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ABSTRACT

One of a series of educational packages designed for implementation either in a workshop atmosphere or through individual study, this Hot Topic guide presents a variety of materials to assist educators in designing and implementing classroom projects and activities centering on the topic of the computer as an aid to reading instruction. The Hot Topic guide contains guidelines for workshop use; an overview/lecture on the computer as an aid to reading instruction; and 6 focused documents and articles from scholarly and professional journals. A 29-item annotated bibliography of items in the ERIC database on the topic is attached. (RS)

HOT TOPIC

GUIDE 27

The Computer as an Aid to Reading Instruction

Revised Edition

This Hot Topic Guide is one of a series of educational packages designed for implementation either in a workshop atmosphere or through individual study. With the comments and suggestions of numerous educators, the Hot Topic Guide series has evolved to address the practical needs of teachers and administrators. As you take the time to work through the contents of this guide, you will find yourself well on the way to designing and implementing a variety of classroom projects and activities centering on this topic.

TABLE OF CONTENTS:

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In-Service Workshops and Seminars:
Suggestions for Using this Hot Topic Guide as a Professional Development Tool

Before the Workshop:

- Carefully review the materials presented in this Hot Topic Guide. Think about how these concepts and projects might be applied to your particular school or district.
- As particular concepts begin to stand out in your mind as being important, use the Bibliography section (found at the end of the packet) to seek out additional resources dealing specifically with those concepts.
- Look over the names of the teachers and researchers who wrote the packet articles and/or are listed in the Bibliography. Are any of the names familiar to you? Do any of them work in your geographical area? Do you have colleagues or acquaintances who are engaged in similar research and/or teaching? Perhaps you could enlist their help and expertise as you plan your workshop or seminar.
- As you begin to plan your activities, develop a mental "movie" of what you'd like to see happening in the classroom as a result of this in-service workshop or seminar. Keep this vision in mind as a guide to your planning.

During the Workshop:

- Provide your participants with a solid grasp of the important concepts that you have acquired from your reading, but don't load them down with excessive detail, such as lots of hard-to-remember names, dates or statistics. You may wish to use the Overview/Lecture section of this packet as a guide for your introductory remarks about the topic.
- Try modeling the concepts and teaching strategies related to the topic by "teaching" a minilesson for your group.
- Remember, if your teachers and colleagues ask you challenging or difficult questions about the topic, that they are not trying to discredit you or your ideas. Rather, they are trying to prepare themselves for situations that might arise as they implement these ideas in their own classrooms.
- If any of the participants are already using some of these ideas in their own teaching, encourage them to share their experiences.
- Even though your workshop participants are adults, many of the classroom management principles that you use every day with your students still apply. Workshop participants, admittedly, have a longer attention span and can sit still longer than your second-graders; but not that much longer. Don't have a workshop that is just a "sit down, shut up, and listen" session. Vary the kinds of presentations and activities you provide in your workshops. For instance, try to include at least one hands-on activity so that the participants will begin to get a feel for how they might apply the concepts that you are discussing in your workshop.
- Try to include time in the workshop for the participants to work in small groups. This time may be a good opportunity for them to formulate plans for how they might use the concepts just discussed in their own classrooms.
- Encourage teachers to go "a step further" with what they have learned in the workshop. Provide additional resources for them to continue their research into the topics discussed, such as books, journal articles, Hot Topic Guides, teaching materials, and local experts. Alert them to future workshops/conferences on related topics.

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After the Workshop:

- Follow up on the work you have done. Have your workshop attendees fill out an End-of-Session Evaluation (a sample is included on the next page). Emphasize that their responses are anonymous. The participants' answers to these questions can be very helpful in planning your next workshop. After a reasonable amount of time (say a few months or a semester), contact your workshop attendees and inquire about how they have used, or haven't used, the workshop concepts in their teaching. Have any surprising results come up? Are there any unforeseen problems?
- When teachers are trying the new techniques, suggest that they invite you to observe their classes. As you discover success stories among teachers from your workshop, share them with the other attendees, particularly those who seem reluctant to give the ideas a try.
- Find out what other topics your participants would like to see covered in future workshops and seminars. There are nearly sixty Hot Topic Guides, and more are always being developed. Whatever your focus, there is probably a Hot Topic Guide that can help. An order form follows the table of contents in this packet.

Planning a Workshop Presentation
Worksheet

Major concepts you want to stress in this presentation:

1) _____

2) _____

3) _____

Are there additional resources mentioned in the Bibliography that would be worth locating? Which ones? How could you get them most easily?

_____

_____

Are there resource people available in your area whom you might consult about this topic and/or invite to participate? Who are they?

_____

_____

What would you like to see happen in participants' classrooms as a result of this workshop? Be as specific as possible.

_____

_____

_____

_____

Plans for followup to this workshop: [peer observations, sharing experiences, etc.]

_____

_____

Agenda for Workshop
Planning Sheet

Introduction/Overview:

[What would be the most effective way to present the major concepts that you wish to convey?]

_____

_____

_____

Activities that involve participants and incorporate the main concepts of this workshop:

1) _____

_____

_____

_____

2) _____

_____

_____

_____

Applications:

Encourage participants to plan a mini-lesson for their educational setting that draws on these concepts. [One possibility is to work in small groups, during the workshop, to make a plan and then share it with other participants.]

Your plan to make this happen:

_____

_____

Evaluation:

[Use the form on the next page, or one you design, to get feedback from participants about your presentation.]

End-of-Session Evaluation

Now that today's meeting is over, we would like to know how you feel and what you think about the things we did so that we can make them better. Your opinion is important to us. Please answer all questions honestly. Your answers are confidential.

1. Check (✓) to show if today's meeting was

   ❑ Not worthwhile ❑ Somewhat worthwhile ❑ Very worthwhile

2. Check (✓) to show if today's meeting was

   ❑ Not interesting ❑ Somewhat interesting ❑ Very interesting

3. Check (✓) to show if today's leader was

   ❑ Not very good ❑ Just O.K. ❑ Very good

4. Check (✓) to show if the meeting helped you get any useful ideas about how you can make positive changes in the classroom.

   ❑ Very little ❑ Some ❑ Very much

5. Check (✓) to show if today's meeting was

   ❑ Too long ❑ Too short ❑ Just about right

6. Check (✓) whether you would recommend today's meeting to a colleague.

   ❑ Yes ❑ No

7. Check (✓) to show how useful you found each of the things we did or discussed today.

   Getting information/new ideas.

   ❑ Not useful ❑ Somewhat useful ❑ Very useful

   Seeing and hearing demonstrations of teaching techniques.

   ❑ Not useful ❑ Somewhat useful ❑ Very useful

   Getting materials to read.

   ❑ Not useful ❑ Somewhat useful ❑ Very useful

Listening to other teachers tell about their own experiences.

❑ Not useful ❑ Somewhat useful ❑ Very useful

Working with colleagues in a small group to develop strategies of our own.

❑ Not useful ❑ Somewhat useful ❑ Very useful

Getting support from others in the group.

❑ Not useful ❑ Somewhat useful ❑ Very useful

8. Please write one thing that you thought was best about today:

9. Please write one thing that could have been improved today:

10. What additional information would you have liked?

11. Do you have any questions you would like to ask?

12. What additional comments would you like to make?

Thank you for completing this form.

The Computer as an Aid to Reading Instruction

by Marge Simic

Discussions concerning computer use in education have rapidly passed through a number of phases. The first phase centered on the need for "computer literacy," generally defined as computer awareness and computer programming. At the height of the computer literacy debate, emphasis shifted to the role of the computer as a tool, and as a method for teaching problem solving. Most recently, attention among educators has turned to yet a third phase. This third phase addresses issues related to computer applications in support of the curriculum.

Research studies (Reinking, 1988) indicate clearly that computer instruction is effective for a wide variety of reading skill and concept areas. The level of popularity of computer-based instruction in reading may vary, but few will dispute the fact that computers have won a permanent place in the classroom. The most common concerns of educators now have to do with the effectiveness of computer-based education and with the appropriateness of the many possible roles computers can play in language arts instruction.

Teachers are reacting to the overuse and misuse of direct instruction and subskill drills by spending increased amounts of classroom time applying holistic approaches to reading and language arts. This movement, whether it be called an integrated language arts or a whole language movement, reflects a healthy concern that children learn language abilities in meaningful contexts that provide motivation for a lifelong love of reading and writing.

Judith Newman (1986) cautions that there is not one "whole language approach." Instead, the term represents a set of beliefs about how language is acquired, with corresponding principles that guide teachers in their instruction.

Considering these reactions, the varying beliefs of educators, and the present thrust in education to provide effective utilization of computers in the classroom, the emphasis is not on using computers to increase reading and writing achievement. Instead, the emphasis is on whether teachers use computers for meaningful reading and writing instruction or are locked into computer-based drill and practice software. This lecture will focus on: 1) why reading, writing, and computing are linked, and 2) how to integrate computers into reading/writing instruction.

Reading, Writing, and Computing

The link between reading and writing processes has recently generated a great deal of research. The result is that the two have come to be viewed as "flip sides of the same coin" (Eckhoff, 1983). Writing well depends very much on reading good writing. Computing has become part of the reading/writing process.

One of the few areas where there is evidence of the computer expanding learning is in the area of writing and reading (Mason, Blanchard, and Daniel, 1983). All three processes -- reading, writing, and computing -- are complex intellectual activities that involve gathering, organizing, and producing information. If one process is neglected, there seems to be a negative effect on the others.

Writing, reading, and computing are being linked in instructional practice. As children use the computer to move from the simple drawings of letters, to the revision of inner speech, to formal essays, their ability to express themselves is dependent upon their ability to develop related technology-based language arts concepts.

Reading and writing are related and different. Reading is a receptive process by which meaning is constructed from printed materials. Writing is an expressive process by which thoughts and ideas are worked and reworked to construct meaning and then printed (Calkins, 1986). Putting them together with computing forms a highly supportive system. All three are processes that help us construct and extend meaning.

Common skills are needed for reading, writing, and computing. Reading deals with printed or written words, writing with the production of these words, and computing with both. These skills include visual, auditory perception, thinking, and comprehension. Visual perception allows the

Integrating Computers Into Classroom Instruction

Teachers want their students to become more fluent writers and more attentive readers. For many teachers, traditional texts and methods are not enough. An effective use of the computer can help. It can serve as a patient teacher-assistant, guiding students through efficient reading-writing strategies, encouraging reading-writing connections, and providing individualized skill training in vocabulary and spelling.

While the first software efforts in the language arts field were disappointing, more and more of the current software packages can indeed help teachers reach their objectives. By choosing software that supports their curriculum, their students' needs, and their preferred teaching style, elementary reading/language arts teachers can spend more time guiding individual students and small groups, and less time presenting unproductive lessons in front of the entire class.

Although there is no substitute for reading and writing in context, students need ongoing supplementary practice in discrete reading and writing skills. Again the computer can help. The market is abundant with drill and practice type software. Finding appropriate skill-building software that has teacher utility options allow the teacher to add new information that makes the skill-building software more compatible with the individual needs of the students.

The computer is an aid to reading instruction and should help to extend classroom instruction. The teacher provides the "foundation" for learning through initial instruction and the software programs "build" on that foundation. Courseware must supplement, not supplant, classroom instruction. The software provides assistance, but the teacher remains in control, helping students move through their assignments and facilitating peer review and group work. The correct choice of software depends on the teacher, the students, and the curriculum.

The attached guidelines serve to summarize the information and may also be used as a checklist to help teachers of the language arts match their use of computers with what is known about the reading/writing process. We hope that this checklist will be used in a context where students are given opportunities to work in all the various computer modes: tool, tutor, and tutee.

Guidelines for Computers and Reading

1. Computer instruction in reading should focus on meaning and stress reading comprehension.
2. Computer instruction in reading should foster active involvement and stimulate thinking.
3. Computer instruction in reading should support and extend students' knowledge of text structures.
4. Computer instruction in reading should make use of content from a wide range of subject areas.
5. Computer instruction in reading should link reading and writing.

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Belajthy, E. (1987). What Does Research on Computer-Based Instruction Have to Say to the Reading Teacher? *Reading Research and Instruction*, 27, (1), 54-65.

Calkins, L. (1986). *The Art of Teaching Writing*. Portsmouth, NH: Heinemann.

Eckhoff, B. (1983). How Reading Affects Children's Writing, *Language Arts Journal*, 60, (5).

reader and writer to realize that many complex letter shapes fit together to form words that form meaningful phrases and sentences. Auditory perception involves taking the sounds in the language and relating them to the different letters. Computing increasingly involves visual and auditory skills.

Thinking enters the reading process when a student analyzes print and extracts meaning. When writing, a student must use organized thoughts and ideas to develop a conceptual image, and then express this image. Computing involves both.

Comprehension is dependent on the mix of visual, auditory, and cognitive processes. Although comprehension is the end result of reading, it also plays a part in the writing process. Without comprehension, not much reading or writing can take place. A student must first understand the purpose for writing. For the written work to make sense, the student must continue to understand and logically express his/her thoughts. As the level of students' reading comprehension increases, so does writing complexity.

