AN INFORMATION PROCESSING MODEL FOR COMPUTER-ASSISTED
INSTRUCTION FOR FOREIGN LANGUAGE READING

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ABSTRACT

This article presents the rationale behind a model for the use of the computer in the development of reading comprehension. Basic assumptions concerning reading are delineated. The model is explained as having three basic components: intake (text processing and text comprehension), personalization, and extension. The operationalization of the model is also described.

KEYWORDS: CAI, Comprehension, Extension, Information Processing, Personalization, Reading
Text Processing, French, German, Spanish, Woksape, University of Minnesota

The University of Minnesota has just received a 7.5 million dollar grant of hardware and software from IBM for some 40 or more projects. The overall project is called Project Woksape, a Dakota Indian word for learning. It is a comprehensive program to expand the use of microcomputer work stations in both teaching and research at the University of Minnesota. Part of the project is a cooperative undertaking among two colleges and four departments within the University. The colleges of Education and Liberal Arts have sponsored a joint project among the departments of French and Italian, German, Spanish and Portuguese, and the Program in Second Languages and Cultures Education in the Department of Curriculum and Instruction. This joint project is concerned with creating courseware for the development of reading comprehension in three languages: French, German, and Spanish. One of the project’s main benefits will be to extend microcomputer use in second languages beyond the usual drill and practice of grammatical structures. The products of the project will be courseware packages in French, German, and Spanish which will lead students to develop their ability to comprehend written text.

This article presents pertinent background in the language learning and acquisition fields, specifically relating to input and intake, as these relate to the development of reading comprehension, a few assumptions about reading upon which we draw heavily, the presentation of a model for reading in a second language using the computer, and the operationalization of the model in a computer program.

IMPLICATIONS FROM LANGUAGE LEARNING AND ACQUISITION FOR READING COMPREHENSION

Since the basic assumptions about the nature of language learning have been modified since the 1960s, it is important at least to give a flavor of the principles that currently function. In this regard, we present a summary of the major hypotheses concerning the learning of a second language as presented in Krashen (1982). He discusses five hypotheses in second language learning/acquisition: the acquisition-learning distinction, the natural order of language acquisition, monitoring as learning, input, and affective filters. These hypotheses can be synthesized to create two basic principles, namely that acquisition is more important than learning, and, that to acquire language, two conditions are necessary: Comprehensible input must be available to the learner, and a low affective filter should allow input in.

The implications of these principles suggest that the conscious knowledge of grammar and vocabulary, though necessary and important, is not as important as acquisition which is the ability to use language for communication. Knowing about language is conscious learning, whereas knowing the language to communicate involves implicit learning. Further, learners should have the opportunity to comprehend language before they are asked to produce it, shifting the emphasis in language learning/acquisition from production to comprehension before production. In other words, input should come before output.

Listening and reading should come before speaking and writing. For input to be meaningful, it needs to be comprehensible and just slightly out of the reach of total comprehension, at a level which Krashen designates as i + 1 (i =
current competence in the language). In order that input be meaningful, comprehensible, and challenging, it must appear in a context, in quantity. The acquisition environment needs to be rich with such input. If the input is comprehended, it is taken in or linked with already known language, discourse structures, and facts of experience (Oller and Richard-Amato, 1983). The production of language develops from the intake, after acquisition has already taken place and only after the acquirer is ready to produce. In other words, acquisition precedes production. Affective variables are also linked to input and intake. Motivation, self-confidence, and anxiety seem to be important in taking language in. They make up what Dulay and Burt (1977) call the Affective Filter. Krashen (1982) argues that attitudes of learners which are not optimal are related to a strong affective filter and will not allow input in. Learners who have optimal attitudes are those with a low affective filter; they are more open to input. The former will not seek input, while the latter will.

In this discussion, learning plays the role of editor or monitor; it helps make changes in the forms used in communication, after the forms have been acquired. Monitoring occurs either before or after speaking or writing take place. It can be thought of as self-correction. In order for self-correction or monitoring to take place, three conditions have to be met: there must be time to apply the rules; the focus of the learner must be on form; and the performer must know the rule. In order that acquisition/learning takes place, the individual must be motivated, have a good self-image, and participate in acquisition/learning environments where there is low anxiety.

It needs to be stated here that we are providing a resume of a current model of language learning/acquisition (Krashen, 1981) which we know is not without criticism or flaws (Brumfit, 1984; McLaughlin, 1978), but the model does provide us with an important framework which can be used as a context from which CAI courseware can be developed. For other similar models, see Bialystok (1978), Gardner, et al (1974).

