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ABSTRACT

A study used schema theory as a basis for developing an instrument to evaluate reading software. The instrument was designed to assess software used in English-as-a-second-language (ESL) reading instruction. Evaluation criteria and questions were developed to address the programs' interactive capabilities (flexibility, response to student errors, and ability to distinguish between significant and insignificant errors), approach to information processing (encouragement of the use of prediction and problem solving strategies, use of text-based activities in the context of a reading passage, and encouragement of textual analysis skills for comprehension), approach to background knowledge (assumption of existing knowledge, and the building of schemata through pre-reading activities), and general software construction and use. The instrument was then used to examine a sampling of four current software packages. The results of the evaluations are presented, and the advantages and limitations of the instrument are discussed. (MSE)

# Computers, Reading and Schema Theory: What's the Connection?

## AN EVALUATION OF READING SOFTWARE ACCORDING TO SCHEMA THEORY

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## ABSTRACT

Two separate but interrelated areas within the field of second language learning are reading comprehension and computer-aided instruction. In recent years, the field of ESL reading has been dominated by schema theory. Since the educational community has adopted the computer as a widespread medium of instruction, it was important to question whether programs designed to teach reading are rooted in this theory. Although much recent research criticizes the quality of reading software programs, few appraisals examine software from the perspective of schema theory. This study addressed the following question: What criteria should be used in evaluating ESL reading software within the context of schema theory?

Schema theory was the basis for developing an evaluation instrument that could be used by ESL instructors and materials developers interested in computer-aided reading instruction (CARI). This instrument was then used to examine a sampling of current reading software programs. A call for furtner cooperation between computer programmers and ESL reading specialists was recommended for future development of software.

The purpose of this study was to devise an evaluation instrument based upon the current model of schema theory which could be used by English as a second language (ESL) and other reading professionals to evaluate reading software programs. It was also the purpose of this study to implement this instrument by applying it to several computer software programs currently on the market. By implementing this tool, it was hoped that it could be determined whether schema theory, as it relates to ESL reading methodology, is actually being applied in current computer-aided reading instruction.

The focus of this study stemmed from two separate but interrelated fields within the area of second language instruction: reading comprehension and computer-aided instruction. In recent years, the field of ESL reading comprehension has been dominated by schema theory, the fundamental tenet of which is that spoken or written text does not in itself carry meaning (Adams & Collins, 1979). Rather, the text only provides clues to enable readers and listeners to construct meaning from their own previously acquired knowledge (Carrell & Eisterhold). Because schema theory has been applied primarily to the area of reading instruction in the field of ESL, it is within this context that this research was conducted.

One aspect of schema theory that has particular relevance for second language (L2) reading is its description of how input is processed. According to the

theory, all input is mapped against an existing schema, or knowledge structure, and all aspects of the schema must be compatible with the input information for successful comprehension to occur (Carrell & Eisterhold). This principle suggests two basic modes of information processing : bottom-up processing and top-down processing.

According to Adams & Collins (1979), bottom-up processing is evoked by incoming data which enter the system through the best fitting bottom-level schemata (plural). Schemata are described as being heirarchically organized, with the most general knowledge structures at the top and the most specific at the bottom (Carrell and Eisterhold, 1983). Bottom-up processing describes the process whereby bottom level schemata converge into, and thus activate higher-level, more general schemata (1983). On the other hand, top-down processing, " . . . occurs as the system makes general predictions based on higher level, general schemata and then searches the input for information to fit into these partially satisfied, higher order schemata" (1983). Thus, reading is both a bottom-up, text-based process and a top-down, knowledge-based process in that, as a reader reads, s/he looks at the print, the letter, the word, and the sentence, and at the same time uses his or her background knowledge to relate to what is on the page (Lalas, lecture handout).

The other area within the field of second language instruction that was the focus of this study was computer-aided reading instruction (CARI). Since the educational community has adopted the computer as a widespread medium of instruction, it was important to question whether this medium of ESL reading instruction employed the methods derived from the well accepted and well founded schema theory of reading. According to a position paper by the New England Reading Association (1986), it was found that many of the current programs available for reading instruction are nothing more than electronic workbooks, since the software is of a drill-and-practice variety, and that there are few higher-level thinking programs available. "Overall, the quality of reading software is far below the expectations of most teachers of reading" (1986, pp. 3-4). It was apparent that many programs for computer-aided reading instruction were not adequate. Not only was schema theory not being applied, but the capabilities of the computer were also not being utilized by the reading courseware programs.

Although much of the current research criticizes the quality of reading software programs, this study found very few appraisals examining software from the perspective of schema theory. Existing appraisals either concentrated on the surface features of the program (i.e. pacing of the program, graphics, sound, etc. (Bradley, 1983), or the appraisal was not stated in any systematic

or specific form that could be used as a tool by the instructor (Underwood, 1984; Geoffrion and Geoffrion, 1983).