The computer has become an ally in teaching comprehension. Research (Eckhoff, 1983) indicates that common skills are needed for reading, writing, and computing, and that learned ability in one area reinforces one's ability in the other areas. Students who perform well in one area tend to do well in the others. Students who read and write well are most effective in utilizing the computer. But more encouraging than ever is that the computer has become a stimulating and motivating source for the child who has difficulty and does not perform well in reading and writing.

Children must hear and read literature in order to write well. Next to direct experience, the reading the children do (either on or off the computer) is usually their most important source of new words and ideas. A well-presented story can do much to motivate students to write as well as strengthening writing skills, vocabulary development, sequential order, organization and creativity. The interactive possibilities presented by technology add a unique dimension through which children "enter" the story and interact with the characters.

The reading and writing connection itself is enhanced through the use of computer technology. When composing, the student is engaged in a writing-reviewing (reading) process. Each time the student presents written information, it must be read back silently and reviewed on the monitor to insure proper structure. Even the technology now available in most schools will allow the student to interact with a children's story, or write and revise a composition of their own. Whether it is prewriting, writing, or revising, the technology has become an integral part of the process.

Two of the more disconcerting problems facing teachers today are how to approach the new computer-based learning technology (the "new literacy"), and how to overcome student indifferences or sheer rejection of reading and writing (the "old literacy"). As educators, we now have the ability to reach toward a fusion of a rich intellectual invention, the computer, and a powerful medium for the use of language, which is literature. With computers, we can make the affective impact of literature immediate. People hear and see things and react to them in a different manner than when print is used alone. The result can promote an individual's understanding, interest in, and desire to read (Adams, 1986).

The research suggests (Strickland, 1987) that computer-mediated text may enhance comprehension among younger and poorer readers by stimulating more metacognitive activity. Interaction with the computer appears to provide a stimulus for the reader unmatched by conventional print technology. Print size may be increased, speed may be altered, and graphics can be created when using computer-mediated text. The control of text information can reside with either the student or computer. This allows the students to interact with the computer, which provides manipulation of and interaction with the text. Information may be externalized into the background knowledge, important aspects can be pointed out, and checking for information is reinforced. Students have immediate access to: 1) definition of key vocabulary; 2) a simpler, less technical version of the text; 3) supplemental background information; and 4) pictorial presentation of text (Reinking, 1985).

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Comparing the Use of Computers with Traditional Print in Reading Instruction: What the Research Says

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As computer technology becomes more accessible and cost-effective, there is increasing interest on the part of educators to maximize the potential of its use in classrooms (Fish & Fellowman, 1987). Chapter and Halcomb (1989) point out that the use of computers in education is becoming nearly as common as the chalkboard; therefore, how to use the computers properly to optimize the academic learning time (Whitaker, Schwartz & Niockell, 1989) and to improve students' learning are important topics for educators. Although the microcomputer is an educational tool of unprecedented power, Leigh et al. (1984. p. 4) suggest: The potential is great for making serious mistakes when microcomputers are being considered as an aid in the teaching of content or skills. One serious mistake is to adopt computer-assisted instructional materials without evidence of effectiveness and efficiency. Computer-assisted learning methods need to be compared with and evaluated against more traditional methods of teaching. However, few studies have directly compared computer-assisted instruction with traditional instruction, and results have been mixed (Kinder, Sherwood, & Loofbourrow, 1989). This article, therefore, reviews studies which compared computer-assisted instruction with traditional print to determine what researchers have discovered about using computers in reading.

A comprehensive search of the literature used the following sources: the ERIC system, Current Index to Journals in Education, Resources in Education, and the bibliographies of other related works. Studies that included the act of page-turning and on-line conditions are included in the review However the studies conducted before or during the early 1980s are not selected due to the low availability of microcomputers in the nation's classrooms (Ordorensky, 1989) and the hardware limitations that inhibited the development of sophisticated educational software at the beginning of the 1980s (Nuccio, 1989-90). The research findings are then compared and integrated through using the following five categories between the two modes of presentation: interaction, attitude, instructional control, time on task, and efficiency.

Interaction

Researchers have found that readers. when attending to computer- displayed texts, are more active in self-monitoring their comprehension. Keene and Davey (1987) found that the computer group outperformed the printed page group in lookback strategies and in attitude. They concluded that the use of computers may result in greater frequency of text reinspection. Harper and Ewing (1986) added that users' on-line attention to task behavior was also relatively high (80 percent or above). Gifted children and SLD students alsoshow great concentration when using computer (Boyer, 1984). Sawyer (1988) found that college students used the computerized study guides more often than the conventional study guides in study.

Although most investigators agreed that the students might develop concentration when using computers, some studies also investigated the reasons why students are more involved in using computers. Keene and Davey (1987) explained that lookback strategies may also have been used more frequently as a result of the "fun" associated with manipulation of the machine.

Students' desire to improve their reading skills, parents' support and encouragement, and knowledge of the fact that their teacher would be provided with results of their performance may increase their concentration on task (Harper & Ewing, 1986).

Attitude

Most researchers found that their subjects had a preference for or positive attitude toward the use of computers (Gambrell et al., 1987; Harper & Ewing, 1986; Keene & Davey, 1987; Mikulecky, Clark, & Adams, 1989; Morrison et al., 1988; Wepner & Feeley, 1987; Zuk & Danner 1986). The positive attitude may be used to increase motivation and renders it a particular alluring medium for facilitating the reading performance of LD students (Keene & Davey, 1987) and of students of different school levels.

Although most researches have found a positive attitude of their subjects toward the use of computers, the users' characteristics have to be taken into consideration. Morrison et al. (1988) found that the CBI group showed less confidence and more conservative attitudes, which, they concluded, might work as a disadvantage for achievement and learning efficiency They further pointed out that the newness of CBI may cause many subjects to perceive it as more difficult or challenging than print. Harper and Ewing (1986) also found that at the beginning of their study, the subjects expressed a great deal of fear of the microcomputer. It also happened that when the users became familiar with the computer; some would become impatient as they waited for new problem or the cartoon-like characters and reinforcement messages to appear on the screen (Campbell et al., 1985). Boyer (1984) observed that the lower IQ subjects became restless if answers were missed. Weaker readers felt more uncomfortable shifting between passages and questions (Feldmann & Fish, 1987) . Bourgue and Carlson (1987), in their study on "Hands-on vs. computer simulation method in chemistry", found students anxious to interact with the computer and also anxious to return to the classroom to interact on a personal level with the instructor. They concluded that the students accepted the quaint positive learning reinforcement dialogue from the computer as pleasantries, and that students accepted personal learning reinforcement from the instructor with appreciation and a sign of accomplishment. Some users may lose their interest in using the computer when considering achievement (Balajthy, 1988).

Instructional Control

Findings on instructional control, whether student or computer-based, show a mixed result. MacGregor (1988 a) found that computerized-text system had differential effects on students' vocabulary knowledge, comprehension recall, and on the amount of time students spent on task. however, he concluded that instructional control, whether student or computer based. had no effect on comprehension or time on task. Feeley and Wepner (1986) also pointed out that it did not seem to matter whether students read the selections on screens or in traditional text form, the practice in reading whole-text passages under self-controlled, timed conditions appeared to increase college students' reading efficiency. Morrison et al. (1988), in their study on learner control using text density as the decision variable found that the learner control groups learned better than groups receiving standard materials. However, Reining and Rican (1990), comparing the vocabulary and comprehension attainment of sixth graders who were put on 4 conditions: off-line dictionary and glossary conditions, on-line self-selection condition, and on-line computer-controlled condition, found that reading comprehension could be increased when

computer-mediated texts were used to expand or control options for acquiring information, which also supported the finding (Reinking & Schreiner, 1985) that 11-12 year-old pupils in the all-option group reading high difficulty texts, whether strong or weak readers, performed significantly better than the off-line group. They concluded that increases in comprehension found in other studies employing computer-mediated texts may be due in part to the requirement that subject viewed the meanings of difficult word, and the learning of difficult words during independent reading of informational texts may be enhanced with the aid of a computer.

Some researches investigated the difficulties the learners involved in using learner's control. Balajthy (1988) noted that college level developmental reading students were unable to accurately monitor the success or failure of their own vocabulary learning. He concluded that the computer-based instruction per se was not the cause of poor metacognitive performance. On the contrary, the difficulties may be caused by learner-control, whether in computer-based or traditional formats.

This learners' poor metacognitive use is supported by some studies. Morrison et al. (1988) found that less skilled readers typically selected high-density text while the skilled readers selected low-density text. They pointed out that retrieval of main ideas is not facilitated by providing additional details in the text. Main ideas support the recall of details. Low density text also has the advantage of providing only the essential information needed to learn task

relevant skills. Balajthy (1988) suggested that the teacher must be aware that students have difficulty in monitoring their own learning, both in traditional and in computer-assisted tasks. Due to the learner's poor use of metacognition, he therefore pointed out, learner-control of instruction may result in adverse consequences as a result. Requiring subjects to make decisions concerning which word to investigate may also interfere with other comprehension processes (Reinking & Rickman, 1990).

Further research is necessary regarding whether the purpose of a learner to investigate specifically a word is to increase knowledge or to remove a barrier to comprehension (Reinking & Rickman, 1990) or is due to interest (Balajthy, 1988).

Time on Task

Research findings on time on task between the two modes of text presentation show a mixed result. Clausing and Schmitt (1990) found no significant differences in reading speed from electronic screens to paper. Keene and Davey (1987) found that LD students using computer-presented text spent a similar amount of time reading the passages compared to students reading the traditional printed page Reinking (1988) noted that reading time for short expository texts appeared to be unaffected by simply displaying the text `,n a computer screen, but readers used more time to reading computer-mediated text than to reading texts displayed on printed pages. Haas and Hayes (1985a) found that college students needed more time to retrieve specific information from texts displayed on the computer screen than did students who read the same texts on printed pages. Other studies (Morrison et al., 1988; Zuk & Donner, 1986) concluded that CBI subjects took longer time to finish the task on computer than the print subjects. Morrison et al. (1988) also found that CBI subjects rated the lesson as slower moving than did print subjects, especially when high density material was used.

Researchers have also been trying to explain the reasons why CBI groups take longer in task completion time. Zuk and Danner (1986) explained that the general unfamiliarity or novelty of the computer and the task, and the process of pressing an arrow took longer. This was in sharp contrast with the automatic and familiar printed-page turning process which does not usually require much attention. Leigh et al. (1984), in their study on math drill and practice on computer vs. traditional drill and practice on print pages, pointed out that the print group could readily move from problem to problem, while the computer group had to wait until the graphic reinforcement message was generated and displayed. This process had to be repeated again when new problem was generated This is supported by Baek and Layne's finding (1988) that the animation group spent significantly more time, because the subjects were delayed since they were required to wait for the animation sequences to run the course before they could continue through the lesson" (p. 135). Reinking (1988) also described that reading and study time might increase when options for assistance were included in computer-mediated text. Reading level may also be a factor affecting reading rate from electronic screens or paper, and readers may reduce their reading rate in order to maintain comprehension (Clausing & Schmitt, 1990).

To solve the reading speed problem, Morrison et al. (1988) proposed that the management system would monitor performance and time on task, and use the data to make appropriate changes in text density level throughout the lesson. If a reader were taking longer than the established mean time, the management program might switch to low-density to improve the user's efficiency.

Further investigations on the effects of computer text presentation on task completion time when longer texts are used and if the reading rate and/or comprehension would deteriorate given longer reading spans (Clausing & Schmitt 1990; Keene & Davey, 1987) need to be investigated.

Efficiency

Does the use of computers increase students' comprehension and reading efficiency more than the traditional print? The research findings can not provide a definite answer to this question. Taylor and Rosencrans (1986) reported that the use of computer-assisted instruction did not improve vocabulary skills among entry level college students enrolled in a developmental reading program. Zuk and Danner (1986) concluded that subjects were not on task any more often, they did not stay on task any longer, and they did not comprehend better when reading from the computer screen. Sawyer (1988) discovered that college students using traditional study guides performed better than those using computerized study guides. Haas and Hayes (1986) found that adults experienced problems in locating information in word-processed text. Their study showed that locating, retrieving, and comprehending textual information displayed on screen was more difficult than reading from print-out. Cato, English, and Trushell (1989) also found that middle school students generally performed less well locating information on-screen: in particular, students were less successful at locating information within prose passages onscreen. Reinking and Schreiner (1985) found that 11-12 year-old primary pupils performed better on low difficulty tests when reading from print rather than on-screen except the all-option group who produced similar or marginally better performances.

