

# Breaking a Conceptual Bottleneck in Computer Application to Language Arts through a Focus on Transactional Learning

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Although microcomputers and language arts educational software titles are increasingly available in schools, little evidence exists that computer applications in language instruction are seen as offering a broad or even appropriate approach to learning. We feel that this is the result of a conceptual bottleneck caused in part by the acceptance of an inappropriate behavioural model of language learning. We endorse instead a transactional model of language learning and define an overall paradigm of computer use with three categories of computer applications based on this model. We argue that, unlike the contemporary product orientation of the behavioural model, the process orientation to computer use which arises out of the transactional model will employ the technology more fully and appropriately and lead to greater language learning.

Bien que les micro-ordinateurs et les logiciels servant à l'apprentissage des langues soient de plus en plus répandus dans les écoles, il ne semble pas que ces logiciels soient considérés comme des méthodes d'apprentissage complètes ou même appropriées. Nous croyons que c'est là le résultat d'une sorte d'embouteillage conceptuel causé en partie par l'acceptation d'un modèle d'apprentissage (comportemental) inapproprié. Nous privilégions plutôt le modèle transactionnel d'apprentissage des langues et définissons un paradigme global en regard de l'utilisation des ordinateurs ainsi que trois catégories d'applications informatiques fondées sur ce modèle. Nous soutenons que *l'orientation processus* de l'utilisation de l'ordinateur, laquelle dérive de ce modèle, réussira mieux que la présente *orientation produit* à tirer profit de la technologie et à favoriser l'apprentissage des langues.

As soon as microcomputers appeared in schools, educators began to laud their potential. Hirschbuhl (1978), for example, described the computer as "education's dream machine," and Papert argued that the ability of the computer to "concretize" the formal would have consequences for intellectual development that "could be qualitatively greater than the cumulative effects of a thousand other" innovations (1983, p. 4). With respect to language arts, similar optimistic projections appeared and continue to appear. Clements (1985), for example, feels that "the area in which [computers] may have the most profound impact on children's thinking is language arts" (p. 191).

However, these visions soon were accompanied by parallel observations of impediments. Forman summarized a series of studies which identified reasons why "there is such a gap between the actual and potential use of computers in education" (1983, p. 133). She found the following situations consistently cited as impediments to effective computer use in schools: insufficient funding for hardware and software, insufficient and inadequate software, confusing diversity of computers, lack of opportunity for teacher training, and negative or skeptical attitudes held by some teachers and administrators about the management of computer access in school settings. Chambers and Bork (1980) gave a similar list of problems but predicted that these difficulties would be considerably reduced by 1985.

Their prediction has been fulfilled. Multiple sets of computer systems are now found in most elementary and secondary schools; over 8,000 commercial software packages are now available, many of high technical quality, and most of this available software runs on one specific popular microcomputer system with which many teachers and students are familiar. Inservice opportunities for teachers are more readily available, and most faculties of education offer computer applications courses (Collis & Muir, 1986). Yet, despite this reduction of the major problems of the early 1980s, classroom use of the computer for language education is still limited. For example, a recent survey of over 2,300 elementary and secondary schools in the United States conducted for the National Institute of Education and the National Center for Education Statistics indicates that only 6% of all English teachers use computers as a teaching tool (Newsnotes, 1985, p. 166). Why, when the major problems have been minimized, is the potential of computer use in language education still so far from the practice?

We feel there is a fundamental reason, a *bottleneck*, which is limiting the impact of computers in language education, and this bottleneck no longer can be blamed on lack of hardware or teacher training. Instead, we perceive it as conceptual in nature. We believe that the conceptual bottleneck occurs because many of the suggested uses of computers in language instruction are based on an inadequate and outdated *behavioural* model of language development, which emphasizes *product*, rather than on a *transactional* model, which emphasizes *process*. And at issue behind this contrast of models is how one is to conceive of language.