Two appraisals in the form of evaluative tools were felt to be somewhat more helpful, although incomplete, in terms of a thorough application of schema theory. Rude (1986, pp. 170-173) concentrated on whether the program taught decoding skills and on the integration of these skills with comprehension skills. However, he did not specifically mention the prediction, pre-reading, and problem-solving skills so basic to a schema theoretic approach to reading instruction. Stieglitz (1987), likewise, failed to include these skills as a part of his evaluation. Nevertheless, it must be pointed out that neither of these evaluations were intended for use by reading instructors of second language learners, and perhaps it is for this reason the specific implications of schema theory were not included as integral parts of their evaluations. Thus, this study concluded that an evaluation instrument incorporating the tenets of schema theory and focusing upon those tenets as the basis for evaluating software was needed in the field of ESL reading instruction. Within this perspective, this study investigated the following question: What criteria should be used in evaluating ESL reading software within the context of schema theory?

## EVALUATION

Based upon research of schema theory, criteria were established for evaluating ESL reading software, and appropriate questions were developed in light of current knowledge of computer-aided instruction. Questions were grouped according to four criteria headings: Interactive Capability, Information Processing, Background Knowledge, and General. The "General" category included questions which do not necessarily apply to schema theory, but which are pertinent for the successful use of computers in ESL reading instruction. Following is a description of each criteria heading and the questions which pertain to it.

## INTERACTIVE CAPABILITY

Traditional understanding of reading comprehension almost exclusively emphasized the text to be comprehended, not the comprehender (Carrell and Eisterhold, 1983). According to this view, each well-formed word, sentence and passage was said to "have" its own meaning, existing separately and independently from both writer and reader (1983). The reader was thus considered a passive recipient of meaning (Silberstein, unpublished). Conversely, a schema theoretic understanding of reading comprehension views the reader as an active processor of information, interacting with the text to reconstruct meaning (Pearson-Casanave, 1984). Efficient readers are said to develop presuppositions or expectations about the

content of a particular text, based on their knowledge of the world. If these presuppositions are confirmed, the reader continues, having acquired a greater store of information. If, on the other hand, these presuppositions are not confirmed, the reader must reread the text more carefully (Silberstein, unpublished).

Perhaps the most important reason for using computers in ESL reading instruction is their ability to interact with the student as s/he interacts with the text. Unlike any other instructional aide, the computer can adapt its responses to the person who is using it, something which has so far only happened in the classroom through the teacher or other students (Cook 1985, p. 22). Nevertheless, most current reading programs do not take advantage of the computer's interactive capability. Thus the following questions were designed to aide instructors in the evaluation of reading software with regard to this characteristic:

1. Is the program flexible in its questioning strategies, and in its responses to student answers?

In order for the the interaction between the computer and student to be meaningful during the reading process, it must be flexible. Currently, most reading programs re-create those features of the classroom which are better avoided, these being a very controlled presentation of the material to be studied, a continuous evaluation of student responses with regard to rightness

and wrongness, and an overly structured, piece-by-piece presentation of the material, presented in a way that can later be "measured" and "evaluated" (Underwood 1984, p. 49). Alternatives do exist, however, to this all too common, "wrong-try-again" model of instruction (Underwood 1984, p. 45).

One possibility is for programs to ask more open-ended questions, and to accept any answers they receive. A well known example of software which attempts to tap this interactive capability is "Eliza", a program which simulates a conversation between a non-directive therapist and a patient. Using a key-word search technique, the computer examines each student response for a word or phrase stored in its internal lexicon along with cues for its use (Dever 1986, p. 206). The computer will then either give a stock response, (eg. each time the word "machine" occurs, it will respond, "Are you afraid of computers?"), or it will incorporate the key-word into its next question (p. 206). For example, the patient might begin, "I'm very unhappy these days," to which the therapist will respond, "I am sorry to hear you are unhappy." The patient continues, "The problem is my father," to which the therapist queries, "Tell me more about your father," and so continues the conversation (Underwood 1984, p. 71).

Another example of this kind of interactive flexibility is described by Dale Burnett and Larry Miller

in their review of a reading program for elementary students, grades 4-6 (1984). The program begins by displaying only the title of the story, "An Unusual Friend", followed by the question, "Who or what do you think An Unusual Friend is?" Students may then respond with as many as six answers, but must insert at least one answer before the program will allow the next page to be seen. Students reconsider their answers after each additional segment of text is read, at which point they may keep, delete, or add new answers. The intent of the lesson is to focus on the reading process rather than product, thus, invented spellings are encouraged, and no record of responses is kept. When the last part of the story is revealed, students are informed that their final predictions are required, and they have the option of re-reading all or part of the story. Small group discussions follow the computer exercises, and students discuss the reasons for their choices at various stages of the activity (Burnett and Miller, 1984). There is no fixed answer to the question posed at the beginning of the program, rather any answer which logically fits with the story is acceptable.

