Intended as a reference for researchers, teachers, and administrators, this book chronicles research, programs, and uses of computers in reading. Chapter 1 provides a broad view of computer applications in education, while Chapter 2 provides annotated references for computer based reading and language arts programs for children and adults in classroom and clinic settings, including LOGO, cloze procedure, language experience approach, special education, spelling, Native American education, and English as a second/foreign language. Chapter 3 introduces the reader to software evaluation guidelines and criteria, including references about the development of computer based reading programs and projects. Chapter 4 reviews computer based research on teaching reading, reading assessment, and psychological and physiological aspects of the reading process. Chapter 5 presents references on word processing, writing, and reading, and Chapter 6 offers explanations for the puzzling questions surrounding computer based readability and text analysis. References to computer based activities in reading readiness and beginning reading are presented in chapter 7, while chapter 8 discusses computer managed reading instruction. Chapter 9 details advances in computer based speech technology and reading instruction and the focus in chapter 10 is on text legibility and computers. Chapter 11 provides references about recent developments with CD ROMs (Compact Disk Read Only Memory) and CDIs (Compact Disk Interactive), and chapter 12 summarizes by speculating on the importance of other emerging applications in computer based reading, such as simulations, artificial intelligence, programming and authoring systems, communications and satellite communications, and robots. Two appendixes list companies that produce software and describe integrated learning systems that contain reading and language arts software.
Computer Applications in Reading

Fourth Edition

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TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)"

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International Reading Association

Newark, Delaware 19714

BEST COPY AVAILABLE
To Ira E. Aaron, President of the International Reading Association 1983-1984, and Alumni Foundation Distinguished Professor Emeritus of Reading, University of Georgia.
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The International Reading Association attempts, through its publications, to provide a forum for a wide spectrum of opinions on reading. This policy permits divergent viewpoints without assuming the endorsement of the Association.
Foreword

Computer Applications in Reading enters its third edition as a chronicle of research, programs, and uses of computers in reading. An index of the rapid changes that have taken place in the use of computers in reading is that this edition has a new and different set of references from that in the earlier editions. These form a body of recent literature that supersedes and augments the more than 900 citations included in the second edition. Many of the speculations and predictions included in the earlier editions have come to pass, often sooner than predicted. This edition includes topics that were barely more than fantasy in 1979 when the first edition was published.

The impediments to widespread educational adoption of computers have changed since 1979. The potential of computers in education has been linked to the costs of both hardware and software. Hardware capabilities of computers have also limited their educational utility. Slow processing speed, restricted memory capacity, lack of voice recognition and synthesis, and poor quality graphics have all played (in the past) a role in keeping the computer from becoming a dominant force in education. And much of the software was of dubious quality.

However, costs for microcomputer hardware have continued to spiral down while capabilities have greatly improved. Microcomputer systems can now perform tasks that required mainframe computers only a few years ago. Although hardware development usually outpaces software development, computer materials for use in reading are significantly improved. This is due in part to improved capacities of computers and in part to the efforts of major reading materials publishers who have finally become convinced of the reality of the computer in schools. Consequently, the use of microcomputers is continually expanding in education generally and in reading specifically.

Just as hardware costs are approaching affordability for most schools, a persistent problem has begun to loom larger than ever before. We have begun to realize that our broad based systematic knowledge of how to teach reading is inadequate to create software that will take advantage of the new,
different, and expanded capabilities of computers. While computer technology has provided a dizzying array of new potentials, our knowledge of how to teach reading remains geared to older and more stable technologies. Teachers and students often find themselves more comfortable with convenient texts and tasks that are “friendly” if not entirely effective or satisfactory.

Nevertheless, the computer “revolution” in reading will probably not be deflected from success. We have had convincing recent demonstrations of the effectiveness and the cost effectiveness of computers as instructional intervention devices, despite the claims of inadequate software and expensive hardware. Computers have become too pervasive, their promise too enticing, and their cost too irresistible to ignore. As educators, students, and parents are exposed to computers, more applications will be generated.