#### THE BEHAVIOURAL MODEL AND PRODUCT

The behavioural model of language development assumes that the environment shapes the learner and that a subskills approach is appropri-

ate in providing the repeated exposure necessary to develop an associative bond between language and referents. Implicit in the behavioural model is the belief that language is a closed system where words have the same meaning for all speakers of the language. Learning results from the development of a stimulus-response bond, where the learner is passive, and from sufficient iterations of a delivery process which gradually strengthens the required associative bond (Carey, 1982). Complex processes must be simplified to their various component parts so that each of the parts can receive the necessary strengthening. It is this behaviourist view of language acquisition which seems to underlie most current applications of computer-assisted language learning (Miller & Burnett, 1985; Rubin, 1983). We see this behaviouristic approach fostering a product orientation to computer applications in language instruction – using the computer to drill predetermined content – and we observe this orientation in many contemporary reviews of the place of computers in language education (Standiford, Jaycox, & Auten, 1983). This approach takes learning to be a convergent or deductive activity – one of assembling information or building discrete skills. The teacher's or program's task is to present learning with the general aim of mastery of rules, skills, or concepts. The examples cited by Standiford et al. focus on such observable products or results of learning. They also reflect the types of language arts materials most typically available from commercial distributors. A survey of such published material reveals that about 85% can be classified as drill and practice (Collis & Green, 1984a; 1984b; Rubin, 1983). The product view of computer application involves types of courseware which can be categorized as: *drill and practice*, the reinforcement of skills and concepts through repeated review; *tutorial*, the introduction of new content and the application of such knowledge to "fix" it in memory; and *gaming and simulation*, the practicing of skills and the application of concepts in a new game-like setting to improve understanding and transfer.

It should be noted that conceptually this view conceives the computer as a vehicle or channel through which predetermined content is introduced, reinforced, and applied. Student response is evaluated by reference to predetermined correct responses. Useful as this approach might be in taking some of the drudgery and tedium out of drill for some learners (see for example, Roblyer, 1985), it fails to excite classroom teachers because it is based on an outmoded and inadequate model of language learning (Harste, Woodward, & Burke, 1984) and understanding of language.

## THE TRANSACTIONAL MODEL AND PROCESS

In contrast to the behavioural model, the transactional model of language development is based on the interactions between the learner, the environment, and other individuals. Language, then, is understood as evolving continuously through "the circumstances of use in transaction with the history of literacy which the language user brings to the setting" (Harste et al., 1984, p. 93). Language is learned through the active interpretive efforts of the language user; language is open, but operates within a total semiotic system. This system includes its graphophonemic, syntactic, semantic, and contextual subsystems but cannot be reduced to any one of these component parts. None of these language subsystems is functionally independent, and any attempts to make them so distort their operation. Hunt describes the result of such isolated analyses as "textoid" language; "synthetic fragments of language which exhibit none of the complex richness of natural language, ... a richness which enables us to navigate ... effortlessly and unselfconsciously around the hermeneutic cycle of understanding" (1983, p. 5).

Within the transactional approach, the learning task is a semiotic one – a process of drawing meaning from reality and attaching it to total systems of signs and symbols. We believe the transactional model reflects the natural language learning process, and we believe its focus on process and integrated language experiences can provide a framework for computer-assisted language activities which will break through the conceptual bottleneck which currently impedes computer use in language instruction. This does not imply that we endorse without question the use of microcomputers. Instead, the position is that computers be used as a natural part of language learning.

## THE PROCESS ORIENTATION AND COMPUTER APPLICATIONS

When we reconceptualize the use of the computer from a process orientation based on the transactional model of language learning, we identify three general categories of computer applications. These are: *data retrieval*, the location and retrieval of information to solve some learning problem; *heuristic applications*, the use of the search, comparison, and analytic capabilities of the computer to determine the nature, qualities, or characteristics of the matter under investigation, based on characteristics already defined; and *model building and programming*, the development of the theoretical or conceptual nature of the matter under investigation – identifying its significant features and characteristics –

frequently through writing programs incorporating these constructs to analyze exemplars in the area of concern.