Adventure games and interactive fiction programs are examples of flexibility in computer questioning and response. In the former, the reader experiences a series of adventures while working his/her way through a maze. The program describes each step along the way, requiring

the reader to make decisions which will enable him/her to escape. The computer is able to respond appropriately to the reader's natural language responses due to the limited dimensions of the maze and the scope of interaction demanded by the program (Dever 1986, p. 205). Where an adventure game is primarily a puzzle solving activity, interactive fiction depends on the reader becoming a character in the story. The reader essentially interacts with the story characters, giving them advice or asking hypothetical questions (p. 205). In both types of programs, reader choices have definite consequences, a feature which demonstrates the flexibility of computer response.

2. How does the program respond to student errors?

A program format in which there is no right or wrong answer may not be appropriate for some instructional goals. In this case, it is important to examine how the computer handles student errors. Many programs use multiple choice questions as the only questioning strategy, and in some cases, when students answer incorrectly, they are simply given two or three more tries before the computer gives them the answer (Underwood 1984, p. 47).

Alternatives to this kind of error response exist, one of which involves anticipating errors and then diagnosing them in order to provide hints as to the nature of the problem (p. 48). Similarly, Dever points out that

"materials can be designed which branch into instruction in a number of skills based upon each student response" (1986, p. 198). In this case the program would analyze student errors, "branching" or guiding the reader in exercises appropriate to the student's needs and explaining correct answers.

3. Can the program discriminate between significant and insignificant errors?

Most programs currently in use do not allow student responses to vary either syntactically or orthographically from the "correct" programmed response. However, programming techniques do exist which enable the computer to distinguish between significant and insignificant errors (Underwood 1984, p. 42). Underwood describes a program for teaching French at Dartmouth which exemplifies this capacity. The program edits student input, recognizing non-significant errors, such as typos and extra letters, while judging significant errors as "close" or "not close". If the student response is close to the correct one, students get a second chance to answer (1984, p. 42).

## INFORMATION PROCESSING

According to schema theory, both text-based and knowledge-based schemata must be activated for successful reading comprehension to occur. Text-based processing ensures that the reader will be sensitive to information

that is new or that doesn't fit his/her ongoing hypothesis about the content or structure of the text, while knowledge-based processing helps the reader to resolve ambiguities or select alternative interpretations of incoming data (Adams and Collins, 1979; Carrell and Eisterhold, 1983). Furthermore, text-based processing requires knowledge of rhetorical structures and conventions, whereas knowledge-based processing requires knowledge of the world outside texts, for example, knowledge of personal relationships (Silberstein, unpublished). Although schema theory makes the above distinction between these modes of information processing, it also asserts that both occur at all levels simultaneously (Rumelhart, 1980). In reality, it is difficult to pinpoint which reading skills activate text-based schemata and which activate knowledge-based schemata, since reading is a wholistic and interrelated process. Nevertheless, this distinction is useful in understanding the reading process, and determining which activities aide in more effective comprehension. The following questions were developed to help instructors determine if reading software engages the reader in both processing modes:

4. Does the program encourage the use of prediction strategies?

In her evaluation of a reading program called "TRAY", Vivien Johnston points out that reading is an

active process of psycholinguistic guessing which involves all language systems, including syntactic, semantic and orthographic information, and that "both perceiving and predicting meaning are important in effective reading" (1985). "TRAY" exemplifies this in that students must recreate text by predicting missing letters, letter groups, words or longer units. Students may "buy" letters from the computer; however, predicting scores points, while buying loses them. For example, in one class session, students began by buying the letters "e" and "a". Knowing that the source of the passage was from a text called "Coral Island", students hypothesized that the pattern "ea-ee" was "sea-ee", and went on to infer "sea-weed" (Johnston, 1985).

The "Unusual Friend" program mentioned above requires students to make predictions about this unknown entity using syntactic, semantic and pragmatic clues contained within the story, as well as those within the students' minds (Burnett and Miller, p. 145). In addition, the program helps students to see reading as a process, since they must alter their predictions based on increasing amounts of information (p. 145).

5. Does the program encourage the use of problem-solving skills?

Like adventure games, computer simulations are good examples of programs which demand the use of problem-solving skills in order to accomplish some purpose.