What we must strive to achieve is an integration of innovative uses of computers with our traditional knowledge of reading and reading instruction. We must also become aware of what we need to know (about both computers and reading) to increase effective uses of computers in reading and instruction. When such a synthesis can be produced, we will have reached the final phase of the computer “revolution” in reading.

Until then, this work is the most thorough compilation of the recent research on and applications of computers in reading, reflecting our current state of knowledge and practice. It provides us with an encouraging summary of what has been and can be done with computers.

Michael L. Kamil
University of Illinois at Chicago
Introduction

It is important to note that in this edition of *Computer Applications in Reading* most annotations and comments from the earlier editions have been deleted. However, a few historically important references have been retained for those who might not have access to earlier editions.

The format of the third edition is somewhat different from earlier editions for reasons of economy. All references, both annotated and nonannotated, are arranged in alphabetical order by year of publication.

The third edition of *Computer Applications in Reading* contains twelve chapters. Chapter 1 provides a broad view of computer applications in education. Chapter 2 describes computer applications in reading with special sections on **logo**, cloze procedure, language experience approach, special education, spelling, Native American and bilingual reading instruction, and English as a second language and foreign language education. Chapter 3 introduces the reader to software evaluation guidelines (including IRA's Criteria for the Selection and Utilization of Nonprint Media for the Reading Curriculum) and includes references about the development of computer based reading programs and projects. Chapter 4 reviews computer based research on teaching reading, reading assessment, and psychological and physiological aspects of the reading process. Chapter 5 presents references about word processing, writing, and reading. Chapter 6 offers some explanations for the puzzling questions surrounding computer based readability and text analysis. Chapter 7 presents references to computer based activities in reading readiness and beginning reading. Chapter 8 discusses computer managed reading instruction. Chapter 9 details advances in computer based speech technology and reading instruction. Chapter 10 focuses on text legibility and computers. Chapter 11, The Optical Era and Reading, provides references about recent developments with CD ROMS and CDIS. Chapter 12 speculates on the importance of other emerging applications in computer based reading; namely, simulations, artificial intelligence, programming and authoring systems, telecommunications and satellite communications, and robots. Appendix A is a comprehensive listing of companies that produce or distribute reading and language arts software.
Appendix B describes integrated learning systems that contain reading and language arts software.

Special thanks go to MaryAnn Jones of the Ralls, Texas, Public Schools, Susan Awbrey of Computer Curriculum Corporation, and to the Colleges of Education at the University of Georgia and Texas Tech University. In addition, the authors wish to acknowledge the efforts of the reviewers: Richard L. Carner, Michael P. French, and James R. Layton. Preparation of this text was supported in part by a grant from Texas Tech University.
It is possible that the computer will become an educational friend to all students within the next decade. Indeed, the computer probably will become an important part of all classroom instruction. However, the computer is still in its horse and buggy days, and its impact on education is just beginning.

It was not until the early 1960s that American colleges and universities began to develop the first computer based educational programs. Development projects were launched by partnerships among universities, the government, and computer manufacturers (e.g., IBM System 1500 and Stanford University). The programs developed were mainly for elementary and secondary education. They ran on mainframe, time sharing computers. Unfortunately, this approach to computer based education did not spark enough widespread public interest for continued support. As federal funding decreased, so did the involvement of American colleges and universities, and prior to the introduction of the microcomputer only a few computer based education projects were in operation. But the introduction of the microcomputer aroused great public interest. Soon there were hundreds and then thousands of microcomputers, not only in American schools but also in the schools of many countries (notably in Europe and the Far East).

An overview of selected applications in education

Diverse computer applications in education and reading continue to grow. Several years ago computers were used principally for drill and practice activities with few innovations. Today, drill and practice activities are just one use for computers in education. Some of these uses are introduced in this chapter; they will be discussed in greater detail in later chapters.
Testing

Computers can administer virtually all types of assessment instruments (with or without teacher support): achievement and aptitude tests and interest and reading inventories, whether norm referenced or criterion referenced. These instruments can be administered in group or individual settings. For example, Kendall-Hunt offers a computer based reading assessment instrument, in both English and Spanish, that can evaluate reading performance with or without teacher support. (See Appendix A for addresses of software publishers.)