Some studies found no significant differences between computer group and traditional print group at different school levels. Gambrell et al. (1 987), in their study conducted on 8 and 10 year-old pupils, reported that there was no significant difference in the performance of 'free recall' and 'cued recall' tasks when subjects read texts on-screen as opposed to text in-print. Wagiler and Feeley (J987) found no significant differences in 'reading comprehension' and 'recall' when third-and fifth-graders read computer vs. printed text. Clausing and Schmitt (1990) did not find a significant difference in eighth grade students reading from electronic screen or paper. Castecl (1988- 89) also found no significant difference between traditional (LD) group using chunked passages and the CAI (LD) training group using chunked passages. Boyer (1984) found that the 5th grade CAI students increased 9 months over the control group: whereas, the control group in the 4th grade increased 4 months over the CAI group.

Some findings do support the use of computers in reading. Goldman (1988), comparing basal reading with computer reading, found that students using computers developed a greater inference ability in reading than did the basal group. She further pointed out that the experimental group ended the study reading at a higher level. Gambrell et al. (1987), when considering age variable, found that older pupils tended to perform slightly better on 'free recall' and 'cued recall' tasks on-screen rather than in-print. Feldman and l~ish (1987) concluded that the microcomputer did not seem to hinder the performance of poor readers any more than print. They pointed out that reading from the microcomputer screen was not more difficult than reading from print.

Some researchers also investigated the reasons why the computer group failed to perform better or as well as the print group. Sawyer (1988) pointed out that computerized study guides have some disadvantages when compared with traditional study guides. The use of computers generally limits the time and place in which the study guide can be used (Grabe, Petros, & Sawler 1989; Sawyer, 1988). Sawyer concluded that the computerized study guide made poor use of study time. He finally suggested, "unless computerized study guides include features not available in conventional study guides, such as interactive, graphics. or simulation, conventional study guides are preferred" (p. 82). Bourge and Carlson (1987) also suggested that unless a student's comprehension in CAI is monitored closely, the student's assimilation level wanes and his learning does not progress effectively. This can be supported by Reinking and Rickman's finding (1990) that extending or controlling options for assistance in independent reading may increase reader's comprehension.

Conclusion

Research findings have unanimously concluded that subjects in CAI group are more interactive with the task. Subjects are also more positive about the use of computers. This evidence indicates that computers have a potential to develop and improve students' reading or learning if they are used or integrated properly into classroom setting. However, integrating computers into curriculum requires the knowledge of other factors that might affect students' motivation and attitude toward learning using computers. Novelty may cause either fear, conservation, or excitement. The teacher needs to know how to help students overcome negative feelings. On the other hand, the teacher has to maintain students' motivation and excitement even after the novelty wears away. Otherwise, it is possible that the students may grow tired of using computers once they find nothing particular new or interesting to them.

Although research findings on instructional control show mixed results, we still have to acknowledge that for less able readers, computer control may improve their learning task. Due to poor metacognition, less able readers may not know how to monitor their learning task; they may not understand when there is a need to opt for assistance, or they may know when to find help but they do not know how to find help. Computers can provide this special feature that is impossible when using traditional print.

Most investigators conclude that subjects in CAI group tend to use longer task completion time. However, most of them also point out that there are more features included in computers. These features may help attract attention from the users. They can provide immediate feedback or enough wait time" for the use's to process or understand the underlying reasons why they have missed the question. In this regard, computers act more like a teacher who is standing or sitting next to the children and is ready to intervene the learning failure, which will naturally take longer time.

Another reason for the increased time on task can be explained through the software itself. It is very common to see different software use different directions to direct the users to run the program. Some require the users to memorize keys; some use arrows; and some use letters. The inconsistency of directions may require a certain amount of time to adjust to the software when they run on computers. This can not compare with the automatic or unconscious page-turning action.

Although research findings on reading comprehension or learning efficiency are not very conclusive, some researchers suggest that the failure to achieve positive results among the experimental computer groups may be due to the inappropriate use or the quality of the software. In evaluating software, we may find that some interesting software fails to produce clear, legible print on screen. Some screens even produce glare. This is evidenced by Feldmann and Fish's finding (1987) that one quarter of the students said 'reading from the screen hurt their eyes.' Some programs are much more complicated to operate. Even some games or problem-solving programs that appear to be interesting and motivational fail to engage students in actual reading due to the fact that the users can bypass the reading to get to a quick solution.

Here we are not saying that computers can be used to replace current instructional instruments. However, they can be an additional tool that can be used to help children learn (Kinzer, Sherwood, & Lootbourrow, 1989). The proper use of good computer software can add new and exciting dimension in planning instructional strategies. However, the traditional classroom is still the main focus for the exchanges of ideas and discussion (Bourgue & Carlson, 1987). For understanding more about the benefits of using computers, Kinzer, Sherwood, and Loofbourrow (1989, p. 48) suggest that:

...more efforts are needed to determine the effects of types of software, types of computer use, and types of teacher mediation and support across various instructional situations and subject areas. Only when a significant body of such research exists will it be possible to say with some certainty the areas in which instructional computing technologies are most beneficial.

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Application Report: THE POTENTIAL OF ADVENTURE GAMES FOR THE DEVELOPMENT OF READING AND STUDY SKILLS

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While adventure games have potential for develop. g text processing skills, these games were not designed to serve an instructional role and at present have instructional limitations. This paper describes some existing limitations and provides suggestions for modifications that may improve the instructional potential of adventure games. A prototype, developed according to some of these suggested modifications, is described and data obtained from the use of the prototype with more and less able sixth grade readers is provided. As expected, the more able readers performed at a superior level on aspects of the game hypothesized to relate to more effective text processing.

This paper considers the use of adventure games (Note 1) as an academic activity that may develop text processing skill. Others (Geoffrion & Geoffrion, 1983; Malone, 1981; Steffin, 1981) have noted the instructional potential of commercial recreational adventure games. However, existing commercial products, even the games written for younger players (Note 2), were not designed with a priority on the games' instructional potential as reading activities. An explanation of how adventure games might be designed to foster the development of higher-level reading skills and a description of a prototype of one such game follow.

Many microcomputer enthusiasts have experience with recreational adventure games. For the uninitiated, traditional adventure games have been described (Liddil, 1980) as word recognizing computer programs that employ a narrative style (Note 3 — text vs graphic adventures) to present a series of puzzles. The puzzles tend to be naturally embedded within the prose of the game and must be identified and solved by the player. The format of the game can be nearly any organized grouping of locations (Commonly called rooms) centering on a single theme. A characteristic of adventure games is the active role given players in shaping their experiences within the context of the game. Players move from location to location avoiding danger, collecting clues and treasure, resolving minor difficulties, and ultimately mastering the central task(s) of the game. The decisions and resultant actions of players have good and bad outcomes. For the most part, outcomes experienced by a player can usually be predicted from information presented in the game or can be improved based on previous experiences.

Text based adventure games contain several components that have potential instructional value. First, a text based adventure game requires that the player read to find the information or locate the objects needed to solve an ever changing set of problems. In some cases, the player must sift through a considerable amount of material to locate the appropriate text segments. Secondly, a text based adventure game represents a reading situation in which the player must engage in self-directed thinking and problem solving. A more traditional reading task might inform the student of the questions he/she is to answer before reading or perhaps has the student read without guidance and then requires the student to answer unpredictable questions afterward. In contrast, the text based adventure game requires that the player formulate what the problems to be solved are while reading.

Finally and perhaps of greatest importance, an adventure game forces the player into an active role. In reading from a traditional text, the only truly required activity might be turning the pages. A student can read to the end of a story without understanding or active involvement. In an adventure game, unless the material is understood and the problems imposed by the game are identified and resolved, the game cannot be completed. The very method by which an adventure game is played also requires that the participant plan and take action. Unlike a book which is primarily read in one direction, an adventure game presents a relatively unstructured reading task. The player may visit the various locations several times. Whichever direction the player decides to pursue, moving in that direction requires an active

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decision. In addition, gathering objects in one location to solve a problem in a different location requires that the player identify and return to the location that contains the object. The player must then exercise some command to collect the object, move to the location in which the object is to be used, and issue a command in an attempt to successfully use the object. Each step in this process requires preplanned activity. More traditional reading activities (memory, drawing inferences, integration of information, etc.) are also involved.

Recent reading and study skills research has focused on strategic cognitive behaviors that bear a strong resemblance to many of the behaviors required in an adventure game. This research, frequently labelled as the study of metacognitive or metacomprehension skills (Brown, Armbruster & Baker, 1986), investigates how students: (a) activate and control reading behaviors in response to text or external task imposed demands; (b) evaluate their success in completing these tasks; and (c) respond to any perceived task failures. For example, research that exemplifies metacognitive responses to task demands has demonstrated that more able readers are more adept than less able readers at differentiating the levels of importance of individual ideas in text (Brown & Smiley, 1977) and at identifying ideas that would be of greatest interest to a person reading a given passage to locate a specific type of information (Grabe & Prentice, 1979). As an example of self-monitoring behavior, more able readers have been repeatedly shown to be more able than less able readers to locate errors purposefully inserted in text (Grabe & Mann, 1984; Markman, 1979). Finally, reading ability group differences in the diversity of "fix-up" strategies readers say they employ in response to comprehension failures have been demonstrated by Myers and Paris (1978). More able readers employ a greater variety of strategies and also strategies that have a greater chance of success. Creative tasks that encourage the development of these types of metacomprehension skills are needed.

While existing adventure games exhibit potential as environments for encouraging the development of metacomprehension skill, these games were not intended as instructional activities. Several problems can be identified. First, traditional commercial games may contain some text, but in most the text is sparse and disjointed. In many of the more recent games, too much attention is paid to pictures. Secondly, the emphasis in most games is obviously more on problem-solving than reading skills and some of the problems are extremely difficult. In addition, the games usually provide no alternative to solving the problems and seldom provide a source of assistance. Many frustrated players are forced to abandon games because they encounter a problem they are unable to solve and simply find themselves stuck part of the way through the game. A third difficulty involves the mechanics of interacting with the game. Part of the challenge in most games involves discovering the legal or valid commands. Most games employ a large number of commands and may not have a provision for listing commands for the player. While an interesting facet of a game with a problem-solving orientation, this uncertainty regarding how a desired activity should be executed proves a distraction in a reading task. Finally, part of the strategy of playing existing games requires the compilation of detailed records and maps. Without these time consuming activities, players would find themselves hopelessly disoriented and unable to achieve any degree of success. Again, the focus on reading is diluted.

A list of some improvements related to the problems just identified might thus include: (a) the use of room descriptions employing more coherent, descriptive and interesting text, (b) the use of problems that are less challenging and based more directly on reading tasks, (c) the inclusion of remediation or help routines that assist the player when a particular problem cannot be solved, (d) the use of a smaller number of general purpose commands or the inclusion of a large and straightforward vocabulary, and (e) self-contained maps and other information sources that reduce the need and time required to record information.

A Prototype Adventure

We have developed and are evaluating the prototype of an adventure game designed to stress metacomprehension skills. The following material describes some of the features of this activity and provides information related to our evaluation efforts. The intent of this presentation is to get others to consider the potential of adventure games and other forms of interactive fiction as instructional activities.

The player in our adventure game is given the task of completing his or her adventure using as few moves as possible. To accomplish this task, the player must find and solve the problem posed in each of ten game levels. Each level is made up of from four to six locations (see sample materials in Appendix A). The player experiences each location primarily as a multisentence description of the physical properties of that place. Additional material is integrated into some paragraphs to indicate the player's intent and to provide background or interest. In one of the locations a problem is present that prevents the player from advancing to the next level. Problems are not directly identified, but rather must be inferred from the descriptive material. As an example, the description of the city gate in one level contains the information that the gatekeeper collects a 5 piesta fee before a vehicle is allowed to pass. Another location within the level contains an object that can be used to solve the problem. In the level used here as an example, one of the locations is a bank and money is one of the objects described to exist within the bank.

Before proceeding to other properties of the game, some of the significant characteristics just mentioned should be highlighted. First, the game utilizes intact prose. While the game is not exactly like reading a book, the location descriptions are paragraphs of at least four complete and related sentences. This is different from many commercial adventure games which employ very brief and cryptic messages. Secondly, the problems are less difficult than in traditional adventure games and are based on such reading skills as memory for detail, drawing inferences, and integration. Finally, the player is confined to a limited portion of the game (i.e., a level) until a particular problem is solved. This feature is useful in preventing the player from becoming frustrated and wasting time.

Only five commands are required to play the game. A player types GO and a direction (e.g., GO EAST) to move. Valid moves are listed on the screen and can be determined from a map. The TAKE command (e.g., TAKE SHOVEL) allows the player to acquire an object so that the object can be carried from location to location. Because the player is allowed to carry only one object, LEAVE (e.g., LEAVE SHOVEL) drops an object when used. When a player has carried an object to the site of the problem and wants to determine if the object will actually solve the problem, the player employs the USE (e.g., USE SHOVEL) command. The fifth command (MAP) is used to display a graphic representation of the arrangement of the locations making up a level. Because the different commands are displayed on the screen (see sample screen display in Appendix B), the player does not have to retain them in memory. Statements that attempt to employ illegal commands (e.g., GET SHOVEL) or request an action that is not possible (e.g., TAKE HOUSE) result in appropriate explanations (e.g., I d n't know how to GET or You can't take the HOUSE). The intent in this set of features was to reduce the demands of the nonreading components of adventure games. To accomplish this goal we have employed a simple set of commands and have provided easy access to necessary information (e.g., maps, commands and possible moves) on the screen.

