical connections between computer
technology and reading comprehension is recent. This interest
has been propelled by the fact that of the four skills in
second language learning, reading seems best suited to
initial theoretical study in CAI. This, according to Pederson
(1985) is not only because of the degree of control that can
be exerted over the variability in student responses, but
also because practice in another receptive skill (listening)
requires the interface of peripherals (such as a tape
player).

Recently, some investigators in L1 reading have
considered how the technological attributes of the computer
enable unique textual manipulations that may affect the comprehension of printed material. L'Allier (1980), for example found that computer-mediated text can carry out online diagnosis that enables the text to be adapted to the needs of a particular reader. McConkie (1983) and McConkie and Zola (1987) have reported a preliminary evaluation of a computer-aided reading program for nonliterate adults. The computer, in McConkie and Zola’s (1987) study, made it possible for beginning readers to read above their instructional level by providing pronunciation of an unfamiliar word when it is touched on the computer screen.

More recently, educators and reading researchers alike, have attempted to explore theoretical frameworks that might be used to think about computers and reading (Fish and Feldman, 1991; Kozma, 1991; Linn and Liberman, 1991; Reinking 1987, Reinking & Rickman, 1991; Stevens, 1989; Wyatt, 1989; among others). Kamil (1987) notes that computers and the more recently derivative field of artificial intelligence (AI) have given reading researchers opportunities to develop new models of the reading process, to carry out more complex research studies, and to provide more effective instruction.

The importance of considering how computers, reading, and theory interact stems from two realities, one pragmatic and one theoretical. The nature of reading when text is displayed by a computer promises to become an increasingly important issue as more reading takes place on a computer
screen. From a theoretical perspective, one can safely argue that there exists a need to delineate the differences between microtext and printed text and to clarify the connections between reading theory and computers. Until then, educators argue, it will be difficult to consider appropriate uses of the computer in the field of reading. Kamil (1987), moreover, notes that since much CAI software entails making independent "metacognitive decisions", these are crucial issues that need to be explored in much greater detail. At any rate, Kamil (1987) notes that finding ways to induce a higher level of processing in readers should be of primary concern in any use of computer-assisted reading practice.

Computer Capabilities and Reading

In terms of current or rapidly-developing hardware and software capabilities, Wyatt (1989) argues that computers are likely to play an extensive role in the development of reading skills. For example, at the decoding level, the computer medium can be used to introduce and develop recognition skills with a new alphabet. At the higher end, an extensive range of mechanical and meaningful reading exercises can be made available to learners. More importantly, Wyatt (1984b) argues, computers can assist in the development and checking of discourse-level comprehension which constitute an increasing common component of reading courses at the intermediate level and beyond. Some of these
skills involve recognition of referential relationships such as the stylistic considerations that often prompt writers to avoid repetitious use of a single term and instead, two of more expression may be used to vary the presentation. Another example of referential relations-hips is the use of anaphora (backwards reference) and cataphora (forward reference). Such references may span several sentences and present comprehension problems for less skilled readers who may need assistance and practice in recognizing the referential meaning (Mackay, 1974).

Anchoring/Situating Learning in Technology

Researchers' thoughts about problems with traditional approaches to instruction have been influenced by Whitehead's (1929) discussion of what he termed "inert knowledge" problem. Inert knowledge "is knowledge that can usually be recalled when people are explicitly asked to do so but is not used spontaneously in problem solving even though it is relevant" (The Cognition & Technology Group at Vanderbilt, 1990, p. 2). The major goal of "anchored" or "situated" learning/instruction (Brown et al., 1989; Porter, 1989; Salomon et al., 1991 Scardamalia & Bereiter, 1985) is to overcome the inert knowledge problem. This is achieved by "creating environments that permit sustained exploration by students and teachers and enable them to understand the kinds of problems and opportunities that experts in various areas
encounter and the knowledge experts use as tools" (Cognition and Technology Group at Vanderbilt, 1990, p. 3).

Kozma (1991) argues that in the active and constructive learning process, both the internal and the external cognitive resources operate in tandem to help the learner in the construction of meaning. The relationship between the internal and external cognitive environments is explicitly addressed by the emerging discussion of "distributed cognition" or "cognitive partnership" (Norman, 1989; Pea, 1989, 1990; Salomon, 1990; Salomon, Perkins, and Globerson, 1991; The Cognition and Technology Group at Vanderbilt, 1990). According to Norman (1989), there are two perspectives one can take in this discussion: a system view or a personal view. Pea (1990) and Perkins (1990) take a system perspective and examine how cognition with the system is augmented by its distribution among individuals and between individuals and artifacts (e.g., computers, calculators, etc.). The second view adopted by Salomon et al. (1991), among others, examines the effects that the sharing of cognition between an individual and a medium has on the cognitive representation and processes of that individual, particularly those effects that endure beyond the immediate interaction. In this context, Salomon et al. (1991) examine how technologies, particularly computer technologies, aid in cognitive processing, support intellectual performance, and enrich individuals' minds.
Recent work by Brown et al. (1989), Porter, (1989), Scardamalia and Bereiter (1985), The Cognition and Technology Group at Vanderbilt (1990) about problems with traditional approaches to instruction has been influenced by Whitehead's (1929) discussion of what he termed the "inert knowledge" problem. Inert knowledge is "knowledge that can usually be recalled when people are explicitly asked to do so but is not used spontaneously in problem solving even though it is relevant" (Cognition and Technology Group at Vanderbilt, 1990, p. 2). Thus, the major goal of anchored instruction is to overcome the inert knowledge problem "by creating environments that permit sustained exploration by students and teachers and enable them to understand the kinds of problems and opportunities that experts in various areas encounter and the knowledge these experts use as tools" (Cognition and Technology Group at Vanderbilt, 1990, p. 3).

Generally speaking, situating learning in technology serves as a scaffolding in the early stages of learning (Kozma, 1991). Software that combines CAI with a coaching feature can provide supportive scaffolding in the form of hints, suggestions, and performance evaluations. Then as the learner demonstrates more advanced skill, the scaffolding can decrease and finally fade away. To teach students how to think critically and autonomously, the software could lead them through a process of cognitive apprenticeship in which they learn to think like experts. They would have a chance to
work in the expert's environment, experiment with the main variables in that environment, develop appreciation of the complex skills required for expertise, and observe expert practice when examples are demonstrated on the computer (Collins, Brown, & Newman, 1986; Sleeman & Brown, 1982). In other words, computer-mediated programs may also enhance the development of mental models of poorer learners (readers). Experts in a domain are distinguished from novices, in part, by the nature of their mental models and how they use them to solve problems. The processing capabilities of the computer can help novices build and refine mental models so that they are more like experts.

Hypotheses About the Relationship Between Vocabulary Knowledge, Syntactic Knowledge, and Background Knowledge and Comprehension Skills

The rationale for selecting reading supports stems from the fact that the technological attributes of the computer permit several manipulations of written text not feasible on the printed text. In the present study, the selection of the different manipulations or supports was based on several theoretical and empirical criteria. First, a reading support was selected if theory and research suggested that it is a contributing factor in reading comprehension. A second criterion relates to a reading support's potential for
underscoring cognitive processing capability that may impact comprehension.

In an effort to determine the role each plays in comprehension language researchers have examined the various dimensions of reading's extratextual and intratextual components. The interactive nature of comprehension, however, makes it difficult to determine the relative influence of each. Generally speaking, studies have shown that vocabulary knowledge, background knowledge, and syntactic knowledge are major factors in a reader's ability to comprehend a text.

In reading instruction, an important issue in comprehending difficult texts is how to help students use information and strategies such as background knowledge, vocabulary meaning, text structure, memory supports, etc. Such information is traditionally provided by the teacher when needed. When the teacher's help is not available, the technological capabilities of the computer might be useful in monitoring readers' performance and in providing independent support to enhance reader's comprehension. Moreover, a number of previously unavailable manipulations are attainable in a systematic and consistent fashion.

Lexical Items

Cognitive and educational psychologists have long recognized the intimate connection between vocabulary knowledge and reading comprehension. Numerous theories have
been proposed for the long-recognized but poorly understood findings that vocabulary size is the single best predictor of reading comprehension and overall intelligence (Anderson & Freebody, 1981; Brown et al. 1976; Sternberg & Powell, 1983; among others). Perfetti (1990) argues that a correlation between the two variables does not permit the establishment of a direct causal link, nor does it permit ruling out of an indirect relationship between the two through their dependence on a third, higher order variable. For this reason a number of hypotheses have been offered for the strong correlation between vocabulary knowledge and comprehension (cf. Anderson & Freebody, 1981).

Anderson and Freebody (1981) summarize three views of reading that attempt to explain this strong link between vocabulary knowledge and reading comprehension. The first, the instrumentalist position, states that readers' knowledge of words enable the understanding of a text, a claim that "vocabulary knowledge is directly and importantly in the causal chain resulting in text comprehension" (p. 81). The second view posits that vocabulary knowledge highly correlates with verbal aptitude, and that the latter, not direct vocabulary knowledge, is the main factor in text comprehension. The third, the general knowledge hypothesis, suggests that vocabulary is linked to reading comprehension through a general knowledge of the world.
Empirically, the relationship between vocabulary knowledge and reading comprehension has been well established in first language reading research. After extensive investigation involving empirical correlational studies and factor analysis, Davis (1944, 1968, 1972) identified four main subskills affecting the ability to read: recalling word meaning, determining meaning from context, finding answers to explicit questions, and drawing inferences. Of these four factors, vocabulary was the most important and had the strongest effect. Other studies by Spearitt (1972) and Thorndike (1973) supported Davis' findings of the strong link between vocabulary and comprehension.

In the second language context, virtually all second language reading researchers agree that vocabulary development is a critical component of reading comprehension. Barnett (1986), Bernhardt (1991), and Strother and Ulijin (1987) have demonstrated that vocabulary is an important predictor of reading ability.

Background Knowledge

Research on learning from prose has been dominated by two perspectives. One perspective emphasizes the importance of the structure of the text, and the other perspective focuses on the world knowledge that the reader brings to the text (Britton & Black, 1985). Many investigators have discussed the nature of detailed knowledge structures that
can be invoked to mediate text comprehension. This research has firmly established the individual importance of domain knowledge (e.g., Alverman, et al., 1985; Anderson et al., 1977; Rabinowitch & Chi, 1987) in text learning and comprehension. Prior knowledge thus, specifically facilitates a number of the component reading processes that otherwise occupy the resources of the cognitive workbench. Spiro et al., (1987), (in Bernhardt, 1991) note that the "fundamental tenet of all recent theories of comprehension, problem solving, and decision making is that success in such cognitive arenas depends on the activation and appropriate application of relevant pre-existing knowledge" (p.177). Prior knowledge also aids in the assignment of importance in text, which is necessary for main idea construction.

In L2 reading, Bernhardt (1991) notes that the literature is replete with terms associated with the nonvisible or knowledge-driven facet of reading. The terms conceptually driven, implicit, internal, reader-based, and knowledge-based all imply "the existence of information critical to the reading process that does not appear explicitly as part of the written text" (Bernhardt, 1991, p.95). Bernhardt (1991) divides knowledge into three types:(1) local-level knowledge which is highly idiosyncratic knowledge that individuals carry with them, (2) local-level knowledge which includes knowledge of history, arts, sciences, music, and language and which is normally provided
by schools, and (3) culture-specific knowledge is knowledge which includes ritualistic knowledge as well as cultural-historic knowledge.

**Syntactic Knowledge**

Extensive research has been carried out to demonstrate the relative contribution of the different processes in sentence and text comprehension (Fillenbaum, 1971; 1974a, 1974b; Fodor & Bever, 1965; Fodor, Bever, & Garrett, 1974; Fodor & Garrett, 1967; Jarvella, 1971). Adams (1980), cited in Bernhardt (1991), for example, notes that "syntax is the primary means by which we can specify the intended relation among words. ... It is clear that syntactic competence is an important dimension of linguistic competence in general" (p.18). More recently, there has been a more forceful reappraisal of the role of syntactic knowledge in reading comprehension. Perfetti (1990) notes that "after a period in which the study of comprehension became closely identified with the analysis of higher level textual processes and in which syntactic processes typically were assumed to be either inscrutable or irrelevant, it is again credible to claim that comprehension depends in part on processes that are essentially syntactic" (p. 205). Recent research on parsing, Perfetti (1990) adds, has provided "a salubrious injection of syntax into our theories of comprehension" (p. 205).

Syntactic analysis, or syntactic parsing "segments sentences
into grammatical constituents and determines how those constituents are related to each other” (Just and Carpenter, 1987, p. 129). Just and Carpenter (1987) note that syntax “allows sequences of words to coalesce, forming higher-order constituents (phrases and clauses) that can bear a variety of grammatical relations to each other” (P. 130). The process of syntactic analysis relies on cues in the text such as word order, word class, function words, affixes, word meanings, and punctuation to indicate intra- and intersentential syntactic interrelations among the different constituents of the sentence or discourse.

The L2 reading research community has also recognized that syntactic and vocabulary knowledge are critical components of reading comprehension (Berman, 1984; Bernhardt, 1991; Carrell, 1989a; Koda, 1989; Swaffer, 1988). The importance of syntactic knowledge in L2 reading comprehension is underscored in Bernhardt’s (1991) model of second language reading which includes three text-driven factors: word recognition, phonemic/ graphemic decoding, and syntactic feature recognition. Syntactic feature recognition involves the relationship between and among words. Syntactic features processes include interpreting present tense sentences from the text as past tense or singular nouns as plural.

As one of the syntactic features of Arabic language, the verb system and particularly its morphosyntactic composition poses a serious problem for readers of Arabic in general, and
readers of AFL in particular. Of concern in this context is the fact that Arabic, being a subject pronoun drop language, does not require subject pronoun in its verbal sentence, primarily because of subject agreement which codes all pronominal features of the subject onto the verb. Thus, in Arabic, one finds one-word sentences in which the trilateral verb form serving as the core or the stem and the different suffixes, prefixes, and infixes carrying the other sentential features of the verbal sentence. For example:

1 a- I shall learn/study it (a word or a language). (مُكَذَّب)
1 b- He will learn/study it (-------------------). (سَيْنَتِنَا)
1 c- She will learn/study it(-------------------). (سَيْنَتِنَا)

Where the letter (س) in all three sentences denote future or incomplete action, the letters (أ), (ث)، and (ث) stand for first person (Masculine or feminine), third person (masculine), and third person (Feminine) respectively, and the letters (و) at the end in a suffix referring to "it."

In the past tense:

2 a- I (masculine and feminine) learned/studied it. (لَكِنَّ(ن)
2 b- They (feminine, dual) learned/studied it. (نَلْكِنَا(ن)
2 c- They (masculine, dual) learned/studied it. (نَلْكِنَا(ن)
2 d- They (plural, masculine) learned/studied it. (نَلْكِنَا(ن)
2 e- We (masculine and feminine) learned/studied it. (نَلْكِنَا(ن)

Another aspect of the verb system in Arabic that constitutes a serious problem for both foreign and native learners (readers) of Arabic relates to verb agreement. Agreement in
Standard Arabic is still in many ways a 'puzzle'. One aspect of this puzzle is why the verb is singular when it precedes its subject (be that singular/plural), but agrees fully in gender and number with a preceding subject (see Examples 3a,b, and 4 a,b).

3 a- يُذَهِبُ المُسْلِمُونُ إِلَى مَكَّةَ لِلْحَجَّ (Muslims go to mecca for pilgrimage)

3 b- المُسْلِمُونُ يُذَهِبُونَ إِلَى مَكَّةَ لِلْحَجَّ (Muslims go to mecca for pilgrimage)

4 a- درَسَ سَمِي وَأَحْمَدَ الْعُلُوْجَةَ الْإِنْجِيْلِيَّةَ (Ahmed and Sami studied English language)

4 b- سَمِي وَأَحْمَدَ دَرَسَ الْعُلُوْجَةَ الْإِنْجِيْلِيَّةَ (Ahmed and Sami studied English language)

Definition of Terms

Reading Comprehension: Reading comprehension is defined as the number of weighted propositions (pausal units) recalled after reading a text and scored according to the Johnson system (1970).

Pausal Units: The words surrounded by locations in a text that are “acceptable for pausing to catch a breath, give emphasis to the story, or to enhance meaning” (Johnson, 1970, p. 13).

Proposition Importance: According to the Johnson (1970) procedure, the reading passage propositions are divided into
four levels according to their importance to passage meaning, one being least important and four most important. Beginning AFL readers: AFL readers enrolled in the 102 or 103 Arabic courses offered at the Arabic department at OSU. Text/Passage: An informative reading of approximately 125-150 words. The four texts will be adapted from the Elementary Modern Standard Arabic (EMSA), (1983) textbook edited by P. Abboud and E. MaCarus. Judgment will be used as a criterion for deciding on text difficulty because of the lack of readability formulas or any other indexes to empirically judge text difficulty in Arabic. Computer-Mediated Text (Microtext): Any display of connected, written text that is under the immediate control of a computer program. Computer Program: Any sequenced series of commands executed by a computer to accomplish a pre-defined outcome. Reading Supports/Textual Manipulations: Categories of information that address comprehension difficulty:

  a) Translation of vocabulary items: translation of vocabulary words selected by a panel of three experienced AFL teachers that are judged to be critical to the comprehension of the four passages; vocabulary items that the members of the panel would select to be pre-taught to help students understand a passage.

  b) Background information/knowledge: information about a particular topic that the subjects may need to enhance their
comprehension of a text. In related literature, the term is used synonymously with topic familiarity and prior knowledge.

c) Verb conjugation: conjugation of the verbs (past and present) that appear in the two texts.

The computer programs will be prepared by the researcher with technical assistance from an experienced AFL teacher who also specializes in computer science and instructional design and technology.

Computer-Assisted Instruction (CAI): A generic term referring to instruction that uses a computer and is interactive (i.e., the software provides instruction or stimulus, the subject responds, and the software provides feedback to the subject concerning his or her response).

Free-Recall Protocol: A reading comprehension measure in which subjects write in their native language all that they can remember about a given text.

Technology: The means by which individuals fulfill their needs at a level that is highly predictable and transferable.

Technological Attributes (of a medium): A defining attribute of a medium. The attribute is dependent upon a technology.

Instructional Medium (media) or Medium of Instruction: Refers to the type of stimulus used to communicate information; e.g., voice, text, motion pictures, computers, slides, etc. (Gange' and Briggs, 1979).
Medium (media): "Our cultural apparatus for selecting, gathering, storing, and conveying knowledge in representational forms" (Salomon, 1979, 3).

Likert Scale: A type of composite measure developed by Rensis Likert in an attempt to improve the levels of measurement in social and educational research through the use of standardized response categories such as strongly agree, agree, disagree, and strongly disagree. Such items can be used in the construction of true Likert scales or in the construction of other types of composite measures.

Assumptions

The proposed study is based on the following theoretical and procedural assumptions:

1. The choice of the reading supports/textual manipulations is based on the assumption that they are recognized in reading research as factors in reading comprehension.

2. Panel members' decisions and judgments in each phase of the study will be valid and reliable.

3. Students' responses on the Likert scale perception task will have response validity (Hennigs, 1987). That is, subjects are expected to respond reflectively and in a non-haphazard fashion.

4. The passages chosen are of the same or comparable level of difficulty.
5. The subjects will perform the tasks to the best of their ability on all measures.
6. The recall protocol format provides a valid and reliable measure of reading comprehension of computer-mediated informative, expository and narrative texts.
7. Subjects' placement into the beginning Arabic course accurately reflects their proficiency level.
8. The researcher makes all the assumptions that undergird the Latin square factorial designs.
9. The length of the texts does not limit generalizability to texts of different lengths.
10. It is assumed that subjects are familiar with the computer-mediated reading support system.

Limitations of the Study

The following are the limitation of the present study:

1. The proposed study is exploratory. As such, it will serve as preliminary information in analyzing data about the facilitative effect of computer-mediated reading supports in reading expository texts. Replication of this study using other texts, samples, and text manipulations is necessary.

2. Generalizability of the results is limited by the assumptions that undergird the Latin square factorial design.

3. The texts used in this study are adaptations of authentic texts. Generalizations must be made with caution.
4. Any attempt to conduct research in reading Arabic as a foreign language will inevitably involve the problem of small sample size. Thus, another serious limitation of the study is the small sample size. This is due to the small enrollment of students in the Arabic classes.

5. A limitation that is related to the previous one and which constitutes a major concern for the researcher relates to the fact that the optimal design that the researcher may find with which to approach the research question may require more subjects than are available. Thus, the statistical power of the analysis may be weakened by variability within subjects that can either mask or nullify the results of the experiment.

6. Subjects will have no formal training.

7. Random selection of subjects will not be possible. Subjects will participate in the study on a voluntary basis. The results, therefore, can not be generalized to other populations.

8. The length of the passage to be displayed on the computer screen will be limited by the size of the screen.
CHAPTER II
REVIEW OF LITERATURE

Introduction

This chapter addresses the issues and notions of learning with media, interaction of media attributes, situating or anchoring learning in technology and its cognitive and affective dimensions, CAI and computer-mediated reading supports, theoretical and empirical evidence for the facilitative effect of vocabulary, syntactic, and background knowledge on reading comprehension, and reading research in AFL. Studies addressed in this review contribute to the theoretical framework advocated in this study and in particular the interface of computer technology, reading instruction and reading comprehension.

Learning with Media

Since the early 1960s, there has been a continuing and broadening debate on the influence of media in shaping cognition. Much of the recent and present debate focuses on whether or to what extent media should be used in instruction and how learning can be maximized (Clark and Salomon, 1986).
The argument concerns the relative role of the characteristic symbol of media—the combination of pictures, sounds, print—and how these distinctive forms might affect information processing demands. Succinctly said, investigations and debates in the last 15 years center around the following question: Do media influence learning? Research suggests that capabilities of a particular medium, in conjunction with methods that take advantage of these capabilities, interact with and influence the ways learners represent and process information. These capabilities may also result in more or different learning when one medium is compared to another for certain learners and tasks. The processing capabilities of the medium can complement those of the learner; they may "facilitate operations that the learner is capable of performing or perform those that the learner cannot" (Kozma, 1991, pp. 181-182).

Different media thus, differ in the way that they affect cognitive structures and processes (Anderson et al., 1979; Kozma, 1991; Salomon, 1983). Linguistic information presented on television, for example, can be orthographic and oral. Because in television linguistic and pictorial symbol systems are transient and because they are presented simultaneously, "viewers may process this information in a very different way than the back-and-forth serial processing of linguistic and representational information in books" (Kozma, 1991).
Few empirical studies have been conducted to test the effects of media on cognitive skills. Those studies, according to Reinking (1983) appear to uniformly support the differential effects of media attributes, learner characteristics, and cognitive skills. In a study conducted in 1970, Salomon and Seiber have demonstrated that the attributes of a medium are more important in accounting for learning than is the medium itself. They found that subjects viewing randomly spliced film segments generated more alternative explanations for the film content than when viewing a straight-forward version. Subjects found recalling factual information more difficult in the randomly spliced condition, however, even when directed to do so. More recently, Freeman (1984), concluded after conducting 13 studies which compared effects of various visual materials to film that learning depended more on the nature of instruction and individual characteristics than the visual medium employed.

A second line on the effect of media in learning investigates visual attention. Research indicates that visual attention is influenced by several factors. One set of factors, according to Kozma (1991) is termed "formal features" which come to be seen by young learners as corresponding to the presentation of more or less meaningful content, and it is this second factor, the meaningfulness or comprehensibility of the presentation, that guides visual
attention (Kozma, 1991). Anderson, Lorch, Field, and Sanders (1981) found that visual attention to segments of "Seasame Street" was greater for normal segments than for the same visual presentation for which comprehensibility was experimentally reduced by using background speech or a foreign language.

A third area of investigation relates to Salomon's (1983) construct of "amount of invested mental effort," or AIME. Salomon (1983) coined the term to account for the difference between what is viewed and the depth of comprehension. Salomon (1984) found that a sample of sixth graders rated TV as an easier medium from which to learn than books. When assigned to view comparable stories from television or print, the effort spent on learning reported by the reading group was significantly greater than that reported by the group that viewed the television program. Both groups scored that same on a test of factual recognition, but the print group scored higher on a test of inferences based on the story.

Krendl and Watkins (1983) exposed fifth-grade children to a 15-minute educational television program. They manipulated the purpose of viewing by telling half of the students to watch it for entertainment purposes; the other half were told that it was an educational program and that they should watch it in order to answer questions. Whereas recall of the storyline was the same for both groups (i.e.
the number of recalled actions, facts, scenes, etc.), the group instructed to view the program for educational purposes responded to the content with a deeper level of understanding, that is they reported more story and character elements and included more inferential statements about the meaning of the show.

A fourth line of research investigates the computer's capability of helping learners construct links between symbolic domains and the real world phenomena they represent. Computers' technological capabilities can play a role in aiding learners to elaborate their mental models and correct their misconceptions with the use of microworlds (Kozma, 1991). Morkos and Tinker (1987), for example, found frequent errors among seventh-grade and eighth-grade students in the interpretation of graphs. The researchers used a microcomputer-based lab (MBL) with 125 middle school students for three months. Morkos and Tinker found a significant increase from pre- to posttests on the interpretation of graphs (from mean =8.3 to mean =10.8 on a 16-item test).

In summary, current research based on symbol system theories argue that the very nature of cognitive processing may be influenced by the symbolic codes employed by media (Meringoff et al., 1983). Through these symbol systems, media are thought to deliver distinctive messages that may activate (Olson & Bruner, 1974; Olson, 1976) and may cultivate (Kozma, 1991; Salomon, 1984) certain mental capabilities and methods
of reasoning. These studies also suggest that the perceptions students have about a medium and the purpose they have for viewing influence the amount of effort that they put into the processing of the message, and consequently, the depth of their understanding of the story.

In contrast to the above cited claims about the technological capabilities of a medium, some researchers and theorists (Clark, 1983; Rumelhart, 1980; among others) claim that a medium's symbolic codes are mere conveyers of content, and therefore, do not serve any unique function in cognition and learning. In his synthesis of research on learning from media, Clark (1983) finds no evidence to suggest that symbol systems serve any unique function at all in cognition and learning, arguing that "media are mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries cause changes in our nutrition" (p. 445). Neuman (1992) also argues the role of a medium's symbol system may be less consequential than some researchers have assumed. Indeed, as conveyers of content, symbol systems may play a supporting role in processing information. Neuman (1992) adds that media selection in teaching might be related more to its convenience, its cost, and its efficiency in achieving particular learning goals, rather than the medium's perceived cognitive benefits.
Computer-Assisted Instruction (CAI)

Computer-assisted instruction (CAI) is defined as instruction that uses a computer and is interactive (i.e., the software provides instruction or stimulus, the subject responds, and the software provides feedback to the subject concerning his or her response). CAI is a field whose recent development has reflected the exponential rate of change inherent in other aspects of computer technology. As far as language teaching and learning are concerned, this change, according to Stevens (1989), has been taking place against a backdrop of equally significant shifts in perceptions of how people learn languages, in perceptions of who language learners are, and what their individual needs and differences are.

In the field of language teaching and learning, Stevens (1989) notes that the first efforts of any significance in the teaching of languages using computers occurred during the late 1960s and for more than a decade, where computers were used in language learning, it was usually in ways designed to structure learning along the lines of behaviorist models then in vogue. Based on the theories of learning advanced by Thorndike (1911) and later by Hull (1934) and Skinner (1954), programmed learning employed small increments of new information presented individually in discrete units termed "frames." Accordingly, programmed instruction (PI) was considered the optimal model for courseware design.
Stevens (1989) argues that the salient flaw in instructional algorithms based on behaviorism was the assumption that learning could be reduced to its lowest common denominators, and that teaching could thus most effectively proceed as a series of preplanned discrete steps. Because programming is also a discipline in which steps in a given task are clearly defined, it was tempting to conceptualize early CAI efforts along the lines of the behaviorist models. Drill-and-practice became the preferred mode of delivery.

Some investigators (Chappelle and Jamieson, 1986; Johnasen & Tennyson, 1983; Leiblum, 1982; Lozano et al., 1985; Morrison & Adams, 1968; Pederson, 1985; Post, 1983; Pusack, 1984; Scafeffer, 1979, 1981; Wyatt, 1984; among others) have moved beyond evaluative models toward more empirical research that is grounded in theory. Some (Leiblum, 1982; Pederson, 1985) had noted that some frustration experienced by those who have to deal with CAI is due to the failure of second language researchers and educators to investigate theoretical issues in educational technological applications. Pederson (1985) notes that "in spite of the numerous testimonials available from second language instructors concerning the efficiency of CAI, other practitioners are far less enthusiastic about developments in second language computer-assisted instruction to date" (p. 13). Along the same lines, one cannot fail to notice that
research on the use of the computer for second language practice has been extremely limited (Kender & Rubenstein, 1977; Mooney, 1982; Pederson, 1985; Schaffer, 1979).

Different types of basic CALL and CAI studies were carried out in the late 1970s and early and mid 1980s to investigate the effect of manipulating some independent variables combination—learning styles, aptitude, learning task, the coding elements—on achievement or attitude. Schaeffer (1979, 1981) for example, examined students' understanding of materials presented in a drill or exercise format. Two treatment groups of undergraduate first-semester students of German (one focusing on structure and the other on meaning) received instruction on the past perfect tense. Results pointed to the value of higher-level processing (i.e., meaningful language practice).

Johnason and Tennyson's (1983) study examined the degree to which learner control of instruction can be facilitated by using the computer to instruct students on how to make instructional choices. Students were blocked into three treatment groups (advisement, full, and partial learner control in learning punctuation rules of English). Results indicated that the advisement learner-controlled group outperformed the other two groups on criterion-referenced posttest. This, according to Pederson (1988) is interpreted as a "support for Salomon's (1974) contention that optimally
coded CAI can activate dormant or underdeveloped metacognitive strategies" (p. 117).

Pederson (1985) investigated passage availability, "a coding option" of interest in the design of CAI software for second-language reading. The focus of her study was whether or not a reading passage should remain available for reinspection during readers' attempt to answer comprehension questions. Pederson's subjects were college students learning French as a foreign language. The dependent measure was subjects' scores on a free recall. Results showed that passage unavailability during questioning leads to higher comprehension than does passage availability regardless of the level of question difficulty or level of subjects' verbal ability.

Hatva (1988), interested in the effectiveness of CAI for low and high achievers, observed in detail the strategies high- and low-achieving elementary students used to effectively work through a tutorial containing material not yet studied in class. Low achievers, more than high achievers, were prone to make mistakes associated with hardware and software and were less able to adjust to the special environment of computer work and derive great benefits from it. Mandinach and Corno (1985) studied the cognitive engagement processes used by males and females and high and low achievers in a computer problem-solving game. High-ability students were more successful because they used
self-regulated learning rather than recipient learning. Females were more likely than males to adopt and maintain only one type of engagement throughout the entire problem solving.

Effectiveness of CAI

The effectiveness of CAI has been investigated extensively over the past twenty years. Philips (1985) has suggested that CAI can allow the student to experience realities not otherwise accessible in the classroom, through an interactive process whereby interaction leads to the "creation of a unique transaction". Liberman and Linn (1991) argue that by integrating computer activities into instruction, educators can provide unique and diverse learning environments that supply and manage a vast amount of information, interact with the learner, adapt to individual needs, provide either private or social learning experiences as needed, employ various sensory modalities, stimulate a range of cognitive styles, and blend explicit tutoring with experiential learning (p. 388). This variety and flexibility are major advantages of computer based instructional technology.

Wolff & Legenhausen (1987), on the other hand, note that the computer has a hypnotic effect on some teachers, causing them to accept methodology which would be quite unacceptable for them if presented in print. Many exercises are highly
mechanical, simply requiring students to match irregular verbs, put nouns in lists, translate items, etc. This seems dangerous in that "such exercises—though they may have some limited application—will soon cause students to lose interest in what is potentially a very powerful learning tool" (Wolff & Legenhausen, 1987, p. 168).