Philip Brady describes one such program, called "Where in the World is Carmen Sandiego?" in which players take the role of a detective who must solve a mystery (1986). In an attempt to track down a wanted criminal, the detective travels around the world finding and analyzing clues. This simulation requires readers to use skills such as: attending to details, recognizing cause and effect, drawing inferences and using reference materials. Furthermore, because the reader is using these skills in a meaningful and responsive context, the simulation provides natural consequences for errors. According to Brady, in the "real world" reading is guided by the reader's own motivation or needs; thus, it makes sense to teach reading comprehension in a more realistic, problem-solving context (1986).

"TRAY", described earlier, is another example of a program which uses problem-solving as a strategy for developing reading skills. This occurs as students use bottom-up processes such as phonic recognition and word attack skills needed to decode individual words, as well as top-down processes to recreate the meaning of the text as a whole (Johnston, 1985).

6. Are text-based activities presented in the context of a reading passage?

Despite the fact that students often need practice on specific text skills, it is important that such exercises occur in the larger framework of a reading

passage. Schema theory clearly reinforces the interrelatedness of the two processing modes; however, bottom-up skills are often isolated in an effort to focus on discrete skills.

In her chapter on Computer-Aided Reading Instruction, Dever introduces a chart which separates vocabulary building activities according to level of complexity and processing (bottom-up/top-down) skill (1986, p.187). Although the bottom-up vocabulary-building skills focus on discrete items, they are always presented within the context of a larger passage (see Appendix 2). For example, a text-based activity within the context of a reading passage might require the reader to work through a maze to find words which describe the main character of the story (p. 187).

7. Does the program encourage the use of contextual analysis skills to help improve comprehension?

Stieglitz recommends contextual analysis activities, such as cloze procedures, as an alternative to the traditional subskill approach to improving reading comprehension (1987, pp. 29-28). These activities encourage the reader to use the linguistic and semantic clues of a particular context in order to recreate the meaning of a text. This is exemplified by the "TRAY" program which requires readers to use language resources, such as a grammatical knowledge, to predict potential meanings (Johnston, 1985).

BACKGROUND KNOWLEDGE

Carrell and Eisterhold point out that as early as 1781 Immanuel Kant claimed that "new information, new concepts, new ideas can have meaning only when they can be related to something an individual already knows" (Carrell and Eisterhold, 1983). Based on this tenet, schema theory asserts that people do not passively receive information into "empty receptacles". Rather, because of their accumulated knowledge of how the world works, they are able to impose organization and inferences onto input (Lebauer, 1985). This is certainly true for any person involved in the reading process; however, of particular relevance to ESL reading comprehension is the existence, or lack thereof, of culture-specific background knowledge. If a reader's background differs significantly from that of the author, and if the schemata needed to understand a particular concept are culture-specific and not part of the reader's cultural background, miscomprehension is likely to occur (Melendez and Pritchard, 1985; Carrell and Eisterhold, 1983). For this reason, ESL instructors using computer-aided reading instruction must consider whether or not a program builds on and activates existing background knowledge, in particular culture-specific knowledge needed to comprehend the text.

8. Does the program pre-suppose knowledge outside the realm of student experience?

Although schema theory asserts the need for appropriate background knowledge for successful comprehension, it does not imply that students should read only about things with which they have some familiarity. Nevertheless, the importance of background knowledge in ESL instruction has generally been under-emphasized (Carrell 1984, p. 332), ard is, therefore, a significant consideration when selecting computer software. Instructors must be aware of the ways in which a program presumes culture-specific knowledge. With this awareness, they can choose either to use pre-reading activities to activate and build schemata, or select another program which is not so culturally bound.

9. Does the program build and activate necessary schemata through pre-reading activities?

Pre-reading activities which prepare the ESL reader for a text generally require the provision of background information and the previewing of the text so that students avoid reading material "cold" (Carrell and Eisterhold, 1983). Such activities help students gain familiarity with the norms, values and behaviors found in the cultures and texts of the target language (Melendez and Pritchard, 1985). Carrell suggests the use of key-word or key-concept association tasks as particularly helpful for ESL students of lower proficiency levels, for whom meaning tends to break down at the word level (1984). Brady points out that computer simulations could address

this need by allowing readers to ask for background briefing at critical points during the task (1986). In addition, programs such as "The Unusual Friend" program discussed earlier exemplify how background knowledge can be activated by using open-ended questions followed by class discussion.

GENERAL

There are many considerations in the selection of reading software which this evaluation does not address, and which are not in the scope of this study. However, the following questions seemed to stand out as crucial factors in the usefulness of reading software for ESL reading instruction:

10. Is the computer put to good use?

Although this question does not pertain to schema theory, it is an important one to include in any evaluation of reading software. Much of the criticism of current software refers to available programs as nothing more than electronic workbooks (New England Reading Association, 1986). In other words, if a workbook can perform the same task as the software, then how can the considerable expenditure for both hardware and software be justified? The reading professional, then, should insist that the computer do more than the workbook, and that software programs make use of the interactive capabilities of the computer.