How do these implications impact on the use of CAI? The first implication for CAI courseware is that games and drill and practice of discrete grammatical structures and vocabulary definitions are but limited uses of the computer. Although we do not deny the use of CAI for these purposes, the goal of foreign language learning/acquisition is communicative competence. Drill and practice in Foreign Language Education, which are restricted to the knowledge level of the Bloom taxonomy (1956), must involve higher order cognitive processes in the language which contribute to the development of communicative competence. Then, drill and practice can be expanded to involve other elements of cognition, including analysis, synthesis, evaluation, and transfer of learning.

Another implication is revealed by an examination of existing materials used to teach reading in foreign language. This investigation demonstrates the contrast between current methodologies and those implied from recent developments in language acquisition theory. In practice, courses which seek to develop foreign language reading competence are directed toward the decoding of individual letters, words, and grammatical structures. Such an emphasis suggests a bottom-up approach to the development of reading competence. However, to gain real meaning from a text, the student must be led beyond letters, words, and structures to the relationship of words to sentences, sentences to the author's desired meaning, and to a connection with the reader's background knowledge. Text processing does not deny the importance of a command of vocabulary and structure, but requires that the learner focus such elements on meaning as well as on form within a context. Research in reading (Bernhardt, 1984; Carrell, 1983; Carrell, 1984; Johnson, 1970; Meyer, 1977) suggests that readers approach a text with preconceptions of passage structure and sequencing of information related to text presentation, a top-down process. In other words, the reader's background interacts in a major way with the text itself in the establishment of meaning for that text. The reader does not necessarily concentrate only on individual elements, but on the intent of the text. This research suggests limitations for the decoding processes currently used in reading practice in second languages. More important, it suggests that bottom-up and top-down processing of text are both important in the development of reading competence. In this regard, Samuels (1985) discusses the importance of attention in both decoding and comprehension activities in a developmental reading model. When attention is focused on decoding, then comprehension is reduced. Switching attention between decoding and comprehension allows for comprehension to take place. But reading is slow and laborious for the beginning reader who places heavy demands on attention and memory. Fluent readers, giving less attention to decoding and focusing more on comprehension, perform both decoding and comprehension tasks automatically and simultaneously. Although we have certainly not exhausted a discussion on reading, it is clear that reading is more than bottom-up processing from within the text itself. Any program for the development of reading must take a broader information processing approach.

A DIFFERENT VIEW

It is our belief that CAI materials can be created to use the computer's power to integrate lower level knowledge with higher order cognitive skills in developing learners' competence to process text in the target language. In this article, we present an example of a foreign language computer-assisted instructional program to develop reading
comprehension. This program teaches students text processing strategies and incorporates some writing to reinforce and expand the use of higher order cognitive processing skills.

The input hypothesis posed by Krashen suggests that language is best acquired through use and not by concentrating on the discrete elements of language structure or lexicon. Language, as studied in the classroom, generally focuses on the learning of grammatical rules; such a focus is not appropriate to acquisition. However, if the classroom is the major source of comprehensible input, particularly through the Intermediate level delineated in the ACTFL Provisional Proficiency Guidelines (1982); it can prepare students to understand and produce real language. It is our contention that there is a relationship between language learning and acquisition.

We argue that the separation of language learning from acquisition creates artificial categories. In the classroom, language learning and acquisition form a continuum where the two concepts are interrelated. There could be more emphasis on one or the other at times, depending on the focus of the classroom activity and prevalent classroom conditions. Such a continuum allows for activities to be proportionately directed to either learning or acquisition without completely ignoring the other. Such direction permits a label of focused acquisition in which some grammar learning/acquisition is taking place because of the processing exigencies of a contextualized activity in the target language. The learners/acquirers focus attention on the language and its linguistic feature(s) which fit their needs at a particular point and may facilitate intake. That need is determined by the content of the communication being used for practice. Further practice with such intake is needed to confirm or deny the learner’s hypotheses which, when confirmed or corrected, become a part of the conscious system of rules and are stored in long-term memory. At least some logical support for this continuum is available from Higgs and Clifford (1982) who suggest that plateaus in language development occur when there is an imbalance between acquisition and learning.