Numerous studies have compared students' performance using computer-assisted instruction (CAI) with their performance using the methods of traditional instruction such as instructor-led or print-based instruction, but the results have been mixed depending on research variables such as learning tasks, learners' situations, and the strategies and types of CAI used in these studies. Moreover, this research has traditionally been conducted using regional population bases, confining the scope of study to a single discipline.

In the field of reading research, several reviewers have summarized the applications of computers in reading and reading comprehension (Mason, Blanchard, & Daniel, 1983; Mason, 1980). These applications range from instructional uses to the collection of data pertaining to readers' eye movements during reading. In a number of studies, the computer is used as a device for conveniently administering, controlling, or recording an experimental manipulation (Reinking, 1984).

Several experimental studies, for example, were carried out to investigate the effects of extended CAI drill and
practice in reading and reading achievement. In one experiment, Atkinson (1974) matched 100 elementary school students on a number of variables. Students in the experimental group received 15 minutes of CAI in reading each day while the control group received only classroom reading instruction during this time. Results indicated that after first grade, the groups differed by over five months on grade-equivalent scores on a standardized reading test. After another year without CAI, the group still differed by over four months.

An example of how computer technology might alter the contingencies of reading and learning from conventional texts can be found in a study by Anderson, et al., (1974) in which college students in an economics course were given reading assignments on the computer. After completing a 15- to 20-min. reading assignment, students were required to answer several multiple-choice comprehension questions. Students who failed to achieve a criterion score of 75% were signed off the computer for a period of time until they had the opportunity to reread the assignment, after which they would again attempt a set of comprehension questions. New reading assignments were deferred until students have demonstrated mastery of the content as measured by the comprehension questions. Students in three economics classes whose reading was monitored by the computer in this fashion scored
significantly higher on final exams than did students reading and studying on their own.

Three of the most recent and available meta-analyses of CAI indicate the wide diversity of settings in which CAI has been studied. Kulik and Kulik (1986, 1987), Kulik, Kulik, and Cohen (1980), and Niemic and Walberg (1987) performed meta-analysis on well over a hundred achievement studies among the following populations: elementary, secondary, college, and special education. In a review of research results on CAI, Kulik and Kulik (1986) concluded that CAI has not been uniformly successful in all its guises and at all instructional levels.

In another meta-analysis of findings from 254 controlled evaluation studies, Kulik and Kulik (1987) reported that CAI generally produces positive effects on students, and that CAI programs raised students' performance by 0.30 standard deviations in the average. In an examination of literature reviews of computer-assisted instruction, Niemic and Walberg (1987) reported that a typical effect of CAI is to raise outcome measures moderately by 0.42 standard deviations. In addition, the results of many comparison studies between CAI and the methods of traditional instruction have supported the superiority of CAI. Hannafin and Peck (1988) contend that when CAI is compared to traditional instruction which does not account for individual differences, it is likely that CAI will produce more learning in a given amount of time or will
produce a given amount of learning in a shorter period of time, and that retention following a CAI lesson is at least as good as retention following the more traditional methods of instruction.

Other studies about the effect of computer-based instruction, however, showed that there are no significant differences in students' achievement between CAI and the methods of traditional instruction. Clark (1983) contends that "achievement gains found in these CAI studies are overestimated and are actually due to the uncontrolled, but robust, instructional methods embedded in CAI treatments" (p.249). That is, Clark (1983) is denying the fact that CAI instruction is a main factor in making students' learning more effective than traditional instruction such as print-based instruction. Easterling's (1982) study showed no gains on standardized tests after four months during which students in an experimental group participated twice weekly in CAI drill in reading. In a recent comparison of CAI vs. paper and pencil on elementary school students' performance, Nativa (1988) reported that the majority of students performed a given task more poorly using the computer than using paper and pencil in an arithmetic exercise, with the exception of a few bright students. This result seems to indicate that computer-assisted learning performance might be rather less effective for some students and some learning tasks than
paper and pencil-assisted learning performance, depending on the characteristics of the learners and tasks.

Mutter et al. (1982) study showed no differences between the print and microtext groups on reading comprehension. Heppner et al. (1985) report, however, that reading performance on the Nelson-Denny Reading test was better with the print than with the computer monitor. Subjects for the study, including university students, staff, and faculty, were each given both computer and print formats for the timed test. Yet, when scores were adjusted for reading rate, no significant difference existed between the print and the computer. The authors concluded that the performance differences were probably due to slower reading speed associated with using the computer monitor. Kleinman (1987) investigated the effectiveness of CAI using experimental and control groups. Results indicated that CAI did not enhance the reading comprehension of ESL readers. Pre- and posttest scores showed no difference between groups with and without CAI.

From this brief review one cannot but notice that the postulations and findings of different researchers are not un-equivocal. This state of affairs could be traced to two reasons. First, the dominant comparative research paradigm (Becker, 1988; Kulik and Kulik, 1985; Kulik, Kulik, and Bangert-Drowns, 1985; Kulik, Kulik, and Shwalb, 1986; Kulik and Kulik, 1987; Niemic and Walberg, 1987; Reeves, 1986) has
tended to preclude "more important research questions such as how computer-related technologies can provide the optimum conditions for learning and which components of instruction foster more affective learning for which types of learners" (Williams and Brown, 1990, p. 104). The second reason is that earlier studies of computer-related technologies for instruction were often based upon the behavioral paradigm of stimulus-response learning the theoretical bases of which have been called into question by recent works in cognitive science (Libermann & Linn, 1991; Aschcraft, 1989; among others).

In conclusion, the value of such studies in answering significant questions concerning the use of computers in reading instruction is questionable for several reasons the most important being, the design and control of the studies, the nature of instruction delivered by the experimental and control groups, the absence on any theoretical explanation for any interaction between CAI and the cognitive demands of the task, and the nature of dependent variables which were global and provided no on-going information about subjects' performance along a number of dimensions (Reinking, 1983, 1987; Tierney and Cunningham, 1984).
Affective Dimensions of "Situating" Learning in Technology

The mixed results reflected in the review of CAI studies in the previous section led several researcher to argue against using media comparison studies as a yardstick for judging the effectiveness of CAI. Neuman (1992), for example, argues that because media comparison studies are still inconclusive, further research needs to be conducted with rigidly controlled instructional methods. In particular, whether or not the computer is intrinsically a superior medium under more rigidly controlled instructional conditions should be examined in terms of motivational functions of the computer-based instruction.

Over the years, the effectiveness of CAI has been defined in several ways. The most common measure has been enhanced achievement, such as improved test scores, but other measures of effectiveness have been employed as well, including heightened affective responses or better attitudes. Thus, motivation has recently been suggested by the research community as another important component in the design and utilization of interactive instructional systems. In fact, many argue that the motivational function of CAI is probably its strongest asset (Lepper, 1986; Swanson & Anderson (1987). Lepper indicates that one of the main aims of using the computer in many instructional programs is to enhance student motivation. It is widely recognized among educational
psychologists that motivation to learn is a major determinant of task achievement.

The motivation function of the computer has thus been considered as an important factor in many CAI programs. For example, Hannafim & Peck (1988) have noted that intrinsic features of the computer such as immediate feedback, animation, sound, active interaction, and individualization were more effective in stimulating their subjects' learning motivation than the print media. Computer-based learning often appeals to students who normally resist other forms of instruction (Lepper & Malone, 1987; Liberman, Chaffee, & Roberts, 1988; Liberman & Linn, 1991). Lepper (1985) has noted that slow and unmotivated young learners become captivated by computer learning environments. The appeal of computer-based technological tools offers educators a new opportunity to impart self-directed learning skills to even the most reluctant learners. Several studies have found that students find interactive, precise, and consistent computer learning environments fascinating and tend to prefer activities that deliver multiple solutions, provide messages individualized to the learner, reduce drudgery, and help make abstract concepts concrete (Bork, 1986; Brown, 1985; Linn, 1986; Walker, 1983). Additionally, a meta-analytical finding suggests that gains from CAI at the secondary school level may be greatest for slow- and average-ability students whose lack of motivation to learn was regarded as a major reason.
for their low or average achievement (Kulik & Kulik, 1986, 1987).

Yang's (1991-92) study investigated the effects of computer-assisted instruction (CAI) versus print-based instruction (PBI) on motivation, continuing motivation, and content recall. A total of fifty-two 11th graders were randomly assigned to either a CAI group or a PBI group. The CAI and PBI groups studied Lincoln's Decisions on the computer screen and in print text, respectively. After motivation and continuing motivation in both groups were measured with the Instructional Materials Motivation Survey, immediate and delayed recall was measured with sixteen multiple choice items. Results showed that the CAI group showed significantly higher motivation and higher scores in the immediate recall over those of the PBI group, but the results of delayed recall were not significant between the two groups, and continuing motivation was difficult to interpret.

Taken together, these studies point to the importance of the motivational function in technology-based learning especially, for slow and average learners. Despite its differential and short-term effect, it is incumbent on curriculum designers to consider the motivational factor of media as an integral part in any computer activity.
Research on the Relationship between CAI and Student Attitudes

Informal observations as well as formal attitude questionnaires have been used to elicit students' CAI attitudes and perceptions. Dixon (1981, p. 105), for example, reported that ESL students were "happy" and that usage was "high" with ESL and CAI lessons on PLATO system at the University of Illinois. Reid, Lindstrom, McCaffery, and Larson (1983) reported that all the ESL students who used a text analysis program for composition "enjoyed the cultural experience" (p. 41). Questionnaire results typically reflect favorable attitudes toward CAI. Positive attitudes, for example, were reported in the studies of CAI for written French (Brebner, Johnson, and Mydlarski, 1984), English grammar (Oates, 1981), and reading (Lysiak, Wallace, and Evans, 1976). Other studies, however, (Alderman (1978) and Sarracho (1982) found poor attitudes for CAI.

Chapple & Jamiseson (1989) note that although these observations indicate something about overall attitudes, they share the problems of studies of effectiveness: "They attempt to summarize the attitudes of all students to the use of CAI in general. A more useful direction would be to note attitudes toward specific features of programs" (p. 53). For example, positive attitudes were reported toward some features of the experimental lessons and tasks employed in
Robinson’s (1986). Analysis of these features reveal principles of design that may stimulate positive attitudes. Constant or stable characteristics such as learners’ cognitive style may also have an impact on students’ attitudes toward CAI materials. In a study of ESL students using CALL, Chapelle & Jamieson, (1986) found that field-dependent students tended to have a positive attitude towards them, while field-independent students didn’t like them. Negative attitudes of users toward CAI in Sarracho’s (1982) study were accounted for by ethnic differences in learning styles.

In summary, one can safely argue with Chapelle & Jamieson (1989) who contend that to adequately assess attitude toward CAI, both lesson (program) and learner variables must be examined. If students believe lessons are appropriate and useful, they are likely to have good attitude toward them. Appropriateness appears to be “a function of characteristics such as cognitive style and ability level” (Chapelle & Jamieson, 1989, p. 53).
Adjunct Study Aids

Attempts to enhance reading comprehension have normally focused on the reader or on the text. Levin (1976) has noted that

Good readers typically comprehend; poor readers do not. In order for poor readers to perform like good readers, one of two events must occur: a) the reading materials must be changed in some way...; or b) poor readers must learn (be taught) to employ some of the 'habits' of good readers (p. 322).

Reading supports are categories of information that address comprehension difficulties. Several studies have investigated the effects of using computer-mediated texts to provide readers with several options for assistance during independent reading (Reinking, 1983, 1988; Reinking and Schreiner, 1985). Reinking and Schreiner (1985) have suggested a number of text manipulations which have the potential for more actively engaging readers in processing expository texts. These include 1) definition of vocabulary, 2) paraphrase or less technical version of the content, 3) supplemental background information or illustrations, 4) main ideas and supporting details. To this list one may add vocabulary item translation and verb conjugation for second and foreign language learners.

Text manipulations that have been used in traditional printed texts include such adjunct study aids as advanced organizers (Ausubel, 1963; Omaggio, 1979, 1986), inserted
questions (Rothkopf, 1966), pictures (Samuels, 1970) and adjacent-to-text glosses (Otto, 1980). The major purpose of introducing such interventions is to attempt to reshape and enhance semantic processing by manipulating structural and organizational features of printed text. Such traditional interventions do occasionally produce limited, local, and short-term benefits. They have not, however, shown positive effects on understanding new texts (Tierney & Cunningham, 1984). In other words, a serious limitation is that there is no reason to believe that adjunct study aids have any long-term effect on reading and study behavior as the case may be when learning is "situated" or "anchored" in technology.

In typical reading and study context these manipulations must intrude in some fashion on the text targeted for understanding. Their presence is no doubt useful for some readers under certain conditions, but they can also be superfluous or cumbersome for those readers who may be more effective in managing their own reading and study. Inserted questions, for example, have been shown to have a deleterious effect on the recall of information not addressed in the questions (Anderson & Biddle, 1975; Hartley & Davies, 1976). Furthermore, there is no reasonable way to guide a particular reader's use of these aids during independent reading or study. Also, a general admonition to using the textual manipulations may or may not be heeded by a reader. These limitations are a direct result of the constraints imposed on
print displayed on pages and the resulting contingencies of normal reading and study. Because adjunct aids are a static component of the text and cannot confront the needs of any particular reader, they may lead readers to only a superficial consideration of their own comprehension.

Wilkie (1978) submitted this technique to experimentation. Using fifth-grade readers stratified on the basis of reading ability, one group read glossed passages, one read glossed passages with feedback provided by an answer key, and one group read passages without gloss. The groups reading glossed passages scored significantly higher on an experimenter-designed comprehension test which contained items both related and unrelated to the glossing activities. There was no evidence, however, that glossing activities transferred to other reading. Otto (1980) reported similar results and concluded that the glossing technique had thus far only intuitive, theoretical, and practical appeal. Carver's (1973) study was designed to overcome the problem of ignoring textual manipulations in typical reading study tasks. Carver (1973) explored the use of a technique he termed "programmed prose." Readers were required to choose the one of two words which made sense at the end of each short line of text. He argued that unlike cloze procedure, this technique was less disruptive of normal reading and yet forced the reader to interact with the text's meaning. He found that college students' comprehension was increased when
using this technique under low-incentive conditions, but decreased in high-incentive conditions.

In L2 context, Pederson (1985) used the computer to provide her subjects with adjunct questions of two levels of difficulty (low- and high-level questions). The results of her study showed that both low- and high-ability early-intermediate French learners can be expected to benefit from the use of passage unavailability during reading practice with adjunct questions.

Computer-Mediated Reading Supports

In reviewing reading comprehension research, including adjunct study aids, Tierney and Cunningham (1984) concluded that one of the difficulties in obtaining consistently positive findings is the complex interactions among readers, texts, and tasks. One of the obvious limitations of conventionally printed text is the relatively limited range of textual manipulations that can be employed to accommodate this complexity in any one text. The interactive characteristics of the computer, on the other hand, might be used to deal with a wider range of readers and tasks within a particular text (Reinking, 1987).

Presumably, the difficulty in externalizing interactions between the learner and text-based information is a factor which makes learning from written text often more difficult than learning from a teacher. The computer allows readers to
interact with written text in ways which are normally available only during oral communication. Recently, several L1 researchers have proposed theoretical frameworks that highlight those characteristics of computers that may influence comprehension by offering richer interactions between a reader and a text (Daniel and Reinking, 1987; Duchastel, 1986; Reinking, 1986, 1987; Reinking and Schreiner, 1985). Moreover, "providing readers with options to interact overtly with the text would encourage more active processing of the text" (p. 538). Finally, it is believed that the ease with which readers of computer-mediated texts can access reading supports may affect their propensity to seek help when faced with comprehension difficulties.

In summary, computer technology permits the reader to interact with the text in the pursuit of meaning in a way not particularly possible on the printed page. In this condition the following advantages may be realized:

Readers may be required to ponder more seriously the adequacy of their comprehension. By doing so they may select options to circumvent or overcome comprehension failure which, in turn, make them more sensitive to the factors that impact their own comprehension.

Readers will have the chance to work in an expert's environment which enables them to experience the relevance and the importance of comprehension skills and aids. In other words, reading supports or textual manipulations serve as an
external model of the processes involved in reading comprehension. Such modeling is believed to benefit readers who are lacking in these internal, cognitive processes.

From a research perspective, the technological capabilities of the computer enable the researcher to record in an unobtrusive and consistent fashion the different on-task processing measures and observations for making intra- as well as inter-reader comparisons.

Research and Instructional Applications Involving Computer-Mediated Text and Computer-Mediated Reading Supports

In the early 1980s, some investigators have begun to consider how the attributes of the computer enable unique textual manipulations that may affect the comprehension of printed material. L'Allier (1980) used a computer program which automatically lowered the readability estimates of expository text ad revised passage structure on the basis of reading time and responses to comprehension probes. The comprehension of low-ability high school readers under this condition was equal to high-ability readers reading text which was not adapted. This study demonstrated how computer-mediated text can carry out online diagnoses that enable text to be adapted to the need of a particular reader. McConkie (1983) has reported positive results in using a computer program which provides a pronunciation of unfamiliar words
when they are touched on the computer screen. Nonliterate adults using this program were able to read and understand material above their estimated instructional reading level. Boyd et. al., (1984) used computerized learner-support systems to enhance student performance. Their findings show differential effects of reading supports. Steinberg et. al. (1985) found that memory support charts did facilitate performance.

Reinking and Schreiner (1985) used computer-mediated text to provide intermediate-grade readers with assistance when they experienced difficulty in comprehending short expository passages. Good and poor readers read expository texts under various conditions (definition of key vocabulary, paraphrase or less technical version of the content, supplemental background information or illustrations, and some representation of the content’s structure which separates the main idea and the supporting ideas). The results of their study indicated that computer-mediated reading text can influence reading comprehension and that comprehension was most consistently increased when manipulations of the text were under computer control.

Reinking and Rickman (1990) investigated whether intermediate-grade readers’ vocabulary learning and comprehension would be affected by displaying texts on a computer screen that provided the meanings of difficult word. Sixty sixth-grade subjects read two informational passages
containing several target words that had been identified as difficult. Subjects were assigned to four treatment conditions. In two of the conditions they read the passages on printed pages accompanied by either a standard dictionary or a glossary comprised of the target words. In the remaining two conditions they read the passages on a computer screen that provided either optional or mandatory assistance with the meanings of the target words. The results indicate that subjects who read passages with computer assistance scored significantly higher on a vocabulary test that measured subjects' knowledge of the target word. Subjects who read the passages on the computer screen with mandatory assistance also outperformed other subjects on a test measuring comprehension of the experimental passages. Moreover, subjects free to select which of the target words they would investigate chose to do so more often when the computer provided assistance. The authors concluded that these results support and help explain previous studies that have found increases in comprehension when computer-mediated texts have been used to expand or control readers' options for acquiring knowledge.

Reinking (1988) investigated claims that computer presentations that offer the reader access to additional information, or control the reader's processing of text, do facilitate comprehension. The study also investigated whether computer presentations of texts would affect readers' passage
preference, their estimation of their own learning, the time taken to read the text, and whether these factors in turn would contribute to comprehension differences. Thirty-three good and poor fifth and sixth grade readers read expository passages on a printed page and the three computer presentations that varied as to the availability of computer assistance, and whether the computer or the reader controlled their options for acquiring information. Results showed that reading time was longer for computer-mediated texts with options for assistance but after the effect of reading time was removed statistically, comprehension scores remained significantly higher for readers of the computer-mediated texts that offered computer assistance.

Using the computer to mediate reader activated glosses, Bohlm (1982) investigated the effects of a computer presentation that permitted college students to request information helpful to understanding the text they were reading. Bohlm found that subjects who had an option to use these "computer-aided glosses" recalled more idea units than did subjects who did not have this option. Rickman (1985) found improvements in intermediate-grade students' comprehension of passages for which the computer provided only definitions of difficult vocabulary words. Kunz, Schott and Hovekamp (1987) found that college students reading either printed texts or computer-mediated texts that provided assistance did not vary significantly in their comprehension
or overall reading time. However, those students reading the computer-mediated text spent significantly less time reading complex sentences and sentences more relevant to comprehending the text.

Fish & Feldman (1987) conducted two studies to investigate differences in reading informational and directional materials from print and microtext (text presented on a microcomputer screen). Thirty-six advanced doctoral students served as subjects in Study 1, and twenty-three masters students participated in Study 2. Results using analysis of covariance, with reading competence as the covariate, indicate no differences in comprehension for following directions. Near significant differences for informational material, favoring print, were found and are not attributable to reading speed. Reader characteristics, such as prior experience and interest in microcomputers, age, and self-efficacy ratings were not significant factors in performance.

Feldman and Fish (1991) investigated whether providing reading supports for high school students who read computer-mediated text would further their comprehension. Independent variables included subjects' reading achievement level, the difficulty of the text, passage order, and subjects' perceptions of the experimental task. Results showed that while most subjects in the reading support condition used them, reading supports did not improve subjects' reading
comprehension scores on easy or difficult reading passages. When the subjects were blocked as high or low readers, reading supports also showed no effects on comprehension scores. It was found that reading supports were used more on the high-difficulty than low-difficulty reading passages. Subjects' perceptions of the reading task showed that good readers understood the value of rereading for better comprehension and that poor readers were aware of the role of vocabulary and questions in making the comprehension task difficult.

As to the issue of learner vs. computer control, a number of studies suggest that students are often not good judges of the type and amount of instruction that they need to improve their learning. Gay (1986) reports that poor students tend to disregard review and mediation options when learner control conditions. Belland et al., (1985) found that students who need elaborate feedback were the least likely to opt for it. Finally, Reinking and Schreiner (1985) have reported increases in reading comprehension when manipulations of the text were under computer control.

Research on the Importance of Vocabulary Knowledge in Reading Comprehension

The importance of lexical acquisition is especially evident in reading. Indeed, vocabulary knowledge seems to be the most clearly identifiable subcomponent of the ability to
read (Chall & Stahl, 1985; Davis, 1944, 1968, 1972; Nation and Coady, 1988; Thorndike, 1973). Although the subject of great deal of research, the precise relationship between vocabulary knowledge and comprehension is not known (Anderson and Freebody, 1981). The strongest evidence that the knowledge of word meanings influences comprehension is correlational. Davis (1944) found in a factor analysis of nine comprehension tests that scores on subtests measuring vocabulary knowledge were strongly related to reading comprehension. Readability research also supports the link between vocabulary and comprehension since many of the formulae used to compute readability have a word-difficulty component (Klare, 1974, 1984). These findings suggest that comprehension will be enhanced if a reader understands the meaning of the words contained in a particular text.

Although this view has additional intuitive appeal, it has been difficult to verify in experimental studies. Direct instruction on the meanings of words found in a passage may not increase comprehension in that passage. Tuinman and Brady (1974), for example, had intermediate-grade readers read passages containing difficult words. Prior to reading the passages, subjects were given direct instruction on the meanings of the difficult words. Although instructed students scored better on a later test of word meanings, comprehension of the passage was not greater than non-instructed controls. Jackson and Dizney (1963) found similar results with high
school students as did Jenkins, Pany, and Schreck (1978) with disabled children.

Several studies, however, have found, that substituting higher frequency words for lower frequency word in a text significantly improves comprehension. In similar studies, Marks et al. (1974), Witrock et al. (1975), replaced 15 percent of lower frequency words in a passage with synonyms of higher frequency. In marks et al. study, intermediate-grade children showed significant improvement in comprehension when reading the passages containing the higher frequency words. Kamenui et al. (1982) and Reinking (1983) found that a procedure which stressed integration of a word's meaning into a passage improved comprehension more than substituting easier synonyms alone. The two studies suggest that comprehension as well as vocabulary knowledge may be increased via the reader's attempts to integrate word meaning into the context of what is being read. This finding is significant for the present study in that the computer also provides word meanings in the context of the passage. It is hypothesized that providing word meanings in context could enhance comprehension as well as increase the acquisition of word meaning although the latter issue will not be investigated or discussed in the present study.

Cumulatively, these studies suggest that comprehension may be enhanced by increasing word knowledge as long as word
meanings are integrated into the context in which the word is found.

In L2 contexts, Barnett (1986) undertook a study to answer the question of whether English speakers' ability to comprehend a French text depends more on vocabulary analysis than on syntactic analysis. She found that subjects' recall of the two texts increased according to the level of vocabulary and syntactic proficiency. Results showed that both sets of skills are necessary to English speakers' reading comprehension of French and that these skills interact with each other. Koda (1989) conducted a study to explore effects of transfer of L1 vocabulary knowledge on the acquisition of linguistic knowledge, verbal processing skills, and reading comprehension. Subjects were college students from diverse language backgrounds who were enrolled in a first-year Japanese program. Koda's study demonstrated, among other things, that L2 vocabulary knowledge was most highly correlated with reading comprehension and that vocabulary knowledge was the single most significant factor differentiating students with related L1 orthographic backgrounds from those with unrelated L1 orthographic backgrounds.

Background Knowledge in Reading Comprehension

The knowledge that readers bring to the text is paramount (Anderson et al., 1977; Rumelhart & Ortony, 1978;
Spiro, 1980). World knowledge—sometimes called content knowledge, domain knowledge, background knowledge, or reader’s schema—is defined as “organized knowledge that provides much of the basis for comprehending, learning, and remembering ideas in stories and texts” (Anderson, 1984, p. 243). What is typically called “world” or “prior knowledge” comes in many forms: (a) specific knowledge about the topic of the text; (b) general world knowledge about social relationships and causal structures; and (c) knowledge about the organization of the text (Resnick, 1983). Paris et al., (1983) add “declarative, procedural, and conditional knowledge,” all of which relate to knowledge that students need about strategies.

Prior knowledge has been shown to facilitate comprehension processes generally. Schema theory suggests an explanation for the facilitative effect of prior knowledge on text comprehension (e.g., Anderson & Pearson, 1984; Anderson and Pitchert, 1978; Anderson, Reynolds, Schallert, and Goetz, 1977; Bransford and Johnson, 1973; Fass and Schumacher, 1981; Voss, et al., 1979). Readers with high prior knowledge of the content domain have well-developed schemata, or knowledge structures, into which they assimilate the information from the text. That is, in the terms used by Voss, Vesonder, and Spilich (1980), information from the text is mapped onto the reader’s existing knowledge structures. Succinctly said, it is safe to argue with Dole et al., (1991) in noting that
"for better and for worse, knowledge plays a critical role in cognitively based views of reading" (p. 241).

Research from world knowledge, however, has been criticized for failing to explain how readers acquire such world knowledge (Bransford, 1984). More importantly, Dole, et al., (1991) argue that although readers' existing knowledge is crucial to comprehension, "the relationship between that knowledge and text comprehension is not a simple, orthogonal one" (p. 241). Sometimes, the knowledge is "inert" and therefore not brought to bear in the comprehension process (Bransford & Johnson, 1972; Whitehead, 1929). Other times the knowledge is incomplete, fragmented, naive, or even misleading (Lipson, 1982). And when readers possess knowledge that conflicts with the information encountered in text, readers' existing knowledge can and often does prevail over textual information (Alverman, et al., 1985; Anderson & Smith, 1987). Afflerbach (1990) notes that prior knowledge specifically facilitates a number of component reading processes that otherwise occupy the resources of the cognitive workbench (Baddaley and Hitch, 1974). Dole, et al., (1991) note that across all levels and ability, readers use their existing knowledge as a filter to interpret and construct meaning of a given text (Anderson & Pearson, 1984). They use this knowledge to determine importance (Afflerbach, 1986), to draw inference (Hansen, 1981; Hansen & Pearson, 1983), to elaborate text (Hansen & Pearson, 1983), and to

A reading support mediated by the computer in this study attempts to accommodate the differences between the knowledge required for comprehension of the text and reader's prior knowledge. Some of the evidence in L1 and L2 literature which supports such efforts is reviewed below.

Research on World Knowledge/L1

Kulikowich (1991) observes that readers' world knowledge has been investigated by researchers using three basic approaches. In the first approach, researchers have manipulated the knowledge variable but not the text. Some of these researchers have manipulated the reader's knowledge by either providing or not providing a background picture, title, or a perspective when they presented subjects with an ambiguous passage (Bransford and Johnson, 1972; Pichert and Anderson, 1977; Schallert, 1976). Other researchers have selected readers with different levels of knowledge about passage topics, based on differences in culture or differences in level of expertise (Chi, 1978; Chi et al., 1981; 1982). In each of these studies, the researchers focused on manipulating the reader variables while keeping the texts constant across readers' groups. All of these studies reported strong effects of knowledge on comprehension.
The often-cited experiments of Bransord and Johnson (1972, 1973) dramatically demonstrated the importance of invoking a schema to interpret textual information. In these experiments, a picture or short title was used to disambiguate cryptically written text. Subjects who were given the title or picture had no difficulty in understanding the text or agreeing in its meaning. The title or picture apparently activated knowledge which made the text comprehensible. In contrast, subjects who read the text without the title or picture had difficulty comprehending the text and offered a variety of explanations for its meaning.

A second approach to studying effects of readers' world knowledge on comprehension is the crossover design. In this approach, two groups of readers read two passages on two topics, each of which is familiar to one group but unfamiliar to the other (Anderson et al., 1977; Lipson, 1983; Steffenson et al., 1979). This type of design manipulates the reader and the passage simultaneously. These studies have also demonstrated strong effect of knowledge on reading comprehension. Anderson et al. (1977) used a passage which could be interpreted either as a card game or the practice of musical quartet. Physical education students were more likely to provide the former explanation and music students the latter.

A third approach is to the study of the effects of readers' world knowledge when it conflicts with information
presented in the text (Alverman et al., 1985; Anderson & Smith, 1984; Carey, 1986; Hynd & Alverman, 1986; among others). Alverman et al. (1985) suggest that when prior knowledge is activated that contradicts information in the text, readers may allow prior knowledge to override the text. On the other hand, Peck et al. (1982) suggest that text that specifically refutes possible misconceptions may result in better comprehension. In either event, world knowledge has strong effects on readers' construction of meaning from a text.

A new line of research tests how domain-related knowledge influences inference generation during text comprehension. In Fincher-Keifer (1992) three groups of subjects, each with differing degrees of domain knowledge, read a domain-related text that included both "global" and "local" inferences. Results showed that all knowledge groups processed sentences involved in local inferences similarly. However, knowledge differences emerged in the processing of the sentences involved in global inferences. Thus, the results of the experiment suggest that individuals with prior knowledge used their knowledge actively to generate global inferences during reading.

Afflerbach (1990) examined the influence of prior knowledge on the strategies used by expert readers to identify the main idea of the text when the main idea is not explicit. His subjects--expert readers from the fields of
anthropology and chemistry—read texts from familiar and unfamiliar content domains, and gave verbal reports of the strategies they used in constructing a statement of the main idea. Results indicated that readers reported automatically constructing the main idea statements significantly more often when they had prior knowledge of the content domain of the text, whereas when they lacked such prior knowledge. Alexander and Kulikiwich (1991) analyzed the role that domain knowledge, analogic reasoning, and interactive knowledge play in the comprehension of scientific exposition. Their sixth grade, high-school students and college undergraduate read expository passages on different topics with and without supporting analogy. Results showed that those who scored above the passage means possessed superior domain knowledge than the below-average groups.

Research on World Knowledge/L2

Second language (L2) studies have supported the importance of the role of background knowledge in reading comprehension (Carrell, 1983, 1984; Johnson, 1982; Steffensen et al., 1979). Bernhardt (1991) notes that a considerable portion of second language reading research has been devoted to knowledge-based or internal, reader-based factors which relate to the topic or the cultural implication of particular reading passage and particular second language reader. Bernhardt (1991) also observes that a considerable number of
recent studies have revealed the importance of background knowledge within the comprehension process in a second language. This finding, according to Bernhardt (1991) "is hardly surprising since a preponderance of first language studies have yielded parallel results" (p. 29).