Probably the characteristic of existing adventure games that makes them most inappropriate as learning activities is the failure to include a mechanism for defining and responding to situations in which the player is unable to resolve a particular problem. To deal with these situations, we have included a remediation routine in our prototype adventure game. The remediation routine is called by the program when the player has visited the rooms containing the problem and the solution object and has accumulated a predetermined number of additional moves. The actual number of additional moves varies as a function of the number of locations in the level. When the remediation begins, the player is asked if he/she has identified the problem and if he/she knows the object needed to solve the problem. A positive response to both questions allows the player to continue attempting to solve the problem. If the player fails to solve the problem within a predetermined number of additional moves, the game ignores the player's earlier positive response to the remediation question and assumes the player lacks the necessary information. When the player gives a negative answer to either of the remediation questions or is judged to lack the necessary information, he/she is placed in the location that is related to the question he/she was unable to answer (object or problem), told that the problem or object is contained in this location, and again asked if he/she can now locate the problem or object. A negative answer to this question or a failure to engage in the appropriate behavior immediately upon being returned to the game causes the program to provide the player with the information required (e.g., you must take the shovel — you need it to solve the problem). If after receiving this information, the player fails to solve the problem in a specified number of moves, the program explains and solves the problem for the player (e.g., a shovel can be used to widen the tunnel so that you can escape from the basement).

Prototype Evaluation

Our intent in developing the prototype adventure game was to achieve two goals. The first was to develop a reading activity that a wide range of students would find interesting and challenging. We feel this objective has been satisfied because most students introduced to the adventure game completed the activity on their own and because the game was completed by readers functioning significantly below grade level. Our second goal was to design a game that engaged the student in meaningful reading activities. The accomplishment of this goal is difficult to operationalize. In part, we and others faced with this task point to the intuitive relationship between theoretical accounts of skilled reading and the cognitive activities required to accomplish a particular task. Our earlier comments on the design of this activity to emphasize metacomprehension skills were of this type. We believe that it is possible to go a step further. We believe that if an instructional task requires the activation of specific reading skills, it should be possible to demonstrate that individuals possessing the skills (i.e., skilled readers) should perform better on specific aspects of the task than individuals less likely to possess the skills. We have used the remediation hierarchy to operationalize specific reading skills.

The remediation hierarchy can be thought of as a mechanism for understanding the severity of a student's processing difficulties. Because each subsequent level of the remediation routine provides the student more and more detailed help, the further into the remediation

sequence the student must go before solving the problem, the greater difficulty he/she is having. For example, assume a student cannot solve the problem in a particular ring and has been provided a description of the problem. The necessity of also needing to be told which room contained the object required to solve the problem would demonstrate the student was having greater difficulty than if the student was able to locate the needed object without having the room identified.

Method

Subjects

Twenty-three sixth grade students from a local elementary school completed the prototype adventure. These students were differentiated into more and less able reading ability groups on the basis of performance on the reading subtest from the Iowa Test of Basic Skills (Hieronymus, Lindquist, & Hoover, 1978). Mean grade equivalent scores for the more and less able groups were 6.4 and 8.6 respectively.

Procedure

Students were given an individual introduction to the commands of the adventure game and played the first level of the game under supervision. Once introduced to the game, students worked to complete the game as their class time allowed. The game allowed the player to stop after each ring had been completed. Two microcomputers were available in the classroom and the teacher monitored student work to make certain students worked on this activity individually.

Results

Four variables were used to compare the game performance of the two reading ability groups. *Moves* represents the total number of location changes the player accumulates across the course of the game. While the player must expend a certain number of moves exploring the various locations to find the problem and solution for a particular ring, additional moves were accumulated as the player returned to reread material in search of problems and solutions that had not been detected. The original instructions and feedback after each ring were used to motivate the player to keep total moves as low as possible. *Enter Remediation* represents the number of times the player entered the rooms containing the two sources of required information and failed to solve the problem of the ring in the specified number of moves. *First Level Remediation* represents the number of times the player could not correctly provide a description of the problem or solution once involved in the remediation procedure. *Second Level Remediation* indicates the number of times the player still failed to identify a problem or solution after being positioned in the necessary location and being informed that the necessary information was present in that location. The maximum value for all remediation variables was 10, i.e., the number of levels in the game. Because getting to a deeper level of remediation required a failure at a shallower level, the remediation measures are to some degree interdependent.

Group performance on the four dependent variables was evaluated using one-way analyses of variance. Significant group differences were found for Moves, $F(1, 21) = 7.27, p = .014$; First Level Remediation, $F(1,21) = 5.25, p = .032$; and Second Level Remediation, $F(1, 21) = 7.95, p = .010$. Mean and standard deviations are provided in Table 1.

Table 1. Performance Scores Means and Standard Deviations for More and Less Able Readers.

Variable	Reading Ability	
	Less Able n = 11	More Able n = 12
Total Moves	mean = 106.00	86.50
	std. dev. = 18.84	15.81
Enter Remediation	2.36	2.00
	1.74	1.12
1st Level Remediation	1.90	.83
	1.37	.83
2nd Level Remediation	1.36	.25
	1.28	.45

More and less able readers demonstrated differences in the efficiency with which they could complete the prototype adventure game. The only comparison not demonstrating statistically significant group difference was the number of times the student entered the remediation routine.

Discussion

This article discusses the possibility that adventure games can be modified to serve as instructional reading activities. After discussing the limitations of existing adventure games as instructional activities, a prototype adventure game was described. This game was based on

skills emphasized at the metacomprehension level of reading. Because skills requiring the establishment of reading goals, the development of inferences, and purposeful search behaviors were of interest, the major dependent variables were operationalized in terms of a hierarchy of remediation steps the game took when the player could not identify the problems or draw the proper inferences to solve them. It was argued that the more assistance the player required, the greater difficulty the player was demonstrating in performing the necessary reading tasks. Differences in reading ability were related to the efficiency of completing the game and to two of the three remediation variables. While further work will be required to validate this approach, the variables operationalized here appear to be associated with differences in reading competence.

The demonstration that less able readers have greater difficulty with this task does not demonstrate that the activity has instructional potential. In fact, the instructional potential of individual activities (e.g., a particular worksheet or exercise) can rarely be demonstrated. Only activities which students would utilize over an extended period of time would be likely to demonstrate an impact on general reading skill that could be empirically observed. It would be unlikely that schools would want to have students play adventure games for such an extended period of time. However, at a logical level of analysis, the game described would seem to require cognitive skills important to purposeful reading and study behavior. To progress through the game, students had to evaluate and interpret the text presented and take purposeful action based on the information gathered. Thus, the game provides a reading task with immediate and self-contained consequences for successful reading behavior. It is hoped that the prototype described here will encourage additional development and evaluation efforts.

Reference Notes

1. Many commercial adventure games are now available. The generic term "adventure" comes from the first participatory computer story created by Willis Crowther and Don Woods at Stanford in the 1970s. Commercial text adventures, such as Infocom's Zork, represent the type of game discussed in this paper.

2. Commercial games such as Spinnaker's Snooper Troops and Broderbund's Where in the World is Carmen Sandiego? have purposefully been developed for younger players.

3. Games vary in the degree to which they are oriented toward text. Zork is an example of a game based exclusively on text. More and more games are using graphics to present clues and portray the action of the game. The difference is something like the difference between controlling a character in a novel and in a movie.

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Appendix A
Location Descriptions from a Typical Level of the Prototype Adventure

Kitchen

You find yourself in the deserted office of the Dahshur outfitter. You have come to pick up the jeep you have rented. The room is empty with the exception of an old oak desk topped by a brass lamp. No one is around to help you prepare for your trip to the pyramid.

Living Quarters (contains needed object)

The merchant and his family stay in a single room. The room contains several beds, a table and a small stove. On the night stand beside the bed are a set of keys. Doors lead to the east and to the south.

Supply Room

The merchant's stocks include all that is necessary for a venture into the desert. He has made a living by selling supplies to the oilmen. A stack of tents is piled against the far wall. Cans for hauling water are stacked in the center of the room.

Porch

The front porch faces toward the bazaar. A rental jeep can be seen in the street. The floor is covered with the sand that has blown in through the screens. A pile of old magazines has been thrown in the corner.

Jeep (location of problem)

The jeep is a rusty relic from 1952. From its sand blasted appearance, the jeep has made many trips into the desert. The merchant has assured you that the old machine is still reliable. As you open the door you notice that the ignition key is missing.

Appendix B
Example of Typical Screen Format

Location	#1	Office Ring #1
Carrying	Nothing	0 Moves
Can Move	N E	Entered 1234

You find yourself in the deserted office of the Dahshur outfitter. You have come to pick up the jeep you have rented. The room is empty with the exception of an old desk topped by a brass lamp. No one is around to help you prepare for your trip to the pyramid.

What is your command?

Commands: MAP GO TAKE USE LEAVE QUIT

BUILDING AN ANTHOLOGY OF "INTERACTIVE FICTION"

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Introduction

Interactive fiction has, in computer time, a fairly respectable history. Virtually the first recreational use of computers occurred with the development in the 1970's of a program at MIT variously known as "Adventure," "Colossal Caves," "Hunt the Wumpus." The object was to explore a cave, seeking treasure and avoiding or overcoming hazards. The programs recognized and responded to short phrases in English. The first such program to be made widely available was Zork. Developed in 1977 at MIT by students, it was first marketed commercially in 1980 (Adams, 1985, a, b). Today there are at least 50 titles on the market (Swan, 1986). Our own work with interactive fiction is more recent, we first used these programs with students in a summer workshop held at Utah State in 1984.

Before proceeding further we need to clarify what we mean by interactive fiction. We include all programs in which the player must complete a quest of some kind. The player is presented with a series of dilemmas he/she must resolve in order to complete the quest: e.g., finding the treasure, rescuing the maiden, identifying the murderer, and so on. To do this requires the thorough exploration of some well-defined territory, e.g., forest, a mansion, a town, the land of Oz, an island, etc. Hence, we lump together programs which have been called "graphic adventures" and those called "electronic novels" or "text adventures." At one extreme a program like Zork utilizes no graphics while at another extreme, a program like Dragon's Keep utilizes very little text and virtually no storyline or plot.

Our motives are largely pragmatic. We have found that reading and text comprehension per se is not the most significant limiting factor as far as success with a particular program is concerned. We have found that students are better off if they learn the basic conventions of the genre in programs wit little text and story line.

Let us briefly turn to a discussion of these basic conventions. First, players learn that they must thoroughly explore the territory. And they must keep track of where they've been and the resources/hazards present at each location. To aid one's exploration a map is essential. Many programs, especially those for younger children, come equipped with a map (e.g., Dragon's Keep, Troll's Tale, Winnie the Pooh in the Hundred Acre Wood, Death in the Caribbean). We have found (Forsyth, 1986) that students use these maps and can successfully reconstruct them from memory following completion of the program. For most programs, however, the student must construct his/her own map. Although we teach them how to do this, many elementary age children lack the patience to systematically construct and utilize a map.

Second, players must "keep track of" various things. In Winnie, there are 20 objects scattered around the wood. Each belongs somewhere else. As a player explores he/she must remember where objects are located so that when he/she runs into a likely "owner," he/she can retrace his/her steps to fetch the object and deliver it to its proper owner/place. Again, in the simpler programs, the computer assists with this record keeping, the player can call for a log of objects found/treasures located/suspects interrogated, etc. In more difficult programs, the player must either develop a phenomenal memory or use a pencil and paper.

Third, each program has its own problems to solve. In Death, in order to get down the side of a cliff, one needs a rope. The only way to get a rope is to take the rope from a child's swing one just happens to pass on the way to the cliff. There may be messages in code, the chronological order in which events occur is often important, logical syllogisms are endemic and so on. Undoubtably, the most challenging aspect of interactive fiction for those who progress beyond the novice level is the problem-solving. The Infocom series which includes Zork, as well as Wishbringer and Sea Stalker which we have used in our workshops, publishes a hint book with each work of interactive fiction. There is at least one monthly newsletter devoted to assisting players with the solutions to knotty problems (Questbusters, edited and by published by Shay Adams) and 40 people a day call Spinnaker's hot-line for clues to solving problems in one of their many works of interactive fiction.