It will be readily apparent that, while the computer and its programs are still part of the channel or vehicle through which learning takes place, the process approach also makes the technology a *tool* for the learner. It becomes an extension of thinking and problem-solving behaviours as it is applied to the resolution of meaningful and relevant problems. In effect, the learner uses the computer in transactions with people and circumstances in the environment. If the learner can use the computer as a kind of thinking machine, then this process focus should be emphasized along with the product one. Perhaps one of the difficulties educators have in reconceptualizing the use of the computer to reflect the transactional model is that the locus of control of the educational endeavour shifts from the teacher to the learner. It becomes, to a much greater extent, the learner's decision what material is used under what circumstances.

We offer a number of suggestions for computer applications based on the three process categories. These suggestions are examples of the potential for language education which can be found in the interaction of the transactional model of language learning with the unique capabilities of the microcomputer. In each case, courseware for these applications either exists or is capable of being developed readily. Each application involves a kind of interaction between the user and the computer which is qualitatively different from that used in the product approach. The challenge is not therefore to develop new technology or new software but to change the perspective from which teachers apply computers to educational tasks.

### *Data Retrieval Applications*

As the three types of product applications of computers shade or blend into one another, so the three computer functions identified in the process domain flow together. These uses can be best considered as points along a continuum with data retrieval at the one end and modelling at the other. Data retrieval activities therefore are the simplest computer applications from the process perspective just as drill and practice activities are the simplest from the product perspective. Data retrieval activities enable the location and retrieval of information to solve some learning problem. At least nine types of data retrieval programs reflect the transactional model.

### Information Retrieval Programs

This type of software is perhaps the most basic example of data retrieval applications to language instruction. This approach includes the use of data bases which provide access to titles and descriptions of books and articles dealing with specific topics which correspond with areas in the reading or literature curricula in language arts. Included with such a listing would be the level of difficulty of such materials. For example, a system called *Library* has been developed for the storage and retrieval of this type of information (Collins, 1983). *Library* lets elementary students store and retrieve under different descriptions information about books read over a school year. Such programs would give students ready access to a range of information which could serve to develop reading skills as well as be a foundation for composition activities.

### Dynamic Books

Traditional hardcopy texts or reference books are linear in organization and appearance. Although users can enter the book at any point, they must at least search through tables of contents or indexes for listings, going on to the appropriate place in the book. Weyer (1982) has developed a dynamic or interactive social studies text which reduces the linearity of the information search process and so enables readers to find information without reading through the entire text. His program contains a browser which the reader can use to find information about particular topics or questions. This browser provides a table of contents and an index which are displayed at the same time as the text. Items selected from the content listing cause the program to display appropriate textual material, and the headings from the table of contents are consequently reset around the text on the screen. Key words from the subject index are also highlighted in the text. Such an approach greatly accelerates information search and retrieval, making it easier for the student to draw on more sources of information in preparing oral and written reports. Rubin (1980) suggests that such dynamic books may make reading more interactive and bring it closer to the process of conversation. This type of program has both process and product components. As an example of the use of this kind of software for product objectives, Anderson and Biddle (1975) have noted that interactive books can be designed to ask questions to determine if readers understand the content and, if a problem is found, to present the material in simpler form. More sophisticated programs might estimate the reader's compre-

hension level by the answers to questions and present text geared to the reader's ability and knowledge. This kind of procedure would parallel teaching judgements of a students' ability level through oral interaction (Collins, Warnock, & Passafiume, 1975).

### Spelling Programs

Spelling checking capability is now frequently available within word processing programs to identify incorrect spelling. This is data retrieval in language education in its most basic sense. While students should learn to spell all words used in writing, such a checking program can save considerable time in manual checking as well as encouraging the writer to use appropriate words even if unsure of their spelling. Such a use of the computer is really an extension of the writer's memory; it serves as a tool for checking the correctness of words.

In addition to checking spelling against an existing dictionary, these programs identify words used which are not in the dictionary. These words can be checked manually and added to the dictionary which then includes more of the writer's own vocabulary. These additions could be examined periodically by the student to gain some index of growth in both spelling and vocabulary and could be used by the teacher for personalizing spelling lists.