Bernhardt (1991) divides L2 reading background knowledge studies into three categories: The first group of studies investigated the impact of "cultural background" knowledge in the reading comprehension process (Steffenson et al., 1979; Johnson, 1981; Campbell, 1981; Connor, 1984; Perkins & Angelis, 1985; Parry, 1987. The second set of studies examined the strength of "topic knowledge" or "topic familiarity" as a predictor of comprehension ability (Alderson and Urquhart, 1988; Johnson, 1982; Mohammad & Swales, 1984; Nunan, 1985; Zuck & Zuck, 1984). The third strand manipulated the "manner and type" of background knowledge that can be provided to the reader to enhance reading comprehension (Adams, 1982; Carrell, 1983; Hudson, 1982; Lee, 1986; Omaggio, 1979; and Roller and Matambo, 1992).

One of the earliest studies that investigated the effect of cultural background knowledge on comprehension is that of Steffenson et al., (1979). The researchers had their Indian and American adult subjects read two texts one of which was of U.S. content while the other was of Indian content. Using several independent variables—reading time, recall of
important and important information, and modification of text in recall, the researchers found that text corresponding with speakers' native background was read more quickly, was recalled better, and that the recalls of native passages contained appropriate elaborations.

A second study in the first group is that of Parry (1987). Parry's study investigated the importance of activating the appropriate schemata during reading. Parry's ESL subjects were asked to supply synonyms (definitions) of words in context and answer some comprehension questions. Results indicated that misinterpreted context led to the activation of incorrect schemata as evidenced by the incorrect word definitions provided by the subjects.

Alderson and Urquhart (1988) conducted two studies to investigate the facilitative effect of topic familiarity on reading comprehension of students from different academic backgrounds. Subjects read five texts in different areas of specialization. Results showed that subjects generally tested better on cloze tests and short-answer responses involving texts in their field and concluded that topic familiarity is a more accurate predictor of comprehension ability than overall linguistic proficiency. Mohammad and Swales' (1984) adult ESL learners and native speakers of English subjects who were of different proficiency levels and of different academic orientations were tested for speed of completion of a mechanical task. As in Alderson and Urquhart's (1988) study,
Mohammad and Swales found that field familiarity was a better predictor of comprehension than overall language proficiency. Carrell (1983), Lee (1986) and Roller and Matambo (1992) replicated, totally or partially Bransford and Johnson’s study. Carrell (1983) found that native (English) readers used context and transparency to improve their comprehension. Surprisingly, Carrell’s subjects recalled the unfamiliar text better than the familiar one. None of the background information factors influenced the high-intermediate L2 readers whereas the familiarity factor influenced their reading comprehension. Like their L1 counterparts, they recalled the unfamiliar Ballon Serenade better than the more familiar Washing Clothes. The explanation Carrell gave for her results is that nonnative readers failed to use background information because they were linguistically bound and suggested that there may be a threshold level of language proficiency that allows readers to engage in top-down processing.

Lee’s (1986) subjects were L1 English students studying Spanish (L2). In his study, subjects wrote their recalls in their native language (English). His results and those of Carrell’s differed substantially and he explained this by arguing that readers’ performance in Carrell’s study might be the result of inability of students to write what they recalled rather than their inability to recall what they read.
Roller and Motombo (1992) replicated Bransford and Johnson study to examine the familiarity effect using another population of subjects—Zimbabwean A-level students. Results indicated that the Zimbabwean bilingual subjects used context to improve comprehension on some passages. The researchers report an interaction between passages and provision of a context that is similar to an interaction found in Lee's (1986) study which was a partial replication of Carrell's (1983) study.

These studies clearly demonstrate that comprehension is to some degree impacted by the knowledge a reader brings to the text and how readily accessible that knowledge is. Bernhardt (1991) notes that despite a number of problematic areas within this set of studies, they “reveal a remarkable consistency in the impact of prior knowledge on the scores generated in the studies” (p. 35).

Research on Syntactic Knowledge and Reading Comprehension

On a very basic level, syntactic knowledge is believed to have an important facilitative effect on reading (Garnham, 1985; Perfetti, 1989, 1990; Rayner, 1990; Tannenhaus, 1988). In second language reading contexts and despite the paucity of studies, the role of syntactic knowledge in comprehension has also been supported both theoretically and empirically.
Bernhardt (1991) notes that relatively few second language reading studies have investigated the contribution of syntactic knowledge to reading comprehension. This lack of data, according to Bernhardt (1991) is surprising in light of the fact that second language classrooms "tend to expend a significant amount of time in the instruction and practice of syntactic structures" (p. 42), and secondly because instructional reading materials "are developed principally according to readability formulae that are clearly measures of syntactic complexity" (p. 42).

In her review, Bernhardt (1991) notes that research in the area of syntax is characterized by three strands of research. The first strand, characterized by Bean, Potter, and Clark (1980), and Robbins (1983) examined reference in text. Robbins (1983), for example, had her adult speakers of Spanish and English subjects do a referent task in an attempt to investigate their accuracy in the understanding of reference. Results indicated that there exists little correlation between readers' performance on the reference task (reference use in a passage) and their overall comprehension of the text. Robbins (1983) concluded that partial language proficiency does not constitute a hindrance to comprehension.
The second strand investigates syntax at the sentence level and beyond. Barnett’s (1986) and Guarino and Perkins (1986) studies point to the direction of differential impact on comprehension of increases in syntactic knowledge. Bhatia’s (1984) and Blau’s (1982) studies showed that simple text does not necessarily mean simple meaning. Their ESL subjects performed better on cloze and multiple choice tests that assessed their comprehension of unedited, syntactically complex texts. Bhatia’s (1984) and Blau’s (1982) findings are consonant with those found in LI literature (Pearson, 1975; Bormuth et. al., 1970).

Barnett’s (1986) study, alluded to earlier, investigated the effect of syntactic and vocabulary knowledge on reading comprehension as measured by multiple comprehension measures. Barnett’s 131 adult subjects studying French as a foreign language at the university level read texts of varying lexical and syntactic difficulty. Their performance of multiple choice and cloze tests as well as their recall scores indicated that comprehension increases in relation to vocabulary and syntactic knowledge and that these increases are differential in upper proficiency levels. Strother and Ulijn (1987) also investigated the effect of syntactic complexity on reading comprehension. Their subjects’--163 university students of different linguistic and academic backgrounds--reading comprehension was assessed using true/false comprehension questions. Results indicated that
vocabulary knowledge is more important than syntactic knowledge and that syntactic complexity does not affect comprehension significantly.

Reading Research in Arabic

A major characteristic that differentiates reading research in English from that in Arabic is that the substantial body of quantitative research that exists in the former helps form valid conclusions that feed into pedagogy in reading English. Reading instruction in Arabic, on the other hand, suffers from a lack of empirical data. The majority of scholarship in Arabic on reading comprehension in general, and reading processes in particular, is nonempirical in nature. Practitioners and specialists in the field of reading AFL depend on speculations about the role of different components of the reading process.

Recently, a small number of empirical studies have been carried out mainly in the field of word recognition (Khaldieh, 1990; Robertson 1990; Roman and Pavard, 1987). Before that, the dominant area of research in Arabic was a description of the phonology or grammar of Arabic (Abdo, 1969; Card, 1983; Erickson, 1965).

Using an eye-movement technique, Roman and Pavard (1987) conducted experiments on two Arabic texts one of which was vowelized and the other was not. Results of the study were compared with those in reading processes in French. Results
indicated that reading unwoveled texts impaired comprehension in addition to reducing reading speed. At the same time, the presence of vowels in a text significantly increased fixation durations.

More recently, Robertson (1990) investigated whether learners of Arabic as a foreign language (AFL) would benefit more by initial reading instruction either with texts that include vowel markings or with texts that are unwoveled. Robertson’s (1990) study was conducted with the purpose of examining the effects of two approaches utilized in initial reading instruction to effect word recognition, namely phonics and whole-word, in the teaching of AFL. His subjects were USAFA cadets who elected to study first-year Arabic. Robertson’s (1990) first experiment focused on the individual word. Results indicated that beginning AFL readers process a word more efficiently through its letter components rather than holistically, and that voweled words were apprehended more slowly than unwoveled words by the two experimental groups. Results also showed that voweled items (experiment 1) were pronounced more accurately than unwoveled words. In the second experiment, Robertson (1990) examined the effects of orthographic variation in textual processing. Results indicated that first semester AFL readers have yet “to formulate strategies to decode and Arabic text efficiently even in a “rich” environment of familiar lexical items and contexts” (p. 120).
Another word recognition study is that of Khaldieh (1990). Khaldieh investigated the type of encoding—visual versus phonological—employed by AFL readers and native readers of Arabic. The subjects in Khaldieh’s (1990) study consisted of two groups: nine native speakers of Arabic and 27 native speakers of English who had instruction in AFL. The results indicated that beginning and intermediate non-native readers made more visual errors than phonological errors while advanced non-native readers demonstrated the opposite, and that the latter group made less overall number of errors. These results were interpreted as suggesting that "non-native readers developed an awareness of the sound and orthographic system of the target language (Arabic) as their reading proficiency developed" (p. 84). Taken together, Khaldieh’s (1990) two experiments showed that non-native readers were more dependent on the visual than the phonological route in reading individual words in isolation. This was interpreted as a preference on non-native readers’ part to use visual processing route. However, on the sentence level, the dominance of phonological errors was interpreted as demonstration of a preference for phonological processing. Finally, and within the area of lexical access, Courrieu and Do (1985) used a lexical decision task to investigate the mode of analysis of lexical items and lexical decision time. Results indicated that both Arabic and French words are analyzed serially and pointed to the existence of perceptual
competition between Arabic words that differ by only one letter.

Summary of the Review of Literature

The major purpose of this review of literature has been to develop a rationale for the use of computer technology to affect reading comprehension. The review has examined theoretical and empirical evidence from a variety of discipline, including reading, media research, and educational and cognitive psychology. Several conclusions seem defendable based on this review.

The unique attributes of different media, in conjunction with methods that exploit such attributes, interact with and impact the ways learners represent and process information. Moreover, the research reviewed suggests that media attributes, learner characteristics, and cognitive skills affect learning differentially.

Generally speaking, CAI and the interactive processes it promotes, provide unique and diverse learning environments, stimulate a range of cognitive styles, and adapt to individual needs. In the field of reading instruction, computer-based technology might alter the contingencies of reading and learning from conventional texts.

The motivational function of CAI seems to be one of the major factors that impact learning.
Textual manipulations in the form of adjunct questions, advance organizers, and glosses designed to enhance processing have proven to be inconsistent and short-lived in terms of their effect. This is due to their inability to account for the complex interaction among readers, texts, and tasks.

Complex skills as the ones involved in reading comprehension (e.g., inferencing, comprehension monitoring, etc.) are probably best learned and/or enhanced under conditions in which the reader is given the opportunity to work in an expert's environment where he/she is provided with selected options for enhancing comprehension.

Three factors which could be mediated by the computer and which have some potential for enhancing reading comprehension are: vocabulary knowledge, (b) syntactic knowledge, and (c) background information/knowledge.

The data base in AFL reading is comprised of a handful of studies in word recognition and lexical access. Although these studies provide insights into visual vs. phonological encoding, lexical access in terms of the mode of analysis and lexical decision time, and the effect of voweled vs. unwoweled script, the data base remains very limited. Other studies of a different nature need to be done to formulate valid conclusions about the effect of media, computer-mediated text, and computer-mediated reading supports on reading comprehension and the reading behavior of beginning
nongative readers of Arabic. The present study is an attempt
to broaden this data base and is intended to serve as the
basis for further qualitative and quantitative studies in the
field of technology-based instruction.
CHAPTER III
DESIGN AND PROCEDURES

Population and Sample Selection

The population from which the sample was drawn consisted of second and third quarter (Arabic 102 and 103) students at The Ohio State University (OSU). The university requires students pursuing a Bachelor of Arts and Sciences degree to complete four quarters of a foreign language. Generally, approximately 60-80 students enroll in Arabic courses. Their ages range between 18-40 years. Almost 90% of these students are native speakers of English.

The sample consisted of students enrolled in Arabic 102.01/102.51 and Arabic 103.01/103.51 during the Fall quarter of 1992. Arabic 102 and 103 are the second and third courses in a five-course series offered at the Arabic Department. The 102/103 have invariably been labeled beginning. In the two courses, instruction in each of the four skills is emphasized.

All participants in the study were volunteers who were each compensated ten dollars ($10.00) for their participation. The subjects were recruited via information fliers in the Arabic classes and in the Arabic Individualized
Learning Center (see Appendix A). Arabic instructors were requested in writing to distribute the fliers in their classes (see Appendix B).

Research Design

The overall design for the present study was hybrid in nature, involving a quantitative analysis of the reading performance of beginning American learners of AFL during independent reading, and a qualitative analysis of their perception of the different features of the experimental task. In addition, and as measures of triangulation, the present study involved the qualitative analyses of subjects' recalls and of five think-aloud protocols. Data collected in the qualitative analyses were employed to supplement the experimental and the survey data used to examine the effects of media on learners' perceptions, their mental representation, and the constructive cognitive processes during independent reading.

Both inferential and descriptive statistics were employed to investigate the individual and collective contribution of reading supports to subjects' reading comprehension. A Graeco-Latin squares-type design was chosen for the present study. Latin square designs are factorial designs in which only a fraction of the potential treatment combinations is included in an experiment, providing some
useful information about additional independent variables, but not as much as one obtains from a completely balanced factorial experiment.

The Latin square design was used as a way of controlling the so-called nuisance factors. Any set of nuisance factors that a researcher feels should be controlled in this manner is a candidate for a Latin square arrangement. There are clear advantages to Latin square designs: an expansion of the number of variables manipulated with no increase in the number of subjects or groups, the increased generality of the results obtained under varied conditions of testing, and the possibility of increasing power through the control of sources of variability that are left unchecked in a standard experimental design. A problem associated with this sort of design, however, is the confounding of main effects by the presence of interactions between the different factors forming the Latin square. The Latin square design is not a complete factorial, but these interactions can still influence treatment means. Only in complete designs are things balanced to maintain orthogonality or independence between the different sources of systematic variability. What this means is that some amount of variability attributed to the main effects is contributed by interaction that may be present in the experimental situation (Keppel, 1982).
For Phase I of the study, the sets of recall scores were analyzed to determine whether there are any effects of the major independent variable (Treatment) on the dependent measure (Reading Comprehension Scores). The statistical program subjected the data to a four-way mixed effects ANOVA procedure that tested the following model. The model attempted to account for all the possible sources of variability in the subjects' dependent measure:

\[ Y_{ijklm} = \mu + \Omega_i + \delta_j + \epsilon_k + \Delta_l + \Sigma_{ijklm} \]

where \( Y_{ijklm} \) = the dependent measure, \( \mu \) = the overall mean, \( \Omega_i \) = the treatment effect, \( \delta_j \) = text effect, \( \epsilon_k \) = the order effect, \( \Delta_l \) = student as random effect, and \( \Sigma_{ijklm} \) = the random error variance.

Since treatment effect was significant, the Dunnett procedure was performed as a subsequent process to compare various means. The Dunnett procedure was used to perform a number of two-tailed t-tests, testing if any treatments are significantly different from a single control for all main effects means in the MEANS statement. In particular, the \( \mu \) of the control (CNTL) was compared with the \( \mu \) of TRT2, TRT3, and TRT4. In addition the General Linear Models (GLM) Procedure was used to calculate the Least Squares Means for the four treatments and the four texts.
In addition, and to check for the relative contribution of the different reading support, a number of pairwise comparisons was performed on the data using Tukey's Studentized Range (HSD) Test. In this procedure, the treatments were compared not only against the control, as the case was with the Dunnett Procedure, but also against each other, including the control condition. The level of significance for all the computations was set at 0.95.

Phase II of the study involved the qualitative analysis of subjects' responses on a sixteen-item Likert-type attitudinal survey. The Likert scale was employed to elicit subjects' perceptions of the different features of the experimental task. Before it was used in the actual study, the items in the survey were subjected to item analysis using Cronbach Coefficient Alpha (Internal Consistency Correlation). The analysis resulted in discarding 6 items from the original questionnaire that were found to have low internal consistency correlation indexes with the total.

Phase III of the study involved a qualitative analysis of students' recalls using Bernhardt's (1988) model of L2 text comprehension. This model was used because it emphasizes not so much the product but the process of comprehension.

In Phase IV of the study, Langer's (1986) Meaning Construction Analysis System was used to analyze subject's think aloud protocols. Again, this system was chosen because
it permits the identification of the knowledge and skills a reader calls upon during the reconstruction or interpretation of a particular text. From the on-line protocols, the system permits a look "through" what readers say in order to find underlying patterns in their reasoning, content knowledge, linguistic choices, strategic approaches, and the monitoring of what they do (Langer, 1986).

Several other descriptive statistical analyses were performed on the data that were collected simultaneously during the reading of the four experimental texts. A number of scatterplots and histograms were plotted to depict the relationships between overall time of the experiment and the number of times reading supports were consulted on one hand, and subjects' scores on the dependent measure, on the other.

Variables and Treatment Conditions

Variables

There were four independent variables in the quantitative analysis of the effects of reading supports on the dependent measure, reading comprehension. The major independent variable was treatment with four levels: (a) no access (text only), (b) access to Type I (glossary), (c) access to Types I and II (conjugations—past and present—of selected verbs in the passages), and (d) access to Types I,
II, and III (background information about the text). Each of these requests was employed in the present study to allow beginning American learners of AFL to interact overtly with the written text in ways which are normally available only during oral communication. Each of these requests has a counterpart when considering the comprehension of written text. Each is also a recognized contributing factor to comprehension in both L1 and L2 reading comprehension research.

Text, the second independent variable also had four levels representing the four different texts used in the experimental task. The third independent variable, order of presentation of text, had four levels. The fourth independent variable, subjects, was treated as a random selection variable and had 24 levels corresponding to the number of subjects. Text, order, and subjects were treated as blocking factors.

In order to determine what information subjects had understood about the texts, one quantitative variable—reading comprehension—was evaluated in Phase I of this study and was measured via the immediate recall protocols.

The dependent variable in Phase II of this study was subjects' responses on a 16-item attitudinal survey. This measure was analyzed qualitatively and was compared with subjects' performance on the reading comprehension task to
check for any non-causal relationship between the two dependent measures.

Treatment Conditions

The present study was designed to permit comparisons among three varying conditions of textual manipulation mediated by a computer (Appendix E). In addition, a fourth condition—text only—was used as a baseline or control condition. The baseline and the three treatment conditions varied as follows:

Condition 1: Subjects read microtexts (texts displayed on the computer). No textual manipulations were available.

Condition 2: Subjects read texts on line. One type of textual manipulations (glossary) was available.

Condition 3: Subjects read texts on line. Two textual manipulations were available (glossary and verb conjugation).

Condition 4: Subjects read texts on line. Three textual manipulations were available (glossary, verb conjugation, and background information).

Eight Graeco-Latin squares were developed for the present study. For a given square, the treatment was randomly assigned the treatment to the rows, texts to the columns, and students to the letters (Figure 3). The subscripts on the
letters give the order in which the student saw the
treatment/text combinations.

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</table>

**Figure 3. Graeco-Latin Square**

Student A reads text 1 with treatment 1 1st, text 4 with treatment 2 2nd, text 2 with treatment 3 3rd, and text 3 with treatment 4 4th.
Materials

Texts

To enhance the generalizability of the results and to control for text type as an intervening variable, four different text were used in the experimental task (Appendix C). They were chosen on the bases of length, topic, difficulty, and level appropriateness. The four experimental texts were adaptations of passages selected from *Elementary Modern Standard Arabic* edited by P. Abboud & E. McCarus (1983). This textbook is not being used for Arabic instruction at the Arabic Department at OSU. The texts were selected for the following reasons:

1. The texts were relatively short (120-150 words) so that reading comprehension could be measured by the recall protocol. The texts, however, could be read in isolation as intact entities.

2. The texts resembled the informative expository writing style and difficulty level of beginning AFL textbooks.

3. Content and topics of the passages were judged to be culturally accessible to all subjects yet not predictable enough to give meaning clues without reading.

4. The four passages were judged by a panel to be of comparable level of difficulty.
The first text was entitled "رسالة" [risala] (A Cover Letter). The second text was entitled "زيارة إلى الشرق الأوسط" [ziyara ilā asharq al-awsat] (A Trip to the Middle East). The third text was entitled "نهر النيل" [nahr annīl] (The Nile River). The last text was entitled "مراحل التعليم في العالم العربي" [maraḥl attaśālim fi al-akhālam al-ṣarabī] (Stages of Education in the Arab world) (see Appendix C).

The texts fit the limited space available on the computer screen except for two texts where one or two lines had to be accessed by the scrolling bar arrow. The titles were not provided. The text entitled [A Trip to the Middle east] describes a visit made to Jerusalem and the Holy Land by an American student studying Middle Eastern studies at Harvard University. The text, written in the first person narrative, details the student's trip and the sites he visited. The text entitled [The River Nile] talks about the Nile, where it originates from and empties into, and the cities along it. It also talks about the dams built on the Nile and the importance of the river to life in Egypt. The text entitled [Stages of education in the Arab world] describes the educational system in the Arab world, the responsibilities of the ministries of education in terms of the curriculum and assessment. It also talks about the different public and private higher education institutions in
the Middle East. The text entitled [A letter] is a cover letter sent by a doctoral candidate in TESL to the University of Kuwait's English Department. In the letter the Egyptian student talks about the fields of study he had covered and his experience as a teaching associate, and about his future plans.

In order to select the four final texts, three Arabic-speaking AFL instructors first read through 8 texts selected by the researcher and rated them according to difficulty, interest, length, and level appropriateness. Each factor was judged on a five-point scale with three being average for beginning AFL learners level. Because of the absence of any readability formula for analyzing the difficulty level of texts, instructors' judgment was used in selecting and adapting four texts.

Experimental Procedures

Data were collected individually from each subject using several Macintosh Classic and Plus microcomputers in the Arabic Individualized Learning Center located in Cunz Hall at The Ohio State University. The data collection session included reading four experimental microtexts, typing four recalls for the texts, and completing the Likert-type attitudinal survey. For five subjects, the data collection
session included taking part in a think-aloud procedure. The session lasted approximately two hours per subject (average of 90 minutes).

The experimental procedures are divided according to whether they occurred before, during, or after the actual reading of the text or the completion of the experimental task.

**Pre-Experiment**

When subjects arrived at the center, they were briefed on the purpose of the study and data collection procedures. They were told that their participation would help the experimenter learn more about reading. As far as procedures are concerned, they were told that they would read four short Arabic texts on the computer monitor, taking as much time as they needed to read the texts, and then type their individual recalls—in English—using the word processor. They were informed that their reading and recalling time would be recorded but that it would not affect their comprehension scores. They were also told to read each text for content and comprehension. A brief demonstration was carried out by the researcher.

The five subjects who voluntarily took part in the think-aloud procedure were individually briefed and trained. The training session lasted between 15-30 minutes and included a
sequence of direct explanations, coaching, and modeling. The subjects were instructed to "say out loud everything that comes to mind as you try to read and comprehend the text." The experimenter first provided an example and modeled thinking aloud. The subjects were then individually asked to think aloud about a short passage, and the experimenter provided feedback and in some cases more modeling. Subjects practiced thinking aloud on two more short passages. No additional practice was needed. During the actual experiment, the experimenter did not interfere with the procedure, i.e., no prompting was used.

Experiment

The actual experiment was conducted in the computer laboratory that houses the Arabic Individualized Learning Center, in Cunz Hall at The Ohio State University. Prior permission was sought and was granted from the Chairperson of the Department of Near Eastern, Judaic, and Hellenic Languages and Literatures (NJH) and the Coordinator of the Arabic Language Program. Data collection sessions for the experiment were conducted during the 1992 autumn quarter.

The basic procedure for all subjects was the same. Each subject began by reading the first of the four texts, taking as much time as desired. When finished, s/he clicked on the "Done" button. The text was then removed from the screen and
Instead, a blank screen appeared with one line of instructions in English asking subjects to type—in English—all they could remember from the text they had read. The same procedure was repeated for the other three texts. Subjects did not have the option to write their recalls by hand.

Subjects were monitored by the experimenter from a distance to insure smooth running of the experiment and to offer assistance when necessary. Assistance and intervention were occasionally needed in the initial stages of the experiment.

As subjects completed the program, the information stored both on the hard disk and the 3.5 diskettes (i.e., subject number, social security number, typed recalls, overall experiment time, reading time and recalling time for each text, the number of times each available reading support was used) was printed out.

**Post-Experiment**

Upon completing the recalls, subjects were asked to complete a 16-item Likert-type attitudinal survey to discern the relationship (not causal) between their performance and how they perceived the experimental task.
Data Collection and Instrumentation

The instrument used in assessing reading comprehension was the immediate recall protocol, a measure commonly used in L1 research. This measure was chosen because it is considered by many L2 reading experts as a direct reflection of what the reader has actually processed and understood about the text. According to Bernhardt & James (1987), the value of this measurement device lies in its ability "to determine the extent to which adequate and accurate comprehension is occurring" (p. 71). Johnston (1983) calls the recall protocol "the most straightforward assessment of the result of text-reader interaction" (p. 54), and Hayes (1989) considers it "cognitive psychology's most powerful tool for tracking psychological processes" (p. 69). Bernhardt (1991) concurs, pointing out that the recall reveals the integrated comprehension product of the student rather than features of the text selected by the teacher or researcher--factors seen in multiple-choice and true/false tests. In addition, the protocol also avoids other validity problems found in multiple-choice and true/false tests, such as being passage independent.

A weighted propositional scoring instrument was developed for each text according to the procedure described by Johnson (1970). The four texts were first divided into pausal units or breath groups. The researcher and three
Arabic-speaking AFL instructors divided the texts into acceptable pausal units, then ranked and equally divided the units from one to four, depending on their salience to the message of the text—"one" being with the least semantic significance and "four" being with the greatest semantic significance. Level "4" information, according to Bernhardt (1988) represents the thread of the discourse in a telegraphic style. (See Appendix D for Scoring Templates).

The raters' individual pausal units and the point value for those units were averaged to produce the final scoring instrument for each text. In conflicting instances, the shorter pausal units were selected for the scoring instruments, as recommended by Bernhardt (1988).

Recalls were written in English (subject’s first language) to avoid the confounding effects of a second language (Lee, 1986). Bernhardt (1986) also asserts that if the target language is used: (a) those who score the recalls may become distracted by the grammatical errors and focus less on the student’s actual comprehension; and (b) students will attend to grammar, vocabulary, and spelling in the target language and may not recall much information. Swaffer, Arens, and Byrnes (1991) note that writing the protocol in the students’ native language helps reveal "how the readers' logical manipulations— their predicting, organizing, and
inferencing about textual meaning--interact with their recognition of textual vocabulary and syntax" (p. 164).

The recall protocols were analyzed quantitatively using the Johnson System of weighted propositional analysis. This system was chosen over the Meyer System because it is easier to score yet correlates highly with the Meyer method (Bernhardt, 1991).

The researcher analyzed the protocols comparing them with the created scoring instruments and awarding points for each pausal unit recalled correctly. The sum of the weighted values of all of the propositions that were included in the protocol comprised the recall score. Subjects' scores on the recalls depended on the importance of the pausal units they remembered. A subject recalling many units with a value of "4", therefore, earned a higher recall score than a subject recalling primarily units with a value of "2". Following Murphy and Puff's (1982) recommendations, incorrect or inaccurate information did not count against the score. Furthermore, neither identity nor the experimental condition of the protocol's author was available to the rater.

The researcher scored all the recalls twice. Inter-rater reliability was established via Pearson product-moment correlation. In order to insure rater reliability, the experimenter spent two hours training two college-level Arabic instructors on how to use the propositional rating
scale and on how to score a protocol. Next, four protocols were randomly selected from the pilot study. The researcher and the two instructors (raters) scored separate photocopies of the four protocols. Person product-moment correlations between the researcher's scores and the two independent raters were \( r = .80 \) and \( .82 \) respectively. In an attempt to raise the level of inter-rater reliability, the researcher spent one more hour with the raters discussing the discrepancies between the propositions identified for each of the four protocols scored. Two additional recall protocols from the pilot study were selected and scored by all three raters. From this process, an inter-rater reliability coefficient of \( .90 \) and \( .92 \) was established. Since the correlations were strong, one scorer was considered sufficient to score the rest of the recalls.

**Student Attitudinal Survey**

The survey was conducted after the subjects had finished the computer task. It was constructed to elicit subjects' perceptions of and attitude toward three features of the experimental task. It was also intended to find out how subjects' perceptions about the task correlated with their performance on the dependent measure. No causal relationship between the two was posited.
The survey consisted of 16 statements to which subjects responded by completing a Likert scale (Appendix E). Readers' perception was investigated with regard to the following: Seven questions (1, 5, 6, 7, 9, 10, and 16) examined the perceived effects on text comprehension of the reading supports (Category I). Three more questions (2, 12, and 14) looked into procedures specific to reading from the microcomputer (Category II). The last six questions (3, 4, 8, 11, 13, 15) probed subjects' perceptions of the computer program and the reading supports in general (Category III).

The Likert method is based on the assumption that the overall score based on responses to the many items that seem to reflect the variable under consideration provides a reasonably good measure of the variable. These overall scores are not the final product of index construction; rather, they are used for purposes of an item analysis resulting in the selection of the best items. Essentially, each individual item is correlated with the large, composite measure. Items that correlate most with the composite measure are assumed to provide the best indicators of the variable, and only those items would be included in the index that was ultimately used for analysis of the variable.

Although not an experimental variable, the items in the Likert-scale in this study were subjected to the following procedures. First, prior to being utilized in the study, each
item was examined for the informal criteria required of Likert-style items as outlined by Edwards (1957, pp. 34–35). These criteria include avoiding the use of the following: past tense, universals (such as "only," "just," etc.), esoteric terms, complex statements, factual statements, double negatives, statements that are generally held as true by the public at large, and ambiguities. In order to control against an acquiescence response set (Triandis, 1972), approximately one half of the items were reversed from positive to negative wording.

Second, item analysis using Cronbach Alpha was conducted on the pilot study data to determine if each item discriminated adequately between overall favorable and overall unfavorable reactions. The twenty-one items in the original survey were subjected to correlational analyses to detect the items that did not correlate highly with the composite score. A series of analyses resulted in dumping six items. The final Cronbach coefficient Alpha for the raw and standardized variables was 0.768939 and 0.751003 respectively. (see Tables 1 and 2 for simple and Cronbach Coefficient Alpha).
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Simple Statistics For Likert-Scale Items

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</table>
Several Macintosh Classic and Plus microcomputers installed in the Arabic Individualized Learning Center in Cunz Hall on the campus of The Ohio State University were employed to run the programs which dispensed on-line treatments. The data collected for each subject was stored on computer diskettes and used for further analysis.

The reading texts and reading supports were programmed especially for the study. A diskette was prepared with the reading passages and the reading supports. Within each condition, the order of the four reading texts and the accompanying reading supports was varied based on the Graeco-Latin square procedure.

The computer program written for each text enabled a reader in the different reading conditions to request help in the form of reading supports when s/he experienced comprehension difficulty. The specific content of these textual manipulations was derived from the work of the researcher and the AFL-instructor panel. Each program enabled a reader to read the text on-line, select from among the available textual manipulations, and type his or her recall
on the computer screen. A significant feature of the program was that it was designed to allow a subject to type his/her recalls individually using the word processor and to simultaneously and unobtrusively collect and record the following data:

1. Overall experiment time for each subject;
2. Reading time for each text;
3. Recalling time for each protocol.
4. Number of selections made or reading supports consulted for each text.