ASSUMPTIONS ABOUT READING

Before we present the CAI program model for foreign language reading, we present the assumptions upon which it is based. Those assumptions are drawn from the following definition of reading:

Reading is a complex process involving the organization of standardized visual symbols which represent both sound and referents, the processing of those symbols within a text, and the inference of meaning based on those symbols, the processing, and the experience an individual brings to the text.

The assumptions drawn from this definition for reading instruction, though few, are important. They are as follows:

1. The central focus of reading instruction should be on comprehension. Reading as comprehension is not a linear process, beginning with the symbol, moving then to the word, the phrase, the sentence, the paragraph, and finally to a text. Comprehension involves the integration of all such elements, and more, within a person’s head.
2. Without a context, words by themselves have no real meaning. Words take on meaning when they are processed within a text. Reading through word lists offers no opportunity for words to be experienced within the context of a story, a newspaper article, or an essay. Texts are the contexts from which meaning is derived.
3. Reading should be continuous. Comprehension should not be interrupted with cues and notes to the reader. In current foreign language instruction, readers are interrupted by cues, notes, and glosses which take them away from the processing of meaning.

DESCRIPTION OF THE MODEL

Since most students only encounter the target language in a classroom situation, it is necessary to deal with Krashen’s concept of Input in a more practical sense which supports our alternate position. The manipulation of input can be achieved with the capabilities that CAI provides. These capabilities focus Krashen’s concept of Input in such a way that it allows for control of content/context, function, and accuracy (Liskin-Gasparro, 1982; p. 22). Combining Krashen’s idea of Input with CAI forces us to rethink the use of the computer’s capabilities. An example would be a CAI reading model in which the computer is used to help the learner process reading through learner engagement of meaningful contexts. The goal is to provide enough comprehensible language to motivate the student to transfer what has been learned in the controlled and structured acquisition environment to produce independent, personalized target language (Raschio and Lange, 1984).

The following describes a computer model which uses a processing approach to reading comprehension. The phases of the model are as follows: intake, personalization, and extension.

Intake Phase

The Intake Phase comprises two elements: text processing and text comprehension.

Text Processing

In text processing, a text is presented to the learner to read. Before the learner actually reads the passage, a Preview Section introduces structures, vocabulary, and information to be encountered in the text. Thus, the Preview serves a dual purpose: 1) it calls attention to new lexical and structural items to be encountered; and 2) it orients the learner to the new content of the reading passage. In this manner, the learner draws upon previous knowledge and some experience with new vocabulary and structure to facilitate comprehension, allowing a relatively uninterrupted flow while
the text is actually being processed. The preview may be seen as often as the reader wishes prior to reading the text itself.

Once the Preview has been presented, the learner reads the text. During the first two text presentations, the learner simply engages the text. In the third presentation, two types of layered help routines are available. The first help routine presents words and structures which have been anticipated as being possibly troublesome to learners. The help screens are presented in a layered format which provides progressively more specific decoding help with each successive level as the student attempts an understanding of an unknown word or structure. These screens contain a combination of suggestions or contexts designed to help the learner process language items in the text. They contain the words, phrases, and structures in target language sentences where their meaning is obvious. They are not intended to provide word-for-word translations, nor are they word glasses normally found on the sides of pages while reading.

The second type of layered help routine is not geared to anticipated problem items, but is generic in nature. These help screens present general decoding strategies and reminders, applicable to most decoding needs that would be encountered in a particular text. If the student still is unable to comprehend the item, it is suggested that a dictionary be the last resort. Both Help Routines make the learner's process unknown information in a context instead of providing a translation. Learners may read each text several times if needed. In so doing, they are afforded the opportunity to check vocabulary and attempt a fuller understanding of the text.

Text Comprehension

Once the student has been exposed to a text and has attempted to comprehend it, a series of activities to check the student's comprehension of the text is presented. The texts to be chosen for this project will most likely be loosely related to the typology of texts as outlined in Child's (1982) and the most recent revisions of the ACTFL Proficiency Guidelines (1985). It is our intention to work with the contextual information and contextual macrostrategies of van Dijk and Kintsch (1983) when it is appropriate to apply them to the texts that are chosen. These macrostrategies are largely associated with narrative prose and may not be applicable to all text types.

Some suggested general activities relating to text comprehension which are applicable to programming with microcomputers and which we intend to use are the following:

1) Sentence Sequencing. One way of checking text comprehension is to present segments of the text on screen followed by a set of numbered sentences which, when arranged correctly, restate the content in different words. The student types the number of each statement in the preferred order and waits for verification of the choice. If an error is detected, the program will display the original text segment from a point just prior to the error; the student will be asked to try again. If needed, the program will display the original text segment from a point just prior to the error; the student will be asked to try again. If needed, the program will display the original text segment and the correctly sequenced sentences.