11. Does the program have a text-authoring system?

An important consideration for any reading professional interested in using software is whether the user has the option of entering texts of his/her choice. The option to edit is important if the program is to be used for any length of time. If the text selections are limited, then once the activities designed for that text are completed, the program becomes obsolete. In addition, a program is much more valuable if teachers have the ability to adapt lessons and texts to their own students. This is particularly true in the case of ESL students where culture-specific knowledge is a significant factor in selecting reading material.

## APPLICATION OF THE EVALUATION INSTRUMENT

In this section of the paper, the evaluation instrument discussed above will be used to evaluate four software programs currently on the market. A general description of each program will be followed by a point-by-point examination of the software using the evaluation instrument. The purpose of this section is to demonstrate how reading professionals might use the evaluation instrument.

Diascriptive Reading II, by Carol & Ron Buchter. Educational Activities, Inc., Freeport, New York. © 1984 Activity Records, Inc.

This program is described in the literature which accompanies it as a "diagnostic, prescriptive, tutorial

reading program". It is diagnostic in the sense that it includes diagnostic tests for student placement, prescriptive in that it prescribes at which level students should begin, and tutorial in how it works with the student.

The performance objectives of the program are as follows: "Through the development of six skill areas, the student will increase his/her reading comprehension, and will also benefit from the immediate tutorial responses as well as from the opportunity of being able to progress at his/her own rate".

The rationale behind the program's design is that students can work at their own pace while the computer responds by providing encouragement for correct answers and instruction for incorrect answers.

The tutorial section of the program is the focus of this evaluation because it directly involves the student. The program involves the student in six tasks:

1) answering questions which pertain to details from appropriate selections.

2) distinguishing fact from opinion based on a variety of material.

3) drawing inferences or conclusions about feelings, moods, speaker, personalities, advertising, techniques, etc.

4) categorizing and identifying main ideas, and finding statements which do not belong in paragraphs.

5) ordering events, lists & directions.

6) answering a variety of multiple-choice questions relating to synonyms, antonyms and homonyms in cloze exercises and analogies.

EVALUATION

1. Is the program flexible in its questioning strategies, and in its responses to student answers?
This program is not flexible in its questioning strategies, nor in how it responds to student answers. Each question has a "right" answer; if the student fails to produce it, the computer is programmed only to respond that the student's answer is not correct.

2. How does the program respond to student errors?
In only one section of this program, the "Sequence" segment, are students encouraged to "try again". Usually the program simply provides the correct answer.

3. Can the program discriminate between significant and insignificant errors?
No option is provided for this. All questions are in a multiple choice format.

4. Does the program encourage the use of prediction strategies?
No. This program includes no exercises which encourage students to make predictions about the reading.

5. Does the program encourage the use of problem-solving skills?

The program does encourage some problem-solving in that students are asked to draw inferences. However, isolated paragraphs, graphs & tables are used as the text. There is no larger context for problem-solving.

6. Are text-based activities presented in the context of a reading passage?

The vocabulary exercises are presented in the context of a paragraph. Students read the paragraph and answer questions about it.

7. Does the program encourage the use of contextual analysis skills to help improve comprehension?

There are isolated exercises where students are expected to rely on context clues in order to answer a question about the reading selection.

8. Does the program pre-suppose knowedge outside the realm of student experience?

Not really; these are quite general topics.

9. Does the program build and activate necessary schemata through pre-reading activities?

No. There are no pre-reading activities, or exercises to help students activate schemata.

10. Is the computer put to good use?

The only salient feature of this program in this respect is that students get immediate feedback.

11. Does the program have a text-authoring system?

No. Teachers cannot add their own texts or exercises to this program.

SUMMARY: This program focuses primarily on lower-level skills, while ignoring higher-level processing. It does not encourage the student to "make meaning" out of the text, but rather dictates what the meaning should be. It does not approach reading wholistically.

VERSATEXT READMaster: A Reading Skillbuilding Program, © 1987 Innovative Courseware Design, Provo, Utah.

This program is designed to help students improve their reading skills and includes 14 lessons covering a variety of topics at several skill levels. Each lesson includes a reading selection and five types of reading skill-builders. These are:

1) Timed Reading---the student selects the speed at which s/he wants to read. This can be increased or slowed as the student wishes.

2) Vocabulary Helps---some of the uncommon or difficult words in the reading are highlighted and then defined upon request. This can be done while the selection is being read or separately.

3) Main Idea Helps---main ideas from the reading selection are highlighted. This can be done while the student is reading the passage or as a separate activity.

4) True/False Questions---this gives the student the opportunity to check his/her comprehension of the reading passage. If the student answers incorrectly, the section of the text that contains the correct answer is displayed on the screen.