The program used in this study was written in hypercard and was stored on double-sided, double density 3.5" diskettes. The researcher and the programmer worked collaboratively on the lay out of the screens and other issues relating to the design of the program.

Because it is difficult to completely describe the nuances of the textual manipulations and passage presentation mediated by the computer, a sample program of the on-line treatment conditions for a single passage is shown in its entirety in Appendix. A disk containing the programs used for all four texts in the on-line experiment is available from the author.
Textual Manipulations/Reading Supports

A panel of three college-level Arabic-speaking AFL instructors aided in the selection and preparation of the texts and the content for the three textual manipulations offered by the computer. The computer was programmed to offer the definition of difficult words used in the text. The vocabulary words selected were judged to be critical for comprehension in the four texts. Verb conjugation (past and present tenses) of selected verbs was also offered. Background information was offered in the form of relevant and useful information about the topic—provided in English—except for the "Nile River" text for which a map was provided. Split decisions by the panel members were decided by the experimenter. These supports were available during independent reading of the four computer-mediated texts. The supports were not available during the typing of the recall protocol.

Data Analysis

Data from the dependent variables were analyzed separately using the statistical procedures outlined in the Research Design section. The following null hypotheses were tested.
H₀₁: There will be no significant effect of access to computer-mediated reading supports on the reading comprehension of subjects as measured by the number of weighted propositions recalled.

H₀₂: There will be no significant difference among the three types/levels of treatment attributable to a particular type of reading support as measured by the number of weighted propositions recalled.

H₀₃: There will be no significant relationship between reading comprehension scores and readers' perception on the three categories of the reading task as measured by an 16-item Likert type attitudinal survey.

Pilot Study

In order to evaluate the feasibility and efficacy of the features of the proposed experimental procedures and materials, a pilot study was conducted with 8 subjects from the same population six weeks before the actual collection of the experimental data.

The pilot study was conducted to gain insights and understandings with regard to research questions, procedures, materials, lay out of computer screens, and also to debug the computer program. Specifically, the pilot was necessary to determine (a) if the materials were appropriate, (b) if
subjects would choose options on their own, (c) how much training in the use of the computer would be necessary, (d) whether subjects could understand and carry out directions, (e) to discover any errors in the computer program, (f) to estimate the amount of time the experiment would take.

In addition, the recall protocols generated from the pilot study were used to establish inter-rater reliability on the scoring of the recall protocol and to carry out internal consistency correlational analysis (Cronbach Alpha) on the items of the attitudinal Likert-type survey. Each subject in the sample of 8 students who voluntarily participated in the pilot study, was compensated ten ($10.00) for his/her time.

The results of the pilot study indicated that all of the materials were suitable for the experiment. The pilot study also revealed that the subjects clearly understood the written and verbal instructions given to them and that they were able to perform all of the experimental tasks adequately. After careful scrutiny of all the phases of the experiment, the researcher concluded that the procedures and the materials were generally acceptable. No adjustments in the materials or the experimental procedures were, therefore deemed necessary, except for some minor programming modifications.

Item analysis of the Likert scale items led to omitting of 6 items that had low internal consistency (Cronbach
coefficient Alpha). The final correlation coefficient for the raw and standardized variables were 0.768939 and 0.751003 respectively (see Tables 1 & 2 for detailed simple statistics and correlation analysis).
CHAPTER IV
ANALYSIS OF THE DATA

Introduction

Research evidence in both L1 and L2, although not consistent, suggests that presenting text electronically may increase comprehension (Anderson et al., 1974; Blohm, 1982; L'Allier, 1980; Reinking & Schreiner, 1985). Additional studies in L1 indicate that readers may benefit from providing them with textual manipulation mediated by the computer during independent reading (McConkie & Zola, 1988; Boyd, Douglas, & Lebel, 1985; Steinberg, Baskin, & Mathews, 1977; Reinking, 1987; Reinking and Schreiner, 1985). This hypothesis has not been extended to L2 contexts and no empirical evidence has been established.

The present study had three specific purposes: (a) to examine the effect on comprehension of computer-mediated reading supports in the L2 context. In particular, to determine if beginning AFL readers benefit from providing them with three self-controlled computer-mediated types of reading supports, (b) to determine which type of the reading supports, or a combination of them, is more conducive to
improvement in comprehension during independent reading of informative texts, and (c) to discern students' attitudes toward the different features of the experimental task and to find out whether or not there is any relationship between students' perceptions and their reading comprehension scores. This research also sought to provide general data about text processing behavior of beginning American readers of Arabic.

Results

Phase I of the Study

To assess the effect of three types of computer-mediated reading supports on the processing and reading comprehension of beginning readers of AFL, a Graeco-Latin square design was used for statistical analysis in Phase I of this study. The Graeco-Latin square design was chosen because of its potential for examining the main effects of the independent variables on the dependent measure. The major independent variable in this study, treatment, had four levels. Text, the second independent variable also had four levels and was treated as a blocking factor. The third independent variable, order of presentation of text, was also treated as a blocking variable with four levels. Subjects, the fourth independent variable, was treated as a random assignment blocking factor with 24 levels representing the number of subjects in the study (Table 3).
Table 3
Class Level Information for the Four Independent Variables

<table>
<thead>
<tr>
<th>Class</th>
<th>Levels</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT</td>
<td>4</td>
<td>CNTL TRT2 TRT3 TRT4</td>
</tr>
<tr>
<td>TXT</td>
<td>4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>ORDER</td>
<td>4</td>
<td>1 2 3 4</td>
</tr>
<tr>
<td>RSNUM</td>
<td>24</td>
<td>1 2 3 4 5 6 7 8 9 10 11 12 17 18 19 20 21 22 23 24 25 26 27 28</td>
</tr>
</tbody>
</table>

Number of observations in data set = 96

The only quantitative dependent variable measured in Phase I of this study was reading comprehension which was assessed through immediate written recall protocols performed by the subjects after reading the texts (Table 4).
A four-way (Treatment X Text X Order X Subject) mixed factor ANOVA was run for the dependent variable in Phase I of the study. The General Linear Model Procedure (GLM) was performed using SAS version 6.06 on IBM 3270. The statistical program subjected the data to an ANOVA procedure that tested the following model which attempted to account for all possible sources of variability in the subjects' dependent measure (see Table 5 for the ANOVA testing the entire model):

\[ Y_{ijklm} = \mu + \Omega_i + \beta_j + \partial_k + \Delta_l + \Sigma_{ijklm} \]

where \( Y_{ijklm} \) = the dependent measure, \( \mu \) = the overall mean, \( \Omega_i \) = the treatment effect, \( \beta_j \) = text effect, \( \partial_k \) = the order effect, \( \Delta_l \) = student as random effect, and \( \Sigma_{ijklm} \) = the random error variance.
Table 5
ANOVA to Test the Fit of the Entire Model

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td>32</td>
<td>31054.05573967</td>
<td>970.43924186</td>
<td>13.24</td>
<td>0.0001</td>
</tr>
<tr>
<td>Error</td>
<td>63</td>
<td>4619.35051033</td>
<td>73.32302397</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corrected Total</td>
<td>95</td>
<td>35673.40625000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

R-Square C.V.

The results of the ANOVA test for the dependent variable examined in Phase I of the study are reported in the following section.

ANOVA Results for Reading Comprehension Variable

The ANOVA for the dependent variable of reading comprehension as measured by the written recall protocol scores produced a significant effect for Treatment, Text, and Subject variables \((F(1,3)=15.47, \text{ Pr}>0.0001}; F(1,3)=5.91, \text{ Pr}>0.0013}; F(1,23)=15.16, \text{ Pr}>0.0001)\) as indicated in the ANOVA Table 6. The Order of presentation of text variable had
no significant main effect at the 0.05 level of significance
\( (F(1, 3)=2.73, \text{ Pr}>0.0511) \).

<table>
<thead>
<tr>
<th>Source</th>
<th>DF</th>
<th>Type III SS</th>
<th>Mean Square</th>
<th>F Value</th>
<th>Pr &gt; F</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT</td>
<td>3</td>
<td>3403.53752672</td>
<td>1134.51250891</td>
<td>15.47</td>
<td>0.0001</td>
</tr>
<tr>
<td>TXT</td>
<td>3</td>
<td>1299.53228037</td>
<td>433.17742679</td>
<td>5.91</td>
<td>0.0013</td>
</tr>
<tr>
<td>ORDER</td>
<td>3</td>
<td>601.00365634</td>
<td>200.33455211</td>
<td>2.73</td>
<td>0.0511</td>
</tr>
<tr>
<td>RSNUM</td>
<td>23</td>
<td>25573.15625000</td>
<td>1111.87635870</td>
<td>15.16</td>
<td>0.0001</td>
</tr>
</tbody>
</table>

It is not uncommon in Graeco-Latin square designs to find the blocking factors to be significant. The fact that the Text and Subjects variables revealed significant main effects should be interpreted in light of the nature of the design itself. In particular, the logic of the Latin square design is to include only a fraction of the treatment conditions in the experiment. The three blocking variables (Text, Order, & Subjects) were included in the design to adjust for the analysis and make sure that all subjects are treated on fair bases; i.e., to guarantee fair comparisons.
The results of the ANOVA for the dependent variable suggest that at least one level of the factor whose effect was measured (Treatment) is different from the rest.

To answer the question of whether there are any significant differences in comprehension scores between the no access/Control condition (Level I) and the access treatment conditions (Levels II, III, and IV), the significance of all possible differences between pairs of treatment means (pairwise comparisons) was evaluated. It was also of interest to determine whether each of the experimental groups showed a significant loss or gain relative to the control group. In order to calculate the critical control-experimental (C-E) difference, \( q_D \), which is an entry in the Table of the critical value of Dunnett Test for comparing treatment means with a control was obtained. This procedure was prompted by the need to be alert to positive as well as negative differences in the experiment.

The Dunnett procedure, which controls the type I experiment error for comparisons of all treatments against the control, was performed on the quantitative data from the recall protocol scores. Alpha was set at 0.05 (Confidence=0.95). Table 7 shows the results of the Dunnett's \( t \) tests for the score variable.
Table 7
Dunnett's T Tests for the Score Variable.

<table>
<thead>
<tr>
<th>TRT Comparison</th>
<th>Simultaneous Lower Confidence Limit</th>
<th>Difference Between Means</th>
<th>Simultaneous Upper Confidence Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT4 - CNTL</td>
<td>10.092</td>
<td>16.042</td>
<td>21.991 ***</td>
</tr>
<tr>
<td>TRT2 - CNTL</td>
<td>7.550</td>
<td>13.500</td>
<td>19.450 ***</td>
</tr>
<tr>
<td>TRT3 - CNTL</td>
<td>7.384</td>
<td>13.333</td>
<td>19.283 ***</td>
</tr>
</tbody>
</table>

Alpha= 0.05  Confidence= 0.95  df= 63  MSE= 73.32302
Critical Value of Dunnett's T= 2.407
Minimum Significant Difference= 5.9498

Comparisons significant at the 0.05 level are indicated by '***'

Hypothesis 1: There will be no significant effect of access to computer-mediated reading supports on the reading comprehension of subjects as measured by the number of weighted propositions recalled. Examination of Table 7 points to strong main effects for the treatment independent variable. Subjects who had the reading support available for inspection during independent reading scored higher on the recall measure than when not. This consistent pattern of the higher recall scores being achieved by the availability of computer-mediated reading supports conditions is demonstrated by the mean scores of the three treatment conditions (Table 4 repeated here as Table 8).
### Table 8
Simple Statistics for the Reading Comprehension Dependent Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std. Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>CTL (TRT I)</td>
<td>24</td>
<td>30.0000</td>
<td>19.4221</td>
<td>720.0</td>
<td>0</td>
<td>62.0000</td>
</tr>
<tr>
<td>TRT II</td>
<td>24</td>
<td>43.5000</td>
<td>21.4679</td>
<td>1044.0</td>
<td>8.0000</td>
<td>76.0000</td>
</tr>
<tr>
<td>TRT III</td>
<td>24</td>
<td>43.3333</td>
<td>17.0591</td>
<td>1040.0</td>
<td>19.0000</td>
<td>72.0000</td>
</tr>
<tr>
<td>TRT IV</td>
<td>24</td>
<td>46.0417</td>
<td>16.0393</td>
<td>1105.0</td>
<td>20.0000</td>
<td>74.0000</td>
</tr>
</tbody>
</table>

A review of the means for the different conditions (control vs. treatments II, III, and IV) (Table 8) reveals that all comparisons were significant at the 0.05 level. The largest difference ($\mu= 16.042$) was between the Control and Treatment IV means, the second largest ($\mu=13.500$) was between the Control and Treatment II, and the least difference ($\mu=13.333$) was between the Control condition and Treatment III. In all three pairwise comparisons, the critical value of Dunnett's $t$ was 2.407, and the minimum significant differences was 5.9498. Thus, the apparent differences in the recall scores for the three treatment conditions were confirmed by the Dunnett $t$ Test and led to the rejection of the null hypothesis of no difference between the means of the Control condition and the Treatment conditions. This finding
indicates that comprehension is enhanced when readers have access to three types of reading supports mediated by the computer and that reading supports are a significant contributing factor in the students' recall protocol scores.

To investigate the individual and collective contribution of the reading supports, Tukey's Studentized Range (HSD) Test for the score variable was performed. In all, 12 pairwise comparisons were performed, including three pairwise comparisons with the control. The Alpha for the 12 pairwise comparisons was set at $p > 0.05$ (confidence = 0.95). The critical value of Studentized Range was 3.732, and the minimum significant difference was 6.5232 (Table 9).
Table 9
Tukey's Studentized Range (HSD) Test for Score Variable

<table>
<thead>
<tr>
<th>TRT Comparison</th>
<th>Simultaneous Lower Confidence Limit</th>
<th>Difference Between Means</th>
<th>Simultaneous Upper Confidence Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT4 - TRT2</td>
<td>-3.982</td>
<td>2.542</td>
<td>9.065</td>
</tr>
<tr>
<td>TRT4 - TRT3</td>
<td>-3.815</td>
<td>2.708</td>
<td>9.232</td>
</tr>
<tr>
<td>TRT4 - CNTL</td>
<td>9.518</td>
<td>16.042</td>
<td>22.565 ***</td>
</tr>
<tr>
<td>TRT2 - TRT4</td>
<td>-9.065</td>
<td>-2.542</td>
<td>3.982</td>
</tr>
<tr>
<td>TRT2 - TRT3</td>
<td>-6.357</td>
<td>0.167</td>
<td>6.690</td>
</tr>
<tr>
<td>TRT2 - CNTL</td>
<td>6.977</td>
<td>13.500</td>
<td>20.023 ***</td>
</tr>
<tr>
<td>TRT3 - TRT4</td>
<td>-9.232</td>
<td>-2.708</td>
<td>3.815</td>
</tr>
<tr>
<td>TRT3 - TRT2</td>
<td>-6.690</td>
<td>-0.167</td>
<td>6.357</td>
</tr>
<tr>
<td>TRT3 - CNTL</td>
<td>6.810</td>
<td>13.333</td>
<td>19.857 ***</td>
</tr>
<tr>
<td>CNTL - TRT4</td>
<td>-22.565</td>
<td>-16.042</td>
<td>-9.518 ***</td>
</tr>
<tr>
<td>CNTL - TRT2</td>
<td>-20.023</td>
<td>-13.500</td>
<td>-6.977 ***</td>
</tr>
<tr>
<td>CNTL - TRT3</td>
<td>-19.857</td>
<td>-13.333</td>
<td>-6.810 ***</td>
</tr>
</tbody>
</table>

Alpha = 0.05  Confidence = 0.95  df = 63  MSE = 73.32302
Critical Value of Studentized Range = 3.732
Minimum Significant Difference = 6.5232

Comparisons significant at the 0.05 level are indicated by '***'.

Hypothesis 2: There will be no significant difference among the three levels of the treatment variable attributable to a particular treatment or combination of treatments as measured by the number of weighted propositions recalled. Table 11 shows the difference between the means for all the
comparisons as well as their lower and upper confidence limit. A review of Table 9 reveals that the only significant comparisons at $p < 0.05$ were those between the Control condition and the three treatment conditions. All the other pairwise comparisons—TRT4-TRT2 = 2.542, TRT4-TRT3 = 2.708, TRT2-TRT4 = 2.542, TRT2-TRT3 = 0.167, TRT3-TRT4 = 2.708, and TRT3-TRT2 = 0.167—were not significant. The null hypothesis of no difference was retained.

Two additional types of data collection were utilized during the course of the study. These measures included the results of an attitudinal Likert-scale questionnaire about the different features of the experimental task and data from simultaneous reading and recalling measures (overall experiment time, reading and recalling time for each text, number of reading supports consulted/accessed for each text). These data were conceived as additional, descriptive data that may prove useful in the design of further research in this area. In addition, they provide useful information concerning possible causes for the above experimental results. They are not to be construed as experimental results. Moreover, they cannot legitimately be used to predict results in replications using other experimental texts, samples, and languages.
Phase II
Results from Descriptive Data
Likert-Scale Measure on Subjects' Attitudes and Perceptions of their Computer-Assisted Reading Task

Student's attitudes toward reading on the computer have been studied in both L1 and L2 contexts. Most investigations indicate that those using the computer show greater interest in reading the text (Gambrell et al., 1985; Wepner et al., 1987; Wepner et al., 1989).

In this study, subjects responded to an attitudinal survey by completing a 16-item Likert-scale. This task, conducted after the subjects have finished the experimental task, was intended to discern the type of readers' attitude toward the different features of the experimental tasks. To avoid the pitfalls of previous studies in which all the features of the computer program and students' practice experiences were lumped and analyzed as one entity, this study was designed to investigate readers' perception with regard to the following categories that cover the different features of the experimental task: (a) the perceived effects on text comprehension of the reading supports, (b) subjects' perceptions of the computer program and the reading supports in general, and (c) procedures specific to reading from the microcomputer. The dependent variable in this phase of the
study was responses marked on the 16-item attitudinal survey.

Overall, the subjects demonstrated a positive attitude toward their computer reading experience. The means of the entire sample on the three-category, 16-item survey that tapped perceptions and attitude toward the different features of the experimental task were $\mu=20.5417$ out of a range of 5-30 for Likert Category I, $\mu=11.8333$ out of a range of 5-15 for Likert Category II, and $\mu=26.7917$ out of a range of 5-35 for Likert Category III (Table 10).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIKECAT1</td>
<td>24</td>
<td>20.5417</td>
<td>4.7272</td>
<td>493.0</td>
<td>11.0000</td>
<td>28.0000</td>
</tr>
<tr>
<td>LIKECAT2</td>
<td>24</td>
<td>11.8333</td>
<td>1.8337</td>
<td>284.0</td>
<td>8.0000</td>
<td>15.0000</td>
</tr>
<tr>
<td>LIKECAT3</td>
<td>24</td>
<td>26.7917</td>
<td>2.9337</td>
<td>643.0</td>
<td>21.0000</td>
<td>33.0000</td>
</tr>
</tbody>
</table>
Hypothesis 3: There will be no significant relationship between overall reading comprehension score and readers' perception on the three categories of the reading task as measured by a 16-item Likert-type attitudinal survey. Table 11 presents the mean and the standard deviation for the total recall protocol score (4 recalls).

Table 11
Simple Statistics for the Total Recall Score

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTSCORE</td>
<td>24</td>
<td>162.90</td>
<td>66.69</td>
<td>3909.0</td>
<td>62.00</td>
<td>270.00</td>
</tr>
</tbody>
</table>

A Pearson product-moment procedure produced 3 correlation coefficients of $r=-0.01591$, $r=0.25973$, and $r=0.13764$, $p>.05$, between comprehension scores and responses on the Likert scale categories I, II, and III, respectively (Table 12).
Table 12
Pearson Product-Moment Correlation between Total Score and Likert Categories

<table>
<thead>
<tr>
<th></th>
<th>LIKECAT1</th>
<th>LIKECAT2</th>
<th>LIKECAT3</th>
<th>TOTSCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>LIKECAT1</td>
<td>1.00000</td>
<td>0.11620</td>
<td>0.65432</td>
<td>-0.01591</td>
</tr>
<tr>
<td>LIKECAT2</td>
<td>0.11620</td>
<td>1.00000</td>
<td>0.34888</td>
<td>0.5087</td>
</tr>
<tr>
<td>LIKECAT3</td>
<td>0.65432</td>
<td>0.34888</td>
<td>1.00000</td>
<td>0.0</td>
</tr>
<tr>
<td>TOTSCORE</td>
<td>-0.01591</td>
<td>0.25973</td>
<td>0.13764</td>
<td>1.00000</td>
</tr>
</tbody>
</table>

A review of the scatter plots (Appendix I) also reveals a random pattern of relationship between the two dependent variables. No linear pattern is discernible which is consistent with the low positive and negative correlations obtained.

These findings suggest that there is no significant relationship between overall comprehension of beginning AFL readers and their perception of the experimental task. This led to the retention of the null hypothesis. The low insignificant correlation indicates that subjects' favorable responses to the 16-item survey accounts for a minute percentage of the variance in the subjects' overall
comprehension scores. The low degree of common variance between the two variables suggests that subjects' scores on the Likert-type survey are not good predictors of their overall comprehension.

Data from Simultaneous Reading and Recalling Measures

In all, four bits of information were collected by the computer program for each text read by each subject. This data collection was unobtrusive and simultaneous with the experimental task. These measures included:

1 **Overall Experiment Time**: The overall amount of time (in minutes) the subject spent reading and recalling the four experimental texts, consulting/accessing/reviewing the different reading supports provided by the computer.

2 **Reading Time**: The amount of time the subject spent reading each of the four experimental texts.

3 **Recall Time**: The amount of time the subject spent recalling and typing each of the four experimental texts.

4 **Number and Type of Reading Supports Accessed**: The number of times each subject accessed each of the reading supports provided for consultation.
Time on Task

Reading time is another factor that may affect comprehension of computer-mediated texts that provide aids for expanding or controlling readers' options for interacting with text.

The computer recorded the reading and recalling time for each text. Overall means and standard deviations for the total experiment time as well as the reading and recalling time by Treatment are presented in Tables 13, 14, 15.

Table 13
Simple Statistics for the Total Time Variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTTIME</td>
<td>24</td>
<td>90.667</td>
<td>16.921</td>
<td>2176.0</td>
<td>54.0000</td>
<td>119.0</td>
</tr>
</tbody>
</table>
Table 14
Simple Statistics for the Reading Time Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRTI</td>
<td>24</td>
<td>14.0416</td>
<td>4.0052</td>
<td>7.0000</td>
<td>21.0000</td>
</tr>
<tr>
<td>TRTII</td>
<td>24</td>
<td>16.7550</td>
<td>5.9362</td>
<td>5.0000</td>
<td>35.0000</td>
</tr>
<tr>
<td>TRTIII</td>
<td>24</td>
<td>15.0000</td>
<td>7.0402</td>
<td>3.0000</td>
<td>40.0000</td>
</tr>
<tr>
<td>TRT IV</td>
<td>24</td>
<td>18.1666</td>
<td>8.8792</td>
<td>8.0000</td>
<td>39.0000</td>
</tr>
<tr>
<td>Av.</td>
<td>96</td>
<td>15.9895</td>
<td>6.7862</td>
<td>3.0000</td>
<td>40.0000</td>
</tr>
</tbody>
</table>

Table 15
Simple Statistics for the Recall Time Variable

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRTI</td>
<td>24</td>
<td>7.0416</td>
<td>3.5932</td>
<td>2.0000</td>
<td>15.0000</td>
</tr>
<tr>
<td>TRTII</td>
<td>24</td>
<td>7.1666</td>
<td>4.8334</td>
<td>3.0000</td>
<td>28.0000</td>
</tr>
<tr>
<td>TRTIII</td>
<td>24</td>
<td>5.9583</td>
<td>2.5448</td>
<td>2.0000</td>
<td>15.0000</td>
</tr>
<tr>
<td>TRTIV</td>
<td>24</td>
<td>6.5416</td>
<td>2.2062</td>
<td>3.0000</td>
<td>13.0000</td>
</tr>
<tr>
<td>Av.</td>
<td>96</td>
<td>6.6770</td>
<td>3.4289</td>
<td>2.0000</td>
<td>28.0000</td>
</tr>
</tbody>
</table>
The overall (reading & recalling) mean experiment time was 90.6667 minutes. The standard deviation was 16.9210, and the minimum and maximum reading times were 54.00 and 119.00 minutes, respectively (Table 13).

The mean reading time and standard deviation for the Control condition (Treatment I) were 14.0416 and 4.0052, respectively. The mean reading time and standard deviation for Treatment II were 16.7500 and 5.9362, respectively. The mean reading time and standard deviation for Treatment III were 15.0000 and 7.0402, respectively. The mean score and standard deviation for Treatment IV were 18.1666 and 8.8792, respectively. The mean recalling time and standard deviation across the four treatment conditions were 15.9895 and 6.7862 (Table 14).

The mean recalling time and standard deviation for the Control condition (Treatment I) were 7.0414 and 3.5932, respectively. The mean recalling time and standard deviation for Treatment II were 7.1666 and 4.8334, respectively. The mean recalling time and standard deviation for Treatment III were 5.9583 and 2.5448, respectively. The mean recalling time and standard deviation for Treatment IV were 6.5416 and 2.2062, respectively. The mean recalling time and standard deviation across the four treatment conditions were 6.6776 and 3.4289, respectively (Table 15).
To investigate whether or not there are differences in reading time between the no access condition (Control) and access to reading supports conditions (Treatments II, III, & IV), several paired t tests were performed using Tukey's Studentized Range (HSD) Test procedure (Table 16).

Table 16
Tukey's Studentized Range (HSD) Test for Reading Time

<table>
<thead>
<tr>
<th>TRT Comparison</th>
<th>Simultaneous Lower Confidence Limit</th>
<th>Simultaneous Difference Between Means</th>
<th>Simultaneous Upper Confidence Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT4 - TRT2</td>
<td>-3.207</td>
<td>1.417</td>
<td>6.040</td>
</tr>
<tr>
<td>TRT4 - TRT3</td>
<td>-1.457</td>
<td>3.167</td>
<td>7.790</td>
</tr>
<tr>
<td>TRT4 - CNTL</td>
<td>-0.498</td>
<td>4.125</td>
<td>8.748</td>
</tr>
<tr>
<td>TRT2 - TRT4</td>
<td>-6.040</td>
<td>-1.417</td>
<td>3.207</td>
</tr>
<tr>
<td>TRT2 - TRT3</td>
<td>-2.873</td>
<td>1.750</td>
<td>6.373</td>
</tr>
<tr>
<td>TRT2 - CNTL</td>
<td>-1.915</td>
<td>2.708</td>
<td>7.332</td>
</tr>
<tr>
<td>TRT3 - TRT4</td>
<td>-7.790</td>
<td>-3.167</td>
<td>1.457</td>
</tr>
<tr>
<td>TRT3 - TRT2</td>
<td>-6.373</td>
<td>-1.750</td>
<td>2.873</td>
</tr>
<tr>
<td>TRT3 - CNTL</td>
<td>-3.665</td>
<td>0.958</td>
<td>5.582</td>
</tr>
<tr>
<td>CNTL - TRT4</td>
<td>-8.748</td>
<td>-4.125</td>
<td>0.498</td>
</tr>
<tr>
<td>CNTL - TRT2</td>
<td>-7.332</td>
<td>-2.708</td>
<td>1.915</td>
</tr>
<tr>
<td>CNTL - TRT3</td>
<td>-5.582</td>
<td>-0.958</td>
<td>3.665</td>
</tr>
</tbody>
</table>

Alpha= 0.05  Confidence= 0.95  df= 63  MSE= 36.83387
Critical Value of Studentized Range= 3.732
Minimum Significant Difference= 4.6234

Comparisons significant at the 0.05 level are indicated by '***'.
An examination of Table 16 reveals no statistically significant differences in reading time between the means of the Control condition and those of the three treatment conditions, the minimum significant difference being 4.6324. Moreover, the paired t tests did not detect any significant differences in the mean reading time between and among the three treatment conditions themselves.

Again, and to investigate whether or not there are differences in recalling time between the no access condition (Control) and access to reading supports conditions (Treatments II, III, & IV), several paired t tests were performed using Tukey's Studentized Range (HSD) Test procedure (Table 17).
Table 17
Tukey's Studentized Range (HSD) Test for Recall Time Variable

<table>
<thead>
<tr>
<th>TRT Comparison</th>
<th>Simultaneous Lower Confidence Limit</th>
<th>Difference Between Means</th>
<th>Simultaneous Upper Confidence Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>TRT2 - CNTL</td>
<td>-2.1033</td>
<td>0.1250</td>
<td>2.3533</td>
</tr>
<tr>
<td>TRT2 - TRT4</td>
<td>-1.6033</td>
<td>0.6250</td>
<td>2.8533</td>
</tr>
<tr>
<td>TRT2 - TRT3</td>
<td>-1.0200</td>
<td>1.2083</td>
<td>3.4366</td>
</tr>
<tr>
<td>CNTL - TRT2</td>
<td>-2.3533</td>
<td>-0.1250</td>
<td>2.1033</td>
</tr>
<tr>
<td>CNTL - TRT4</td>
<td>-1.7283</td>
<td>0.5000</td>
<td>2.7283</td>
</tr>
<tr>
<td>CNTL - TRT3</td>
<td>-1.1450</td>
<td>1.0833</td>
<td>3.3116</td>
</tr>
<tr>
<td>TRT4 - TRT2</td>
<td>-2.8533</td>
<td>-0.6250</td>
<td>1.6033</td>
</tr>
<tr>
<td>TRT4 - CNTL</td>
<td>-2.7283</td>
<td>-0.5000</td>
<td>1.7283</td>
</tr>
<tr>
<td>TRT4 - TRT3</td>
<td>-1.6450</td>
<td>0.5833</td>
<td>2.8116</td>
</tr>
<tr>
<td>TRT3 - TRT2</td>
<td>-3.4366</td>
<td>-1.2083</td>
<td>1.0200</td>
</tr>
<tr>
<td>TRT3 - CNTL</td>
<td>-3.3116</td>
<td>-1.0833</td>
<td>1.1450</td>
</tr>
<tr>
<td>TRT3 - TRT4</td>
<td>-2.8116</td>
<td>-0.5833</td>
<td>1.6450</td>
</tr>
</tbody>
</table>

Alpha = 0.05   Confidence = 0.95   df = 63    MSE = 8.555909
Critical Value of Studentized Range = 3.732
Minimum Significant Difference = 2.2283

Comparisons significant at the 0.05 level are indicated by '***'.

An inspection of Table 17 shows no statistically significant differences between the recall time means of the Control condition on the one hand, and the three treatment conditions, on the other. In fact, the means of recall time for treatment conditions III and IV (μ = 5.9583, μ = 6.5417) are smaller than that of the Control condition (μ = 7.0417) which translates into decreases of 2 and 7 percentage points. This finding is not surprising given the fact that reading time
was longer for the two treatment conditions under consideration. Recall time of Treatment 2 texts increased by about 2 percentage points. Moreover, no statistically significant differences were detected between and among the recall time means of the three treatment conditions themselves.

To investigate whether or not there are relationships between the overall experiment time, reading and recalling time across the four conditions on the one hand, and the recall scores, on the other, several Pearson product-moment correlation procedures were performed (Tables 19, 20, & 21).

As previously shown in Table 11 and Table 13 (combined here as Table 18), the means and standard deviations for the total score and the total time variables were \( \mu = 90.6667 \) minutes, \( \text{sd.} = 16.9210 \) and \( \mu = 162.9000 \), \( \text{sd.} = 66.6896 \), respectively.