Information and instruction management

Computers can ease most educational record keeping tasks by managing data derived from any number of sources. Computers can schedule classes, plan cafeteria menus, arrange bus routes, keep immunization records, dial the telephone numbers of absentees, and manage or prescribe most types of instructional activities. When these activities are coordinated with test administration and materials management, the computer can play a major role in the total instructional program in any subject, including reading.

Drill and practice

Computers can be used to present information in drill and practice formats for instruction and review purposes. In the past few years, much progress has been made in the refinement of drill and practice programs, especially by companies such as the Computer Curriculum Corporation and the Control Data Corporation-PLATO. (See Appendix B.) Although much maligned, drill and practice activities can provide valuable instructional support for the classroom teacher.

Tutorial/dialogue

Many computer based instructional programs are available that feature computer and student dialogue. These programs are called tutorials or dialogue programs because their algorithms make decisions about student performance; they alter (branch) the program content, level, or rate. These decisions and the accompanying adjustments in the program increase the likelihood of student success in mastering the program content.
Simulations

Computers can convey information through programmed experiences that imitate reality. These computer generated models of the real world allow teachers and students to role play decisions without the consequences often associated with the real world (danger, expense, time). Today, many fine simulations are available for school use.

Telecommunications/information retrieval

Computer telecommunications can provide easy and inexpensive access to information as well as the ability to correspond using electronic mail. Telecomputing in its commonest form requires a computer, a telephone, a modem, a subscription to a telecommunications service such as CompuServe (5000 Arlington Boulevard, Columbus, Ohio 43220), and the appropriate telecommunications software. Teachers and students in any location that has phone service can get information on virtually any topic by searching on-line databases.

Word processing

Teachers and students using word processing can focus on all aspects of language skills, including prewriting, grammar, punctuation, composing, editing, and proofreading. Word processors that focus on many aspects of the writing process include The Writing Workshop (Milliken) and Electric Writing (Creative Publications). Similar programs that feature only prewriting activities are Proteus and Proteus, Jr. (Research Design Associates). These programs are designed to help students collect their thoughts during the initial stages of composing.

In the past few years, word processors have been integrated (in one program) with databases and spreadsheets. Integrated word processing programs present unique opportunities for teachers and students in all curricular areas. Appleworks (Apple Computer) is an example of an integrated program; it contains a word processor, database, and spreadsheet. Those interested in the application of integrated word processing programs throughout the school curriculum may wish to read Trends in Educational Computing. Decreasing Interest and the Changing Focus of Instruction in the May 1986 issue of Educational Researcher, or contact The Scholastic Teacher Network, Integrating Computers into the Curriculum (Scholastic). In addition, several word processing programs now contain activities that permit applications across the curriculum. For example, Scholastic PFS...
Curriculum Data Bases and Appleworks: Data Bases (Scholastic) contain activities in U.S. history, U.S. government, world geography, physical science, language arts (poetry, mythology, literature, composition), climate, and U.S. Constitution. Students and teachers can use these previously developed databases or create their own to help organize information.

Utilities
There are many computer based programs (not designed to be educational) that support educational activities. These teacher utilities are programs that enable teachers to create word search puzzles, signs, greeting cards, worksheets, word lists for games, and other material useful for instruction. An example is Print Shop (Broderbund), a program that allows teachers and students to create almost any kind of printed display (greeting cards, letterheads, stationery, posters).

Interactive fiction
Computers can help teachers and students create and complete stories. Much like simulations, interactive fiction programs allow students to build their own stories from computer generated story fragments. The number of possible story outcomes is broad enough so students will not readily write all the stories. One good example is Winnie the Pooh in the Hundred Acre Woods (Disney).

Also available are writing programs that help students create fiction. Examples of such programs include Story Tree (Scholastic) and The Playwriter Series—Tales of Me, Adventures in Space, Mystery, Castles and Creatures (Woodbury Software). Recently, Grolier Educational Software introduced a new twist to interactive fiction programs. In the programs entitled Treasure Hunter, The Secrets of Science Island, Hospital, and Farewell Alaska (Knowledge Explorer Series), students are expected to use a reference source (New Book of Knowledge Encyclopedia) in order to complete the interactive fiction. A similar program is entitled Where in the World Is Carmen Sandiego? (Broderbund). This interactive fiction thriller requires the use of The World Almanac for successful completion.