Fourth, there are several basic procedures for "interacting" with interactive fiction. For several of the most basic programs (Dragon's, Troll's, Winnie) the player is given a 2 to 4 item multiple choice list of options. A typical list in Winnie would be:

Talk to Owl
Leave Owl's House
Take
Drop

The player moves the cursor to his/her choice with the space bar, then makes the choice by pushing the "return" key. At the next level of difficulty, players must type in two word commands like "Go North" or "Take Key." Directional commands can often be abbreviated (e.g., Go North=N). A few programs, like Swiss Family Robison, provide the player with a list of the vocabulary words that the computer will acknowledge as appropriate at that time. Indeed each program contains something called a "parser" which is a mechanism for sorting the players input into categories (verb, object, adjective, etc.) and making the appropriate response. Those with limited vocabulary respond with a phrase like "I don't know how to..." when the player has typed in a verb not contained in the vocabulary. In most programs the player must learn the vocabulary through trial and error. In

very advanced programs such as those published by Infocom, the parser accepts (understands?) whole sentences. Next to the problem-solving, the greatest source of frustration for out students surrounds the difficulty in making the right choice of words to "get the computer to do something."

A final consideration concerns time. The simpler games can be completed in under 1/2 hour even by children in the primary grades. The harder programs may take 20 hours or more to complete. The more recently published programs all have a "save" feature that allows you to set aside you "quest" and return at the point where you left off. However, not all students have enough "staying power" to continue the quest for hour after hour.

Given all these considerations we have organized all our classes in such a way that we present a developmental progression to the students so that: (a) they learn the basic conventions in simple-to-use programs, where the problem-solving and vocabulary difficulties are minimized, (b) we provide direct coaching and encouragement in the use of maps and note-taking, (c) we have a large program library (see Appendix A) which makes it relatively easy to match each student's ability and interest with the appropriate program. (However, we wish there were more programs available with the same difficulty level as Winnie.) In the next section, we turn to the question of why one would want to use interactive fiction in an educational setting and offer some ideas on how to do this.

Using "Interactive Fiction" to Enhance the Reading Activity of Reluctant Readers

Among those interested in helping children learn to read, it is clear that half the task is to teach children how to read while the other half involves getting children to use that ability often enough to become fluent readers. To do this we need to develop readers who enjoy reading to the extent that they utilize their reading ability often enough and in ways that contribute to continual growth in this important skill. However, children cannot be taught to love to read. Children must be helped in learning that reading is just one more means of doing and enjoying those things that they want to do and enjoy. We don't read just for the sheer joy of casting our eyes across printed symbols. We read for what the results of reading means to us personally. Unfortunately, for many children they have not had the opportunity to find in the books they read personal satisfaction to the extent that they choose reading as a recreational or free time activity.

We believe that students are more likely to become fluent readers if they are exposed to "real" texts written for real purposes and that are highly motivating and interesting to children. We believe that interactive fiction could offer students who are reluctant readers a new motivation and interest to use their reading ability for personal satisfaction. The

"genre" is characterized by combining sophisticated programming with the traditional tools of the storyteller to create engrossing fictional worlds. Some people maintain that interactive fiction, even it its infancy, marks a new literacy form. That claim is debatable, but there is no doubt that these sophisticated, interactive games involve the reader in activities that clearly require and enhance the use of the reading behaviors that many current reading theorists would emphasize as important and essential in developing reading comprehension strategies (Smith, 1983; Rumelhart, 1983). Consequently, we wanted to conduct an exploratory study to determine if students who had little or no interest in reading as a recreational activity would play computer games that required extensive reading.

We tried to determine the following from this exploratory study: Primarily, do interactive fiction games which require extensive reading provide motivation enough to encourage children to play the games regardless of their interest in reading. Secondly, could we encourage and aid children to progress from games that required less reading to games that were all--text with few illustrations.

The subjects were eight children enrolled in a special summer computer workshop. These students paid a fee for participating in the workshop. Students ranged in grade level from fifth grade to ninth grade. There was one sixth grade girl. The workshop met for three hours a day, four days a week, over a four week period. All students completed the Wisconsin Reading Attitude Inventory Form II (Dulin, Chester, 1976). This is an inventory to asses student interest in reading. Results of the inventory suggested that all of the students had no more than an average interest in reading recreationally.

The children were assigned to particular programs based on their prior experience and expertise. We moved students through a developmental sequence as discussed in the first part of this paper. As children became more skilled we moved them toward more text-oriented interactive fiction. We will discuss two students as individuals as we present our findings. Both of these students were boys entering ninth grade the following Fall. Both students had expressed low to average interest in recreational reading as measured by the Reading Attitude Inventory used in the study. These students were introduced to the advanced electronic novel, Sea Stalker, and asked to play it for the last eight days of the workshop.

The treatment in this exploratory study was simply to encourage the students to continue their interaction with the program for extended periods of time. Encouragement was provided by an observer who gave clues or suggestions for overcoming problems or dilemmas encountered by students as they engaged in their quest. The primary function of the observer was to not allow the students to get "bogged down" because of their inability to solve dilemmas or problems. No help was offered in

reading the text as it appeared on the screen. As students solved or completed a quest, they were given a program at the next level of difficulty in our anthology of interactive fiction.

The findings are presented in the following order: first, general observations regarding all the students and secondly, the specific observation related to the two subjects selected to play Sea Stalker.

It became clear that all students were deeply engrossed in these programs. So much so, that students who had expressed little or average interest in reading would spend as much as three hours a day for two weeks involved in reading activities as they interacted with their programs. The only condition that seemed to cause students to lose motivation or want to stop playing was when they were unable, after repeated attempts, to move ahead or solve a dilemma in the quest. We found that providing clues and suggestions for overcoming these obstacles would help to sustain students' efforts.

If students tired of one game, they would request a change, however, there was never a need to request that students "attend" to their "task." Regardless of the considerable amount of reading that was required in nearly all of the programs, none of the students reacted negatively to this aspect of the programs.

The two ninth grade students whose ability allowed them to interact with Sea Stalker were observed carefully for two weeks. They had expressed less then average interest in reading and had indicated that they would rarely select reading as a free-time activity. Nevertheless, they showed great interest in Sea Stalker eventhough it required exclusive use of reading strategies and reading ability. These students read for nearly three hours a day for eight days as they attempted to complete Sea Stalker. There was little difference in the amount of engaged time for either student. However, one student required more "clues" and "suggestions" in his efforts at the quest.

It appears from our exploratory study that students with no more than average interest in reading will spend large amounts of time engaged in interactive fiction that requires heavy amounts of reading if they are successful at carrying forward with the quest. We view this as having important implications for encouraging students to read independently.

Research suggests that the amount of time students spend in independent, silent reading in school significantly relates to growth in reading achievement (Leinhardy, et al., 1981). However, the amount of time children spend reading in the average classroom is small. It has been estimated that less than 10% of the time is devoted to silent reading in the primary grades. This amounts to seven or eight minutes per day. By the middle grades this has only increased to fifteen minutes per day (Dishaw, 1977).

Research also indicates that the reading students engage in out of school is consistently related to gains in reading achievement. A recent study (Fielding, et al., in press) of fifth graders has indicated that the average minutes per day spent reading books was the best predictor of reading comprehension, vocabulary size, and gains in reading achievement between second and fifth grade. Unfortunately, most children spend very little time reading during free time. In the above mentioned study of fifth graders, 50% of the children read books for an average of four minutes per day or less, 30% read two minutes per day or less, initially 10% reported never reading any book on any day. For the majority of the children, reading from books occupied 1% of their free time, or less.

It is clear that the amount of time children spend reading should be a priority of both parents and teachers. Reading books is perhaps the major source of knowledge about sentence structure, text structure, literacy form, and topics ranging from A to Z. However, from the above research it is clear that many students have not developed the desire to read as a recreational activity.

We suggest that these same students who are reluctant readers may be avid computer hackers, video gamer, LOGOphiles or what have you and will respond very favorably to interactive fiction--despite the heavy demands for accurate, comprehensive reading.

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APPENDIX A

INTERACTIVE FICTION IN THE EDITH BOWEN LABORATORY SCHOOL

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ERIC Clearinghouse on Reading and Communication Skills

ERIC Digest

Software Evaluation for the Teacher of the English Language Arts

Sifting good software from bad is not difficult, but it is not like selecting textbooks. If you use the same strategies, you may waste both time and money. You can flip through many textbooks and get a good idea of their worth because you are sophisticated about what you are looking for. Also, when teaching with textbooks, you are still a major part of the show—preparing, emphasizing, explaining, highlighting, filling in the gaps, and making up for weaknesses. The book will not slam shut if a student forgets to turn the pages in a certain manner. A computer program, however, can create frustration and confusion for the student. It can, in effect, "break down" if it is not thoughtfully designed. Therefore, teachers must learn selection strategies in order to become sophisticated consumers.

What Are the Initial Considerations?

Never buy software without conducting a thorough examination of it. You should look at two parts of the software: the documentation and the actual, running program. The documentation is the written explanation that comes with the computer disk. Beware of any software that does not have such documentation, as lack of documentation often means the person who produced the program didn't organize it well or didn't bother with explanatory material.

The documentation should help answer some basic questions. Are the stated objectives of the program something you need for your students? What equipment specifications does the program take? If the program needs 64,000 units of memory and your computers have only 48,000, do you want to buy additional memory chips for all your machines so that this program will run? Does the success of the program depend on color—if so, do you have color monitors? Trying to distinguish the sentences written in red from the ones in blue on a black and white screen is tiresome, if not impossible. Does the program need disk drives or cassette players? If disk drives, how many? Is one of the strengths of the program that it will print out a paper copy of the student's work? If it is and you either don't have access to a printer or have one printer for thirty students, maybe the program isn't for you.

When First Viewing the Program, What Should You Look for Concerning Organization and Structure?

Suppose you like the subject matter, accept the stated objectives, and have the equipment. It's time to examine the program for the first run-through—and this ought to be the first of several if you are going to be a competent consumer. Concentrate on three areas during the first run: Does the program carry out its stated objectives? Is it user-friendly? Does it have sound pedagogical structure?

You probably do not need help in deciding if the program carries out its stated objectives, because that's a regular part of teaching. But what about user friendliness? Is the program easy to use? Are there clear directions, or do you need technical knowledge about computers to make this program work?

In addition, examine the program for ease of operation. If you have to press the return key after your input, does it tell you to do so? Is the program menu driven? That is, do you start out with a page of choices, or do you have to start in the same place every time—reading directions at the beginning? What about a way to quit if you get bogged down or must leave? Can you get out of the program short of pulling the plug? Can you go back to see those directions you thought you didn't need in the first place, or thought that you'd remember after a quick read-through?

What Should I Know about Feedback?

It's important to look at both positive and negative feedback. These terms do not mean good and bad. Rather, they refer to the feedback given for correct and incorrect responses. Is the feedback appropriate? Too much positive feedback isn't useful. Some programs go too far, using the student's name and a string of superlatives to reward a correct response: "What a marvelous job, Charlie. You sure know your stuff." This approach is boring and often condescending. Field studies show that a simple "Okay" or "Correct" is often enough.

Moreover, does the negative feedback help point students in the right direction? Computers can handle many possible answers in many forms in a helpful way—if the programming was done by a competent programmer and a designer who knows the content. Feedback that says "Think!" is useless to students who thought they were thinking but missed the answer anyway. A more helpful feedback design is the corrective feedback paradigm (CFP). This system reruns missed questions through a questioning sequence at specified intervals to reinforce retention.

Finally, there are some programs that won't let students out until they have answered five or ten or fifteen questions correctly in a row. Some students just can't do that, and they get so frustrated by a lack of success that they quit. Keep this in mind as you evaluate a program. In addition, remember to check whether the program keeps track of the student's work, giving some type of summary and evaluation at the end.

What Pedagogical Issues Should I Consider During the First Viewing?

There are several important issues. For example, is the sequencing pedagogically logical? Does the program permit the student to interact—think, respond, wonder, predict—or does the student just read an electronic workbook? (You can buy quite a few workbooks for the cost of one piece of software, not to mention the cost of the computer.) The more interactive the program, the better. Get students involved in this evaluation and make sure that computer involvement is worthwhile for both their education and their time.

Look carefully at the language: Is it too formal, or too laden with slang? Is it so dependent on fad that it will be outdated in two years? Finally, do graphics and/or sound add anything to the program, or are they window dressing?

What Should I Look for in a Second Viewing?

If the program seems to pass the test so far—you like the objectives, it's user-friendly, and the pedagogy is good—it's time for a second round of assessment, in which you consciously make errors. This may seem hard. Teachers like to do things correctly and neatly. On this run-through, however, you'll need to force yourself to be a confused and/or slow learner.

Find out what happens if you just hit the return key with no input. Can you do it three times, get the correct answer, and page on through or do you have to make an attempt to answer? What does your program do with perceptually correct but literally incorrect answers—especially misspellings, parts of names, or abbreviations? What does the program do with a totally "off-the-wall" response—treat it as such or say, "Wow, that's interesting, Johnnie"? What happens if you hit the escape key, hit many keys simultaneously, or randomly tap the keyboard? Try it. If the program is capable of handling such things, it's said to be "bulletproof." If the program isn't designed to handle accidental or intentional problems, it's going to backfire on some students.