As well as offering a spelling facility, a program developed by Macdonald, Frase, Gingrich, and Keenan (1982) advises students how to edit their prose by giving proofreading advice and checking basic punctuation. Other commercial programs, such as *The Word Plus* (1981), provide the services of both a spelling checker and an electronic dictionary. This particular one shows errors in context and has a 45,000 word dictionary.

### Grammar Programs

Available with some word processing packages, these programs function like spelling programs, but their purpose is to check accuracy of grammatical usage. They scan text to determine correctness in such matters as verb number and tense. Once more, the learner is responsible for being able to use certain constructions. The program merely provides a check on this knowledge, revealing deficiencies which may be remedied by drill and practice or tutorial programs. The writer is informed about the accuracy of the writing and, since information is provided immediately and as a matter of course, the writer's revision activities are greatly facilitated. Using the computer as a tool to measure the accuracy

of certain aspects of writing can lead to more fluent and effective written composition.

### Readability Programs

Several programs designed to determine the statistical readability (grade level) of textual material are available. These programs provide an estimate of the comprehension difficulty of a passage by applying existing readability formulae. Such information would be valuable to the student in various ways, including assistance in selecting appropriate textual material for study purposes. It can also provide a means to gauge the readability of the student's own written material to adjust the readability of material to different audiences. The student can also see how writing might vary in terms of purpose or function – for example, letters compared with journals. Readability information can also provide insights into effective composition techniques.

### Language Characteristics Programs

Text scanning procedures could be used to determine word frequency and tell students the extent to which their writing (or that of others) draws upon frequently used words. High frequency word usage can lead to improved comprehension except where excessively simple vocabulary is employed. Teachers could use such programs to compare the student's writing with grade-referenced vocabulary lists to determine how a particular child's vocabulary corresponds to typical word usage for that grade. Deviations could be interpreted for diagnostic and remedial purposes. Such programs could also be used to obtain data on use of connectives, verbals, or other categories of word form and function and longer structures such as clauses in order to compare different kinds of prose or to identify the characteristics of particular kinds of writing as they relate to enjoyment, appreciation, and effectiveness of expression.

Other characteristics of the language used in reading material and in writing could be examined, including word length and sentence length, and information presented through bar or line graphs in order to compare different kinds of material. Students could then attempt to judge the effect of these variables upon comprehension in reading and effectiveness of expression in writing. A program written for the Apple microcomputer by Collis provides this sort of analysis for prose material and is available upon request.

*Writer's Workbench* (Macdonald et al., 1982) has been designed to perform these stylistic analyses. It is able to compute readability level by

several indexes, determine the average length of words and sentences, calculate the proportions of simple and complex sentences, and count the frequency of passive sentences and the noun forms of verbs. *Punctuation Style* (1982) is designed to catch punctuation errors and to critique writing by suggesting alternatives for commonly misused or overworked phrases.

### Thesaurus and Interactive Dictionaries

A number of programs use the search and replace functions of word processing software to replace words with synonyms. This procedure gives writers an opportunity to test the fit of certain critical words or expressions. Writers can select the most appropriate words and better understand the effect of context upon meaning. Similarly, the connotative dimension of meaning can be explored. For example, words such as "slim" and "skinny," which are ostensibly synonyms, create quite different affective reactions in the reader.

To serve the needs of pre-readers, Lawler and Papert (1982) developed an automated dictionary which ties the computer to a video disc containing a picture dictionary. Children use the program to examine picture-word relationships in any of several ways. These include *browsing*, where the children try to match their invented spelling with conventional spelling; *looking-up*, where they examine items grouped together into conceptual categories; and *labelling*, where they make their own labels for entries to facilitate recovery. Also, various programs have been developed which offer the young child lists of nouns and verbs and then show an animated picture sequence corresponding to whatever simple sentence the child enters from these lists.

### Story Starters

Highly useful and enjoyable programs have been designed to provide story starters for young writers. First, the major elements of story form such as character, setting, and plot are presented. The programs often randomize examples of these elements to give the writer a large choice of ideas. Terry (1983) has a program to stimulate creative writing which, as does its hard copy counterpart, randomly juxtaposes different data phrases identifying person, action, and location as a starting point for writing. This program also supplies specific questions to assist the young writer in getting under way.