It is also possible to format this type of activity as a multiple choice exercise in which sets of sentences are presented and accompanied by a number or letter. The task is to read the sentence sets and to select the most appropriate sentence set. Problem items can be reviewed at the end of the activity.

2) Short Visual Segments and Text Summaries. Another suggestion is to present short sequences of the material with variant summaries of the text. Once the segment is viewed, the student is presented with three written summaries. The task is to select the most appropriate one. If the choice is incorrect, the original sequence is re-displayed; the student is asked to read the text again to select the appropriate summary. Again, at the end of the normal activity, the student may review problem items.

3) Marking, Multiple-Choice, and True/False. These activities may be constructed to check comprehension of general content, specific information, or concepts contained in a text. The student reads the items, types a response, and waits for a judgment from the program. If the selection is incorrect, the program will display the related text segment containing the correct information. Once this series of items has been exhausted, problem items will reappear so that the student is given one more opportunity to deal with the information correctly and come away from the activity with a fuller comprehension of the text.

4) Visual Cues for Concept Identification. This activity involves student-generated responses in written form. A visual stimulus in the form of a graphic or a text segment is displayed. The object of the exercise is for the student to react to the graphic or read the text segment and synthesize the information in different words. The student's responses may take a couple of forms at this point. First, the student may provide freely composed original responses to the cues. The student also may be asked to construct a response using elements presented in columns on the screen. The correct formedness of the response is less important than meaning, and therefore, if errors occur, the responses can be corrected and discussed by the student and the teacher while they view a printout of this activity.

At this point in the model, two paths are possible for the learner. First, the student's performance in the Text Comprehension activities is evaluated for the depth of comprehension that was demonstrated. If the level of
comprehension is lacking, the student is branched to a new text which is at the same difficulty level as the first text. The student then proceeds through the same Intake steps as described previously, but which are geared to the content of the new text. If the student's comprehension level is judged to meet the criteria for appropriate comprehension, the student is presented with the next phase of the model, Personalization.

**Personalization**

At this point, the student will be expected to put the new knowledge gained from the text to work in more personalized contexts. These contexts are to be related to the material that has been encountered in the reading and processing of the texts. Several possible activities may be presented in this phase which are generated by the program, but which are printed out for completion by the student and to be judged by the teacher outside the program. At present, it is not possible for the computer to judge freely constructed language. Therefore, it is deemed most appropriate that the activities generated in this segment of the model be judged by the teacher.

The student may be given a choice of topics accompanied by a set of questions which ask for more personalized information from the learner, but which derive from the content of the reading passages from the lesson. The questions can be drawn randomly from a bank of related questions and question categories in an effort to increase the activity's flexibility and interest level. An example of such a topic bank would be one that guides the learner to create a fictitious background and identity. Each category of questions could be accompanied by help screens which contain high-frequency vocabulary and structures related to the information requested in a particular question set. The task is to answer the questions and to arrange the responses in paragraph form to produce a coherent story or description which uses the processed information from the texts in a more original and personalized context.

It is at this point that student originality and creativity will come about. At this juncture, the learner can be urged to continue the development of the topic or related topics in the Extension phase of the model. If the student's efforts in Personalization are seen as inadequate, the teacher may decide to have the student reenter the lesson to read more passages in an attempt to acquire more command of the vocabulary and structures.

**Extension**

The Extension phase presents the student with the opportunity to draw upon a broader knowledge base to which has been added the newly acquired information and processing skills learned in the lesson. Extension is totally external to the CAI aspect of the lesson, but outlines activities which reinforce the use of materials presented in the reading and comprehension activities of the lesson. Depending on the competence demonstrated by the student in the preceding phases, the teacher suggests activities which engage the learner in reading and writing about areas of interest related to the topic that was developed throughout the lesson. The nature of the activities in Extension may require the student to read other material and to make comparisons and contrasts based on the information learned in the lesson. It is hope that any readings would be selected on the basis of their cultural content and relation to the topic developed in the lesson.