If you look at these aspects, you will have given the program a good preview. If you still like the program at this point, then it's time to turn the program over to some of your students. Choose at least a couple—the quick/bright and the slow/unmotivated—and get their opinions. Their actions and reactions will reveal much more about the program.

What Should I Know about Dealing with Software Publishers?

If publishers will not let you inspect programs on a trial basis, beware but remember that they are not entirely at fault. Software development, especially well-done material, costs money. If publishers send out disks for preview and you copy them and send them back, they stand to lose a great deal of money. So allow for the publisher's qualms when making arrangements for previewing. Send a letter guaranteeing that you will not copy illegally. In addition, request to see the real program rather than shortened preview disks. If they won't send just the disks, ask them to send a sales representative to do a demonstration and then try to get time for your own evaluation. Sometimes several schools can join together and invite several publishers to put on a software fair with a wider range of materials. It takes planning, but it is a way to see the material.

Another factor to check on is how to get a backup disk or multiple copies. You should be given either a backup disk or provision to make your own. Also, how does the publisher deal with your need for five, ten, fifteen or thirty copies for your district? Paying the full retail price for each one could wipe out a budget for software on one item. Negotiate a reasonable, nominal fee for additional or replacement copies. In school settings, disks are sometimes lost, stepped on, or otherwise damaged. In addition, you should investigate the publisher's policy if, for some reason you didn't foresee, the program just will not work out. Do not, however, make the return option an excuse for weak evaluation practice on your part.

Finally, deal openly and honestly with publishers and expect to be treated in the same manner. Remember, they are somewhat new at this also. The copyright laws are ambiguous on computer materials and business policies and practices are just being formed. Publishers and educators must work together to establish a smooth working relationship. Tell your colleagues and educators in other districts about publishers who are good to work with. Set up a network of information.

In addition, make use of general professional resources, like reviews of software from EPIE (Educational Products Information Exchange) and MicroSift. Read software reviews and gather ideas about the instructional use of the computer in journals like *Language Arts*, *English Journal*, and *Computers in Reading and Language Arts*. But don't let others' ideas take the place of your own hands-on assessment. The ideas in this digest, along with documents like "Guidelines for Review and Evaluation of English Language Arts Software" (National Council of Teachers of English 1984) can help you to choose the best software for use with your students.

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INSTRUCTION READING LESSON

BARBARA A. SCHAUDT, *Suny at New Paltz*

Today's teachers are presented with the emergence of a relatively new classroom teaching tool--microcomputers. Although the first device containing the essential processes of a computer was designed in 1835 by Charles Babbage it was not until 1977 that microcomputers entered the nation's schools (Hofmeister, 1984; Shalaway, 1980). Thus, microcomputers have been in the educational setting for less than a decade. Given its limited history, research solely focusing on computer-assisted instruction (CAI) and reading has only recently become available (Mason, Blanchard, & Daniel, 1983). Yet today, approximately one million of the nation's schools are incorporating CAI in the curriculum (Abrams, 1986). Many schools are training teachers to be computer literate, yet there appears to be virtually no training concerning the effective use of microcomputers as an educational tool (Caruso, 1984). As educators are faced with the surge of microcomputers in the classroom, effective computer usage in reading instruction becomes an issue of primary importance. A logical starting point toward determining effective computer usage in reading is to examine CAI in light of the extensive body of teacher effectiveness literature.

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Teacher effectiveness has been a growing concern among educators during the past century. Throughout investigations on teaching students to read, the most significant factor in determining student achievement in reading has been the teacher (Bond & Dykstra, 1967; Gates, 1937; McDonald, 1976). Realizing the importance of the teacher, educational researchers have studied teachers of reading to identify characteristics associated with effective teaching practices. As a result of process-product research, several patterns of effective teaching strategies have emerged (Rupley, Wise, & Logan, 1986). One major pattern associated with increased student achievement in reading is the use of the direct instruction approach. It is in this approach that CAI may be utilized to increase not only the effectiveness of the direct instruction approach itself, but also student motivation and learning. A second pattern particularly germane to the effective use of CAI and reading is the use of a wide variety of materials at the primary grade levels. It is the author's contention that the addition of the computer as a new learning tool, if used properly, may enhance student earning.

Patterns Associated with Teacher Effectiveness

Rosenshine (1979) reviewed and interpreted teacher effectiveness research and categorized patterns of effective teaching behaviors in terms of direct instruction. According to Rosenshine (1979), direct instruction is characterized by:

1. academically focused classrooms
2. teacher directed classrooms
3. the use of materials that are sequenced and structured
4. activities where goals are clear to students
5. sufficient and continuous time allocated for instruction

6. extensive content coverage
7. teacher monitoring of student performance
8. questions which are at a low cognitive level so that students can produce many correct responses
9. immediate and academically oriented feedback
10. teacher controlled instructional goals
11. the choice of materials appropriate for the student's ability
12. the teachers' pacing of the instructional episode
13. interaction which is structured but not authoritarian
14. learning which takes place in a convivial academic atmosphere (p. 38)

An essential component of direct instruction relevant to CAI is academic learning time. Academic learning time consists of three basic components: (a) allocated time, (b) engaged time, and (c) student success rate (Fisher, Marliave & Filby, 1979). Allocated time refers to the amount of time assigned for covering or mastering the content. Research has shown that allocated time is positively related to student achievement (Fisher et al., 1979). Engaged time refers to the amount of time during which students are on task or are actively involved in the lesson. Any form of information processing such as reading, thinking, manipulating objects, or academic interaction with other students constitutes active engagement. Student success rate refers to the level of difficulty of the given task. If the task is at an appropriate level of difficulty and the students are able to produce many correct responses, then they are more likely to be learning. Thus, academic learning time refers to the amount of time students are successfully engaged in an appropriate academic task. Research has indicated that when teachers increase academic learning time, the result tends to be greater reading achievement (Anderson, Evertson, & Brophy, 1979).

Given the components of direct instruction and the capabilities of the computer, the computer may serve as an additional tool to support the direct instruction of reading skills.

Practical Application of the Direct Instruction Model

Based on teacher effectiveness literature, Baumann (1984) developed a practical application of the direct instruction reading model for classroom instruction in comprehension skills. His model consists of five steps:
1) introduction, 2) example, 3) direct instruction, 4) teacher-directed application, and 5) independent practice.

The introduction sets the academic focus. It is during this step that a statement of the goal and purpose of the lesson is made clear to students thus enhancing students' understanding of how the lesson will aid their reading skills. This step also demonstrates the lesson's relevance, that is, why students should pay attention. In step two, the students are given an example of the new skill taken from a section of the text the students will be using. The example demonstrates the relationship between the skill being taught and its application in a reading situation. Step three, direct instruction, is the portion of the lesson during which actual teaching takes place. The teacher is solely responsible for skill acquisition and ensures learning primarily through informing, modeling, demonstrating, and involving the students in the lesson. During step four, teacher-directed application, the teacher maintains control over the instructional goals; however, students gradually become responsible for skill acquisition. This step requires students to apply the newly learned skills while the teacher monitors performance,

provides guidance and feedback, or if necessary reteaches the skill. The final step of a direct instruction lesson is independent practice. Students are provided with the opportunity to apply the newly learned skill and are required to practice it on their own through a reading activity outside the lesson itself.

Incorporating CAI into a Direct Instruction Lesson

It is the author's contention that many elements of direct instruction identified by teacher effectiveness research are applicable to CAI. The most important aspect to bear in mind when incorporating CAI is that the key variable in effective reading instruction is the teacher. Teachers have direct control over the teaching-learning environment, the ways in which they approach the teaching of basic skills, and whether or not students experience success in reading (Blair, 1984). Through proper use, the incorporation of CAI in a direct instruction format can help teachers accomplish their instructional reading goals.

Computer-assisted instruction may be incorporated most logically in the direct instruction reading model during either the teacher-directed application or the independent practice portions of the lesson. Both of these steps first require that teachers choose appropriate software which not only matches the ability level of the student but focuses on the specific skill of the lesson. Software on an appropriate level of difficulty is essential to promoting academic learning time. In addition, the content of the software should reinforce the specific skill presented in the direct instruction portion of the lesson. If the chosen software is presented in a logical sequence supporting the skill of the lesson, the teacher is enhancing structured learning of instructional goals.

Once appropriate software has been chosen, the next decision concerns the placement of CAI within the direct instruction format. Although CAI may be incorporated in any step of the lesson, the most appropriate steps are during either the teacher-directed application or independent practice portions of the lesson. During teacher-directed application students are provided with the opportunity to apply the new skill while the teacher monitors student performance and provides feedback and reteaching. When incorporating CAI during teacher-directed application, instructional goals may be controlled and monitored by the teacher. If teachers first explain the new skill to students and then provide supervised practice on the computer, student learning and motivation are increased. Drill and practice programs are beneficial in this step as they provide the opportunity to practice and reinforce basic reading skills. The use of such programs enhances extensive content coverage.

One essential component of the direct instruction model is the pacing of the instructional episode. Many drill and practice programs allow the teacher the option of choosing both the level of difficulty of the skill, and the speed of the practice session. Using a program with this capability enables the teacher to maintain control over instructional goals for individuals or small groups. A second essential component of the direct instruction model is the monitoring of student progress. While students practice the skill on the computer the teacher may choose to monitor student progress herself or allow the computer to monitor progress, depending on her goals and the type of program being used. If the teacher is using a program with the ability to record student scores, student progress may be observed at a later time, thus freeing the teacher to monitor those students not using the computer.

Research has also shown that the use of systematic instruction during which information is provided, questions regarding the information are asked, and immediate feedback is provided has contributed to higher reading test scores (Stallings, 1976). A majority of computer programs pose skill questions and provide immediate academically-oriented feedback. When reteaching is necessary, tutorial programs may be beneficial. Most tutorial programs follow the direct instruction model by the defining the skill, providing examples, and finally allowing students to practice with the guidance of immediate feedback. Through the very design of the programs themselves, most drill and practice and tutorial programs can serve as an adjunct aid to the teacher.

The final step of Baumann's (1984) direct instruction reading model is independent practice. It is during this step that students demonstrate skill acquisition. Using the computer in this step is most beneficial if the chosen program has the capability of record keeping. The results of the students' independent practice assignment provides the teacher with essential diagnostic data. It is from this data teachers determine strengths and weaknesses of skill acquisition and whether or not the students need reteaching. If the chosen computer program records scores, teachers may use the information to guide the direction of further instruction. According to a study conducted by Schaudt (1985) 81% of the teachers who participated in the study did not use the computer to monitor student progress or to examine reading scores. Using the computer to obtain diagnostic data would save time in terms of grading assignments. and would allow the teacher to focus on planning instruction according to individual needs.

In both the teacher-directed application and the independent practice portions of the direct instruction lesson, the computer may be used to enhance academic learning time. Teachers allocate time on the computer for students to cover or master the content. Through proper software selection and monitoring of student progress, students can perform with a high rate of success on instructional goals.

Conclusion

Computer-assisted instruction has the potential to be an effective tool in helping students master targeted reading skills if time is allocated on the computer for sufficient and continuous content coverage, performance is monitored, and the teacher chooses software appropriate for the students' ability levels. Pearson (1985) suggested a new model of teaching in which the teacher assumes a more central and active role in instruction. This role is highlighted with the teacher helping the student to gradually move toward total responsibilty of skill acquisition. The use of CAI within direct instruction has the potential to help the student make this gradual transition. It may also serve to increase student motivation to learn, to enhance the monitoring of student progress, and to free the teacher to provide more contact with individual students. Computer-assisted instruction presents a feasible tool for augmenting teacher effectiveness.