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTTIME</td>
<td>24</td>
<td>90.6667</td>
<td>16.9210</td>
<td>2176.0</td>
<td>54.0000</td>
<td>119.0</td>
</tr>
<tr>
<td>TOTSCORE</td>
<td>24</td>
<td>162.9000</td>
<td>66.6896</td>
<td>3909.0</td>
<td>62.0000</td>
<td>270.0</td>
</tr>
</tbody>
</table>
A Pearson product-moment correlation procedure produced a correlation coefficient of $r=-0.0061$ (Table 19) between the two variables.

**Table 19**

Pearson Moment-Product Correlation between Total Time and Total score Variables

<table>
<thead>
<tr>
<th></th>
<th>TOTTIME</th>
<th>TOTSCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>TOTTIME</td>
<td>1.00000</td>
<td>-0.00601</td>
</tr>
<tr>
<td>0.0</td>
<td></td>
<td>0.9778</td>
</tr>
<tr>
<td>TOTSCORE</td>
<td>-0.00601</td>
<td>1.00000</td>
</tr>
<tr>
<td>0.9778</td>
<td></td>
<td>0.0</td>
</tr>
</tbody>
</table>

This finding suggests that total time readers spend reading and recalling the four texts is not a good predictor of their comprehension score.

As noted in Table 14, reading times for the subjects in the access to reading supports conditions ($\mu=16.7500$, $\mu=15.0000$, $\mu=18.1667$, for conditions 2, 3, & 4, respectively) were longer than the reading time for the no access (Control condition, $\mu=14.0417$). This may have been time spent comprehending the text, accessing the reading supports, or a combination of both. Because the access condition subjects also scored higher on the recall measure, the question becomes: can the increase in learning be attributable to the
increase in time? These data, when correlated with the mean recall scores produced low positive correlation coefficients (\( r = -0.12632 \) for Control (Treatment I), \( r = -0.40087 \) for Treatment II, \( r = 0.26759 \) for Treatment III, and \( r = 0.4396 \) for Treatment IV) that were not significant at the 0.05 level of significance, except for Treatment conditions II and IV that showed moderate negative correlation with the recall score (Table 20).
These findings suggest that, overall, reading time is not related to comprehension and that it is not a good predictor of recall scores.

To investigate whether or not there are relationships between recall time of a particular text and the comprehension score on that text, a number of Pearson product-moment correlation procedures (Table 21) produced correlations of $r=0.20372$, $r=-0.28409$, $r=0.24670$, and
r=0.44041 between recall time of text by treatment and reading comprehension scores. Except for a moderate negative correlation between the two variables in the Treatments II and IV, the other correlations were not significant at the 0.05 level of significance. These findings suggest that recall time accounts for an insignificant percentage of variance in the comprehension score and that it is not a good predictor of recall protocol scores.

Table 21
Pearson Product-Moment Correlation between Recall Time and Score

<table>
<thead>
<tr>
<th></th>
<th>RCLTIME I</th>
<th>RCLTIME II</th>
<th>RCLTIME III</th>
<th>RCLTIME IV</th>
<th>SCORE</th>
</tr>
</thead>
<tbody>
<tr>
<td>RCLTIME I</td>
<td>1.00000</td>
<td>0.00000</td>
<td>0.20372</td>
<td>0.3397</td>
<td></td>
</tr>
<tr>
<td>RCLTIME II</td>
<td>0.00000</td>
<td>1.00000</td>
<td>-0.28409</td>
<td>0.1785</td>
<td></td>
</tr>
<tr>
<td>RCLTIME III</td>
<td>0.00000</td>
<td>0.00000</td>
<td>1.00000</td>
<td>0.24670</td>
<td>0.2452</td>
</tr>
<tr>
<td>RCLTIME IV</td>
<td></td>
<td></td>
<td></td>
<td>1.00000</td>
<td>0.44041</td>
</tr>
<tr>
<td>SCORE</td>
<td>0.20372</td>
<td>-0.28409</td>
<td>0.24670</td>
<td>0.44041</td>
<td>1.00000</td>
</tr>
<tr>
<td></td>
<td>0.3397</td>
<td>0.1785</td>
<td>0.2452</td>
<td>0.0312</td>
<td>0.0</td>
</tr>
</tbody>
</table>
Frequency of Use of Reading Supports

To determine the extent to which subjects in the study selected reading supports and which, if any, of the supports was preferred, the computer recorded the number of requests for each support. The results were tabulated and are displayed in Tables 22, 23, & 24. Overall, readers requested a mean of 6.1677, 7.9167, and 8.2197 glossary reading supports in Treatments II, III, and IV, respectively. The means for conjugation supports selected were 1.00 for Treatment III, and 0.958 for Treatment IV. The subjects requested a mean of 1.167 background information supports in Treatment IV. These data reveal that subjects given the opportunity to do so, independently chose to select reading supports mediated by the computer and that across all three texts in which the supports were available, subjects chose the glossary support significantly more often than the other two supports.
Table 22
Simple Statistics for Score & Frequency of Use of Vocabulary in TRT II

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>24</td>
<td>6.1667</td>
<td>3.6076</td>
<td>148</td>
<td>0</td>
<td>13.0000</td>
</tr>
<tr>
<td>VOCCON</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VOCCONBK</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCORE</td>
<td>24</td>
<td>43.5000</td>
<td>21.4679</td>
<td>1044</td>
<td>8.0000</td>
<td>76.0000</td>
</tr>
</tbody>
</table>

Table 23
Simple Statistics for Score & Frequency of Use of Vocabulary & Verb Conjugation in TRT III

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>24</td>
<td>7.9167</td>
<td>4.3331</td>
<td>190</td>
<td>1.0000</td>
<td>21.0000</td>
</tr>
<tr>
<td>VOCCON</td>
<td>24</td>
<td>1.0000</td>
<td>0.9325</td>
<td>24.0000</td>
<td>0</td>
<td>3.0000</td>
</tr>
<tr>
<td>VOCCONBK</td>
<td>0</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SCORE</td>
<td>24</td>
<td>43.3333</td>
<td>17.0591</td>
<td>1040</td>
<td>19.0000</td>
<td>72.0000</td>
</tr>
</tbody>
</table>
Future researchers could use this information to test for effects by manipulating the treatments or text and observing the effects on subjects reading behavior as indicated by their selection of reading supports.

Another analysis investigated the possible relationship between the frequency of use of reading supports and reading comprehension. A Pearson product-moment procedure produced the correlation coefficients of $r=0.22400$, $r=0.20920$, and $r=0.14720$, $p<0.05$, between frequency of use of the glossary reading support and recall scores when used in Treatments II, III and IV, respectively (Table 25).

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>Std Dev</th>
<th>Sum</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>VOC</td>
<td>24</td>
<td>8.2917</td>
<td>5.6297</td>
<td>199.0</td>
<td>1.0000</td>
<td>30.0000</td>
</tr>
<tr>
<td>VOCCON</td>
<td>24</td>
<td>0.9583</td>
<td>0.9991</td>
<td>23.0</td>
<td>0</td>
<td>4.0000</td>
</tr>
<tr>
<td>VOCCONBK</td>
<td>24</td>
<td>1.1667</td>
<td>1.2394</td>
<td>28.0</td>
<td>0</td>
<td>5.0000</td>
</tr>
<tr>
<td>SCORE</td>
<td>24</td>
<td>46.0417</td>
<td>16.0393</td>
<td>1105.0</td>
<td>20.0000</td>
<td>74.0000</td>
</tr>
</tbody>
</table>
Table 25
Pearson Product-Moment Correlation Between Score and Frequency of Use of Vocabulary Support

<table>
<thead>
<tr>
<th></th>
<th>Score TRT II</th>
<th>Score TRT III</th>
<th>Score TRT IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>FREQ TRT II</td>
<td>0.22400</td>
<td>0.20920</td>
<td>0.14720</td>
</tr>
<tr>
<td></td>
<td>0.2927</td>
<td>0.3266</td>
<td>0.4925</td>
</tr>
</tbody>
</table>

This finding suggests that there is no significant relationship between frequency of use of the glossary support and reading comprehension scores. The low positive correlations in the three treatment conditions indicate that subjects' frequency of use of the support accounted, at the most, for 5% of the variance in their reading comprehension scores. This also suggests students' frequency of use of the glossary support is not a good predictor of their reading comprehension.

A Pearson Product-moment procedure produced the correlation coefficients of $r = -0.07926$ and $r = -0.22508$, $p > 0.05$ between the verb conjugation reading support and recall scores when used in Treatment III and IV (Table 26).
This finding revealed that there is no significant relationship between frequency of use of the verb conjugation support and reading comprehension scores. The low negative correlations in the two treatment conditions (III and IV) indicate that subjects' frequency of use of the conjugation support accounts for a negligible percentage of the variance in readers' reading comprehension scores. Evidently, the number of times the conjugation reading support is accessed or consulted is not a significant indicator of how well students are able to recall texts.

A Pearson Product-moment procedure produced the correlation coefficients of $r=0.17241$, $p>0.05$ between the background reading support and recall scores when used in Treatment IV (Table 27).
Table 27
Pearson Product-Moment Correlation Between Score and Frequency of Use of Background Information Support

<table>
<thead>
<tr>
<th>Score TRT IV</th>
<th>FREQ TRT IV</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.17241</td>
</tr>
<tr>
<td></td>
<td>0.4205</td>
</tr>
</tbody>
</table>

This finding suggests that there is no significant relationship between frequency of use of the background reading support and reading comprehension scores. The positive low correlation indicates that subjects' frequency of use of the background support accounts for a minute percentage of the variance in readers' reading comprehension scores. This suggests that students' frequency of use of the background support is not a good predictor of their reading comprehension.
PHASE III

Qualitative Analysis of the Recall: Rationale

Over the years, different quantitative scoring methods have been used to score the recall protocols (Brozovic, 1986; Johnson, 1970; Meyez, 1974; Wells, 1986). These methods, however, are not helpful in terms of indicating what parts of the text are particularly problematic for students. It is only through an analysis that is qualitative in nature that the teacher or researcher can begin to discover what is impairing students' comprehension processing and why. The information gleaned from such analyses may ultimately be of more pedagogical value, because it may suggest ways to modify and adjust instruction in order to promote better reading comprehension.

To arrive at this kind of deeper information, several alternative analysis procedures of a more qualitative nature have been suggested both in L1 and L2 contexts. The trade-off is that the objectivity obtained by the binary scoring system will be lost. At the same time, important and deeper insights into the processes and constructive activities involved in reading will be gained (Berkemeyer, 1989).

A useful tool for such analysis is Bernhardt's model of L2 text comprehension. The model elucidates the kinds of
errors students are making. As a qualitative model, it emphasizes the process of comprehension. In so doing, it reveals the "patterns of intrusions, distortions, and omissions which provide much valuable information for understanding the comprehension process" (Berkemeyer, 1988, p. 132). Unlike traditional scoring systems, Bernhardt's model focuses on the connected interactions between various textual features and influences external to the text.

In the following sections, analyses of 94 protocols written by 24 beginning AFL learners are given.

Analysis of the "Cover Letter" Text

An analysis of the recall protocols of 24 subjects using Bernhardt's qualitative model reveals that the "cover letter" text (see Appendix C) presented the students with some interesting comprehension problems. Despite its relative shortness, there was a wealth of information and detail in the text for the student to sort out. The following analysis of students' recalls illustrates how various text-based and extratext-based features interact to affect comprehension.

After classifying the comprehension problems according to Bernhardt's model, it would seem that syntactic features recognition problems account for a good deal in comprehension breakdowns. One of the most serious errors made by the students was interpreting the past tense verb "دَرْسَت" [darrastu] (I taught/gave a course) as "دِرْسَت" [darastu] (I
studied/took a course). The verb "دَرَسْتِ" [darrastu] is a Form II verb characterized by having a stem with a double middle radical indicated by the "ُ" (shaddah). The verb is derived from Form I verb and has causative meaning "to cause or make someone do the action" designated by the corresponding Form I verb, in the example being "دَرَسْتِ" [darrastu] (I studied). The fact that the two forms may be used in this particular context and the great phonemic/graphemic resemblance between them, have compounded the problem for several students. For example, Subjects 24 and 25 mistook "دَرَسْتِ" [darrastu] for "دَرَسْتِ" [darrastu] and so concluded "I took a course in American Literature" and "Last summer he took a course in literature" respectively, rather than "I gave/taught a course in contemporary American Literature." Likewise, subject 11 wrote "he has a teacher that is studying English as well," which is rather awkward in this context. It is not logical to assume that a professor teaching at the English Department of an American university is taking classes in English. This particular textual misinterpretation seems to have arisen from morphosyntactic as well as phonemic/graphemic recognition problems.

Less serious syntactic feature recognition problems involved the particle "ْنَ" [qad] (has/had/already) which, when used with the perfect tense, denotes completion of action. Subjects 27 and 7 misinterpreted the tense of the sentence as present or future rather than past and so deduced that "he
needs to finish his doctoral dissertation" and "I'm going for
my doctorate" rather than "I've completed my doctoral
dissertation." Probably, the students completely ignored the
particle "و" [qad] and this seemed to cause their mis-
interpretation. Other syntactic feature recognition problems
were fueled by misinterpretation of a simple noun-adjective
phrase construction in which a noun is modified by an
adjective. Subject 10, for example, turned around the syntax
and interpreted "OSU is a large and famous university in
Columbus in the USA" as "OSU is well known in Columbus and
all over the US." This student recognized the lexical items
but failed to formulate a coherent sentence due to linking
the modifier to the following prepositional phrase "in
Columbus and the USA" rather than the preceding noun
"جامعة ولاية أوهايو" [jaami'at wilaayat ohio] (OSU). In this
example, the student disregarded an important syntactic clue
to the effect that adjectives in Arabic, unlike their English
counterparts, follow the nouns they modify, instead of
preceding them. Likewise, Subject 23 linked the reference to
"The Ohio State University being large and well-known/famous"
with the reference to it "being in Columbus, U.S.A," and so
concluded that "OSU is famous in Columbus as well as in the
United States." Subject 23 misread the syntax and interpreted
"I've worked as an assistant for Professor Richards" as "he
will obtain his doctorate with the help of Professor
Richards." The student ignored several syntactic clues pointing to the tense of the verbs in the sentence.

In addition to syntactic features, phonemic/graphemic similarities also cause the students comprehension problems. For example, the close resemblance between "أرجو لكم" [arju lakum] (I wish you ...) and "أرسل لكم" [ursel lakum] (I send you ...) led subject 18 to interpret "I wish you and the U. of Kuwait all success in the coming academic year" as "I will send you news of my success next year." Likewise, Subject 2 mistook the same phrase for "أراك" [arakum] (see you) and wrote "I hope to see you in the English Department and U. of Kuwait next year." These students have probably focused on the look and sound of the phrase rather than on syntactic clues. Their interpretations, however, may be fine for this context. Subjects 1 and 8 also misrecognized "أرجو" [arju] and rendered it as "أرجع" [arja?] (go back/return) and so wrote "I plan to return to Kuwait .." and "he will go back to Kuwait and teach English" respectively. All the preceding examples are cases of phonemic/graphemic misrecognition. The close resemblance between the verbs "أكملت" [akmaltu] (I have completed) and "تكلم" [takalamtu] (I have spoken/talked to) led Subject 5 to conclude that "I talked to professor Richards about my dissertation," rather than "I've completed my dissertation." The subject made his/her recall of the
sentence conform to his/her initial interpretation of the verb.

Another major comprehension problem for the students came in the form of false intratextual perceptions. Several students initiated an interpretation of the text as a narrative and tended to adhere to that interpretation despite the several features of the letter (date, opening salutation, signature, etc.). Subject 21 for example, did not recognize the text as a letter and so wrote "In the passage, the narrator speaks of his life as a graduate student." Likewise, Subject 9 recognized some words in the text (letter, Arabic, English) and attempted to reconstruct the text based on his limited information, trying hard to make his interpretation conform to what he perceived simply as a "letter." The lack of vocabulary has, in the student's own words, impeded his/her understanding of the text. The student wrote: "Several words kept recurring whose meaning I didn't understand. I guess I need more vocabulary to understand it." Subject 11, on the other hand, recognized the genre of the text but perceived it as a personal letter to a friend and so prefaced his/her recall with "This is a letter from an Egyptian student to a friend." The subject then proceeded to tell how the writer of the letter studies hard, etc. The subject made the whole text conform to his initial perception. A less serious problem was caused by a false intratextual perception. The number "5" in the date of the letter "June 5,
1992" may have prompted Subject 6 to conclude that the writer
of the letter has been working "at this position since five
months."

Text-driven features, such as word recognition were the
cause of additional misperceptions about the different
features and elements in the letter. For example, "رئيس"
[rafiis] (chairman/chairperson of a department) was
interpreted by several Subjects (27, 12, 26, 24) in the same
sense as "president" which is a loose translation of "رئيس"
[rafiis] and one that doesn't fit this context. "بمش" [b3a], a
noun of quantity which is usually followed by a definite noun
in an *idafa* construction or by a pronoun suffix, was the
cause of some minor comprehension problems. The noun which
 corresponds to English "some" or "some of" appeared in more
than one context and was rendered as "a lot/a lot of" by
Subjects 11 and 26 who wrote "there was a lot of students
from the Arab world" and "his English teacher does a lot for
the foreign students at the university" for the original
textual information "....teaching foreign students some of
whom were from the the Arab world." Subject 7, likewise,
interpreted "بمش" [b3a] (some of) as "few" and concluded that
"few Arab students are studying ...). Subject 8 loosely
translated the verbal noun "حصل" [kusuli] derived from the
verb "حصل" [hasala] (obtained/got) in "I obtained/got my M.A.
in English" into "obtain/get a scholarship/ assistantship," and so concluded "I obtained a scholarship in the English
department." Possibly, the student was influenced by the verb's close association with obtaining or getting a scholarship or assistantship. Along the same line, Subject 3 interpreted "مَسِدَاذٍ [musaqidan] (assistant to) as "scholarship" and wrote "I obtained a scholarship." Likewise, subject 23 interpreted "مساذاة [musaqadea] (assistant) in "I was a TA for ..." as "مَسْاذاة [bimusaqadat] (with the help of) and concluded "I obtained my masters with the help of Professor ..." Subjects 21 and 8 both misinterpreted "أَرْجُ [arju] (I hope) in "I hope to get my degree/diploma in the coming academic year" as "I will finish my doctorate in one year." Subjects 28, 23, & 24 interpreted ".... and the mercy of god" in the opening salutation as "god be with you," "god is great," and "praise to god." Prior knowledge of greeting conventions in the Arab and Islamic worlds, coupled with misrecognition of vocabulary, probably prompted the students to render the salutation in that strange way. Subject 2 loosely translated "مشهورة [mashhûr] (famous) as "old (well established)" and wrote "OSU is an old (well-established) university ..." Subject 10 recognized "رسالة [risala] (letter) in "رسالة الدكتوراه [risalat adduktûrat] (dissertation) and literally translated it as such. Thus, s/he concluded "the student wrote his doctoral letter on ...." In actuality, doctoral dissertation is rendered in Arabic as "doctoral letter."
In attempting to reconstruct the letter, many students relied on metacognition, indicating that they were thinking about and reflecting on what they read. Students' recalls were replete with parenthetical comments, question marks, etc., possibly indicating their uncertainty about the text at hand. Moreover, and in their attempt to reconstruct the text, several students employed two important strategies, namely rendering the text in the letter format and using the first person narrative.

Several Subjects (7, 28, 1, 6, 18, 22, & 10), for example, maintained the original format of the letter as well as the first person narrative in their recalls. Subject 9 began his/her recall by saying "This is a letter from an Egyptian student to an official at the University of Egypt (I think)." The student showed awareness of the text genre and acknowledged the sender but seemed uncertain about the receiver's affiliation. The student, moreover, showed his/her uncertainty about the content of the letter as s/he wrote "I am not at all sure why he was writing this letter, because there were several words that kept recurring which I didn't understand." The student ended his/her recall by saying "My guess is that this person would like letters to be written from American students to Arab students." It is evident that the student began on the right track but couldn't sustain his/her interpretation. Clearly, metacognitive elements were operating simultaneously with student's intratextual
perception to impact comprehension. Subject 9 left two blanks, one after "My name," and one after "and I am a student . . ." to indicate s/he knew something was there but couldn't recall or understand it. Subject 28 wrote "I wrote my doctoral thesis on ?" to indicate that s/he remembered something about a doctoral thesis but couldn't remember the topic. Subject 7 transliterated the greeting "السلام عليكم ورحمة الله" (assalamu ʿalaykum wa-rahmatul lah) (may peace and the mercy of god be with you). The student recognized the sentence as an opening salutation but seemed unable to translate it. Subject 10 recalled the letter in the first person and wrote "I ? (took ? (took courses ?) to signify his/her uncertainty about the names of courses or perhaps to indicate inability to recognize them. Equally possible is the student's uncertainty about whether the person in the text has taken or taught courses. In the original text, the writer states that he has both taken and given courses. Subject 4 used a very effective strategy in summarizing the letter while acknowledging both the sender and the receiver. The student, however, failed to recall many of the details and scored low on the recall despite demonstrating complete comprehension of the content and the purpose of writing the letter. Likewise, Subject 17 gave an excellent summary of the letter but missed many details, resulting in a low recall score. Several students indicated that they were using metacognitive strategies to reconstruct the text by adding parenthetical
comments. Subject 10, for example, wrote "the student is relating how he came to study at the university (he received a scholarship (?))." In fact, the letter does not say anything to that effect. Perhaps the verb "حصلت" [hāsalatu] (I obtained), which is also used in connection with obtaining a scholarship/assistantship, prompted the student to make an assumption that s/he was unable to verify. The original text, however, includes references to the student getting a masters degree and also mentions his being a teaching assistant for Professor Richards. At the end of the opening salutation, Subject 3 wrote "(spelling of name?)" to indicate s/he was thinking about the name but couldn't quite remember the spelling. In fact the letter is addressed to the chairperson of the department whose name is not mentioned. Subject 5 used a question mark to indicate that s/he recognized "another subject/course" taken by the writer of the letter, but was unable to recall it and so wrote "...his classes being in modern American literature and something else (?)..." The same student also seemed uncertain about what was being conveyed in the closing salutation and thus wrote "he then wishes the department of English at KU success (?)". Subject 18, likewise, showed uncertainty about the addressee by placing a question mark between parentheses in "To the English Department at University of Kuwait (?)". Subject 25 acknowledged her/his inability to understand the text by prefacing her/his recall with "This letter was difficult for
me to understand. I was able to pick up that ...." and ending it with "After that, however, it was too difficult for me to continue." In between there wasn't much. The student recognized the format of the letter, identified some specific word meanings (Ohio State, English, literature, Middle East, students) but could not link them together syntactically, which appeared to be the cause of the problem.

Generally, prior knowledge didn't play a major role in the students' recall of the "cover letter" text. The only indications of the use of prior knowledge came in the form of elaborations, additions to, and substitutions of the original opening and closing salutations. One student for example, began and ended the letter with typical salutations (opening and closing) that were not used in the original text, probably prompted by his/her prior knowledge of the conventions of salutation in the Arab and Islamic worlds. Similarly, prior knowledge may have prompted Subject 24 to end the letter with "the faithful one" (sincerely) although no such salutation appeared in the original letter. Subject 10 recognized the text as a cover letter sent by a graduate student seeking employment and wrote "Might I ask what positions are currently available in the university." In actuality, nowhere in the original text was there any indication about such a request. Possibly, the student made the assumption based on the nature of the letter.
Analysis of the "A Trip To The Middle East" Text

With the "A Trip to the Middle East" text (Appendix C), the syntactic feature recognition problems were a major source of comprehension breakdowns. Those problems were compounded by some less serious word recognition and phonemic/graphemic feature problems. A lack of appropriate prior knowledge also accounted for some of the problems the students encountered. Those problems, however, seemed less serious than the ones encountered in the "cover letter" text.

Missinterpretation of some morphosyntactic features led some students to misunderstand some passages in the text. The complicated morphosyntactic features in "[istaqbalanI] إستقبلني" and "[axdanI] لاخذني" (My friend welcomed me/received me at the airport) and "He took me in his car" yielded several erroneous interpretations. Of particular difficulty was the subject-verb-object structure, realized in Arabic in one single word, thanks to the use of prefixes and suffixes. Subject 11, for example, interpreted "[istaqbalanI] إستقبلني" in "my friend Sami received me at the airport and took me in his car to..." as "I took my friend Sami...". Likewise, Subject 5 turned the syntax around and rendered the sentence as "...and I took my friend Sami..." rather than "...and he took me...".
in his car ..." The two students recognized the verbs but ignored or failed to recognize the pronominal suffix (me) affixed to the verbs.

Other less serious syntactic errors permeated the recall of several students. For example, the noun "كل" [kul] which most commonly occurs as the first term of an *idafa* "كل طالب/كل الطلاب" [kul ḥalib/kul alulāb] (all the students/every student) or with an attached pronoun suffix, was the cause of minor comprehension problems. Subject 10, for example, loosely interpreted "كل" [kul] in (and that every student studying Arabic and Islamic studies must visit the Middle East) as "all students in the class ..." which is fine in this context. The student, however, seemed to be unaware of the partitive meaning of "كل" [kul] (all/every/each) and how it relates to the following noun to form an *idafa* structure. In particular, "كل" [kul] can be followed by definite or indefinite nouns. If followed by indefinite, the noun is singular "كل طالب" [kul ḥalib] (every/each student).

When the noun is definite, it is followed by a plural noun (all/all of the, e.g., "كل الطلاب" [kul alulāb] (all/all of the students). Likewise, Subject 24 misinterpreted "كل" [kul] (every) in "Every student....should visit the Middle East" as "any" and concluded "...any student ... would want to visit the middle east." Likewise, Subject 21 translated "كل" [kul] (every) as "only" and loosely interpreted "Every evening I would go to....and have dinner and ..." as "he only ate at
night and drank ...." Apparently, Subjects 28 & 7 overlooked "لندنما" [qindamā] (when/at the time when) which led them to deduce "I have been a student at Harvard University" and "I was a student at Harvard..." rather than "when/at the time I was a student at Harvard University...."

Although syntactic features recognition was probably the most pervasive handicap for students, they also encountered difficulties in other areas. Phonemic/graphemic similarities between certain words, as well as word recognition in general, was an additional source of difficulty for some. For example, despite identifying it as a city, Subject 7 referred to "Damascus" as "السوق" [assūq] (the market) and interpreted "I visited some other cities in the Middle East such as Damascus..." as "I visited the market like the city of Damascus." Probably, the student misrecognized "الشرق" [asharq] (the east) in "I also visited several other cities in the Middle East such as ..., Damascus, and ..." and interpreted it as "السوق" [assūq] (the market) based on the close phonemic/graphemic similarity between the two words. An interesting case of phonemic/graphemic feature misrecognition was also displayed by Subject 26 who misrecognized "الطيار" [almaṣār] (airport) as "الطر" [almaṣār] (rain) and deduced "...meets his friend in the rain."The two words have the same spelling but the former is pronounced with the long vowel "ا:ə" [mataːr] while the latter is spelled and pronounced with
the short vowel "a" (diacritical marker in [matar]. This subject, who coincidentally, participated in the think aloud procedure, used a combination of prior knowledge and metacognitive strategies in his protocol. The student seemed to have assimilated some information in a preceding segment in the text, particularly that "the student made the trip in summer" and said "I thought he travelled during the summer break and I know it doesn't rain there in summer." The student, however, did not attempt to reconcile the discrepancy between her/his understanding and his/her perception. Another interesting case of phonemic/graphemic misrecognition was displayed in Subject 10's recall. The noun phrase "القهوة العربية" [alqahwa alFarabiyyah] (Arabic coffee) was translated as "الكحول العربي" [alkuljQl alFarabi] (Arabic alcohol) which led the student to conclude that "we ate dinner and drank Arabic alcohol." In actuality, there is nothing like "Arabic alcohol." Possibly, graphemic/phonemic similarity was the cause of this problem.

Word recognition problems were rather limited and did not seem to impede students' reconstruction of the text. Last summer break/vacation [tu(lat asayf almadi], for example, was interpreted as "next summer" by subject 17, as "next summer break" by Subject 7, as "last weekend " by Subject 24, and as "last summer" by Subject 28. Subjects 7 and 27 interpreted the statement "the Middle East is the cradle of the three religions of Islam, Christianity, and
Judaism" as "there are three religions in the Middle East," and "there are three religions in the area" respectively. "مهد" (Cradle) was loosely recalled as "home" by Subject 24 who wrote "the Middle East is the home of three religions." Also, the same subject misinterpreted the passive verb "ولد" (was born) as "preached" and so wrote "where Jesus Christ preached" rather than "where Jesus was born."

Intratextual perceptions of the text were determined by students' initial decisions concerning the content of the text. Some of those initial decisions seemed to come from students' prior knowledge and opinions about the topic or the content of the text. Others were caused by misreading the syntax of a structure or because of the lack of adequate vocabulary. For example, Subject 25 misinterpreted "كان" [kana] in "كان أستاذي يقل" (my professor used to say) as is/was—which is correct in a different context—which led him/her to deduce that "the teacher is from the Middle East and teaches religious studies" rather than "my professor used to say that the Middle East is the cradle of the three religions ...." Several students employed the important metacognitive strategy of recalling the text in the first person narrative. Others simply recognized the text as a narrative, but failed to reconstruct it as such. Subject 23, for example, began his/her recall by writing "When the narrator was a student at Harvard University...." Likewise,
Subject 5 prefaced his/her recall with "The text, written in first person ..." Subject 9 formed an initial interpretation of the text as being a narrative about "a student in school of Beirut with special interest in the Arab nations." To further his/her initial perception, the student ignored all syntactic and morphological clues pointing to first person and proceeded to write "She travels with friends through the Arab world," not mentioning anything about the religions or religious places at all. Likewise, Subject 28 somehow got the idea that more than one person was involved in the trip and so interpreted "[istaqbalanI fil majar šadīqī Samī] (he (my friend) received me/welcomed me) at the airport" as "he met us." This perception pervaded the rest of the recall as the student misrecognized the verb "الذهب" [ašhab] and rendered it as "ذهب" [našhab] (we would go).

Based on misrecognizing "اليهودية" [alyahûdiyyah] (Judaism) for phonemic/graphemic as well as word recognition reasons, Subject 21 made an initial perception about the religions of the Middle East. Probably, the student found difficulty deciphering the word "اليهودية" [alyahûdiyyah] (Judaism) and misread it as "(Yoohor du) which he reconstructed as "Hindu."

Later in the text, and to fit his/her initial and limited perception, the student wrote "they visited museums of works of Christians, Islam and Hindus" despite recognizing the fact that the student was visiting Jerusalem. Lack of prior
knowledge about the religions of the Middle East seems to have accentuated the student's misperception.