Videodisks and compact disks
Computers can support and control high speed, text/image storage devices. Computer controlled videodisks and compact disks give educators
the advantages of both television imagery and computerized print display and branching. Computers using videodisks and compact disks undoubtedly will display much of the text material in classrooms of the future.

Speech

*Producing speech.* Computers can be made to speak—at least after a fashion. Currently, there are two forms of computer generated speech: digitized and synthesized. Digitized speech refers to the storage and recall of prerecorded human speech. Synthesized speech is usually constructed by an additive process using discrete phonemes programmed to be combined into sound units listeners will interpret as words. Nothing is prerecorded; the computer constructs “speech” as its program dictates. Each type of speech is available in reading and language arts programs.

Optical character readers (OCRs) can speak and read. The Kurzweil Reading Machine (Kurzweil Computer Products, Waltham, Massachusetts, a subsidiary of the Xerox Corporation, 1341 W. Mockingbird, Dallas, Texas 75247) can read a document and translate print to speech. Classroom applications of OCRs are limited because of the cost ($20,000-$40,000).

*Listening to speech.* Computers also can respond to speech. Voice entry terminals (VETS) allow users to control the computer with voice commands. As problems with variations in individual speech patterns, limited vocabulary recognition, background noise, dialect, and price are solved, computers will respond to spoken commands.

Programming and problem solving

Computers can be used to teach problem solving, both through curricula specially designed to teach a particular problem solving skill and through the teaching of programming techniques. Among the programs created to foster problem solving are Gertrude’s Secrets, Moptown Hotel, and Rocky’s Boots (The Learning Company).

It is generally assumed that teaching programming techniques can help students develop many types of problem solving skills. Teaching students to program is a difficult task that can be simplified by using an authoring language. With an authoring language such as SuperPILOT (Apple Computer), virtually any student can develop original programs combining print displays with graphics.
Summary

The computer has become an effective instructional tool for teachers. The potential advantages of this tool seem to outweigh the potential disadvantages, but there are some problems. Nevertheless, the many applications to testing, information and instruction management, drill and practice activities, tutorial/dialogue activities, simulations, telecommunications/information retrieval, word processing, utilities, interactive fiction, videodisks/compact disks, speech, and problem solving are constantly increasing the usefulness of the tool.

The references in Chapter 1 can help clarify past and present roles of our new tool and help us better predict the future of its use in education.

References

1965

1966

1968
Bundy, R. Computer assisted instruction – where are we? Phi Delta Kappan, 1968, 49 (9), 424-429. Provides an overview of the status of computer assisted instruction as of 1968, with a brief summary of results from research. Makes several recommendations about areas in which further research is needed, reviews the research limitations of past projects, and comments on the future of computer assisted instruction.
Trippon, M. PLATO at work. Phi Delta Kappan, 1968, 49 (9), 439-441.

1969
Adair, J. Computer assisted instruction in adult basic education. In J Mangano (Ed.), Strategies of adult basic education. Newark, DE: International Reading Association, 1969. Discusses selling points of CAI: Instructional programs may be prepared to meet the differing needs of individuals; computer programs can sequence materials, CAI can provide immediate feedback, CAI makes continuous diagnosis easier; and with CAI, a teacher can deal with more students.


1970


Reports results of a 1969 survey of public schools, universities, and research/development centers to determine the extent of computer assisted instruction. Discusses several programs.

Elementary school sets up own minicomputer data bank *Educational Technology*, 1970, 10 (4), 89.

Describes a minicomputer used at Juliette Elementary School in Elk Grove Village, Illinois, believed to be the first elementary school computer installation in the United States. The computer had 8K of memory.


Alerts the reader to potential sources of information on computer assisted education.

Suppes, P., Jamison, D., and Butler, C. Estimated costs of computer assisted instruction for compensatory education in urban areas *Educational Technology*, 1970, 10 (4), 49-57.