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Selected Abstracts from the ERIC Educational Resources Database

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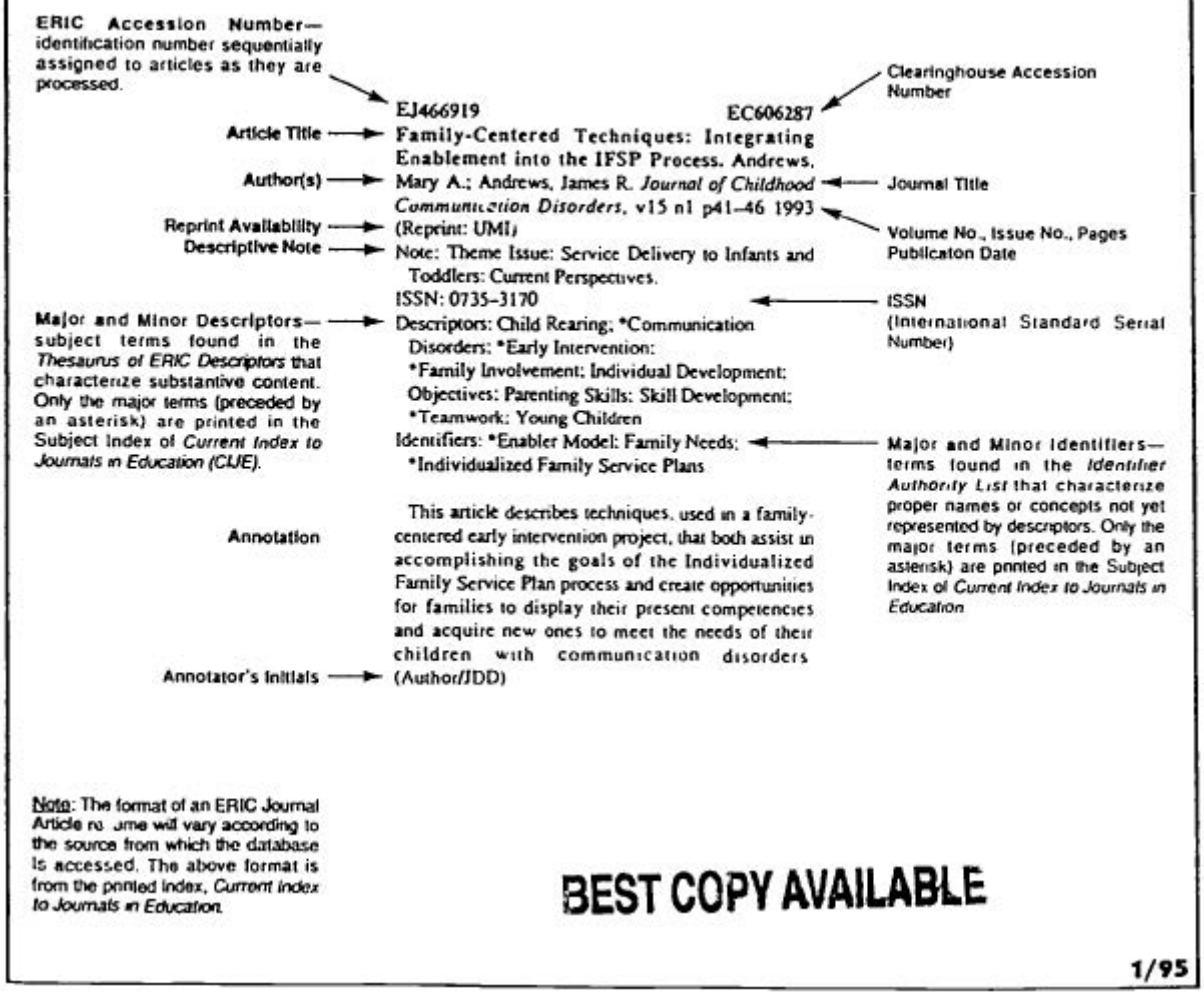

The Following Abstracts on Computers and Reading are from the ERIC Educational Resources Database

AN: EJ426430
AU: Heise,-Bonnie-L.; And-Others
TI: **Building Base Vocabulary with Computer-Assisted Instruction.**
PY: 1991
JN: Teacher-Education-Quarterly; v18 n1 p55-63 Win 1991
AV: UMI
AB: Reports a study which looked for measurable differences between the vocabulary achievement scores of remedial reading elementary students (mostly Hispanic) taught with teacher instruction and those taught with computer assisted instruction (CAI). Although the differences were not statistically significant, consistent improvement was measured for the CAI group. (SM)

AN: EJ407002
AU: Thomas,-Adala; Clapp,-Tillie
TI: **A Comparison of Computer-Assisted Component Reading Skills Training and Repeated Reading for Adolescent Poor Readers.**
PY: 1989
JN: Canadian-Journal-of-Special-Education; v5 n2 p135-44 1989
AB: Two computerized remedial reading programs, the "Autoskill Component Reading Subskills Program" and "Read It Again Sam," were used with poor readers. Compared to 6 controls, the 10 ninth grade students using the programs improved word recognition accuracy and rate, while comprehension gains were modest. Relative strengths of both computer programs are discussed. (Author/JDD)

AN: EJ400783
AU: Majsterek,-David-J.; Wilson,-Rich
TI: **Computer-Assisted Instruction for Students with Learning Disabilities: Considerations for Practitioners.**
PY: 1989
JN: Learning-Disabilities-Focus; v5 n1 p18-27 Fall 1989
AB: Following a description of findings from published research on computer assisted instruction with learning-disabled students, sources of software reviews and suggested criteria for software evaluation are provided. Stressed are the importance of a program's technical and instructional adequacy and the appropriateness of the materials for an individual student. (Author/DB)

AN: EJ398000
AU: Gore,-Dolores-A.; And-Others
TI: **A Study of Teaching Reading Skills to the Young Child Using Micro-Computer Assisted Instruction.**
PY: 1989
JN: Journal-of-Educational-Computing-Research; v5 n2 p179-85 1989
AB: Describes study that was conducted to determine whether four- and five-year-old preschoolers could be taught reading skills with computer-assisted instruction, and whether they could learn basic computer literacy skills without direct instruction and drill. Software is described, and the pretest/posttest single group design is explained. (16 references) (LRW)

AN: EJ396569
AU: Applegate,-Anthony-J.; Applegate,-Mary-DeKonty
TI: **Principles for the Evaluation of Computer-Assisted Instruction in the Teaching of Reading and Language Arts.**
PY: 1989
JN: Journal-of-Reading,-Writing,-and-Learning-Disabilities-International; v4 n3 p215-21 1988-89
AB: Drawing on theoretical and practical sources, the paper develops four basic principles of teaching in the reading/language arts and discusses how these apply to the selection and effective use of computer assisted instruction (CAI). CAI is seen as an integral part of a broad based instructional program. (Author/DB)

AN: EJ370498
AU: Fox,-Jeremy
TI: **Some Advantages and Disadvantages of Developing Reading Skills with Computers.**
PY: 1987
JN: Reading-in-a-Foreign-Language; v4 n1 p59-67 Fall 1987
AB: Examines arguments both for and against using computer-assisted learning (CAL) techniques in the development of reading skills, covering the advantages of control, interaction, power, and versatility. CAL's disadvantages include affective demands, logistics, and methodological limitations. (Author/CB)

AN: EJ361111
AU: Kleinmann,-Howard-H.
TI: **The Effect of Computer-Assisted Instruction on ESL Reading Achievement.**
PY: 1987
JN: Modern-Language-Journal; v71 n3 p267-76 Fall 1987
AB: Study of the reading achievement of nonnative speakers of English enrolled in a basic skills college reading course indicated that those students receiving computer-assisted instruction (CAI) made higher reading achievement gains than students not receiving CAI. An annotated list of CAI reading software is included. (CB)

AN: EJ338970
AU: Simpson,-Mark-W.; Bolduc-Simpson,-Sheila
TI: **Developing a Computer Assisted Reading Instruction Program.**
PY: 1984
JN: CALICO-Journal; v2 n1 p34-39 Sep 1984
AB: Describes the content and structure of a computer-assisted reading instruction program for intermediate level adults learning English in a business environment. The program focuses on the

three reading subskills of skimming, scanning, and guessing. Suggestions for teachers on how to evaluate effective courseware are provided. (Author/SED)

AN: EJ337381
AU: Wrey,-David
TI: Too Much Software? An Update on Computer-Assisted Learning in Language and Reading
PY: 1986
JN: Reading; v20 n2 p121-26 Jul 1986
AB: Outlines a set of criteria for use by teachers in selecting and evaluating educational software. (FL)

AN: EJ336081
AU: Clarke,-David-F.
TI: Computer-Assisted Reading--What Can the Machine Really Contribute?
PY: 1986
JN: System; v14 n1 p1-13 1986
AV: UMI
AB: Describes an integrated series of computer-assisted reading (CAR) materials under development at the University of East Anglia in Norwich. The discussion indicates some of the problems in teaching reading with computers, describes the framework of the CAR project, and gives specific examples of activities. (SED)

AN: EJ304287
AU: Curtin,-Constance; Shinall,-Stanley
TI: Computer-Assisted Reading Lessons.
PY: 1984
JN: CALICO-Journal; v1 n5 p12-16 Jun 1984
AB: A computer-assisted university foreign language project using individualization is described. Its advantages include improved student attitudes and learning efficiency, active practice, student privacy, and increased opportunities for teacher innovation and learning. (MSE)

AN: EJ304271
AU: Wyatt,-David-H.
TI: Computer-Assisted Teaching and Testing of Reading and Listening.
PY: 1984
JN: Foreign-Language-Annals; v17 n4 p393-407 Sep 1984
AV: UMI
AB: Describes and assesses what can be achieved in the learning and testing of the receptive language skills with computer hardware now available. Provides guidelines and suggestions for the development of language learning and testing software. Defines three types of computer programs: instructional, collaborative, and facilitative. (SED)

AN: EJ290190
AU: Regoste,-Marjorie
TI: Computer-Assisted Instruction and Compensatory Education: A Longitudinal Analysis.
PY: 1983
JN: Machine-Mediated-Learning; v1 n1 p97-127 1983
AB: In a four-year longitudinal study of computer-assisted instruction, mathematics, reading, and language arts coursewere developed by Computer Curriculum Corporation was evaluated in four elementary schools. Each curriculum raised students' scores on standardized and curriculum-specific tests. Program costs, participant attitudes, and implications for other schools are reported. Nineteen references are listed. (Author/MBR)

AN: EJ254167
AU: Artley,-A.-Sterl
TI: Individual Differences and Reading Instruction.
PY: 1981
JN: Elementary-School-Journal; v82 n2 p143-51 Nov 1981
AV: Reprint: UMI
AB: Discusses some of the ways reading instructors have responded to individual differences in children. Methods described include grouping for instruction, self-selected reading, language-experience reading, individualized instruction, skill development, and computer-assisted instruction. The teacher's role is discussed. (Author/DB)

AN: ED312629
AU: Potter,-Rosemary-Lee
TI: Using Microcomputers for Teaching Reading in the Middle School. Fastback 296.
CS: Phi Delta Kappa Educational Foundation, Bloomington, Ind.
PY: 1989
AV: Phi Delta Kappa, P.O. Box 789, Bloomington, IN 47402-0789 ($.75 members; $.90 nonmembers).
NT: 47 p.
PR: EDRS Price - MF01/PC02 Plus Postage.
AB: Based on the experiences of using computer-assisted reading instruction in middle schools, this pamphlet proceeds from the conviction that the use of a computer helps middle school students improve their reading. Following an introduction, the booklet is in seven sections: (1) Why Use Computers in Middle School Reading? (2) Software--The Heart of the Matter; (3) Managing Computer-Assisted Instruction in the Reading Classroom; (4) The Reading/Writing Connection: Word Processing; (5) Using Computers for Middle-School Remedial Reading; (6) Some Other Computer Considerations; and (7) Resources. (SR)

AN: ED312608
AU: Boyer,-Nancy-W.
TI: Reading Comprehension and the Computer.
PY: 1984
NT: 29 p.; M.S. Practicum, Nova University.
PR: EDRS Price - MF01/PC02 Plus Postage.
AB: A practicum study was conducted to raise the reading comprehension level of students at least one grade level by using Computer-Assisted Instruction (CAI), and to determine the kind of student who would most benefit by the use of CAI. A control group of 35 students and three experimental groups of 19 computer students, all in fourth or fifth grade, received normal classroom instruction in reading. The 19 students received extra computer training in reading comprehension for a period of 3 months. CAI students used original teacher-developed software entitled "Reading Comprehension" and the commercial reading program, "Our Weird and Wacky

World" by Educetional Activities. All students were tested before end after the use of the computers. Results of those using computers showed an increase when comparing the test scores. The overall gain of CAI students was 1.5 yeers. It wes recommended that this program of study be extended over e 10-month school yeer end thet the curriculum be expended to include en adjustable program to encourege faster reading along with the increase in comprehension. (Seven appendixes containing graphs, reading sources, student opinions, end a sample perent letter are ettached.) (MG)

AN: ED377898
AU: Wilson,-Lex
TI: Enhancing the Academic Skills of Adolescent Students with Learning Disabilities through Computer-Assisted Instruction.
PY: 1993
NT: 64 p.
PR: EDRS Price - MF01/PC03 Plus Postage.
AB: A study was conducted at the Cumberland Campus of Nova Scotia Community College to determine the effect of a computer-based learning system on the academic and personal growth of adolescents with learning disabilities. Eleven learning disabled students, with an average age of 16.1 years, and one observer were chosen to participate in an 8-week summer program utilizing the INVEST integrated learning system, a networkad system of basic instructional software offering lessons in reading, writing, mathematics, and life skills. Results of the study, based on pre- end post-standardized tests and feadback from participants, parents, and the observer, included the following: (1) positive gains were registered in both reading and math, with the group's average reading score moving from below average (29th percentile) to average (40th percentile) end average mathematics score moving from the 32nd to the 49th percentile; (2) improvement in mathematics was more in numerical operations than in reasoning; (3) 70% of the participants thought that the computer approach was better then traditional high school courses, and 80% indicated thet they had learned more than with traditional methods; (4) the instructor indicated that the system accommodeted a wider renge of leerner levels than traditional curricule; end (5) parents of the participants reported positive chenges in attitudes toward school work. Contains 16 references. Tebles, grephs, end the questionnaires are appended. (KP)