Metacognitive strategies were also employed by the students in the recall of this text. Most notable were subjects' use of ellipsis. Subject 25, for example, used ellipses after "this essay describes a student ..." to indicate that something about the student could not be recalled. Likewise, Subject 18 used ellipses after "my friend Sami took me to the Intercontinental Hotel on ..." The student seemed to know that the hotel is on a certain ... but couldn't recall or didn't recognize the name. Several subjects used question marks in different locations in their recalls to show uncertainty or ambiguity. Subject 28, for example, put a question mark after "I visited Jerusalem (the Middle East ?)" probably to indicate uncertainty about whether Jerusalem is located in the Middle East. Similarly, Subject 18 placed a question mark after "my professor taught the three religions (?) Judaism, Christianity, and Islam," probably to indicate that s/he was guessing the meaning of "الديانات الثلاثة" [addiyatan ašalašah] (the three religions) or probably to seek confirmation for his/her interpretation. Subject 18 used a question mark after "I visited many place representative of the religions in Jerusalem: churches, synagogues, (?)" probably, to demonstrate uncertainty about what holy places are representative of the religion of Islam, the third monotheistic religion mentioned in the text. It is
not clear why Subject 5 put a question mark in the sentence "students in this program (often ?) go to the Middle East." One possibility is that s/he was not sure of a particular word in the text--possibly "يجب" [yajib] (must/ought to--visit the Middle East)--and wanted to display his/her uncertainty by using the question mark. Subject 26 somehow made an initial perception that more than one person was in the airport to welcome him and wrote "my friend Sami and (someone else) came to pick me up at the airport (name ?)"
Probably, the student assumed that the name of the airport was given in the text but s/he couldn't recall it, or that s/he had realized that the name of the airport was not given in the text and s/he was questioning its deletion. In actuality, the name of the airport was not mentioned in the original text. Subject 28 misread "Harvard" and thus put a question mark in "When I was a student at the university of Haford (harford ?)" either to show uncertainty about the spelling or to indicate that he knew of no university with that name. Subject 10 wrote "I especially like the church in Bethlehem where Jesus Christ was born. It is very old, indeed." Student brought his/her viewpoint to the text. Finally, Subject 19 used a parenthetical comment in "besides visiting the .... mentioned above, he visited "other" ....(which I neglected to mention earlier)" to indicate that s/he had recognized more information in the text but had failed to mention it earlier. Surprisingly enough, the
student never mentioned what those "other" places were. Subject 27, likewise, seemed to recognize that a paragraph in the text talked about a church in Bethlehem but could not recall its name, probably for lack of prior knowledge or inability to translate its name into English. Therefore, s/he wrote "he visited a famous church in Bethlehem." Subject 20 placed "(Olive)" in "I stayed at the Intercontinental Hotel located on Mt."(Olive)" between brackets and inverted commas, probably to indicate surprise at the name of the mountain. Subject 7 recognized the word "مدينة" [madīnat] (city) in "مدينة القدس" [madīnat al-quds] (the city of Jerusalem) but seemed unable to tell what it referred to in English, so s/he transliterated it as "cads." The last two examples may also be construed as an indication of lack of prior knowledge. Subject 26 recognized "السيد المسيح" [assayed al-masih] (Jesus Christ) in a paragraph but could not tell what it said about him, so s/he wrote "he said something about the birth of Christ."

Prior knowledge seemed to play a less important role in students' ability to reconstruct the text at hand. However, the lack of prior knowledge accounted for some of the problems that the students encountered in their recalls. Most notable was students' lack of prior knowledge and facts about the religions of the Middle East, the names of famous religious sites and churches in Jerusalem and Bethlehem, etc. Subject 9, for example, seemed to be ignorant about the
location of the Church of Nativity, the site of Jesus' birth as s/he wrote "we went to see the nativity scene in Jerusalem." Likewise, subject 21's lack of prior knowledge was reflected in his/her recall where s/he wrote "he also studied Christianity, Islam, and I'm guessing Hindu." Citing "Hindu" as one of the religions of the region (Middle East) indicates lack of specific prior knowledge, given the fact that the student recognized that the text talks about the Middle East. Subject 19 also showed lack of basic cultural-historic prior knowledge relating to the site of Jesus' death as s/he wrote "and the student visited the place where Jesus died."

Two subjects, however, included in their recalls factual information that was not mentioned in the original text. Subject 4, for example, wrote "the Middle East is the cradle of the three monotheistic religions. "Monotheistic" is not in the original text. Subject 19 also included information about the location of Mt. Olives and wrote "the hotel is located in Jerusalem."

Analysis of the "The Nile River" Text

The text "The Nile River" (Appendix C) also presented students with some interesting comprehension problems. One of the major difficulties encountered by students with the text was caused by the phonemic/graphemic similarities between
words. Several problems, moreover, were sustained by misrecognition of key vocabulary items and false interpretation of the text. Prior knowledge was an asset for the majority of the students despite the fact that all elaborations, comments, and personal opinions, contributed little to the betterment of their recall scores.

In their attempt to interpret the text, the students faced an interesting array of comprehension problems caused by phonemic/graphemic recognition problems. The phonemic/graphemic resemblance between "جَدَأ" [jiddan] (very) in "Cairo is a very large city" and "جَدَدَة" [jadiddan] (new) led Subject 12 to deduce that "Cairo is a newer city which is huge" rather than "Cairo is a very large city." A more interesting instance of phonemic/graphemic misrecognition caused by the close similarity between "النيل" [annIl] (the Nile) and "الليل" [alayI] (the night) led Subject 21 to render "نهر النيل" [nahr annIl] (The Nile River) as "the Night River." Likewise, Subject 8 misrecognized "السودان" [as-su'dan] (The Sudan) as "السود" [aswad] (black) and deduced that "the Nile River passes through Egypt and the Black Sea" rather than "the Nile River passes through Sudan and Egypt." Mislead by the close resemblance between "قريب" [qarib] (close to/near) and "غرب" [gharb] (west), and coupled with misinterpreting "west" as "east," Subject 11 deduced that "the High Dam is located in the east of the city of Aswan" rather than "the High Dam is near the city of Aswan." The second step in this
analysis was clearly prompted by word misrecognition resulting in comprehension problems.

Not only the phonemic/graphemic errors, but also some of the vague vocabulary in the text complicated the students' recall task. The text included several ambiguous nouns and adjectives used to refer to the Nile, dams, and cities along it. The difficult vocabulary, however, did not impede students' overall comprehension of the text. Prior knowledge about Egypt and the Nile, helped several students overcome many of the potential comprehension problems.

The nouns "Tarus" [فارس] (bride) and "hiba" [hiba] (gift) were misinterpreted by several subjects. No student, however, misidentified the part of speech of those words, all of which were rightly interpreted as nouns. Subject 20, for example, interpreted "Tarus" [فارس] (bride) as "lady" and so wrote "Alexandria is the lady of the Mediterranean." Likewise, subject 1 interpreted "hiba" [hiba] (gift) as "Jewel" and rendered "Egypt is the gift of the Nile" as "Nile is the jewel of Egypt," clearly with some degree of syntactic misreading. The comparative form of the adjective "أكبر" [akbar] (larger/bigger) was interpreted by Subject 25 as "wider." Apparently, "أكبر" [akbar] (larger/bigger) was also interpreted as "taller" and "wider" by Subjects 21 and 10, respectively. Again, the subjects in the previous examples seemed to recognize the comparative form of the adjectives but missed their meanings. Subject 6 interpreted the
adjective "من짜" [hāmah] (important) as "small" [saghirah] and deduced that "there are many small ports and cities along the Nile." Likewise, Subject 21 misinterpreted the verb "يَنْبِع" [yanbu'ā] (originates from) as "empties" and wrote "the Nile River originates from the Mediterranean" rather than "The Nile River empties/flows into the Mediterranean." This mis-recognition was accentuated by the lack of prior knowledge not only about Egypt and the Nile per se, but also about the relationship between rivers and seas. Finally, Subject 28 misinterpreted "فَقَدْ نَاهَ" [qadlman] (long ago) as "the ancient one" and wrote "the ancient one Herodotous ..." Probably, the reference to the ancient historian "Horodotus" led the student to interpret "long ago" loosely.

Erroneous intratextual perception also accounted for some of the problems encountered by the students in their recalls. For example, Subject 25 built a perception of the text as being simply about the Nile, and thus prefaced his/her recall with "this article deals with the Nile." To further his/her perception, the student ignored all the talk about the dams or cities on the Nile. Consequently, the student attributed all the adjectives in the text to the Nile, e.g., "the Nile River is one of the oldest rivers in the world." Likewise, Subject 21 recognized "نَهر النِّيل" [nahr annīl] (River Nile) and perceived the text as being about rivers. As a result, the student interpreted Cairo, Alexandria, and Aswan as names of rivers rather than cities—which is very
strange given their importance and fame—and wrote "other rivers flow into the Nile, such as the Alexandria, the Cairo, the Aswan." Subject 26 began his/her recall by a summary statement "this is just a passage telling about the Mediterranean Sea" despite the fact that the text's topic sentence clearly indicated otherwise. Possibly, the student recognized the "the Mediterranean Sea" and deduced that as the topic. This perception seemed to pervade the first part of the student's recall. Subject 3 misread the syntax and wrote "It (The Nile) used to be called Alexandria in former times." Misled by his/her initial perception of the text, subject 3 tried to fit the interpretation to his/her initial perception. Likewise, Subject 2 misread the syntax which led her/him to make an erroneous link and deduced that "the Mediterranean is called the white sea by the people" rather than "Alexandria is named/ called the bride of the Mediterranean." This misinterpretation is probably a function of the student's prior knowledge. In Arabic, the Mediterranean is called the "white middle sea." It seems, however, that the student's prior knowledge has tricked him/her into this interpretation. Probably, Subject 11 misperceived what was being modified by the the adjectives "older" and "smaller" and deduced that "Alexandria is older and smaller" (said in comparison to Cairo which is large, as stated in the text). In actuality, the adjectives "smaller"
and "older" were used in the text to describe the dams on the Nile and not the city of Alexandria.

To a greater extent than in the other texts, students' knowledge of the topic substantially influenced text interpretation and rendered it less difficult. As a result, few comprehension problems surfaced in the majority of students' recalls. For example, prior knowledge of the route the Nile takes, probably, prompted Subject 17 to write "Along the Nile are located the cities of Khartoum, Aswan, Cairo, and Alexandria." The text only mentioned the cities of Aswan, Cairo, and Alexandria. Khartoum (the capital city of Sudan) is not explicitly in the text and only hinted at through reference to the fact that "The Nile passes through Sudan and Egypt." The same student, moreover, listed the cities in the order they are actually located along the Nile, beginning with Khartoum and ending at Alexandria. Prior knowledge also played a role in Subject 20's reconstruction of the text which prompted her/him to write "it (River Nile) flows northward through the Sudan and Egypt." The text just said that "The Nile River passes through Sudan and Egypt." Subject 2 embellished his/her recall with factual information that was not mentioned in the text. For example, s/he wrote that "the Mediterranean is called the white sea by the people" which is the actual Arabic rendition of the Mediterranean. In the same recall, the student added "the dam (Aswan/High dam) controls the flow of water from the Nile controlling the
yearly flooding of the river," which is true, but not stated in the text. Likewise, Subject 22 used prior knowledge when s/he wrote "the Blue Nile flows from Lake Victoria to the Mediterranean Sea where as the White Nile flows from Lake Tana in the highlands of Ethiopia to the Mediterranean Sea." In the same recall, Subject 22 added "Aswan Dam taps the water resources of the Nile in southern Egypt." The information included in the two statements is factual and reflected prior knowledge of the geography and topography of the area. Subjects 6 and 23 joined the others in expanding on the original text by including in their recall information about Egypt and the Nile that is not completely accurate. They wrote "the Nile begins in Lake Victoria, in southern Egypt, flows upwards ..." and "the Nile overflows its banks annually." However, lack of prior knowledge and perhaps word-recognition problems prompted subject 11 to deduce that "it (the dam) was built/designed by some Roman guy." The reference here is to the Greek Historian "Herodotous" who is quoted as saying "Egypt is the gift of the Nile." Subject 27 wrote in his/her recall that "Alexandria is known as the "bride of the Mediterranean because of its beauty." No reference in the text substantiates the student's claim. It is only by implication that it could be interpreted in that way. Subject 28 specified the location of the "Aswan Dam" in relation to Egypt as s/he wrote "the High Dam is near the city of Aswan in the west central part of Egypt." Even though
nowhere in the text was the location given, the student probably drew upon his/her prior knowledge.

In this text, the majority of students employed metacognitive strategies and techniques to sort out their perception of the text and to enhance their comprehension. Some students, however, could not sustain them and failed to recall some important details. In this text, as the case was with the previous ones, the students used several strategies effectively. However, one strategy noticeably lacking in the recalls, was the use of summary statements.

To indicate their uncertainty about their interpretations of text information, several students used question marks in their recalls. For example, Subject 28 was not sure what "Λα" [hiba] (gift) meant, so s/he showed her/his uncertainty by writing "hiba? gift? Jewel?" Later in the recall, the same subject indicated that s/he knew that something was said about the city of Alexandria but could not interpret it, possibly for lack of lexical knowledge. Therefore, s/he put three Xs between parentheses "Alexandria is located in the sea and (xxx) the Mediterranean." In the original text, Alexandria is described as "the bride of the Mediterranean Sea." Subject 5 placed a question mark between brackets after "Herotimus (sp?)" to indicate his/her uncertainty about the spelling of the name of the Greek historian "Herodotus."
Parenthetical comments were used frequently by the subjects to elaborate on text information, display prior knowledge, seek confirmation of an interpretation, or detach themselves from text information. In his/her recall, subject 24 made a parenthetical comment "the Nile River originates in Lake Victoria and flows northerly (which is rather strange for a river...not in text)" possibly to display his/her prior knowledge. Likewise, Subject 2 made the parenthetical comment "the Nile River ... passes through Cairo (Cairo is the oldest city in Egypt and is the Capital) and at Alexandria. Alexandria is an old city also," possibly, as a reflection of his/her prior knowledge. Subject 4 demonstrated her/his prior knowledge by making a parenthetical comment about the nationality of "Herodotus" as s/he wrote "by the way, Herudotos, (a Greek historian not Roman) described ..." Subject 12 left a blank space "it (the Nile) flows from ____ to the Mediterranean" to indicate inability to recognize or recall text information about its source. Likewise, Subject 11 used a blank space in "there is a big dam in the city of ____" to reflect her/his inability to remember or recognize the name of the city. Subject 26 left two blanks, one after "Egypt ....." and one after "of ..." probably to indicate that s/he knew something was said about Egypt at the end of the text but couldn't recall it or didn't understand it. The final sentence in the original text was Herodotus' quotation "Egypt is the gift of the Nile." Likewise, Subject
18 left a blank at the end of "there are many cities on the Nile. They include Cairo, Alexandria and ..." to show that s/he remembered something about a third city but could not recall it. Subject 18 seemed to recognize some vocabulary items in one paragraph but failed to recall the names of the dams that were being talked about, and wrote "there are other dams including the ... which is older..." Finally, Subject 17 typed the word "text" in capital letters "according to this TEXT Herodotous stated that ..." probably, to emphasize her/his disagreement with the quotation, to dissociate him/herself from the information, or to question the veracity of the quotation.

Analysis of the "Stages of Education in the Arab World" Text

With the "Stages of Education in the Arab World" text (Appendix C), the intratextual features recognition problems played a major role in comprehension breakdowns. In addition, some serious syntactic errors permeated students' recalls. The readers, however, seemed to have encountered less serious difficulties in their attempts to decipher and recognize lexical items.

A major comprehension problem for the students came in the form of false intratextual perceptions. Subject 4, for example, built a perception of the text as "an expository
piece about teacher education in the Arab world." As a result, the student included in her/his recall many references to teachers and teacher education that are general in nature. Perhaps, the student got the idea from the frequent references to teachers and schools in the text. This perception pervaded the rest of the student's recall, who tried hard to fit all of the information into a coherent whole but found it difficult to do so. The student, however, recognized most of the vocabulary which s/he tried to make fit his initial perception. Subject 26 had hard time getting the gist of the text. The student perceived the text as being about "a female teacher of some sort or a lecturer from the Arab world." The student picked up some words and tried to construct a coherent text based on his/her perceived interpretation of the text. It seems that the student was just fabricating something that fit his/her limited initial perception of the text. As a result, s/he recalled a few isolated facts but was not able to give any substantive information about the text. Likewise, subject 21 perceived the text to be about "a student who studies the languages of English and French and I think also Arabic." There was no information in the text to support this claim at all. In addition to his/her initial misperception, the student faced more comprehension problems due to his/her lack of vocabulary knowledge. The student admitted to this as s/he wrote "I'm not really sure what the paragraph was saying because I
didn't really understand some of the words. But I'm going to say that it was talking about the fact that Arabian food is not often served in the schools' restaurants. I think I would need to know more vocabulary to understand the passage."

There was no single reference in the text to food or school restaurants. Most probably, the student got the idea from interpreting "مطعم الدارس" [مَعْطَم الْدَّارِس] (the majority of school) as "مطعم الدارس" [مَعْطَم الْدَّارِس] (schools' restaurant) because of the close graphemic/phonemic resemblance between the two phrases. Subject 26 somehow thought the text was about some female teacher, and thus wrote "She (I don't know her name) seems to be a teacher of some sort or a lecturer from the Arab world." This misperception pervaded his/her interpretation of the whole text as s/he proceeded to say "She has something to do with high schools, elementary schools, and colleges. She is also studying law and works at the place she studies. She visited Europe and studied at the University of Beirut. She seems to be interested in foreign cultures. She is studying French and English. She visited the hotels in Europe."

Clearly, metacognitive forces were operating simultaneously with students' intratextual perceptions to impact comprehension. The student recognized a good deal of lexical items, but misperceived what the text was about and proceeded to build on his/her false perception. Unfortunately, s/he
faced great difficulty attempting to integrate the information in a coherent form.

Text-driven features, such as phonemic/graphemic, and syntactic feature recognition, also influenced students' recall abilities. Misinterpretation of both words and syntactic features led Subjects 27 and 11 to interpret "كل" [kul] (each/every) as "all" and to deduce that "the ministries of education in all the Arab countries ..." rather than "the ministry of education in every Arab country ...". The essence is similar, but students' recalls reflected the lack of awareness of or inability to detect major syntactic clues (see explanation in the analysis of "Trip to the Middle East" text). Subjects 26 and 1 turned around the syntax of "Arab universities graduate a large number of students" and rendered it as "Arab universities are large and take many students every year" and "the students at the university do something big every year" respectively.

The phonemic and graphemic similarities of words, as well as word recognition in general, was an additional source of difficulty for some students (Subjects 28, 22, 3). For example, the noun "الرياضيات" [arriyadiyyāt] (mathematics) was commonly misinterpreted on the basis of graphemic/phonemic similarity as "الرياضة" [arriyādah] (sports). Word recognition difficulties also appeared in the students' recalls. For example, the noun "وزارة" [wizārat] (ministry/department) was commonly misrecognized and loosely translated as "agency or
office of government," "the agencies," and "offices in the government" by Subjects 1, 6, & 12, respectively. Subject 7 interpreted "بَضْعَ" [baḍʿ] (some) as "few" and concluded that "few Arab students study in the department." Subject 10 loosely interpreted "Arab world" as "the Middle East." Likewise, subject 5 loosely reconstructed "مراحل" [marāḥil] (stages of education) as "kinds of schools. The adjective "الحديث" [alḥadīth] in "الأدب القديم والحديث" [al-adab al-qadīm wa-l-ḥadīth] (old and modern/contemporary literature) was mistaken by Subject 9 as "الحديث" [alḥadīth] (tradition) or (canonic/authoritative reports regarding prophet Mohammed). The same word serves both as an adjective (modern/contemporary) and a noun (tradition). The context is also misleading. Students at the grade school level as well as university level take classes in Islamic religion, "tradition" being one of the subjects covered. However, the fact that "الحديث" [alḥadīth] is used in the text to modify a noun renders it interpretable only as an adjective.

Students' recalls were also rich in metacognitive strategies. A common technique was the use of summary statements in the recall. For example, Subject 1 prefaced his/her recall by saying "This passage is about education systems in the Arab world," whereas Subject 5 suggested a title for the text "The education system in the Arab world." Other students used metacognitive techniques to express uncertainty or ambiguity, to comment on the information in
text, or to express personal opinions. For example, Subject 7 put a question mark at the end of "attend foreign universities in Europe or US or go to the American University of Beirut (AUB) or the American University of Cairo (AUC), or (?)" to indicate that s/he knew that there was another institution mentioned in the text that s/he couldn't recall or didn't recognize. Subject 27 admitted to his/her inability to recognize a word and wrote "they go to universities such as the AUB, AUC and another whose name I didn't recognize." Likewise, Subject 9 used metacognition in admitting that "...or some other places that I couldn't understand," the indication being that the student knew that there was something more about the text but was not able to determine exactly what it was, probably for lack of vocabulary or background knowledge. Likewise, Subject 28 used metacognition to indicate ambiguity when s/he transliterated a word, put it between parentheses, and followed it with a question mark "...as well as other subjects such as ..., (riyadi?)" The word in question is the school subject "mathematics." Similarly, Subject 26 used the same metacognitive strategy as s/he transliterated "aruba" (Europe) to show inability to recognize what the word referred to. Subject 26 also made a parenthetical comment "she (I don't know her name) seems to be ...." probably to indicate that the text was talking about someone whose name s/he didn't recall. In actuality, the text didn't talk about a particular person. The student, however,
made this initial perception identifying the person to be a female. Likewise, Subject 18 indicated that s/he knew of a name of another university mentioned in the text but could not recall or recognize it, and so left a blank at the end of "students attend schools and universities in Europe, America, and ... as well." In the text, several higher education institutions were mentioned.

Students' recalls were replete with information that was not in the original text but could be inferred by recourse to prior knowledge. Moreover, at least for the text at hand, students' recalls reflected no clear indication that students' prior knowledge had a facilitative effect on comprehension. Subject 2, for example, prefaced his/her recall with "The education system in the Arab world is approximately the same as in the US." Likewise, Subject 11 stated in his/her recall that "they (levels of education) are comparable to the American Model." These two examples also indicate the use of an important metacognitive technique, namely that of making summary statements. Subject 11's recall was rich in statements made on the basis of prior knowledge of the topic. For example s/he stated that "The Arab universities are very large and take many students." This is not explicitly mentioned in the text and only hinted at through such things as "Arab universities graduate a large number of students every year." Subject 20's prior knowledge may have prompted him/her to state that "in secondary as well
as the university it is mandatory to study a language, usually English or French." There is no evidence in the text to support this claim—the study of language being "mandatory"—although it was hinted at indirectly through such statements as "Students in schools and universities take languages such as English, French, and Arabic." Subject 7's belief that "many students get scholarship and financial assistance from their government or private businesses" may also be due to prior knowledge. Nowhere in the text is there direct or indirect support for this contention.

Summary

A review of several qualitative analyses of the recall protocol via Bernhardt's (1988) constructivist model of L2 text comprehension reveals that various text-driven and knowledge-driven elements interact with each other to develop an understanding.

The analyses of students' recalls also demonstrate that all factors are indispensable to the comprehension process. Syntactic features misinterpretations, phonemic/graphemic similarities, and misrecognition of certain words, cause students considerable comprehension problems. Yet, simultaneously, students employ various knowledge-driven strategies to promote the comprehension process.

The Arabic data generated in this study validate and expand the German language (Allen et al., 1988; Bernhardt and
Berkemeyer, 1988; Berkemeyer, 1989) and the Spanish language data (Beltran, et al., 1989). The readers in the Arabic language experiment, too, drew on various knowledge sources in order to understand in their second language. The analysis of data also reveals that although certain elements in the reading process seem to interact more vigorously at certain times than others, all of them contribute to the reader's evolving perception of texts.

In the "Cover letter" text as well as the "Trip to the Middle East" text, syntax proved problematic for a good number of subjects. Part of this may be attributed to the possibility that students relied more on microlevel textual features—word level interpretation—rather than attending to more macrolevel features like syntax. Most of those who experienced comprehension problems tended to ignore important syntactic clues, and instead, focused on the look and sound of the lexical items they recognized to build their interpretation of the text at hand. This phenomenon may, at least in part, account for the problems that learners had with the complex syntax of the "cover letter" text.

In the "Stages of Education in the Arab World" text, several subjects were highly influenced by their intratextual perception of the text and tended to adhere to that interpretation, even if it meant ignoring other important textual features. As a result, they attempted to make their
recalls conform to their initial and limited perception of the text.

In a more general way, students' recalls of the "Trip to the Middle East" text, revealed their uncertainty about text content due to the lack of or the inappropriate application of prior knowledge. However, unlike the German language data (Bernhardt, 1988), AFL readers' inappropriate application of nonspecific and vague background knowledge to the text did not severely distort their comprehension of the text.

In the "The Nile River" text, the students faced an interesting array of comprehension problems in trying to interpret the text. Major among them were phonemic/graphemic recognition problems. Moreover, and to a greater extent than in the "Cover Letter" and "Trip to the Middle East" texts, students' knowledge of the topic substantially influenced text interpretation. Students blended their prior knowledge with the actual content of the article to produce their recalls. In this text, the impact of knowledge proved to be a more significant factor in students' recall.

The recalls on all four texts were also rich in metacognitive strategies. Common techniques used by a good number of subjects included making summary statements and parenthetical comments, and using question marks. Students' use of question marks indicates that they have reflected on their interpretations and challenged their comprehension process. Moreover, the different examples in students' recalls
clearly illustrate how several factors in the constructivist model are activated simultaneously to promote the comprehension process.

Several subjects faced little or no difficulty in their attempts to reconstruct the different experimental texts. Their recalls were exemplary in the amount of detail that was remembered. The texts recalled closely resembled the format and organization of the original texts. Moreover, several readers have obviously perceived the texts the way the authors intended and have successfully used word recognition and syntax clues to interpret the texts accurately.
PHASE IV
ANALYSIS OF THINK-ALOUD PROTOCOLS

Introduction

Reading is a cognitive activity, a process of meaning-in-motion in which understandings are developed and changed throughout the process, reflecting an interaction between the textual and extratextual factor at work in the process.

When readers develop their ideas, they rely on various kinds of knowledge: knowledge about the content, genre, and structure and how these work together in the evolution of the conceptualization of an entire unit of discourse (Iser, 1975; Langer, 1986; Langer, et al., 1990). This approach to the use of knowledge grows out of the constructivist view that language comprehension involves active participation on the part of the reader (Bartlett, 1932; Bransford & Johnson, 1973; Spiro, 1980) and that the meaning that develops is the consequence of a wide range of textual, contextual, and attitudinal forces continually at play in the human mind. This view of language comprehension has been adopted by many contemporary linguists (Fillmore, 1982; Halliday, 1977; van Dijk, 1975) and psychologists (Minsky, 1975; Shank & Abelson, 1977; Anderson, 1977; Rumelhart & Ortony, 1977; Spiro, 1977).

Put differently, this approach to the use of knowledge is consonant with the proposition that meaning construction in reading is a function of the interrelationships among a
variety of complex sources, and leads to the contention that "the act of meaning construction cannot be described by a linear, or even a simply recursive model--interpretation and change are deeply interwoven every step of the way" (Langer, 1986, p. 74).

With respect to the construct of reading comprehension, it is known that "direct assessment of the...trait is impossible since it is a mental operation which is unobservable" (Gordon, 1987, p. 5). Using think-aloud protocols is a way of getting at the unobservable behavior of reading comprehension. Verbal protocols or think-aloud protocols have been used in many research studies as a method of getting at the mental processes that language learners use (Block, 1986; Cohen, 1987; Ericson & Simon, 1984; Langer, 1986; Sarig, 1987). A think-aloud protocol is produced when a reader verbalizes his or her thought processes while completing a given task.

Analysis of Meaning Construction

The purpose of this analysis was to explore the kinds of knowledge and strategies readers used when contemplating written texts to build their own consistent patterns of meaning and experience. In particular, this analysis investigated how foreign language readers' knowledge grew, where their ideas originated, and when and how their ideas were used.
The on-line protocols gathered for the present study, supplemented by the qualitative analysis of students' recall protocols, provide the most direct look at such processes. By their very nature, such analyses enable the researcher to look through what readers say in order to describe the underlying patterns of foreign language readers' behavior.

To permit the codification and analysis of subjects' on-line attempts to construct meaning when they read, a detailed system, adapted from Langer's (1986) Analysis of Meaning Construction was used. The system describes the knowledge sources, specific strategies, and general approaches readers use to develop their interpretation of the text. Each comment was categorized along two major dimensions: on the reasoning operations, and on the monitoring concerns that occur during the reading activity. An additional three analyses examined (1) the strategies used in meaning development, (2) the knowledge source used in making meaning, and (3) the time in the reading experience when that particular comment occurred.

The major categories examined in the Analysis of Meaning Construction are summarized in Figure 4).
Reasoning Operations
Questioning  Monitoring (awareness and use)
Hypothesizing  Task goals
Assuming  Task Subgoals
Using Schemata  Genre/Discourse
Making Metacommments  Structure
Citing Evidence  Mechanics
Validating  Lexicon

Strategies
Generating Ideas  Statements of Meaning
Formulating Ideas  Refinements of Meaning
Revising
Evaluating

Knowledge Source
Genre
Content
Text

Figure 4. Analysis Of Meaning Construction

The analyses were concerned with how readers make meaning, as this was revealed in their think-aloud comments about their behavior while reading.

Patterns of Reasoning Operations

One aspect of readers' strategic behavior investigated in this study, is the pattern of reasoning that is involved in meaning construction. During the process of independent
reading, readers ask questions, make assumptions about what they and others know, use information or ideas drawn from their general schematic knowledge, generate hypotheses, give evidence for and seek validation of their ideas. The following is a sample of the thoughtful reasoning behaviors involved in the construction of meaning in the four experimental texts used in this study. The categories as well as the explanation that follow each of the reasoning operations were adapted from the original system of meaning construction developed by Langer (1986). The examples cited reflect comments made by the subjects in this study (Figure 5). Readers' communication units—remarks and comments—(193 in all) were transcribed and tabulated (by the researcher and an assistant) into 13 major categories and subcategories (see Figure 5).
Questioning - uncertainties and incomplete ideas that the reader has at any point in reading—related to the genre, content, or text (no specified guess or expectation). "why is he telling the president about his teacher?" "What's it saying about the summer?"

Hypothesizing 1 Present - plans or expectations the reader makes about what information will be presented at that point in time."So, he is learning how to teach and he is writing to the president of U of Kuwait," "Perhaps this means taught, so he must have taught the Middle Eastern stuff."

(H) Hypothesizing 2 Future - plans the reader makes about what will be "said" in succeeding portions of the text. "I think he will go back to or travel to Jerusalem."

(H) Hypothesizing 3 Past - plans the reader makes about what might now be "said" or "understood" in preceding portions of the text. "May be it meant something like "speak, I speak."

(A) Assuming - meanings the reader assumes need no further explanations or elaborations. "Right, I thought it was about Egypt," "It doesn't seem to be an important thing," "There is nothing to think about."
(S) Using Schemata—the ideas being developed or explained based on genre, content, or text. "Oh, that's in upper Egypt," "that's similar to what we have in the states."

(SP) Using Schemata Personalized—personal experience drawn upon by the reader. "Ya, I've seen it, it's large," "I know that famous saying historically."

(SE) Using Schemata Evaluated—evaluations and judgments being made about what is being read. "It's the capital of Egypt, I know that," "He's visiting Jerusalem, that's pleasant."

(SL) Making Schematic Links—concept links being made by the reader. "He met me in the rain, that's strange. I thought it doesn't rain there in summer," "didn't he say he was Egyptian."

(MC) Making Metacommments Content—comments about the reader's use or non-use of particular content information. "that's not a clear letter," "Ah, there it is, I didn't read the whole sentence."

(MT) Making Metacommments Text—comment about the reader's use or non-use of particular surface features of the text itself. "This is difficult, I can't read it," "the English word is more difficult than the Arabic word."

(E) Citing Evidence—the information the reader presents, the explanations provided, or the evidence developed to
answer a question or carry out a hypothesis. "he's looking for a job," "such an industrious student, this guy."

Validating- information (implied or direct) that the plan was fulfilled or a decision made. "Oh, Herodotus, that's the Greek guy," "I see, that's how it works there."