1971


Describes computer based instructional management systems existing in 1971. Provides a complete review of early CMI programs; mentions some CAI programs. Author hypothesizes that computer based instructional management has greater possibilities than computer assisted instruction because of the cost.

Hall, K. Computer assisted instruction Problems and performance *Phi Delta Kappan*, 1971, 52 (10), 628-631

Points out problems and successes in CAI implementation.

1972

B.,nes, D., and Schrieber, D *Computer assisted instruction: A selected bibliography* 1972 (ED 063 769)

Provides the most extensive and complete bibliography of computer uses in education up to 1971, with 835 entries.


Provides a detailed report of technology elements included in the Carnegie Commission Report on Higher Education.


Summarizes the results of ten CAI programs, three reading related. Stanford University. INDICOM – Pontiac, Michigan, and Harcourt Brace Jovanovich.
1973

Clark, R. The best of ERIC: Recent trends in computer assisted instruction. 1973. (ED 076 025)
Provides an annotated bibliography of computer assisted instruction up to 1973 at elementary, secondary, junior college, community college, and university levels.

Describes CARE, a computer project to bring fundamentals of remediation to teachers of handicapped children.


1974
Lists 78 references from 1968 to 1974 on the uses of computers in education, many of which deal with reading.


1975
Gives an overview of computer assisted and computer managed instruction, including information on PLATO, TICCIT, LOGO, and PLAN. Also includes the author's opinions on present and future capabilities of computers in education.


Provides a review of computer based applications to military training. Some reading programs are mentioned. PLATO IV, Chicago Public Schools, TICCIT, Stanford University, Florida State University, Penn State University, and the University of California

1976
Contains an annotated bibliography of articles about the entire spectrum of computer assisted and managed instruction up to May 1976, including such topics as PLATO, TICCIT, research, teacher training, authoring languages, and costs

Surveys the use of computers in secondary schools up to 1976.


Describes Tel-Catch, a pilot program serving homebound school children in New York State. One hundred children were able to dial a computer and receive both audio and video instruction.


1977


1978


Committee on Science and Technology, Subcommittee on Domestic and International Scientific Planning, Analysis and Cooperation, Congress of the United States *Computers and the learning society*. 1978. (ED 162 643)

给出了的 views of noted authorities on the impact of computers in education as of 1978. Excellent reading for those interested in the history of computer applications in education.


1979


Discusses using the computer to teach logical thinking skills to sixth grade students at Bose Elementary School, Kenosha, Wisconsin.


Discusses the history of computers in education, including early leaders in the field.


Consists of an entire issue devoted to microcomputers in education, with eleven articles discussing the issues.

1980

Discusses the evolution of computer assisted instruction in the public schools. An interesting sidelight describes how PLATO showed positive gains in math achievement on an Educational Testing Service test, but reading did not.

Fitting, M. Computer use in Santa Clara County schools. 1980. (ED 212 253)

Gull, R. A successful transition from mini to microcomputer assisted instruction: The Norfolk (Public Schools) experience Educational Technology, 1980, 20 (2), 41-42.

Hinton, J. Individualized learning using microcomputer CAI 1980 (ED 196 409)
Gives a review and extensive bibliography on microcomputers in individualized learning.


1981

Consists of an entire issue devoted to the topic of computers in the schools.
State of the art review for 1981

Dickerson, L., and Pritchard, W. Microcomputers and education Planning for the coming revolution in the classroom Educational Technology, 1981, 21 (1), 7-12
Warns of the need for teachers and society in general to be computer literate.


Reviews CAI in education up to 1981 and provides some historical background about computers.


Discusses starting laboratory courses in computing


1982

Discusses eight factors relating to the success of a CMI program, all of which apply to CMI in reading programs.
Discusses state of the art development as of 1982 Includes choice of computers and videodisk players and integrating both software, courseware, and suppliers of hardware and software


Provides an overview of computer based educational activities since 1975.


Caldwell, R. The case for and against computer-based education *Performance and Instruction*, 1982, 21 (9), 36-37.

Clay, K. *Microcomputers in education. A handbook of resources* 1982 (ED 235 790)

Contains articles with diverse points of view about computers in education Titles include The Silicon Age and Education, Bringing the Microcomputer into the Junior High, A Success Story from Florida, and Instructional Computing in 2001.