AN: ED310390
AU: Levinson,-Judith-L.; Lalor,-Ide
TI: Computer-Assisted Writing/Reading Instruction of Young Children: A 2-Year Evaluation of "Writing to Read."
PY: 1989
NT: 22 p.; Paper presented at the Annual Meeting of tne American Educationel Research Association (San Francisco, CA, March 27-31, 1989).
PR: EDRS Price - MF01/PC01 Plus Postage.
AB: A study focused on the effects of the Writing to Read program piloted at kindergarten end first grade levels in Community Consolidated School District 65. The report included measures of students' writing, performance on district-made and standardized reading tests, and a follow-up on second graders. Stetistical techniques of group comparison end pre-/post-testing were used to determine the effects of the program. One school site was chosen as the experimental group, and two school sites with comparable demographic characteristics were chosen as the control groups. Results indicated that writing scores of kindergarten and first grade children in the program were better than those of children in the comperison group. Reading vocabulery and comprehension scores of Writing to Read kindergartners were significantly higher than those of the comperison group. First graders in the program received higher scores in reading and spelling. Parents end teachers responded positively to the Writing to Read program. The follow-up testing of second graders showed no significant difference in the average reading scores of the experimental end control group students. There was no statistically significant difference in the distribution of writing scores between the follow-up experimental and the control group; however, when average writing scores were obtained, there was a significant difference favoring the experimental group. The Writing to Read system appears to be an effective intervention for developing writing end reading skills in kindergarten and writing skills in first grade. (Fifteen tables of data are included, and two eppendixes containing a teacher questionnaire and parent survey responses are attached.) (MG)

AN: ED304683
AU: Morgan,-Mary
TI: Content Area Reading in Secondary Educetion. Focused Access to Selected Topics (FAST) Bibliography No. 26.
CS: ERIC Clearinghouse on Reading and Communication Skills, Bloomington, IN.
PY: 1989
NT: 4 p.
PR: EDRS Price - MF01/PC01 Plus Postage.
AB: Focusing on content eree reading in secondary educetion, this annotated bibliography contains references to 29 articles and papers in the ERIC detabase, dating from 1987 to 1989. The citations include erticles discussing computer-assisted strategies, and reading strategies in math, science, end social studies. Other citetions include erticles describing reading strategies applicable to all content ereas. (MM)

AN: ED302226
AU: Gourgey,-Annette; And-Others
TI: Computer-Assisted Instruction Evaluetion Report, 1983-1984 School Year. DRET Report No. 21.
CS: Newark City School District, N.J.
PY: 1984
NT: 233 p.; Prepared by the Division of Research, Evaluetion and Testing.
PR: EDRS Price - MF01/PC10 Plus Postage.
AB: Designed to improve student achievement in reading, language arts, and mathematics, the computer-assisted instruction (CAI) program in the Newark, New Jersey, schools comprises e regular component for remedial end everege-echieving

students, an enrichment component for higher achieving students, and a bilingual component for students having limited proficiency in English. An evaluation of the program's effectiveness showed that: (1) the regular CAI program for mathematics and reading was more beneficial for students qualifying for remedial services than for average achievers; (2) the most effective management strategies were effective encouragement in reading and coordinated instruction in mathematics; (3) elementary students in the enrichment program scored higher in vocabulary but not in reading comprehension than nonparticipants; (4) students in the mathematics enrichment program scored higher than nonparticipants in both math computation and concepts and applications; (5) ninth grade algebra students in the program scored higher than nonparticipants in math computation but not in concepts and applications; (6) students in the bilingual program who were initially the most proficient in English had the smallest returns, but spent the most time on the computer; (7) the reading comprehension component was more effective for sixth grade students than for fourth and fifth graders; (8) CAI-developed skills in English proficiency at the primary level seemed to have no effect on academic achievement; and (9) participation in the CAI program did not significantly assist the performance of students in the upper grades in either English proficiency or mathematics. Six recommendations based on these findings conclude the report. The text is supplemented by 76 tables and 6 appendices that include 2 extensive companion studies: (1) "Reading Competencies and Reading Comprehension"; and (2) "The Impact of Computer-Assisted Instruction on Mathematics Learning Gains of Elementary and Secondary Students." (EW)

AN: ED299548
AU: Goldman,-Janet-M.
TI: **The Use of Computers versus Basal Readers for Reading Comprehension in the Primary Grades.**
PY: [1988]
NT: 18 p.
PR: EDRS Price - MF01/PC01 Plus Postage.
AB: A 10-week study examined whether the use of computers could be more effective than basal readers for improving reading comprehension at the primary level. Subjects, 12 students from the second grade, were divided into two groups, 6 in the experimental group using computers only and 6 in the control group using basal readers only. Both groups used the H.B.J. Basal Reading Program's workbook. The students were given pre-and posttests using the Gates-McGinitie Reading Test, vocabulary and comprehension sub-tests, H.B.J. Reading Program's unit tests, and five selections on the computer using materials developed by Janet Goldman and released by Hartley Courseware. Results suggested that the use of computer-assisted instruction may be more effective than basal readers for improving reading comprehension at the primary level. (Four data charts are included.) (RAE)

AN: ED290937
AU: Balajthy,-Ernest
TI: **Recent Trends in Minicomputer-Based Integrated Learning Systems for Reading and Language Arts Instruction.**
PY: 1988
NT: 27 p.; Paper presented at the Rutgers University Spring Reading Conference (New Brunswick, NJ, March 1988).
PR: EDRS Price - MF01/PC02 Plus Postage.
AB: This paper discusses minicomputer-based ILSs (integrated learning systems), i.e., computer-based systems of hardware and software. An example of a minicomputer-based system in a school district (a composite of several actual districts) considers hardware, staffing, scheduling, reactions, problems, and training for a subskill-oriented reading program for compensatory education students. Specific ILS software packages are then described: (1) the PLATO/WICAT System 300 for primary reading, reading comprehension, writing, language arts (with language arts skills, spelling, and sentence combining components), English as a Second Language, and other academic subjects; (2) the Computer Curriculum Corporation's MICROHOST system for mathematics, reading, language arts, and computer literacy from grade 1 through adult; (3) Houghton Mifflin's Dolphin Curriculum, which is designed to supplement teacher-directed instruction with computer-assisted instruction in reading and language arts skills; and (4) DEGEM Systems' TOAM Computer Aided Instruction System for mathematics and multiple choice drill instruction. The appendix lists publisher, former names, systems software, instructional components, and hardware configurations for each system. (8 references) (MES)

AN: EJ477677
AU: Boone,-Randall; Higgins,-Kyle
TI: **Hypermedia Basal Readers: Three Years of School-Based Research.**
PY: 1993
JN: Journal-of-Special-Education-Technology; v12 n2 p86-106 Fall 1993
AV: UMI
AB: This 3-year longitudinal study used hypermedia computer-assisted instruction (CAI) to provide individualized reading instruction for approximately 300 students in grades K-3. The software provided reading lessons in a hypermedia format designed as supplementary material for a basal reader series. The low ability subjects achieved significantly higher than did control students. (DB)

AN: EJ444473
AU: Farmer,-Mary-E.; And-Others
TI: **Computer-Assisted Reading: Effects of Whole-Word Feedback on Fluency and Comprehension in Readers with Severe Disabilities.**
PY: 1992
JN: Remedial-and-Special-Education-(RASE); v13 n2 p50-60 Mar-Apr 1992
AV: UMI
AB: This article reviews studies of computer-assisted reading programs, both with and without synthesized speech. It then describes a pilot study that used a reading program with computer-

synthesized speech with 14 adolescent readers having severe reading disabilities. The study found no evidence that addition of synthesized speech improved word recognition skills. (DB)

AN: ED257053
AU: Alfeno,-Jo-Ann-L.
TI: **Seventh Grade Vocabulary Computer Instruction vs. Classroom Instruction.**
PY: 1985
NT: 30 p.; M.A. Thesis, Kean College of New Jersey.
PR: EDRS Price - MF01/PC02 Plus Postage.
AB: A study examined students' achievement in vocabulary development under two modes, teacher directed instruction and computer-assisted instruction. The subjects--38 seventh graders who had a one to three year vocabulary deficit, according to the "Iowa Test of Basic Skills" pretest in vocabulary--were divided into two groups, Sample A (control) and Sample B (experimental). Sample A was given vocabulary instruction using the computer program, while Sample B was given the same lessons using the print-out from the computer The computer corrected the control group and the students corrected the errors with the class in the experimental group. Results of the study showed no significant difference between the two methods of instruction. However, there was a slight difference in favor of the experimental, teacher-directed group, showing that computer-assisted instruction is an educational tool but not a replacement for teachers. (An appendix contains lists of the 38 students, their pretest scores, and copies of the vocabulary tests that they were given.) (DF)

AN: ED243091
AU: Thompson,-Richard-A.
TI: **Computer Assisted Reading Instruction Research.**
PY: 1984
NT: 16 p.; Paper presented at the Annual Meeting of the International Reading Association (29th, Atlanta, GA, May 6-10, 1984).
PR: EDRS Price - MF01/PC01 Plus Postage.
AB: In the past two decades, computer assisted reading instruction has developed substantially. From educators using large mainframe computers located at a distance from keyboard terminals in classrooms, today reading educators are capable of using computer-assisted instruction (CAI) on typewriter-sized equipment portable to any location and useable anywhere. Although some investigations have shown computer-assisted instruction to be more effective than teacher-directed instruction, many more investigations are needed before that question can be answered definitively. Nevertheless, research studies have had several important instructional implications: (1) CAI currently has the capability of performing instructional tasks of a drill and practice type; (2) CAI's effect on reading achievement is equal to but no greater than that of teacher directed instruction; (3) students generally demonstrate positive attitudes toward computers, although poorly constructed CAI lessons bore students just as poorly constructed teacher prepared and delivered lessons do; and (4) relatively few teachers were involved in the early experimental research studies as reading experimentation was left to professional computer experts. (HOD)

AN: ED237967
AU: Caster,-Tonja-Root
TI: **Computer-Assisted Instruction in Reading and Language Arts.**
PY: [1982]
NT: 28 p.
PR: EDRS Price - MF01/PC02 Plus Postage.
AB: A review was conducted of 16 research studies evaluating the effectiveness of computer assisted instruction (CAI) in teaching reading and language arts in the elementary school. The studies were of what K. A. Hall has termed "interactive instruction," which includes drill and practice as well as tutoring. Of the studies reviewed, 13 used at least one experimental (CAI) group and one control group. Of these, four evaluated CAI's effectiveness in teaching vocabulary or language, four the teaching of reading, three the teaching of spelling and reading, and two writing instruction. The three studies that did not use control groups evaluated the effectiveness of CAI projects concerned with the teaching of reading. Nearly all of the studies reviewed found that CAI not only was effective but was more effective than traditional methods for teaching reading, vocabulary, and language. Findings for the effectiveness of CAI in the teaching of writing and spelling, however, were mixed. (An extensive reference list is appended.) (Author/FL)

AN: ED362831
AU: Tzung-yu,-Cheng
TI: **Comparing the Use of Computers with Traditional Print in Reading Instruction: What the Research Says.**
PY: 1993
NT: 21 p.
PR: EDRS Price - MF01/PC01 Plus Postage.
AB: Studies comparing computer-assisted instruction with traditional print were reviewed in order to determine what researchers have discovered about using computers in reading. The research findings were then compared and integrated through using the following five categories: interaction, attitude, instructional control, time on task, and efficiency. Most studies indicate that the subjects are more interactive with, and positive toward, computers. Computers help monitor successful learning. Computer groups spend more time on task; however, this is due to the special features used in computers. No definite answer supported either mode of presentation in efficiency. However, the review suggests that the quality of software and hardware may influence computer efficiency and more studies are needed in different instructional situations and subject areas. (Contains 32 references.) (Author/RS)

AN: ED352630
AU: Simic,-Marjorie-R.
TI: **Guidelines for Computer-Assisted Reading Instruction. ERIC Digest.**
CS: ERIC Clearinghouse on Reading and Communication Skills, Bloomington, IN.
PY: 1993

AV: ERIC Clearinghouse on Reading and Communication Skills, Indiana University, 2805 E. 10th St., Suite 150, Bloomington, IN 47408-2698.
NT: 4 p.
PR: EDRS Price - MF01/PC01 Plus Postage.
AB: Focusing on how teachers can integrate computers into reading/writing instruction, this ERIC digest presents guidelines for helping language arts teachers match their use of computers with what is known about the reading/writing process. The guidelines for computers and reading presented in the digest point out that computer instruction in reading should: (1) focus on meaning and stress reading comprehension; (2) foster active involvement and stimulate thinking; (3) support and extend students' knowledge of text structures; (4) make use of content from a wide range of subject areas; (5) link reading and writing. (RS)