Figure 5. Reasoning Operations in Reading

General Patterns

When foreign language learners read, the focus of their attention is almost equally divided between hypothesizing and using schemata, that together, make up more than half of their reasoning operations (Table 28). Other mental operations take place but in lesser frequency. Across the reading texts in the present study, 56 (29%) of readers' remarks (communication units) involved the direct use of hypothesizing--present hypothesizing accounting for 87% of their remarks within that category. 45 (23.6%) of subjects' comments involved using schemata. The remaining comments were split primarily among making metacomments 35 (18%), questioning 29 (15.2%). The reading protocols also showed less concern citing evidence in support of interpretations being formulated 6 (2.8%) and more with validating previous interpretations 22 (11.4%).
Table 28
Reasoning Operations

<table>
<thead>
<tr>
<th>Reasoning Operation</th>
<th>Number</th>
<th>% of Remarks/Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hypothesizing</td>
<td>56</td>
<td>(29%)</td>
</tr>
<tr>
<td>Using Schemata</td>
<td>45</td>
<td>(23.6%)</td>
</tr>
<tr>
<td>Metacommments</td>
<td>35</td>
<td>(18%)</td>
</tr>
<tr>
<td>Questioning</td>
<td>29</td>
<td>(15.2%)</td>
</tr>
<tr>
<td>Citing Evidence</td>
<td>6</td>
<td>(2.8%)</td>
</tr>
<tr>
<td>Validating</td>
<td>22</td>
<td>(11.4%)</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>193</strong></td>
<td>(100%)</td>
</tr>
</tbody>
</table>

Changes in Reasoning Over Time

Being both a dynamic and changing process, one would expect to find different patterns of behavior at different points during independent reading. In this analysis, the sequential coding of each comment in the protocols, permitted a closer look at how these processes change in the course of a single reading. Each protocol was divided into three segments: comments before the task began, comments during the reading activity, and comments after the last word was read.
BEFORE: Three of the five subjects who participated in the think aloud procedure in this study, began their reading tasks simply plunging in, without any preparatory hypothesizing about the passage, i.e., without any reasoning or mental operations. The other two subjects were more reflective, even before the reading task. Before reading, all four (3.7%) comments reflected hypothesizing about what the text would be about. No other reasoning operations were evident in the protocols.

DURING: Considerable consistency in the reasoning operations that occur from one segment to the next, with direct use of schemata and hypothesizing dominating. Questioning operations reflecting uncertainties and incomplete ideas that the reader has at any point in reading were also used more during the early stages of reading and became scarce toward the end.

AFTER: After they had completed reading a text, all subjects engaged in the mental activity of validating or reaffirming the accuracy of information in the text (75%). In addition, two subjects made comments reflecting their focus on their own experience (using schemata personalized).

Monitoring Behaviors in Reading

The process of reading involves a variety of self-regulatory mechanisms which monitor meaning construction. Langer (1986) argues that "monitoring behaviors serve as a "third eye" to see that meanings make sense and to flag
problems when messages become confused" (p. 83).

Comprehension monitoring, employed by the readers in the process, serve a dual purpose. Firstly, when necessary, they help readers become aware of the cognitive activities involved in the process, and secondly, such mental activities help in the development, refinement, and organization of readers' ideas. It is thus safe to argue that the ability to monitor one's comprehension, the ability to detect comprehension breakdowns, and consequently utilize appropriate fix-up strategies, are important aspects of every reading experience.

Monitoring strategies were examined in terms of different concerns of the reader: These categories, with examples of their use, are illustrated in Figure 6.
I- Awareness of Own approaches:

a) aware of task goals/demands. "I'll read it again," "So, let's just review," It's the vocabulary that I basically need, I got the conjugation down."

b) Aware of subgoals: I don't know how to get to this word's meaning."

c) Aware of genre/discourse: "that's someone talking about the Nile," "now we go to the letter which is written in a month which I don't know," "peace be with you, that's a greeting. Let's see, this is a letter."

d) Aware of grammatical routines and mechanical features: "this must be the past tense of something," "So, that's whatever that called, tense, ah, it is called "passive," "I don't know what to do with this sentence."

e) Aware of available or unavailable lexical repertoire: "I didn't know what that word means," "it's a term like "while" or something," "I don't understand this, anyway."

f) aware of statements of meaning: I don't know what to do with this paragraph."

g) aware of refinements of meaning:"It's the capital of Egypt, I know that," "Ah, got that one," "ya, it's the Middle East, Jerusalem is in the Middle East."
II- Uses self-regulating mechanisms
a) formulates task/topic goals: "I'll try to translate this."

b) formulates subgoals: "Ok, I'm confused. Let's go to some
background information," "I don't know some words here, I'll
look up the vocabulary."

c) uses genre/discourse features: No examples.

d) uses grammatical routines or mechanical features: No
examples.

e) makes lexical choices: No examples.

f) states meaning: "he wants to visit Jerusalem," "so he's
decided to take the trip."

g) refines meaning: "oh, hold on, may be there are two dams."
"I don't get it quite well, I'll keep reading."

Figure 6. Monitoring Behaviors in Reading

GENERAL PATTERNS

By the nature of the protocol data gathered, all of the
comments recorded represent some degree of self-awareness or
monitoring of what one is doing while reading. Generally
speaking, foreign language readers' comments reflecting
awareness of one or another idea or strategy exceeded those
reflecting use by about sixfold (85% to 15%). In the former,
the reader is more consciously aware of the choices
available to choose among these alternatives in a strategic
Strategies Used in Reading

In the process of meaning development, foreign language readers, like all other readers, use a variety of broad strategies. Strategies are deliberate, cognitive actions that can be accessed for a conscious report (Paris, Lipson, & Wixson, 1983). Most researchers argue that the strategies and the phases or stages of their use, are interrelated and recursive rather than representing a linear sequence (Flower & Hayes, 1980; Spiro, 1980). Four broad strategies were identified in the protocols of the present study (Figure 7)
1 (G) generating ideas—becoming aware of relevant ideas and experience.
2 (RF) Formulating and refining meaning—drawing on personal experience, linking concepts or propositions, and paraphrasing, and summarizing.
3 (EM) Evaluating meaning—reacting, and monitoring the development of meaning.
4 (RV) Revising—knowing meaning has broken down, and taking appropriate measures.

Figure 7. Strategies Used in Reading

Remarks focusing on formulating meaning occurred most frequently (63%), followed by revising (22%), evaluating (10%), and generating (5%).

Knowledge Sources
Following Langer's (1986) system of meaning construction, three knowledge sources were identified (Figure 8): knowledge of genre, knowledge of the content or ideas themselves, and knowledge drawn from linguistic material of the text.
(G) genre—reference to the specific genre and the organizational structure and presentation of ideas peculiar to that genre (5%).

(C) content—reference to the topic itself (75%).

(T) text—reference to the linguistic material contained in the text—syntax, vocabulary, cohesive ties from the text and reworded it (20%).

Figure 8. Knowledge Sources In Reading

These sources simultaneously impact the reader's developing understanding. Genre expectations about both content and text, which are capable of shaping the reader's perception from the beginning of the reading, accounted for the least number of communication units or comments (5%). The greatest proportion of comments fell into the content category (75%), with the remaining (20%) reflecting concern with text.

Summary

The data presented in this analysis, supplemented by the qualitative analysis of readers' recall protocols, provide
our most direct look at the processes underlying foreign language learner's reading performance.

In their reading, the primary concern of subjects was with the meanings they were developing. Across the various dimensions of the analysis, this emerged in their focus on hypothesizing, using schemata, formulating and refining ideas, focusing on specific content, and validating of the text-model or the text-world that was being developed.

In general, patterns of behavior were somewhat different at different points in the reading process— with more questioning and hypothesizing at the beginning, and more using of what they knew or were learning being reported at later points in time.

The general approaches of behaviors during meaning construction were were predominantly focused on awareness rather than use. In general, readers' comments focused on thoughts about awareness— about the options they might have available, rather than on what they were actually doing. Beginning foreign language readers were more likely to reflect forward or back on the ideas in the text as well as their own ideas than they were to simply provide running comments and remarks.

Though the particular emphasis varied from text to text, the strategies taken by individual readers in constructing meaning (their developing text-worlds or text models) were consistent across texts. Most comments reflected concern with
formulating and refining meaning rather than generating ideas. Generating ideas, by definition, is a limited category due to the nature of the reading task. The reader, unlike the writer, does not have to provide new material but rather focuses more on adapting the developing understandings to fit the author's message.

As they construct meanings, foreign language readers rely on a variety of strategies and approaches, most of which seem to be useful and used across a variety of specific texts.

The analysis of beginning foreign language readers' behaviors while reading leads to the conclusions that the behaviors are varied and complex and that they change slightly with text and topic.

The data reported in this section provide strong evidence that in reconstructing text meaning, even beginning foreign language readers employ reasoning and mental operations, monitor their comprehension, and draw upon different sources of knowledge. The reasoning operations and the strategies are of particular interest in that they may be the focus of instructional interventions. Readers may be trained in the different aspects of mental and reasoning operations as well as other prereading activities that may foster comprehension.
CHAPTER V

SUMMARY, CONCLUSIONS, IMPLICATIONS, RECOMMENDATIONS, AND LIMITATIONS

Overview of the Study

The primary purpose of this study has been to conduct a preliminary investigation into the effects of computer-mediated reading supports on the reading comprehension and the reading behavior of beginning readers of AFL reading informative texts. A second purpose, addressed in Phase II of the study, examined readers' perception of the different features of the experimental task and the relationship between that perception and their reading comprehension. Phases III and IV of this study explored the readers' cognitive activities involved in the construction of meaning as evident in their think-aloud protocols and from the qualitative analysis of their immediate recall protocols. In addition, this study was designed to contribute to the data base of both second language research and computer-assisted language learning.

In this chapter the evolution of this study will be reviewed. In addition, major findings and conclusions will be summarized. Finally, recommendations and directions for
future research will be discussed and recognized limitations will be specified.

Discussion

The purpose of the present study was to investigate the effects of computer-mediated reading supports on the comprehension and the reading behavior of college beginning Arabic learners.

Findings and conclusion will be discussed in five sections: (a) reading comprehension, (b) attitudinal survey, (c) simultaneous measures, (d) qualitative analysis of recall protocols, and (e) qualitative analysis of think-aloud protocols.

PHASE I

Previous research in L1 indicates that comprehension scores should increase when readers read microtexts that provided reading supports of the types available for reader in this study. According to first language research, this increase in comprehension score is the function of the technological attributes of the computer that permit deeper and more interactive flow of information between the reader and the text.

In this study, it was expected that subjects with access to computer-mediated reading supports would have higher recall scores than when not. It was also expected that the combination of two or more of the reading supports
(Treatments III and IV) would result in even higher recall scores.

A four-way mixed factor ANOVA was conducted for the above experimental data. Analysis of the experimental data revealed statistically significant main effects for the quantitative dependent variable. Treatment, the independent variable of primary concern, resulted in a difference in recall beyond the .05 level ($E(1, 3) = 15.47, Pr>0.0001$) (Table 5). The three other blocking factors, text, order of presentation of text, and subjects, all demonstrated main effects that were significant at $Pr>0.0013$, $Pr>0.0511$, and $Pr>0.0001$, respectively. This finding indicates that at least one level of the factor of the variable investigated significantly differed from the rest of the levels.

As a consequence of this finding of significance, several post hoc pairwise comparisons between the different levels of the treatment variable were performed using the Dunnett procedure and Tukey's Studentized Range (HSD) Test. The analysis detected significant differences between the Control condition and the three treatment conditions. Readers with access to computer-mediated reading supports scored higher on the recall protocol measure (Treatment II, $\mu=43.5000$, Treatment III, $\mu=43.3333$, and Treatment IV, $\mu=46.0417$) than when no reading supports were available (Control, $\mu=30.000$). The analysis, however, did not detect significant differences between the means of the three
treatment conditions ($\mu_3 - \mu_2 = -0.167; \mu_4 - \mu_2 = 2.542$, and $\mu_4 - \mu_3 = 2.708$). The minimum significant difference was 6.523. The results of the post-hoc pairwise comparisons indicate that generally, when subjects have access to three types of reading supports, individually, or in combination, they score higher than when they read texts with no access to reading supports. This analysis, however, did not detect significant differences between the means scores of the three treatment conditions. In other words, subjects' recall scores were higher when a combination of two or three reading supports were available. Those differences, however, were not statistically significant. This finding suggests that the availability of more than one reading support at a time did not significantly affect the reading comprehension of the subjects.

Despite the nonsignificant finding, the means obtained in the pairwise comparisons lend partial support to the expectation stated above. These means indicated that on the average, the mean scores of the treatment conditions increased by about 13.5 points (from $\mu=30.000$ for the control to $\mu=43.500$ for treatment II). Also observed was an increase in the minimum recall score (from 0 to 8), the maximum score (from 62 to 76), and the sum (from 720 to 1044).

However, a decrease of 0.167 was observed with the addition of the conjugation reading support in Treatment III. Insignificant differences of 2.541 and 2.708 points were
observed between Treatments II and III on the one hand, and Treatment IV, on the other (μ=46.041 vs μ=43.500, and μ=46.041 vs μ=43.333, respectively). As stated earlier, those differences were not significantly different at Pr>0.05. The addition of the conjugation (Treatment III) and background information (Treatment IV) did not account for much of the difference between the means—μ4−μ1=16.042 with all three reading supports (Treatment IV), μ3−μ1=13.333 with the combination of vocabulary and verb conjugation, and μ2−μ1=13.500 with the addition of vocabulary only.

Further inspection of the data reveals that despite that fact that the minimum recall score increased with the addition of the conjugation reading support (from 8 to 19), the maximum score fell from 76.00 to 72.00. Moreover, the sum of scores for all students was less for Treatment III recalls (1040.00 vs. 1044.00 for Treatment II). The addition of the background information reading support to the other two (Treatment IV) did increase the mean score, but not significantly (from μ=43.500 in Treatment II, and μ=43.333 in Treatment III, to μ=46.041 in treatment IV). The sum of scores went up (1105.00) as well as minimum and maximum scores (20.00 and 74.00), respectively. The maximum score obtained, however, was less than that obtained when the vocabulary was the only support available.

One interpretation for these findings is that vocabulary knowledge is the primary contributor to reading comprehension.
and that background information, at least as far as the results of this study indicate, played an insignificant role in enhancing readers' comprehension during independent reading. The addition of the Verb Conjugation reading support, individually or in combination with the background information support, did not result in a quantitatively superior recall. These results suggests that the role both grammatical knowledge and background knowledge play in reading comprehension needs to be further clarified.

The finding that glossary was the reading support most conducive to increases in reading comprehension scores should, however, be interpreted cautiously. The large increase in the mean score of the recall protocols with the introduction of the vocabulary support (Treatment II) may be the function of introducing it first. Although the decision to introduce the glossary reading support first was not an arbitrary one—it was based on the theoretical and empirical evidence that point to its major contribution to reading comprehension enhancement—the introduction of either the verb conjugation or the background information reading supports first may have resulted in similar increases in reading comprehension scores.

An explanation for the finding of insignificant differences between and among the three treatment conditions may come from the simultaneous data recorded by the computer program during the reading activity. Generally speaking, all
subjects consulted the glossary (Treatment II) at least once with every text, except for one subject (#4), who accessed the glossary the largest number of times while reading texts 2 and 3, (30 and 14 times, respectively) but failed to access it once while reading text 1. In all subject used the vocabulary reading support (Treatment II) 538 times, an average of 22.41 times per subject, and an average of 7.47 per text.

In addition, data revealed that when treatment II (glossary) was provided with text 1, 25% of the subjects (6/24) did not consult it. The largest number of times the glossary was consulted was 14 and the least number of 1. Analysis revealed exactly the same pattern for text 3. With text 2, again, 25% (6/24) of the subjects did not access or consult the glossary. The largest number of times a subject consulted the glossary was 30 and the least was again one time. Again, when the glossary was available for consultation while reading text 4, 25% (6/24) of the subjects did not make use of it. The least number of times glossary was consulted was two and the most was 21.

Treatment III, in which the reading support, the past and present tense conjugation of selected verbs, was provided in combination with the glossary (Treatment II), was accessed only 47 times by all 24 subjects (Figure 5). Fifty percent of the subjects (12/24) consulted the conjugation reading
support during the independent reading of Text 1. The largest and smallest number of times this reading support was consulted were 1 and 4, respectively. When conjugation was available with while reading Text 2, 70.8% (17/24) chose not to consult it. The least number of times consulted was 1 and the most was 3. When available for consultation with Text 3, again 66.6% (16/24) of the subjects did not use conjugation to solve their comprehension problems. The least and the most times this reading support was used was 1 and 3, respectively. Again, while reading Text 4, only 25% (6/24) of the subjects opted to consult the conjugation reading support, the least number being 2 and the most 2. Four subjects did not use the conjugation reading support at all when it was available for consultation. In all, the conjugation reading support was accessed by the subjects 47 times, an average of 2.35 times per subjects (excluding those who did not use it at all), and an average of 2.35 per text.

When a third reading support (background information) was added to the other two reading supports (Treatment IV), only 6 subjects (25%) opted to access it while reading Text 1. While reading Text 2, only 5 subjects (20.8%) chose to access the information provided for them. Only 4 (16.6%) subjects consulted the background information reading support while reading Text 3 and no one (0%) accessed it while reading Text 4. The largest and the smallest number of times the background knowledge reading support was accessed or
consulted was 3 and 1, 2 and 1, 5 and 1, for Texts 1, 2, and 3, respectively. In all, the background information reading support was consulted 28 times (Figure 6) by the 15 subjects who accessed it (9 subjects did not use the background information available at all), an average of 1.86 times per subject, and an average of 1.86 times per text.

In sum, subjects' low frequency of use of the verb conjugation and background information reading supports, whether because of unfamiliarity with their use, the perceived insignificance of their role in improving reading comprehension, or because of subjects' inexperience in managing the contingencies of their reading and study, may account for the no differential effects of treatment conditions on reading comprehension.

Summary

The data in the four-way mixed factor ANOVA and the subsequent pairwise comparisons demonstrated that the computer-mediated reading supports chosen for the study did facilitate the reading comprehension of the four texts by subjects. One way of evaluating the reliability of the present study is to compare these results to those of other computer-mediated reading supports L1 studies (Feldman & Fish, 1988, 1991; Fish & Feldman, 1987; Reinking, 1988; Reinking & Schreiner, 1985; Reinking & Bridwell-Bowles, 1991). Despite the utilization of different assessment
measures for reading comprehension, the results of this study are generally consistent with the findings in LI, except for Feldman's & Fish's (1991) study. The procedural differences in the Feldman & Fish study may be responsible for the lack of agreement with the results of this study. A difference between this study and the previous LI studies, however, is that, all previous LI studies looked at the collective contribution of a particular set of reading supports. Therefore, it was not determined which options were primary contributors to improvements in comprehension. This study looked into the contribution to comprehension of three types of reading supports, individually and in combination.

Phase II

Data collected from the attitudinal survey was used to discern the effects of reading achievement on students' perceptions of the experimental task. A review of the means of standard deviations for the three Likert categories revealed that generally, the subjects had positive attitude toward the reading task and their computer-assisted reading experience.

Possible reasons for the favorable attitude toward the experimental task include the use of the machine itself, the construction of content in the computer program, and the learner control of the program. Other reasons may relate to the intrinsic features of the computer such as immediate
assistance and active interaction which can easily stimulate interest and in turn, favorable attitudes and continued motivation.

One of the ambiguous findings in this study was the lack of any significant relationship between readers' recall scores and their perception of the experimental task. The data analysis for Phase II of the study involved a correlational analysis that investigated the relationship between the two independent variables of primary interest in phases I and II of the study. The results of the correlational analysis of data revealed no significant relationships between the variables investigated (reading comprehension and subjects' perception of the experimental task). The correlations between the two variables of interest were low and insignificant.

This low correlation demonstrated that subjects' overall attitude toward the task accounted for a very low percentage of the variance in subjects' overall comprehension scores. Subjects, in completing a questionnaire after reading and the recalling the four experimental texts, had positive reactions to the task, but, overall, no relationship was discerned between comprehension scores and the scores on the attitudinal survey. In general terms, this finding suggests that readers' perception of and attitudes toward their reading experience did not contribute significantly to readers' abilities to comprehend written discourse.
This is an interesting result but it is difficult to interpret in light of the theoretical and empirical evidence pointing to the motivational power of the computer. Previous LI studies showed that computer motivates student effectively and that motivation and positive attitude brought about by the computer affects their content recall. It is possible that subjects in this study rated their experiences based on how much they believed they understood from their reading task. Subjects' perception of the reading task showed that most readers understood the value of using vocabulary for better comprehension, yet no significant relationship was detected between how they felt and how they reconstructed text. Unfortunately, however, the above possibility can only be viewed as speculation, because the data simply do not provide adequate information for interpretation. It seems that in future replications of this study, there is a need for further refinement of the attitude measures, procedures, and materials when using computer-mediated reading supports.

Simultaneous Measures

Additional data analysis produced no significant correlation coefficients between reading time and recalling time on the one hand, and reading comprehension scores, on the other. The insignificant low correlation between these variables indicated that reading and recalling time, whether
correlated with the recall scores separately, or in combination (total score), accounted for a very low percentage of the variance in subjects' reading comprehension scores. This finding suggests that increases in reading and recalling time alone do not account for increases in comprehension when the computer is used to provide readers with options for assistance. In other words, the time subjects took to finish the experimental task was not a good indicator of their ability to comprehend. One could argue that increases in comprehension under the conditions of this study are more likely to be due to deeper or more efficient cognitive processing than prolonged exposure to the text.

The findings of this study are consonant with similar L1 studies. Reinking (1988), for example, reported that reading time and comprehension scores were not related at a 0.05 level of significance. More elaborate studies need to be carried out to clarify the relationship between time on task and reading comprehension.

Future replications of this study need to investigate whether or not this analysis of time on task demonstrates greater benefits for poorer than better readers. Also, it would be interesting to find out the effect on comprehension of controlling reading and recalling time. In particular, this finding brings to question the policy or practice of allowing readers to spend as much time reading the texts before attempting to write their recall protocols.
The results of the simultaneous measures also revealed no significant differences in reading time between subjects reading microtexts with reading supports available and those who read computer-mediated texts in which these aids were not available. Similar results of no significant difference were also reported in L1 context. Blohm (1987) found no difference in reading and study time between subjects who read computer-mediated texts with "look-up" aids available and those who read computer-mediated texts in which these aids were not available.

Phase III

The qualitative analysis of the readers' recall protocols revealed that various text-driven and knowledge-driven elements interact with each other to develop an understanding. Data generated in this study demonstrated that college-level beginning readers of Arabic drew on various knowledge sources in order to understand in their second language. Although certain factors in the reading process seem to interact more strongly at certain times than others, all of the elements are indispensable to the comprehension process as they all contribute to the reader's evolving perception of texts. Syntactic features misinterpretations, phonemic/graphemic similarities, and misrecognition of certain words, cause students considerable comprehension problems. To compensate for their lack of textual knowledge
(lexical, syntactic, etc.), students employ various knowledge-driven strategies to promote the comprehension process.

The Arabic data showed that in reconstructing text, some students rely more on word-level interpretations rather than attending to macrolevel features of the text, such as syntax. This focus on microlevel features may have prompted some readers to develop a faulty interpretation of the text, based on the look and sound of some lexical items they recognized.

In addition, data generated from the qualitative analysis of readers' recall protocols suggest that several subjects were highly influenced by their intratextual perception of the text and tended to adhere to that interpretation, even if it meant ignoring other important textual features. As a result, many readers produced recalls that conformed to their initial and limited perception of the text.

In a more general way, students' recalls revealed their uncertainty about text content due to the lack of or the inappropriate application of prior knowledge. However, unlike the German language data (Bernhardt, 1988), AFL readers' inappropriate application of nonspecific and vague background knowledge to the text, did not severely distort their comprehension of that text.
In trying to interpret the text, college-level beginning readers of Arabic also faced an interesting array of phonemic/graphemic recognition problems.

Arabic readers' recall were also rich in metacognitive strategies. Common techniques used by a good number of subjects included making summary statements and parenthetical comments, and using question marks. Students' use of question marks and other metacognitive techniques, indicates that they have reflected on their interpretations and challenged their comprehension process.

The qualitative analysis of readers' recalls also revealed that several subjects faced little or no difficulty in their attempts to reconstruct the different experimental texts. Several recalls were exemplary in the amount of detail that was remembered. A large number of recalls closely resembled the format and organization of the original texts. The qualitative analysis of the recalls also showed that some students successfully used word recognition, syntactic clues, and prior knowledge to interpret the texts accurately. This finding lends support to the contention that various textual and extratextual elements are involved in text reconstruction.
Phase IV

Data generated from the qualitative analysis of readers' think aloud protocols revealed that in their reading, the primary concern of beginning readers of Arabic as a foreign language was with the meanings they were developing. This concern was reflected in their focus on hypothesizing, using schemata, formulating and refining ideas, focusing on specific content, and validating of the text-model or the text-world that was being developed.

The analysis also revealed that different patterns of behavior emerged at different points in the reading process. In particular, more questioning and hypothesizing was observed at the beginning, whereas more reflection on the recently acquired as well as prior knowledge was revealed in the later points in time.

Although the emphasis of strategies taken by individual readers in constructing meaning varied from text to text, the analysis revealed that they were consistent across texts. Most comments reflected concern with formulating and refining meaning rather than generating ideas which is the natural trend in constructing meaning of written discourse.

As far as strategies are concerned, the analysis showed that as foreign language readers attempt to construct meanings, they rely on a variety of strategies and approaches, most of which seem to be useful and used across a variety of specific texts.
The analysis of beginning foreign language readers' behaviors while reading leads to the conclusions that the behaviors are varied and complex and that they change slightly with text and topic. In addition, the data reported in this section provide strong evidence that in reconstructing text meaning, even beginning foreign language readers employ reasoning and mental operations, monitor their comprehension, and draw upon different sources of knowledge.

Summary of Major Findings
The major findings of the present study are summarized below according to the research questions they attempted to answer.

**Question 1**: Can the reading comprehension of beginning college reader of Arabic as a foreign language (AFL) be influenced by using the computer to mediate text? In other words, will the comprehension of beginning AFL readers reading informative microtexts be significantly enhanced by having access to three types of reading supports/textual manipulation mediated by the computer?

The data gathered in this study suggest that reading comprehension can be influenced by using the computer to mediate reading aids. The direction of this influence is not difficult to interpret. When comparing subjects' recall scores reading microtexts and selecting textual manipulations
during the reading activity, this study shows progressive superiority of scores when subjects receive external support in the form of computer-mediated supports.

The results of this study can be interpreted in light of the metacognitive theory and technological attributes of the computer which may be employed to mediate text. It appears that beginning readers of AFL are lacking or are less skilled in monitoring their comprehension and in the use of study and learning strategies. The findings also suggest that they benefited from situating them in an expert's environment that enabled them to interact more overtly with text.

Using the computer in reading supports conditions may have encouraged the readers to process more deeply the meaning of text by structuring their exposure to designated reading supports. This interpretation suggests that the computer might provide unique opportunities to manage a reader's interaction with text during independent reading. Alternative ways of displaying and manipulating texts via computers may make the text accessible to a wider range of readers because variations in their background knowledge, reading skills, and strategy use can be accommodated. In particular, The ease with which reader of computer-mediated texts can access word meanings and background information may affect their propensity to seek out the meanings of difficult words and expand their repertoire of general and specific prior knowledge. Increased attention to difficult words
during independent reading may lead to an increase in a reader's vocabulary knowledge, which may in turn increase the comprehension of texts. In addition, expanding a reader's knowledge base may enrich his or her cognitive repertoire and make him or her less dependent on syntactic and lexical knowledge in the interpretation and reconstruction of text. In interpreting the findings of their study, Reinking and Schreiner (1985) have noted that the computer may have helped readers monitor their comprehension by externalizing processing variables which some readers ordinarily ignore.

In summary, the findings of the present study are consistent with the majority of similar LI studies. The results of this and previous LI research indicate that readers' comprehension increases when the computer is used to expand their options for acquiring information from text or to control their processing of text. The findings of this research suggest that the computer may be a potentially important tool for aiding and enhancing comprehension when it is used purposefully to effect more active processing of text during independent reading. The capability to achieve previously unavailable textual manipulations may significantly affect typical reading behavior and the processing of written text. Continued research is needed to understand more fully the inherent impact of computer-mediated reading supports on reading comprehension of
beginning, intermediate, and advanced learners of foreign languages, and to discover their potential uses.

**Question 2**: Which of the reading supports appear to be most beneficial for beginning AFL readers? That is, is the effect greater for one type of reading support than for another?

The analysis of data using both the Dunnett procedure and Tukey's Studentized Range (HSD) indicates that introducing the glossary reading support first (Treatment II) had the greatest effect on reading comprehension. The increase in the mean score was greatest with the addition of the vocabulary reading support (an increase of 13.500 points, from 30.00 to 43.50). The addition of the other two reading supports to the glossary (Treatments II and IV) did not contribute to any significant difference. In fact, the addition of the conjugation reading support resulted in a decrease in the mean score, whereas the addition of the background information reading support resulted in a moderate increase of 2.50 points on top of the mean score obtained with the addition of only the glossary. This finding suggests that, for this sample, vocabulary knowledge was the primary contributor to comprehension enhancement.

These results also suggest that the comprehension of a particular set of informative reading texts can be affected
by variations in reading supports mediated by the computer. It is not clear, however, whether this effect is more a function of using the computer to control readers' exposure to reading supports or simply making reading supports available for reader selection. A more definitive answer could be obtained by manipulating the locus of control (computer-controlled vs. reader-controlled).

A consideration which may have influenced recall scores is that reading supports provided by the computer may have been unnecessary or unused by many subjects. Descriptive data from the simultaneous measures support the second interpretation. Some readers possessing perhaps well-developed metacognitive strategies may have found the manipulations unnecessary to the management of their own processing. Salomon (1979) has reported evidence that the performance of the more cognitively skillful is depressed when they are forced to engage in external processing. Other readers, may have been overwhelmed by the reading supports (especially verb conjugation) or simply unaware of how to use them to enhance their own comprehension. Equally possible is that reading texts on the computer accompanied by unfamiliar reading supports may have distracted some students from focusing on the text's meaning.
**Question 3**: What combination of reading supports, if any, seems to be more conducive to reading comprehension? In other words, is there any interaction between the different reading supports and if so, what is the extent and nature of such interaction(s)?

There is no evidence from the data obtained in the present study that reading comprehension is enhanced by the opportunity to select more than one reading support during the independent reading of microtexts. The readers in Treatment III (verb conjugation) condition had a lower mean score than those in Treatment II (glossary only). Moreover, the mean score in Treatment IV was not significantly higher than those of Treatments II and III. Some readers may have found the options added unnecessary or even a hindrance to their comprehension efforts.

**Question 4**: Do beginning American readers of AFL make use of the reading supports provided via the computer, and if so, will some options be selected more often than others?

Little is known about the cognitive processes employed by beginning second and foreign language readers while reading informative expository and narrative texts. Verbal
protocols are not always reliable. A new method of gathering data concerning reading behavior was investigated in this study. Readers were given the opportunity to enhance their own comprehension by selecting textual manipulations mediated by a computer. By monitoring these selections, the researcher has access to reading and study behavior that is concurrent with and minimally disrupting reading.

The findings reported in this study suggest that beginning foreign language readers will independently select reading supports mediated by the computer in the course of their reading and study. Evidence in the present study suggests that beginning AFL readers may be prompted to interact with the meaning of informative texts when the computer is used to mediate a selected set of reading supports. Simultaneous data collected by the computer during the reading of texts in the access conditions indicated that these readers attempted to enhance comprehension by freely selecting computer-mediated reading supports. Overall, all subjects in the present study used one or more of the computer-mediated reading supports, individually or in combinations. In all, the students used the three types of reading supports a total of 612 times, the minimum being 0 and the maximum 30. For reasons which are difficult to determine from the present study, subjects requested vocabulary reading support significantly more often than both the background information and the verb conjugation supports.
The analysis of options selected revealed that both conjugation and background information were selected significantly less often than the glossary reading support. The analysis also shows that there were no significant differences between the number of selections with respect to different texts or different combinations.