Dorsey, O., and Burleson, J. *Automated learning, individual instruction and computers in the small schools classroom*. 1982 (ED 228 003)
Explores some of the problems and possible solutions inherent in implementing CAI and CMI in small school classrooms.

Evans, C. *An invitation to the (near) future* *Today's Education*, 1982, 71 (2), 14-17.


Gold, J. *New technology partners Video and computers* *Personal Computing*, 1982, 6 (4), 64-70.
Discusses the future of video and computers with specific applications to education.


Discusses in nine articles the diverse services offered to gifted youth by libraries. Includes a treatment of CAI and CMI and provides references.


Describes the start of the Miami Lakes Junior High School computer based education activities.


Suggests both hope and concern for information technology and education: hope because it appears that technology can improve education not only in the schools but also the home; concern because technology will “profoundly” affect education in unpredictable ways.

Samojeden, E. The use of computers in the classroom. 1982. (ED 225 117)

Describes educational computer use, including modeling and simulation, CAI, CMI, information storage and retrieval, statistical analysis, and educational games. Explains the integration of CASSIS (Computer Assisted Study Skills Instruction) into the course of study at St. Cloud State University in Minnesota. Provides additional information on selection of computer systems and appropriate software. Appendix lists software sources and computing magazines.


Tells results of a survey of 134 colleges of education in eight southeastern states, suggesting that “teacher training institutions in the eight southeastern states largely have not responded to the challenge of microcomputer technology.” Florida, with a state adopted policy of educational computing, was noted as having a leadership position in the integration of computer technology into teacher training programs.

1983


Contains chapters of interest to reading professionals. Chapter 6, The Language Arts Curriculum, discusses adventure/story generators and word processing/writing.


Becker, H. Microcomputers in the classroom—dreams and realities. 1983. (ED 217 872)

Warns educators not to “uncritically accept every computer-based anything that comes to the market.” Explores the computer’s role in the instructional delivery system via drill and practice activities, reteaching and remedial in-
struction, CMI, simulations, information retrieval/word processing, and computer programming.


Surveys the impact of computers in education.


Contains eleven articles on computer applications in education, all of which might be of interest to reading educators. Titles include Reflections on the Educational Potential and Limitations of Microcomputers, The Information Society: Byting the Hand that Feeds You, and Terminal Time in the Classroom.


Contains proceedings and papers from a conference sponsored by the Department of Education, November 1982, Pittsburgh, Pennsylvania. Titles include Technologies for Learning, Paradigms for Computer-Based Education, and Research on Reading Education.

Floeger, F. The effectiveness of microcomputers. 1983. (ED 246 876)


Lesgold, A. Computers in education: Realizing the potential. 1983. (ED 235 784)

Reports on a 1982 research conference examining the potential of computers in education. Concludes "striking improvement in the quality and productivity of instructional computer systems is attainable with a coherent and sustained research investment." Summarizes basic cognitive research, prototype research, and related research issues. Includes thirteen invited papers dealing with computers in education and classroom application.

Lesgold, A. When can computers make a difference? Theory into Practice, 1983, 22, 247-252.


Discusses the impact of videogames on children and how the psychology surrounding the success of videogames can be used to improve educational activities.


Discusses some relationships between computer literacy and literacy in general.


Discusses the impact of computer literacy on society with seven ERIC resources serving as focal points.


Reviews studies on computer applications in education.

Oliver, M. *Computer literacy for teachers*. 1983. (ED 234 742)

Gives a very general treatment of the basics in computer literacy. Suggests “computers are only tools that can help teachers do their job.” Emphasis is on teacher use for classroom management and instruction.


Prince, A. *The ghost of computers past, present, and future: Computer use for pre-service/in-service reading programs*. 1983. (ED 239 242)

Suggests the possibility of improved efficiency and effectiveness of teacher learning in colleges of education by using computer assisted instruction and simulations. Concludes that the availability of preplanned, meaningful educational training can give professors more time for classroom supervision and individual and group interaction.

Rheingold, H. *Video games go to school Classroom computers could bring about a profound transformation in the way children learn* *Psychology Today*, 1983, 17 (9), 37-43.