5) Multiple-Choice Questions---this tests the student's memory of the details in the reading. If the student answers incorrectly, the text is shown and the student is encouraged to try again. If the second guess is also incorrect, the text containing the pertinent information is highlighted and the student is given another chance. If the third guess is still incorrect, the program provides the correct answer.

EVALUATION

1. This program is not flexible in its questioning strategies, nor in how it responds to student answers. Each question has a single "correct" answer, and the program accepts only that answer.

2. In the True/False section, this program responds simply by saying "That is not correct" and by highlighting the information from the text that provides the student with the correct answer. In the Multiple Choice section, the student is given three chances to get the correct answer. With each "chance" the student is given more clues to work with.

3. No, there is no option for this in this program.

4. No, this program includes no exercises which encourage students to make predictions about the reading.

5. This program does not encourage the use of problem-solving skills in order to comprehend the reading, although the True/False section does encourage the use of hints.

6. Yes, all exercises are presented in the context of a reading selection.

7. No, this program does not include exercises which encourage students to analyze the context of the passage in order to understand it.

8. Some of the topics of the reading selections seem somewhat culture-specific. For example, for a student who is not familiar with Christianity, the "Bible Stories" reading selections would probably seem quite foreign.

9. Although not designed specifically for this purpose, the Vocabulary and Main Idea Helps sections could be used as pre-reading activities.

10. The program does give immediate feedback and quick "help" when requested, but in other respects it is not much different from a workbook. The Timed Reading option is a nice feature.

11. The READMaster program itself does not have an authoring system. However, the VERSATEXT system does include an authoring system, TEXTMaster¬, which teachers can use to design and program their own lessons to run on the READMaster system.

SUMMARY: This program does not approach reading in a wholistic manner. Students are not encouraged to develop higher-level skills of interpretation or analysis, although many of the exercises provided would be helpful for teaching lower-level skills. This program sets all of the exercises in the context of a reading passage, which

is important for "making meaning," and it includes activities that could be used in pre-reading.

Adventure 1.0, © 1982 The Software Toolworks

This program is an adventure game designed to provide entertainment for adult native English speakers. Because we know of at least one ESL instructor who has used this program in a reading class and because we feel that this type of program is useful, we have included it in this study.

The object of this program is for the player, in this case an ESL student, to follow a series of written clues and hints in order to get through a complex underground adventure, collect treasures along the way and arrive safely back at the starting point. This is done in steps. The player makes a move and the computer responds by disclosing the player's location. By using this information, along with other clues and hints the computer provides, the player can move through the adventure.

EVALUATION

1. Yes, this program asks open-ended questions that have no single "correct" answer, meaning that students can respond as they see fit and the computer will give an appropriate reply, even if it's only "I don't know that word."

2. If the student makes a wrong choice, the computer will give hints on how to get back on the right track. The computer never simply responds, "that is not correct".

3. Yes, if the student misspells a word or uses incorrect grammar, the computer still responds. For example, in the case of a misspelled word the computer may respond with "What?" or "I don't know that word," which encourages the student to correct the mistake or try a different word.

4. Yes. In order to play this game successfully the student must make predictions about which way to go and what to do in order to get through the adventure. If the student's prediction is wrong, s/he must refine it and try again in order to proceed.

5. Yes, the whole adventure involves problem solving. The student must draw inferences from clues and hints and must make decisions based on how the computer responds.

6. Not applicable to this program.

7. Not applicable to this program.

8. Yes, this specific adventure game does seem to presuppose knowledge of magical kingdoms and/or fairy tales. For example, the program refers to "black rod with a star on it," which a native speaker would likely infer to be a magic wand, while an ESL student may not make this inference. In addition, there is a lot of specialized vocabulary.

9. The introduction to the program provides some "pre-reading" information about the game, but it is probably not enough for ESL students.

10. Yes, this program makes excellent use of the interactive capabilities of the computer. (See 1 and 2 above.)

11. No, it is not.

SUMMARY: Although some of the language used in this program would be difficult for ESL students to understand, it nevertheless provides a fun and useful task that engages students and encourages their learning. There is a repetition of vocabulary in sentences, and, because the students are involved in a task which requires problem solving, a communicative urgency to learn the vocabulary is created. Students use many higher-level inductive strategies to get through the game. One major drawback of this particular program is the length of time it takes to successfully complete the adventure. At last count, our native-speaker instructor had spent six hours with the game and had still not finished it!

Reading Strategy Series: Super Context and Super Skills by Lin Lougheed and Peter Combes, Instructional Design International, Inc., © 1986 Prentice-Hall, Englewood Cliffs, New Jersey.