**The Teacher's Role**

The teacher plays an integral role throughout the model. It is the teacher who makes the primary determination concerning the lesson in which the individual student will work. Because student progress is recorded, the teacher is able to evaluate individual performance and prescribe remediation at several points. The teacher's role can be summarized in two main functions. First, the teacher is an evaluator of accuracy in comprehension, vocabulary, structures, and progress. Second, the teacher provides feedback and suggests future activities with which to remediate or to build on the student's current level of competence.

The goal of the model is to help the learner comprehend an ever-increasing amount of the target language. This model of computer use in the processing of text allows the learner to progress from a confined and guided set of related contexts and activities to those which require the synthesis of acquired linguistic and cultural information in more individualized activities. Once the context of the lesson is grasped, the learner proves a degree of proficiency with the targeted information by using it to create responses in the activities, and finally, in personalized and independent reading and some written production. The model allows for the processing of information along a spectrum of cognitive difficulty. We feel that it reaches further than any existing CAI courseware for foreign languages that we have encountered.

**OPERATIONALIZATION OF THE MODEL**

The computer-based model has two components: the individual lessons and the management system that oversees the entire course. A goal of this reading program is to make it adaptive to the needs of the individual student. In keeping with this goal, both components have been designed to learn about the student and to make decisions based on what has been learned.

**The Management System**

The management system, or what Tennyson, Christensen, and Park (1984) call the Macro level, monitors the progress of the student and records other information that will aid it in deciding the conditions of the lesson. In this program, the management system records such data as the number of times the text is read, the time for reading, and scores on the comprehension exercises. The management system also keeps group data with which an individual's data
may be compared. The individual lesson, or what Tennyson, Christensen, and Park (1984) call the Micro level, is chosen by the management system based on the student’s performance and diagnosed needs. Within the lesson, decisions and adaptations are made so that the student will be presented with a prescribed amount of instruction and exercise.

The model for the lesson is represented in Figure 1. When students enter the lesson and type a name, the program will check to see if that student has already begun the lesson. If the student has begun the lesson, the records will be retrieved and the student will be sent to the appropriate section. If the student is new to the lesson, he or she is taken through the Intake phases. For Text Presentation, the program chooses one of four texts. Each text involves similar vocabulary and is at the same reading level. If the management system determines a need for the preview, the student is introduced to new structures and vocabulary by that component.

The text is then presented. The student may view the text as many times as desired, but different conditions may apply for each reading. The first and second times through the text, the student is able to move forward only. The third time through the text, the student may move forward and backward through the lesson. In addition, the student may access help screens that will help with the processing of difficult text. The help screens are of two types: specific and generic.

Specific help screens are available for anticipated difficulties. They have multiple levels so that, for a particular problem, the first level gives a clue that still requires significant processing by the student; each succeeding level gives a clue that is slightly easier for the student to use. For problems that are unanticipated, generic help screens will be available to suggest general methods the student might use to solve the problem. On the fourth and subsequent times through the text, the student may move forward and backward, with generic help screens available. After each reading, the student may elect to read the text again.

Once the student has completed the text presentation, the Comprehension phase begins. At the beginning of this phase, the program evaluates a formula that involves such variables as the time taken to read the text, the number of times the text is read, the number and levels of help screens accessed, the attitude of the student, the student’s previous performance, and the group’s performance. Based on this formula, the program decides on the number and level of comprehension exercises to be presented. The exercises are of a type that can be judged easily by the computer: matching, multiple choice, sequencing, and true/false. After the comprehension exercises are completed, the program will decide if the criteria have been met and will update the performance variables. If the criteria have not been met, another text from the same level will be chosen and presented in the manner described above. If all texts are exhausted, the student is informed that the lesson is being terminated and the teacher is notified that the student needs extra help.

Once the comprehension exercises have been successfully completed, the student enters the Personalization phase. The degree of structure provided is determined by the program, based on the student’s performance. The student’s responses are judged by the classroom teacher and the results are then entered into the program by the teacher.

The Extension phase comprises various suggested activities, involving more writing and creativity than the preceding phases. These activities will be accomplished off-machine and will be evaluated by the classroom teacher.

Upon completion of all phases, the performance data is sent to the management system. When the student returns for the next lesson, the management system uses the accumulated data to make decisions about how the lesson will be presented to the student.

As described above, the computer-delivered lesson will utilize the abilities of the computer to adapt the conditions and amount of instruction for each student. The management system will learn as the student progresses.

Figure 1: Operational Mode
through the course. Within each lesson, decisions about amount and level of instruction will be made that reflect the needs of the individual student.

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