In another program, *Writing a Character Sketch* (1983), students choose to write about a fictional character, historical figure, or personal acquaintance. Upon selecting a character, they are required to type in two words

describing the person. They then go on to develop the character by pursuing certain topics related to character development. If the topic *Behaviour* is chosen they go on to explore such subtopics as "How the character acts" or "What the character says." This procedure is used to explore topics related to character development. The product is a printout of the student's outline for a character sketch which may then be used in a fully developed narrative.

### Message Systems

Readers and writers can communicate their own material to each other through computers, thus developing language skills. Levin (in Collins, Bruce, & Rubin, 1982) reports his use of a message system connecting elementary children in California and Alaska. This system uses micro-computers operating over phone lines and promotes varied kinds of writing in a natural manner. This writing is done for a purpose, thereby developing an awareness of the way language is used under different circumstances. In addition, such a message system introduces children to the broader uses of such electronic mail systems in our society and provides a natural way to make reading and writing as functional for children as for adults.

*The Interactive Toolkit* (n.d.) and the *Computer Chronicles Newswire* (n.d.), developed and marketed in England, are programs that help the student both design new interactive texts and distribute these to other schools. *The Interactive Toolkit* includes a step-by-step tutorial for creating interactive texts which may include pictures, diagrams, and simple animation. Once such a text has been created, the *Computer Chronicles Newswire* can be used for distributing these materials to other schools and an adult newswire service can be simulated.

### Heuristic Applications

Heuristic applications were defined as the use of the search, comparison, and analytic capabilities of the computer to determine the nature, qualities, or characteristics of the matter under investigation based on characteristics already defined. (The distinction between programs in the first category, data retrieval, and the ones described here is not a clear or simple one, and there is a degree of arbitrariness in their placement.)

### Word Processing

These programs help the user solve problems of order and organization in composing. The physical elements (words, sentences, paragraphs, etc.)

and organizational elements of compositions (headings, indentation, punctuation, etc.) make up the features or characteristics by which users analyze their writing. Using an understanding of these features, the student manipulates the material to make it accurate and more effective. The program is in effect a mechanical memory consisting of a number of predetermined slots. The user can fill these slots with information and move this information around until it suits the purposes of the communication. Such manipulation may be similar to the process of thinking and makes revision easier. Daiute (1985) notes that the physical chore of recopying is often a barrier to pre-adolescents. Text editors alleviate this task and benefit children in several important ways: children exhibit less concern about mistakes, their texts look better, there are fewer motor-control or handwriting problems, they produce longer papers, and revise more (1985, pp. 169–172).

### Writing Coaches

Using a predetermined structure for story writing can help children both understand the structure of prose and write more effectively. Levin, Borata, and Vascoucellos (Collins, 1983) have developed a writing coach program in which the children are given a basic story structure and are required to fill in the details. In another program (Collins, 1983), Levin provides poetry structure outlines (e.g. Cinquain) to get writing under way. One of the most elaborate writing programs of this kind is *Quill* (1984; Rubin & Bruce, 1984), which provides assistance in all five of the writing process steps. For the prewriting stage, *Quill* uses a feature called “Planner” to guide organized note taking. The writing stage is aided by a word processing program. The stages of revision and editing are facilitated by a text editor while the publishing stage is aided by a utility operation called “Publisher” which enables easy formatting of newspapers and books as ways of sharing what has been composed. A final component of the *Quill* program, “Story Maker,” is used to foster idea development and stylistic and organizational decisions.

*The Writer's Helper* (1985) is similar but more extensive collection of writing-related programs for use from junior high through graduate school. Prewriting activities provide assistance in selecting and exploring a topic and in organizing information. First drafts are analyzed through available programs to identify errors and check stylistic features. Later drafts are manipulated through a variety of word processing programs.

*Story Tree*, a program to improve creative writing skills, is representative of a group of programs designed to help the student make choices about how a story unfolds or branches. It combines the motivational ideas of

interactive fiction with the flexibility of a word processor to help students compose their own stories.