These figures hint at which of the reading supports was perceived by the readers as more important and more facilitative to the process of reading comprehension. Readers' direct oral comments to the researcher as well as their comments in their recall protocols, think aloud protocols, and the unsolicited remarks on the back of the questionnaire form, all point to the fact that most of the subjects in this study perceived vocabulary knowledge as the most important factor in facilitating their task of text reconstruction. Thus, an important factor in the effective use of computer-mediated aids may be the reader's awareness of what reading supports might be useful in enhancing text comprehension. This may be especially important for weak and beginning readers who do not possess knowledge of strategies and often are not aware of when and how to apply knowledge they possess. It if safe to argue that computer-mediated aid could be of greater value to beginning and weak readers when they are reading more difficult texts, especially if the supports are easily available via the computer.
The fewer selections for conjugation and background information is hard to explain in light of the theoretical and empirical evidence pointing to their importance as factors in improving comprehension. The more choices for vocabulary meanings may have been due to subjects' perception that vocabulary plays a primary role in text comprehension.

**Question 5:** Is American beginning AFL readers' perception of the reading task affected by their reading ability as measured by their recall protocol scores?

Readers' perception was investigated with regard to the following: (a) the perceived effects on text comprehension of the reading supports, (b) subjects' perceptions of the computer program and the reading supports in general, and (c) procedures specific to reading from the microcomputer. The dependent variable in this phase of the study was responses marked on the 16-item attitudinal survey.

Generally speaking, most subjects viewed their experimental task favorably. However, a Pearson product-moment correlation procedure produced no significant relationship between subjects' attitudes and their performance on the reading task. This finding suggests that readers' perception of the different features of the
experimental task did not contribute to their ability to comprehend written discourse. This finding is hard to explain in light of the empirical evidence that has positively associated enhanced performance with positive attitude.

Implications for Further Research and Pedagogy

Theoretical Implications

It is apparent, within the realm of second-language acquisition, that an adequate theory of reading comprehension is a prerequisite for the development and improvement of educational practices. This, according to Kamil, Langer, & Shanahan (1985) can be achieved "through the application of knowledge derived from careful research" (p. ix). Bernhardt (1991) concurs and notes that "[P]rincipled language instruction evolves from a sound knowledge of learners as learners, of learners in the act of accomplishing language tasks...." (p. 224). Bernhardt's model of L2 text comprehension is an example of a learning and comprehension theory that is based on empirical research. More research, however, is needed in different languages and different proficiency levels to verify and substantiate current theory. This study is an attempt in this direction. In addition, more research is needed to investigate readers' cognitive processes under different conditions while manipulating as many variables as possible. This direction must also involve
the utilization of multiple measures that are both qualitative and quantitative in nature. After all, reading comprehension and language learning, in general, is a multifaceted process that no single research paradigm can encompass. This study has attempted to do so by using a design that is hybrid in nature involving both qualitative and quantitative analyses of the readers' recall protocols, their on-line introspection or think-alouds, and their attitudes and perceptions of the experimental task. All three qualitative measure complemented the quantitative data generated in this study.

When the reading protocol is used as a measure for assessing reading comprehension, different scoring systems should also be investigated to find the optimal means by which to analyze recall of written texts. This entails manipulating the variable of scoring system to investigate which system might best demonstrate recall. The present researcher (Aweiss, 1993a) has proposed a scoring system that accounts for the cognitive constructive activities involved in reading comprehension, a system that rewards the reader for attempts to summarize, paraphrase, assimilate, and integrate information from the different segments of the text. The proposed system also rewards the reader for relevant elaborations and comments and for the use of prior knowledge.
The question of effect of computer-mediated reading supports on reading comprehension still remains after this study. The present study was a preliminary investigation into the effects of using the computer to enhance reading comprehension. As implied in the discussion of findings and limitations, the goal of this study was to determine the feasibility of influencing comprehension via textual manipulations mediated by the computer and also to guide further research efforts in this area.

Replication of this study, in numerous ways, is called for to further investigate computer-mediated reading supports. The study could be replicated with different population of learners and across languages--more advanced--for example. The population of this study was limited to second and third quarter university Arabic learners.

In addition to varying the subjects, the study needs to be replicated using different texts. Because of restrictions imposed by the recall protocol procedures, the readings were short. Will these same findings hold when longer text are read? What will happen if the text is easier of more difficult, the topics more or less interesting. These variables were tightly controlled in this experiment. In order to increase generalizability of findings, however, these variables must also be manipulated.

Further research that controls for the factor of type of text (narrative vs. expository) is needed to clarify the
findings of this study. In this study, the type of text variable was not controlled.

Refining the techniques and procedures in accordance with most recent findings in cognitive theory and advances in computer technology may be a beginning point for continued research. In addition, some of the unclear or puzzling findings may be further clarified by careful replication with controlled variations in procedure.

One area of research could involve differential locus of control. An issue that has emerged from the studies investigating computer-mediated texts is the degree to which the reader or the computer controls the assistance provided by the computer. Unlike conventional texts, for example, computer-mediated texts can restrict a reader's access to a text based on contingencies specified in computer program. Despite the encouraging results for computer-mediated reading supports, a number studies suggest that students are often not good judges of the type and amount of instruction that they need to improve their learning (Belland et al., 1985; Carrier, 1984; Gay, 1986; Steinberg, 1977; Tobias, 1987). Thus, the question of reader versus computer control for optimal text comprehension should be researched further.

The present study also generated little evidence that computer-mediated text transfers to non-experimental passages or affects general comprehension ability. There is some subjective evidence that readers exposed to the reading
supports treatment condition did transfer some of the sensitivities highlighted in this condition to other reading. When informally questioned after the experiment, several subjects responded favorably to a question about whether or not the treatment helped them read better. Several subjects spontaneously suggested that the experience helped them think more about what they read and made them aware of the strategies and factors that impact reading comprehension. Follow up studies could explore the possibility of transfer effects on more subtle measures of comprehension.

Further research on the effects of computer-mediated reading supports on the comprehension of beginning readers should attempt to determine whether the types of supports provided in this study are best for all second-language learners. Such research could investigate, for example, how learners at different levels of proficiency benefit from providing them with means of enhancing their comprehension.

Although not the primary concern of this investigation, the study seems to have some implications for identifying relationships between the computer on one hand, and attitudes and motivation, on the other. Based on the data generated in the attitudinal survey and the unsolicited comments by the subjects, the findings of this study indicate that the use of the computer to mediate texts and reading supports has positive motivational effects. Moreover, the ease with which readers of computer-mediated texts can access word meanings
and other reading supports may affect their propensity to seek out the meanings of difficult words which, in turn, may increase comprehension of text for beginning and reluctant readers. Whether such an effort could be realized and whether it might diminish after the novelty of the computer has worn off would be a legitimate research question. The findings, although subjective in nature, suggest that the computer may be a potentially important tool for motivating students during independent reading and study practice. Future research should be conducted in various instructional situations over long-term periods such as one month or one quarter. Such studies would be very important in identifying relationships between the computer and its motivational function.

Pedagogical Implications

The most evident pedagogical implications are perhaps those for novice learners. Those learners are at a disadvantage when they read independently. They normally lack the skill of guessing the meaning of words from context, of using their prior knowledge, or of utilizing the different semantic and syntactic clues in the text. They may even be unable or unaware of such study and comprehension strategies. Putting such readers in an environment where they can benefit from conditions available only to skilled and advanced
readers, would certainly enhance their comprehension and alleviate much of the cognitive load placed on them.

The qualitative analyses of students' written and think-aloud protocols provide several pedagogical implications. The most evident pedagogical implications are perhaps those that relate to instructional goals, objectives and practices. Recall data, when analyzed qualitatively, can help teachers in setting and modifying their instructional goals and objectives. Modifications in pedagogical practices and instructional strategies may also be derived from such qualitative analyses of readers' recalls.

Data gathered in this study suggest that one such useful and practical instructional strategy would be to enable readers to develop some understanding of the text by drawing on their life-long experiences, beliefs, and knowledge. This also entails preparing students for the purpose of reading by providing them with the necessary background knowledge that may be lacking. This recommendation is consonant with Carrell's (1984) contention that readers' accuracy and efficiency in interpreting the text is enhanced by limiting their processing choices. By focusing their attention on what the text is about, readers will be less dependent on other factors that impact reading comprehension that are purely linguistic in nature, such as syntactic and lexical knowledge.
Related to this issue is Bernhardt's (1991) argument that for knowledge to be beneficial, it must be specific. Bernhardt (1991) notes that there are many types of "knowledge." There is, for example, local-level knowledge that is highly idiosyncratic in nature. There is also domain-specific knowledge as well as culture-specific knowledge which includes "ritualistic knowledge as well as cultural-historic knowledge" (p. 97). The data from this study also illustrate that when inappropriate knowledge is accessed during processing, it can impede rather than facilitate understanding, a conclusion arrived at in other qualitative analyses of readers' recalls (Bernhardt & Berkemeyer, 1988, Berkemeyer, 1989).

Another important consideration in preparing students for reading is to familiarize them with different text genres. Experience with diverse types enhances and polishes students' ability to adjust their processing skills to the text genre with which they are dealing. Moreover, such experience enables them to form accurate expectations about the text's content and format. These expectations and initial perceptions may not occur very frequently, but when they do, they persist and tend to force readers to conform to them, to the total neglect of all textual clues.

Another issue that is worth noting in this context relates to the need to train and encourage readers to interpret the text at the discourse rather than the sentence
level. This can be achieved by emphasizing the important role logical connectors and anaphoric references play in arriving at a holistic understanding of the text.

Another useful instructional strategy would be for the teacher to train readers in word disambiguation. There is evidence that readers use two routes—phonological and visual—either separate or in parallel, to access printed words. L2 readers misidentify words because of a deficiency in their knowledge of the L2 phonology/sound system, or because of phonological interference from their LI. Word misrecognition, as evident from the Arabic language data, causes readers to misinterpret the meaning of whole sentences and paragraphs. Moreover, and on the basis word misrecognition, some students build a perception of what the text is about. To alleviate this kind of comprehension problem, learners need to develop an awareness of the sound system of the target language. Readers can be guided, through word recognition activities, to disambiguate recognition.

Syntactic features recognition problems also surfaced in the recalls of the students. The relatively free word order in Arabic (pragmatic word order), as well as the inflectional nature of the language, led to comprehension breakdowns. Continual practice in pronoun and adjective resolutions would certainly help to alleviate this kind of comprehension problem. Students would certainly benefit from practice in using varied word orders, in breaking down more complex
syntactic structures, and in analyzing texts containing anaphoric expressions. After all, students' linguistic competence plays an instrumental role in discourse comprehension. However, for grammar instruction to be effective, one can argue that it must be placed within a discourse context. Berkemeyer (1991) notes that "contextualizing grammar instruction may help readers to use their linguistic knowledge more efficiently and effectively during the comprehension process" (p. 298).

Finally, these data seem to suggest that students should learn to monitor their own comprehension processes by employing various cognitive strategies. Getting students to rely accurately on metacognitive strategies and prior knowledge is not an easy task for teachers to accomplish but is necessary if students' comprehension is to be facilitated. Successful reading comprehension depends not only on readers' ability to access appropriate content and formal schemata, but also on their ability to monitor what they understand and to take appropriate strategic action. In spite of many unanswered questions, comprehension monitoring activities can potentially benefit students and teachers alike. By its very nature, comprehension monitoring requires students to become actively involved with reading matter in an ongoing way. Comprehension monitoring and meaning-making abilities provide language, concepts, and strategic acts that students may draw upon to help overcome comprehension difficulties. Encouraging
students to question their interpretations of the different individual and collective units in the text could serve to improve their comprehension. Comprehension monitoring activities also provide the teacher with one way of assessing how and how well students understand what they read.

The qualitative analysis of readers' think aloud protocols provides other pedagogical implications, the most evident of which relate to the use of processing strategies and reasoning operations during independent reading. The reasoning operations and the strategies are of particular interest in that they may be the focus of instructional interventions. Aweiss (1993) found that readers' ability to engage in proper envisionment-making and hypothesizing correlated highly with their reading comprehension scores assessed via the immediate written recall protocol. Readers may be trained in the different aspects of mental and reasoning operations as well as other pre-reading activities that may foster comprehension.

Limitations of the Study

Several factors constrain the conclusions which can be drawn from the data gathered in this study and may limit the generalization of findings. The following limitations are recognized by the experimenter.

1. It was not possible to select a random sample of
subjects for this study. The subjects who participated in this study were all paid volunteers. The results, therefore, can not be generalized to other populations.

2. Another serious limitation of the study was the small sample size. If sample sizes had been larger, the statistical power of the analyses would have been greater. With greater statistical power, it is possible that significant differences between treatment conditions could have been detected for the dependent variable.

3. Because of the lack of any readability formula, judgment was used to determine the texts' difficulty level. Although all four passages were judged to be of similar or comparable level of difficulty, there was no way to determine whether the superior performance on one or the other of the treatment conditions was simply the function of reading a less difficult text on a more familiar topic. This limitation requires that future replications of this study use texts of varied difficulty levels.

4. Provisions for controlling effects due to subjects' prior knowledge of text content were also limited to the selection of a variety of topics that were judged to be culturally accessible to the sample. Although there is no reason to suspect that this
factor greatly influenced outcomes of the present study, variations in prior knowledge may contribute to potentially confounding variables in studies investigating comprehension differences. Therefore, replications of this study should use different topics. Moreover, recommendations based on the present findings about the use of reading supports must remain tentative.

5. The texts used in this study were relatively short (120-150 words each). A longer reading selection may have made a difference in terms of propositions recalled. Because of the length, subjects were able to re-read the article more than once, as evidenced from the think aloud protocols of some students. This may have contributed positively to the comprehension scores.

6. The selection of manipulations to be mediated by the computer and their content remains subjective. Although the manipulations and their content programmed in this study were not arbitrarily selected, no previous research exists which speaks directly to this issue. Different manipulations may be required relative to differences in reading ability, types of texts, difficulty of text, etc. More research is required before the separate effects of each manipulation can be determined. Such
research may permit the development of controlled definitions and standardized procedures for selecting manipulations and their content with identifiable populations of readers.

7. Although the computer program recorded the number of options requested in the experimental task, there was no way to determine when if at all, the consulted reading support was used effectively.

8. No provision was made to accommodate those who were less able to type. It is not known if typing familiarity affected the amount of information recalled.

9. The free recall protocol used in this experiment was chosen because it was subject-generated. In spite of the advantages of using a non-directive measure of recall, there is a built-in limitation in the use of such an instrument. It taps not only what the subjects recall but also how capable they are of writing down what they recall. Moreover, the subjects who participated in this study may not have had the same ideas about how to write recall protocols or may not have had previous experience in writing them. Individual subjects may also have differed in the perspective from which they chose to present their recalls. Subject differences and lack of experience may have affected the results of the
study.

10. Since the Graeco-Latin Square design is not a complete factorial design, orthogonality or independence between the different sources of systematic variability could not be maintained. As a result, the main effects may have been confounded by the presence of interactions between the different factors forming the Latin square. What this means is that some amount of variability attributed to the main effects is contributed by interaction that may be present in the experimental situation. Only in complete factorial designs are factors balanced to maintain orthogonality.

Despite the limitations that will occur in any empirical investigation, research of the kind reported in the present study is invaluable. The effects of computer-mediated reading supports on reading comprehension and on reading behaviors of second and foreign language readers is an area of crucial importance to researchers, teachers, and students.
APPENDIX A

INFORMATION FLIER ABOUT THE STUDY
ATTENTION STUDENTS STUDYING ARABIC

EARN $10.00 QUICKLY AND EASILY

HOW: Participate in a research project in Arabic.

WHO: 102 and 103 levels of Arabic students are needed.

When: At your convenience. Call to schedule a time. Evenings and weekends available.

WHERE: Room 408 Cunz Hall (Arabic Individualized Learning Center).

WHAT: The data collection session lasts approximately 2 hours. The session consists of a reading comprehension and recalling four short Arabic texts and completing a nine-item Likert scale. Subjects will receive $10.00 upon completion of the session.

ALL PARTICIPATION IS VOLUNTARY AND DOES NOT AFFECT YOUR ARABIC COURSE GRADE IN ANY WAY.

INTERESTED STUDENTS SHOULD CONTACT

SALEM AWEISS, 293-9970 (HOME) OR 292-2976 (WORK)

This project has been approved by Professor Cadora, Chairman of the Department of Near eastern, Judaic and Hellenic Languages and Literatures, and Professor Alosh, Coordinator of the Arabic Program.
APPENDIX B

LETTER OF REQUEST TO DISTRIBUTE
INFORMATION FLYER
Dear Instructor,

Attached you will find a handout describing a research study being conducted in the Department of Educational Studies and Arabic Department. Your cooperation in announcing this study to your classes and in passing out this information is urgently needed. It will be difficult to recruit the number of subjects needed for the study without your help.

Subjects at the 102 and 103 levels of Arabic study, who can read Arabic texts are needed as subjects. As noted in the handout all subjects will receive $10.00 for their participation.

Let me assure you that I have cleared this project with Professor Cadora, Chairman of the NJH Department, and Professor Alosh, Coordinator of the Arabic Program, and have gotten their full approval to request your help and to distribute these handouts. Your cooperation is purely voluntary. You are in no way obligated to pass out this information.

I encourage you, however, to help another graduate student complete his dissertation work. Data collection sessions are very flexible.

I appreciate your help and cooperation very much. Please contact me if you have any questions or concerns at 292-2976, or at 293-9970.

Thank you for your time and assistance.

Sincerely,

Salem Aweiss
APPENDIX C
EXPERIMENTAL TEXTS
THE "COVER LETTER" TEXT

رسالة

5 حزيران 1992
السيد رئيس دائرة اللغة الإنجليزية/جامعة الكويت
 السلام عليكم ورحمة الله،
أنا طالب مصري أدرس الآن في دائرة اللغة الإنجليزية في جامعة ولاية
أوهايو أورهايو وهي جامعة كبيرة ومُشهرة في مدينة كولومبيا في الولايات
المتحدة الأمريكية. حصلت في هذه الجامعة على الماجستير في اللغة
الإنجليزية والأدب الأمريكي وأكملت فيها كل الدروس في الأدب الإنجليزي
المعاصر.

أُعتبر رسالة الدكتوراة تقد اكملتها وأرجو أن أحصل على الشهادة في هذه
السنةدراسية. وقد عملت منذ حصولي على الماجستير مساعداً للأستاذ
ريتشاردز في تدريس اللغة الإنجليزية للطلاب الأجانب وكان
بعض طلابي من الوطن العربي، كذلك درست الأدب الأمريكي الواقع في
جامعة أوهايو خلال الصيف الماضي.

التدوين
كان عبد الجيد
THE "TRIP TO THE MIDDLE EAST" TEXT

زيارة إلى الشرق الأوسط

عندما كنت طالبا في جامعة هارفرد درست عن تاريخ الشرق الأوسط.
كان استاذي يقول أن الشرق الأوسط مهد الديانات الثلاثة اليهودية
والسيحية والاسلامية، وأن كل طالب يدرس الدراسات العربية والإسلامية
يجب أن يزور الشرق الأوسط.

في عطلة الصيف الماضي سافرت إلى مدينة القدس لزيارة الأماكن
المقدسة الإسلامية والسيحية واليهودية. في الطيار استقبلت صديقي سامي
واحذريني بسيارته إلى فندق إنتركونتيننتال على جبل الزيتون. بقيت في
القدس ثلاثة أيام وزرت كثيرا من الأماكن الدينية. زرت أيضا مدينة
بيت لحم وشاهدت كنيسة المهد وهي كنيسة قديمة وجد فيها السيد المسيح.
في مساء كل يوم كنت أذهب إلى بيت صديقي سامي وأكل طعام
المشاة وشرب القهوة العربية.

بعد ذلك زرت بعض الأماكن الأخرى في الشرق الأوسط مثل دمشق
والقاهرة ورجع إلى الولايات المتحدة في شهر آب.
THE "NILE RIVER" TEXT

"نهر النيل".

The Nile is the longest river in the world and the longest river in Africa. It starts in the highlands of Ethiopia and flows through Sudan and Egypt.

The Nile is divided into three main parts: the Upper, Middle, and Lower Nile.

The Delta is the region at the mouth of the Nile, where the river spills into the Mediterranean Sea.

Egypt is located on the northern bank of the Nile Delta.

The Delta is the most fertile region in Egypt, and it is home to the majority of the Egyptian population.
مراحل التعليم في العالم العربي هي الابتدائية والاعدادية والثانوية والجامعية. تُعرَّف وزارة التربية والتعليم في كل بلد عربي مواد وبرامج التعليم وتُدرِّس أيضاً مواد الامتحانات في الدورات الحكومية حيث يعلَّم كثير من المعلمين والعلماء.

تُدرس الدارس والجامعات في العالم العربي اللغات الإنجليزية والفرنسية والربية إلى جانب المواد الأخرى مثل الرياضيات والعلوم والتاريخ العربي والأدب الإسلامي والأدب القديم والحديث.

ومعظم الدارس والجامعات في الوطن العربي حكوميَّة، لكن يوجد بعض الدارس والجامعات الخاصة.

يُخرج عدد كبير من الطلاب والطالبات كل سنة، وبعض هؤلاء الطلاب يذهبون إلى أوروبا وأمريكا للدراسة الجامعية ثم يرجعون إلى بلد它们 للتدريس في الدورات الابتدائية والثانوية والجامعات الحكومية أو الخاصة مثل الجامعة الأمريكية في بيروت وجامعة الأمريكية في القاهرة وجامعة ييرزيت أو يعملون في الشركات والصادر والفنادق والمطافي.
APPENDIX D

SCORING TEMPLATES
THE "COVER LETTER" TEXT'S SCORING TEMPLATE

1 - 1992
2 - السيد رئيس دائرة اللغة الإنجليزية
3 - جامعة الكويت
4 - السلام عليك ورحمة الله
5 - أنا طالب مصري
6 - أدرس الآن
7 - في دائرة اللغة الإنجليزية
8 - في جامعة ولاية أرهاир
9 - وهي جامعة كبيرة
10 - ومشرفة
11 - في مدينة كولم
12 - في الولايات المتحدة الأمريكية
13 - حصلت في هذه الجامعة
14 - على الماجستير
15 - في اللغة الإنجليزية
16 - والأدب الأمريكي
17 - واكملت فيها
18 - كل الدروس
19 - في الأدب الإنجليزي
20 - المعمر
21 - إمالة رسالة الدكتوراة
22 - فقد اختمتها
23 - وأرجو أن أحصل على الشهادة
24 - في السنة الدراسية القادمة
25 - وقد عملت
26 - منذ حصولي على الماجستير
275 - مساعدًا للإساتذة ربعان.
278 - في تدريس اللغة الإنجليزية.
298 - للطلاب الأجانب.
280 - وكان بعض طلابي من الوطن العربي.
291 - كذلك
292 - درست.
31 - الأدب الأمريكي المعاصر.
34 - في جامعة أوهايو.
35 - خلال الصيف الماضي.
36 - أرجو لكم.
27 - جامعة الكويت.
28 - كل نجاح.
39 - في السنة الدراسية القادمة.
40 - التوقع.
THE "TRIP TO THE MIDDLE EAST" TEXT'S
SCORING TEMPLATE

1- When you were a student at Harvard 4
2- Studied the history of the Middle East 4
3- My advisor says 2
4- The Middle East 2
5- The three religions 4
6- Judaism 1
7- Christianity 1
8- Islam 1
9- And all students 2
10- One who studies the Arabic and Islamic 4
11- Should visit the Middle East 4
12- In the summer of the last year 4
13- Visited Jerusalem 3
14- To visit the city of Jerusalem 4
15- The Islamic, Christian, and Jewish 2
16- Stayed in the sky 2
17- Dr. Scott Smith 1
18- And drive by his car 2
19- To the hotel in the hotel 1
20- On the way to Jericho 2
21- Stayed in Jerusalem for three days 4
22- Visited many of the places of worship 4
23- Visited the city of Jerusalem 4
24- Visited the church 2
25. وهي كنيسة قديمة ولد فيها السيد المسيح
26. في مساء كل يوم
27. كنت أذهب إلى بيت صديقي سامي
28. وأكل طعام العشاء
29. وشرب القهوة العربية
30. بعد ذلك
31. زرت بعض المدن الأخرى في الشرق الأوسط
32. مثل مان
33. ودمشق
34. القاهرة
35. ورجعت إلى الولايات المتحدة
36. في شهر آب
1- النيل نهر طويل جداً 4
2- وهو من أطول أنهار العالم 4
3- وأكبرها 4
4- فهو أطول من الأمازون نهر النيل 4
5- وأكبر من الميسيسيبي نهر النيل 4
6- ينبع النيل من بحيرة فكتوريا 4
7- وينتهي في البحر الأبيض المتوسط 4
8- يمر نهر النيل بالسودان ومصر 4
9- تقع على نهر النيل مدن مصرية 4
10- القاهرة 1
11- منها 1
12- أسوان 1
13- القاهرة 1
14- والأسكندرية 1
15- القاهرة هي مدينة كبيرة جداً 4
16- وهي عاصمة مصر 4
17- ومدينة الأسكيشدرية تقع على البحر 4
18- وتسمى 4
19- مرس البحر الأبيض 4
20- السد العالي سد كبير 4
21- قريب من مدينة أسوان 4
22- وهو أكبر سد 4
23- في الشرق الأوسط 4
24- في مصر سد كبير آخر 4
25- على النيل 4
279

276 - وأحسن مد اسوان
277 - وهذا السد أقدم من السد العالي
278 - لكن السد العالي
279 - أكبر منه
280 - وعلى نهر النيل
281 - مدخلا صغيرة أخرى
282 - وتشتهر مصر كثيرا
283 - على مياه نهر النيل
284 - وقدما
285 - قال هيرودبس
286 - مصر حبة النيل
THE "STAGES OF EDUCATION IN THE ARAB WORLD"
TEXT'S SCORING TEMPLATE

-The stages of education in the Arab World are:
- Preparatory stage
- Vocational
- Technical
- The University

1- Determining the education and training plan
2- In every Arab country
3- Training materials
4- Education and training
5- And the university
6- The Ministry of Education
7- The ministry of education
8- In every Arab country
9- And training materials
10- Dates of examinations in the public sector
11- In which a large number of the schools and the training
12- In the Arab countries
13- In the Arab countries
14- In the English language
15- In the French language
16- And the Arab
17- And the Arab
18- And the Arab
19- And the Arab
20- And the Arab
21- And the Arab
22- Training materials and the Arab countries
23- But there are in some training and Arab countries
24- Graduates from the Arab countries
25- عدد كبير من الطلاب والطالبات
26- كل سنة
27- بعض هؤلاء الطلاب
28- يذهبون إلى أوروبا وأمريكا للدراسة الجامعية
29- ثم يزروهم إلى بلادهم
30- للتدريب في الدارس الإبتدائية
31- والثانوية
32- الجامعات الحكومية
33- أو الخاصة
34- مثل الجامعة الأمريكية في بيروت
35- والجامعة الأمريكية في القاهرة
36- وعامة بيروت
37- أو يعملون في الشركات
38- والمصارف
39- والنقاد
40- والعانق
APPENDIX E

SAMPLE COMPUTER-MEDIATED READING SUPPORTS
TEXT 1

Famous — مشهور
Department — دائرة
Literature — الأدب
I Obtained — حصلت
Contemporary — العامل
Completed — اكتملت
Obtain/Get — احمل هل
Dissertation/Thesis — رسالة
Scholastic — الدراسية
Degree/Diploma — الشهادة
Teaching/Education — تدريس
Assistant — مساعد
Since — منذ
Success — نجاح
SAMPLE "VERB CONJUGATION" READIN SUPPORT

دا رس (يدرس)

انا درست (درس) انت درست (درس) هو درس (يدرس)
نحن درست (درس) أنت درست (درس) هي درست (يدرس)

انت درستم (درسون) نم درستوا (يدرسون)

رجع (يرجع)

انا رجعت (رجع) انت رجعت (رجع) هو رجع (يرجع)
نحن رجعت (رجع) أنت رجعت (رجع) هي رجعت (رجع)

انت رجعتم ( Retornaون) نم رجعوا (يروجون)

كان (يكون)

انا كنت (كون) انت كنت (كون) هو كان (يكون)
نحن كنت (كون) أنت كنت (كون) هي كانت (كون)

انت كنتم (كونون) نم كنا (يكونون)

زار (يزوار)

انا زرت (زور) انت زرت (زور) هو زار (يزوار)
نحن زرت (زور) أنت زرت (زور) هي زارت (زور)

انت زرتم (زورون) نم زاروا (يزوارون)
Background Information for Text 1

A large number of students from the Arab world go to the U.S. for graduate study. Many of them major in teaching of English as a second/foreign language (ESL/EFL). In addition to taking courses in education and pedagogy, many graduate students take courses in old and contemporary American and English literature. Many graduate students are employed by their departments as teaching assistants (TAs) to help professors in teaching and grading.

Graduate students pursuing a doctorate (Ph.D.) are required to do research and write a dissertation. Most of the graduates go back to the Arab world to teach (EFL) at schools and universities.
APPENDIX F

ATTITUDINAL QUESTIONNAIRE
Attitudinal Questionnaire

01- Having the chance to explore different textual/manipulations or reading supports enhances comprehension of the reading text.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
1 ____________________2_____________3__________4___________5

02- Generally, I find reading text displayed on the computer screen as comfortable.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
1 ____________________2_____________3__________4____________5

03- The program seems to foster active and overt interaction with the text.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
1 ____________________2_____________3__________4____________5

04- The program does not readily provide information that enhances comprehension.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
1 ____________________2_____________3__________4___________5

05- The use of the different reading supports develops a practical understanding of the text.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
1 ____________________2_____________3__________4___________5

06- The use of computer-mediated reading supports does not strengthen interest and is not likely to promote/enhance comprehension.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
1 ____________________2_____________3__________4___________5
07- I think that the information provided in the form of reading supports makes me comprehend the text more than I do when I read Arabic from a book.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5

08- The type of reading supports (vocabulary meaning, conjugation of verbs, and background information) seem useful for helping me remember the text.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5

09- I feel I was learning as I was reviewing the reading supports.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5

10- The textual information presented in the "background information" section of the reading supports is not helpful.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5

11- Providing context-specific meaning of the different vocabulary items relieves much frustration.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5

12- Having to switch to a different screen to get to the reading supports is disruptive to the process of reading.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5

13- The topics of the reading texts are not interesting.

Strongly Disagree Disagree No Opinion Agree Strongly Agree
1 2 3 4 5
14- This type of computer-assisted reading instruction is frustrating to me.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
_________________  ___________  ___________  ___________  ___________

15- I think I remember less from this type of reading practice than I do when I read Arabic from a book.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
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16- I felt I was learning as I was reviewing the reading supports.

Strongly Disagree  Disagree  No Opinion  Agree  Strongly Agree
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APPENDIX G

SUMMARY SIMPLE STATISTIC
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APPENDIX H

BAR CHARTS OF NUMBER OF TIMES EACH READING SUPPORT WAS USED FOR EACH SUBJECT
| Frequency | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 |
| 50+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 40+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 33+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 30+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 25+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 20+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 15+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 10+       |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 5+        |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |

Bar Chart of Number of Times Vocabulary List was Used for Each Subject
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![Bar Chart](image)

**Bar Chart of Number of Times Conjugation Aid was Used for Each Subject**
Bar Chart of Number of Times Background Aid was Used for Each Subject
APPENDIX I

SCATTERPLOTS FOR LIKERT-SCALE CATEGORIES
AND RECALL PROTOCOL SCORES
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0  10  20  30  40  50  60  70
APPENDIX J

TRANSCRIPTION/TRANSLITERATION SYSTEM
LIST OF REFERENCES


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