Contains seven papers presented at a conference held at Teachers College, Columbia University, April 1982. Titles include Public Policy and Electronic Learning, Learning by Doing Revisited for Electronic Learning Environments, How Children Learn from Electronic Sources, and Toward a Psychology of Electronic Learning


1984


Tells one school district’s ideas on how to organize computer education curricula.

Examines the possibility of computers in education causing a disparity among students. One survey's data indicate 66 percent of affluent school districts have computers, compared to 41 percent of less wealthy school districts. Schools serving disadvantaged students are urged to give equitable exposure to computers and to structure CAI to fit the needs of those students.


Reviews nine resources available on how to choose a computer for classroom or computer lab use.


Explores the computer's role in education with a lengthy section on computers and writing instruction. Becker believes that "by far the most significant advantage of a computer-based writing system is the minimal effort required to make changes in one's text." He cautions that word processors are irrelevant if students are not motivated to improve their text.


Caster, T. *What they won't teach you in your programming course* *The Reading Teacher,* 1984. 38 (1), 123-124

Suggests some of the problems teachers will face as they try to use computers in their classrooms—outlets, breakdowns, traffic patterns, and group size.


Computers and education *Creative Computing,* 1984. 10 (11), 163-188


Crovillo, T. *Evolution of educational software* *The American Biology Teacher,* 1984. 46 (3), 140-145

Traces the development of both computer hardware and educational software. Computer integrated curriculum, artificial intelligence, and videodisk technology are described as realistic expectations in education's future.

Dreyfus, H., and Dreyfus, S. *Putting computers in their proper place: Analysis versus intuition in the classroom* *Teachers College Record,* 1984. 85 (4), 578-601.

Grabe, M. *Evaluating the educational value of microcomputers* *Computers in the Schools,* 1984. 1 (4), 35-44

Presents some ideas on how to evaluate microcomputer applications in the schools.


International Reading Association Computer Technology and Reading Committee *Guidelines for educators on using computers in the schools*. *Journal of Reading*, 1984, 28 (1), 63-65.


Tolman, M., and Alfred, R. *The computer and education. What the research says to the teacher*. 1984 (ED 252 173).

Contains twelve articles on computers and special education, some of which might be of interest to reading professionals.


Contains six articles on computer applications in education. Titles include *Computers in Education Today—and Some Possible Futures*, Educational Computing: The Burden of Insuring Quality, and Forget It! Forget It


1985


Provides information for reading professionals who want to author their own computer-based instruction activities.


Suggests that new computer-based learning environments should feature a process approach to learning rather than a product approach.


Suggests that different instructional approaches to literacy training can be related to the ways schools teach computer literacy.


Describes how the interaction between computers and children can lead to better thinking skills.


Describes IBM's computer education program from the perspective of Educational Testing Service researchers who evaluated the programs in more than one hundred schools.


Consists of an entire issue containing articles about the impact of computers in education.
Discusses the impact of videogames, adventure games, and programming on students. Suggests some reasons for the impact.


Dronka, P. Computer integration into instruction is stuck: experts blame unclear optimal uses and three implementation problems. *ASCD Update,* 1985, 27 (5), 1-6-8.
Criticizes computers in education. Author reports that many experts feel computers do not have and, in the foreseeable future, will not have a positive impact on education. Limited access to machines, limited software, and inexperienced teachers of the computer contribute to the criticism. Also discusses the findings of the Johns Hopkins University survey. *How Schools Use Microcomputers.*

Discusses the demands of using computers with students in three stages of Piaget's development process: preoperational, concrete, and formal.

Contains eleven articles on computers and learning, including *Instructional Uses of New Technology; Language Laboratories: What Have We Learned?; Computer-Assisted Instruction Possibilities and Problems; and The Forgotten Medium—Are We Too Visually Dependent?*

Is this the good life on a chip? *IRT Communication Quarterly,* Spring 1985, 3.
Tells the views of Jere Brophy and Patrick Hannon (staff members at the Institute for Research on Teaching, Michigan State University) on the development of computer software for classroom use. The authors suggest that "software designers have not taken into account an important feature of classroom life—classroom instruction is group-based." Also, computer-based activities are "not worth the trouble" and have been "oversold." However, computers do have the potential to help teachers and students in simulation exercises, computer graphics, and word processing.