### Prose Features and Authorship Programs

Such programs are used to analyze written prose (or poetry) on the basis of stylistic features peculiar to certain authors. Given a sufficient set of criteria, it should be possible to identify particular authors. While such programs are not yet widely available, their content could be developed by scholars of literature (this operation would serve as an example of modelling to be discussed in the next section). Students are often required to describe the characteristics of style of various authors. Such programs would enable them not only to examine many styles of writing to see if they conform to the predetermined patterns but also to understand more clearly the nature of certain prose styles. In addition, by having the program identify and select various characteristics of prose, such as structure and vocabulary, students could focus on their own responses to these characteristics. Knowledge of these structures could later be applied in their writing.

Within this category of computer use perhaps the most advanced system today is *The Writer's Workbench* (Macdonald et al., 1982) mentioned earlier as an example of data retrieval programs. A feature of the program is its prose comparison option which compares material entered with a set of written passages selected to reflect specific standards of effectiveness for certain kinds of expository prose.

Another program falling into this category is *Writing a Narrative* (1983) which approaches the teaching of writing from a process perspective: The focus is on the student's movement through the several stages of composing from prewriting to editing. The program has three sections. The first, "Idea Storming," models the process of identifying and selecting appropriate and effective words and provides guidance in getting writing started and in creating a framework for the narrative. The second, "Catch the Moments," uses open-ended questions to draw the student's attention to key elements in narrative structure. The final section, "Point of View," uses examples to provide guidance for the student in making choices about the voice of the narrator.

### *Model Building and Programming*

Model-building applications were defined as the development of the theoretical or conceptual nature of the matter under investigation by identifying its significant features. This can be accomplished by writing

programs incorporating these features to analyze exemplars in the area of concern.

### Templates For Letters

Such programs are used to identify the elements of various types of letters by structure and essential content. By using these elements or features as a template, the student is able to analyze his letters for appropriateness of form and substance. The value of this approach lies not in the approach or the model itself but rather in the development of the model to describe different categories of letters. Such a procedure would develop in the student not only a knowledge of particular written forms and possible variations but also ways of recognizing characteristics of these forms. It is important to note that the task of developing and programming these models be undertaken by the students as much as possible.

For example, Collins et al. (1982) have developed what they call a publication system which enables students to create texts in different formats and with different page layouts. The publication system can also be used to produce different kinds of letters, such as the invitation, the request, and the thank you letter. *Introducing the Newsroom* (1985) fits generally into this category. This program enables students to design, produce, and print out their own newspaper using information about design as well as a library of clip board art and of different font types. As well, the program has the interactive capability of receiving from and sending to other computers, and so increases students' learning potential.

### Prose Generation Programs

Like the letter template, these programs require the development of the fundamental structure and content of certain prose forms. Using one of these structures, students enter designated components or parts of speech into a story shell. The program randomly generates various story possibilities. Simple versions of this type of program are available which require students to enter representatives of certain classes of words.

Once more, the development of the models for the prose forms to be considered and the requisite programming are the most important learning activities. Being involved in these activities develops greater student awareness of the form and content of prose as well as how changes to either form or content affect the product. This awareness has important implications for both writing and reading.

### Poetry Generation Programs

Just as prose generation programs can be used to structure prose, computer-poem programs can be used to analyze and structure poetry. Such programs are currently available for Haiku as well as other poetic forms. Again the process of designing the model for the poem produces the most important learning outcomes.

Many poem-generating programs simply produce a poem from a data bank of poetic phrases, but Shostak (1984) reports a program that asks the students to think about what they say. This approach permits students to generate ideas as well as control how the various parts of the poem will fit together in the finished product.