The goal of this program is that students "learn how to make assumptions about grammar, style, vocabulary and context" when they read. The program is presented in two parts: "Super Context" and "Super Skills".

"Super Context" is based on the belief that reading is a self-paced, private activity and that teachers must allow students to use what they know in order to learn what they don't know. It is an authoring system programmed to manipulate passages using cloze and fill-in-the-blank formats, which "stress the integrative aspects of language use." Literature accompanying the program states: "Words do not operate independently; they are dependent on one another for meaning. By recognizing grammar markers, the students will become aware of the subtleties of language. By recognizing stylistic markers, they will become more familiar with the cultural components of language. By recognizing contextual clues, they will better comprehend the entire passage."

This program is concerned with the "process in reading." Teachers can design the cloze exercises to suit their students' needs and interests. The teacher can select the text and decide how often (every "nth" word) a word will be deleted, or can delete words selectively to make up the cloze exercise. S/he can also provide a number of clues for the student to use in solving the cloze "puzzle." The options available for clues are: the first and/or last letter of the word, the length of the word, acceptable alternate answers, synonyms for the word, context clues, multiple choice options, the part of speech of the word and a "messages" category for other clues. The student can call up these clues as needed.

The other part of this program, "Super Skills", is designed to help students develop the skills they need to make the previously mentioned assumptions. This part of the program includes Speed Exercises, Scramble Exercises and Completion Exercises, all of which are based on the selected reading passage.

Speed Exercises are designed to "help users improve their eye/word coordination." A student can practice speed reading word by word, line by line, or paragraph by paragraph. Scramble Exercises help students "improve their ability to recognize rhetorical patterns and develop an awareness of main ideas and supporting statements." Finally, Completion Exercises help students "to make assumptions" when they read and "to view a word or a passage as the sum of its parts."

EVALUATION

1. This program doesn't incorporate open-ended questioning strategies; however, the Scramble Exercises allow for a variety of acceptable answers. If a student produces a sentence or paragraph that has a different order than the original, the student is not told that his/her response is incorrect. Instead, the computer simply shows the original order.

2. The "Super Context" Cloze Exercises are set up to provide up to 34 different clues that will aid the student in determining the correct word for each blank. These

clues are written into the program by the teacher, so they can be tailored to an individual group of students.

3. No, this program does not make this distinction.

4. Yes, the Cloze Exercises and the Completion Exercises encourage students to make predictions about the text. In the completion section, students can decide how many words to block out of the paragraph. This gives them the option of making the exercise as difficult or as easy as they wish. Students even have the option of blocking out the whole paragraph and making guesses to fill it in.

5. Problem solving is involved in both the Cloze Exercises and in the Scramble and Completion sections. Students are constantly trying to guess words or letters on their way to discovering meaning.

6. Yes, all activities are presented in the context of a reading passage.

7. Yes, one of the focal points of the program is the cloze exercise, where students analyze the text in order to make it meaningful to them.

8. No, this program includes texts on a wide variety of topics. In addition, because Reading Strategies is primarily a text authoring system, texts especially suited to any one group of students may be typed in by the teacher.

9. This program does not include activities specifically designed for pre-reading.

10. Yes, this program provides hints, clues and immediate feedback that a workbook cannot.

11. Yes, this program is primarily an authoring system. (See 8 above.)

SUMMARY: Although this program does not include activities designed to activate background knowledge, it includes many activities which encourage students to use higher-level skills in processing reading texts. It also includes activities to develop lower-level skills. This program seems to successfully integrate text-based and knowledge-based reading strategies.

## DISCUSSION

Since this study is by no means complete, this section will address the various concerns that arose during the course of the study and will also attempt to define the areas in which further research is needed.

The primary concern of this study was that the evaluation instrument may not have captured all the important aspects of schema theory as it applies to CARI. Since this concern arises whenever theory is applied to a particular field, it is only with time and input from other researchers that this concern can be adequately addressed. Thus, field testing of the instrument among ESL professionals interested in CARI is of primary importance. It is hoped that instructors and materials developers will use and give feedback on this instrument

when designing and reviewing ESL reading software. Only through constructive feedback by professionals can the instrument be refined and further developed for widespread use.

A further problem that this study confronted was the scarcity of reading software available for evaluation. Due to the fact that many ESL professionals have become discouraged with the quality of reading software, and due to time constraints, this study was unable to evaluate a substantial number of software programs. Thus, it is hoped that with wider dissemination of the instrument further field-testing and refinement will occur.