### Programming as a Language Learning Activity

Student activities within this category provide an obvious and potent mechanism for the development of insights into the elements and use of natural language. To be able to develop models of various forms of language, students need a clear awareness of how these forms differ from each other and how both semantic and syntactic elements work within each of them. Using a programming language in which the contrasts between natural and computer languages are highlighted would help them to develop this awareness. Among the major notable similarities and differences between computer and natural languages are the following:

1. Both have a vocabulary and a grammar. In computer languages the vocabulary consists predominantly of commands most of which are in the form of verbs while the grammar is essentially in the form of statements used in constructing these commands.
2. While verbs in natural language can take numerous forms, in computer language there is no variation, verb form being always in the imperative.
3. In natural language, a variety of subjects may be addressed within a sentence; in computer language, the subject is always understood to be the computer.
4. The syntax of natural language organizes parts of speech including subjects, verbs, adverbs, and direct and indirect objects into a variety of sentence types while the syntax in computer language organizes verbs, adverbs, direct objects, indirect objects, and prepositional phrases into statements.
5. Both natural and computer languages have texts longer than sentences or statements. In the former these are organized into "compo-

sitions" or "paragraphs" while in the latter they are "programs" or "procedures."

English and Edwards (1984) examine the issue of programming as a writing activity, noting the similarities between the process of composing using natural language and the process of programming using computer languages. They conclude that "the method of creating a composition or computer program is virtually a textbook example of what English instructors teach" (p. 47). It is the match between these "programs" and the various kinds and forms of written language compositions which should be the focus of language learning activities involving computers within the modelling category.

#### CONCLUSION

In order to realize the potential of computers for language instruction, we feel that computer use should not be limited to approaches based on stimulus-response learning models. Instead, it should reflect the transactional paradigm of language learning and thus include the utilization of computer technology by the student to solve relevant educational problems in a personal social context. The current product emphasis focuses attention on specific skills and concepts to be learned and has created a conceptual bottleneck in computer-aided instruction. Employing the technology from a process perspective would make the student responsible for using the machine as an extension of his brain in a manner which more realistically parallels actual language learning and use. In addition to providing a procedure based upon a semiotic view of language, this "tool" approach to the computer makes more relevant data available to the learner and, because of the rapid processing time of the machine, enables the formulation of models of events in real life and the search for the evidence to support the models. We feel that in language learning this can enable him to think his way through writing and reading problems better and thereby come to a fuller understanding of both processes.

We believe that the bottleneck which inhibits the effective use of computers in language education will begin to dissolve when users – teachers and students alike – feel the computer is being used as an extension of their own cognitive abilities and natural language environment, not as an element apart from them.

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Obwohl die Verfügbarkeit von Mikrocomputern in Schulen und von Software-Titeln im Sprachlern-, künstlerischen und Bildungsbereich weiterhin zunimmt, gibt es wenig Belege, daß die Anwendung von Computern bei der Sprachvermittlung als ein weit umfassender oder sogar angemessener Lernansatz angesehen wird. Wir glauben, daß dies das Ergebnis

einer konzeptionellen Schwierigkeit ist, die zum Teil durch die Übernahme eines ungeeigneten (behavioristischen) Modells des Sprachlernens verursacht wird. Stattdessen befürworten wir ein transaktionelles Modell des Sprachlernens und definieren ein Gesamtparadigma der Computer-Nutzung mit drei Anwendungskategorien, die auf diesem Modell basieren. Wir unterstellen, daß die Prozeß-Orientierung hin zur Computer-Nutzung, die sich aus diesem Modell ergibt, und nicht die heutige Produkt-Orientierung die Technologie vollständiger und angemessener nutzen und zu einem besseren Sprachlernen führen wird.

Aunque la disponibilidad de microcomputadores y de "software" dedicado a la enseñanza del idioma continúa creciendo, hay poca evidencia de que el uso de computadores en la enseñanza del lenguaje se considera como un enfoque amplio o apropiado del aprendizaje. Creemos que esto resulta de una restricción conceptual causada en parte por la aceptación de un modelo poco apropiado (de comportamiento) del aprendizaje del idioma. En su vez, recomendamos el modelo transaccional del aprendizaje del idioma, y definimos un paradigma general del uso del computador con tres categorías de sus aplicaciones basado en este modelo. Nuestro argumento es que la orientación hacia el proceso del uso del computador que surge de este modelo más bien que la orientación contemporánea hacia el producto empleará la tecnología más a fondo y de forma más apropiada, y llevará a un mayor aprendizaje del idioma.

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