Finally, the instrument is limited in that it evaluates reading programs only from the perspective of schema theory. When deciding upon whether to adopt a piece of software, the reading instructor should look at other aspects of the program as well, such as pacing of instruction, clarity in giving directions, clear and legible text, ease of use, appropriate use of graphics, sound, color etc. (Bradley, 1983-1984). These features, also known as surface features, are important in terms of the successful long-term use and should not be underestimated. However, it was not the intent of this study to evaluate these features. Examples of appropriate questions that should be addressed are provided by Bradley in her article, "The Surface Features of Four Microcomputer Reading Programs" (1983-1984).

In conclusion, although the goal of this study was to develop an evaluation instrument based upon the tenets of schema theory, an underlying objective was to expose the need for theoretically sound reading software. The evaluation instrument reflects a theoretically ideal reading software program, despite the fact that such an ideal may not be achieved in any one program. Nevertheless, the instrument remains a valuable tool which can aide ESL professionals in the application theory to practice.

APPENDIX 1

## EVALUATION OF READING SOFTWARE ACCORDING TO SCHEMA THEORY

INTERACTIVE CAPABILITY: Does the program interact with the reader?

1. Is the program flexible in its questioning strategies, in its responses to student answers? (e.g. open-ended questions and responses.) If so, how?

2. How does the program respond to student errors? (e.g. "branching", hints and clues). Describe.

3. Can the program discriminate between significant and insignificant errors? (e.g. computer comprehends student answers despite spelling errors). Explain.

INFORMATION PROCESSING: Does the program engage the reader in both text-based and knowledge-based processing?

4. Does the program encourage the use of prediction strategies? (e.g. program asks reader to form and refine hypotheses). In what ways?

5. Does the program encourage the use of problem solving skills? (e.g. reader must use reading skills, such as drawing inferences, to accomplish tasks). In what ways?

6. Are text-based activities presented in the context of a reading passage? (e.g. word exercises occur in relation to text). How?

7. Does the program encourage the use of contextual analysis skills to help improve comprehension? (e.g. use of cloze procedures). Describe.

BACKGROUND KNOWLEDGE: Does the program build new background knowledge as well as activate existing background knowledge

8. Does the program pre-suppose knowledge outside the realm of student experience? (e.g. how culturally bound is the text?). Explain.

9. Does the program build and activate necessary schemata through pre-reading activities? (e.g. program uses text -previewing activities such as key-word or key-concept association tasks). Describe.

GENERAL

10. Is the computer put to good use? (e.g. program does something "paper and pencil" cannot?) In what ways?

11. Does the program have a text-authoring system? (e.g. can teachers add texts and exercises of their own?)

APPENDIX 2

| | Low Level of Complexity | Mid Level of Complexity | High Level of Complexity |
|---|---|---|---|
| *Bottom-up Skills* Vocabulary Building (Discrete Items) | The student should find the words in the maze that describe the main character in the passage he has just read. (This activity might be presented in a game format, the student racing against time to finish, for example, before the glass overflows or the whachamacallit eats the whole thingemajig or bells and whistles sound and the screen bursts into color.) | If the student cannot guess the meaning of an unfamiliar word, or he determines from further reading that his guess was incorrect, he should study the word for morphemic similarity to other words that he knows. (The computer might respond to the student's request for assistance by listing words with the same root and affixes and asking him to identify them, and to additional requests by helping the student graphically pull the word apart, define root and affixes, identify examples of their use in a randomly selected listing of words, etc.) | The student should define words selected from a reading passage he has just finished reading. (The computer might run a key-word search through the student definition and match words found in the student answer with keywords in the program glossary. When discrepancies occur, the computer can query the student using an expanded Eliza-type interaction until words in the student definition match keywords in the program glossary.) |
| *Top-down Skills* Vocabulary Building (Vocabulary in Context) | The student should utilize context to define specific words and phrases from a reading passage. (The computer might present the student with optional definitions or synonyms down the left side of the screen. A graphical or textual representation occurs on the right that reflects or logically follows from the student's choice. After the student selects one of the options, he views or reads the resulting representation on the right and compares it with the original passage. He may request a "grade" on the accuracy of his definition.) | The student should try to guess the meaning of a word or phrase from its context and check his comprehension against future reading. (The computer might present a reading passage to the student. After he has read the passage the computer might offer the student the choice of selecting the correct definition immediately or continuing to read the passage, this time with contextual clues highlighted. The student may ask for further assistance which will come in the form of further contextual clues being highlighted and in the form of notes on how he can use the highlighted forms to arrive a more complete comprehension.) | The student should work a crossword puzzle with a synonym (or antonym, definition, paraphrase) of the underlined word (or phrase). All hints are sentences from the reading passage he has just read. (The computer may respond to student request or response with hints or contextual clues from the reading passage that he may have overlooked. The student may also request morphological clues. The game aspect of crossword puzzles might be enhanced by scoring most heavily for the use of contextual information.) |

Figure 1: Examples of CARI Activities for Particular Reading Skills across levels of Task Complexity

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