Lists ten essential truths: Computers are tools, new technology is a catalyst for curriculum revitalization, teachers and administrators need more and better training, microcomputers have their limitations, our definitions of computer literacy need clarity, computer education programs must be evaluated, most software is inadequate, technology is a catalyst for increased planning for school systems, technology will alter the organization of schools, and computers are inherently subversive.


Computer applications in reading
Discusses how the computer operates in a “functional learning environment.” In particular, how can LOGO, simulations, and networking help students realize that these activities have a purpose for future learning?


Offers the views of the chief executive officer of Control Data Corporation on the many ways technology can help education.


Reviews available ERIC/RCs documents and provides an adapted evaluation scheme for determining teacher computer competency at three levels of awareness: basic, curriculum, and technological.


Contains a chapter on reading and language arts that discusses sample reading programs and word processing.


Salmon, P. Technological challenges to the education profession *Electronic Learning*, 1985, 5 (3), 17-20


Smith, R. School of the future—from the assembly line to the job shop model. *AESD Monitor*, 1985, 24 (3, 4), 6, 27.


Describes the Houston Independent School District’s Department of Technology Computer Concepts program. The program features a problem solving curriculum using word processing.


Shows how the growth of computer applications in education can be traced by the number and types of journals printing articles about the topic.


Suggests how and when to use computers in the classroom. Of particular interest is Chapter 8, which contains a section on classroom applications of language arts programs.
Reports survey results: More teachers are using computers than in the past; close to 10 percent of secondary teachers in English and social studies use computers for instruction; most elementary teachers are using computers for CAI and secondary teachers are using CAI for computer programming and computer literacy; more male than female students are using computers in the schools; computer theft is not a problem in the schools; and many schools have insufficient computer resources.

Prepresents proceedings of a symposium on worldwide understanding of the role of educational technology in educational systems and the identification of needs for further research at the international level.

Raises many questions (and provides a few answers) about the future of computers as "education machines." Required reading for anyone pondering the future of educational computing in whatever forms it might take.

Prepresents a comprehensive report by the task force to the Secretary of Education. The report discusses transforming education, the status of technology in education, the potential for technology in education, educational applications of technology, effects on education, beginning the transformation, recommendations, and concluding comments. Educators interested in computer based educational applications should read this report.

Provides an up to date treatment of problems surrounding the term *computer literacy*.

Cautions that useful lessons learned from research about televised instruction should not be forgotten. Describes what should have been learned from televised instruction and what computer based research can do to overcome the same errors.

Scheffler, I. Computers at school? *Teachers College Record*, 1986, 87 (4), 513-528
Casts doubt on most of the educational and social precepts that currently drive computer based education. Suggests in a general sense that most of what we should value in education is "beyond the reach of algorithms" and hence today's computer based education efforts.

Prepresents forty student projects that use computers in the classroom. The activities are designed for elementary and middle school students.

Suggests that the instructional practices contained in most of our computer based educational programs are ineffective and that more exploration and discovery programs are needed.


Presents the National Governors’ Association recommendations on technology and the schools plus a seventeen item action agenda. The recommendations include state supported demonstrations of cost effective, efficient school sites; state supported research and development; state supported marketing mechanisms; and state supported development plans for using technologies and training teachers.

1987


Discusses the impact of the computer on our daily lives and on elementary and secondary education.
The first computer applications in reading education were offered on mainframe, time sharing computers. Schools had relatively little interest in computers because the cost of using mainframe computers was high and the rigid drill and practice programs were not enticing. The microcomputer solved the problem of high computer costs, but early microcomputer based reading software was low quality. Fortunately, the reading software of the 1980s is much improved, and the quality continues to improve even though developing quality reading software is a Herculean task.

There are compelling reasons why the quality of reading and language arts software should continue to improve. First, publishers of traditional reading instruction materials are converting their materials for computer based delivery whenever feasible. This represents an enormous financial commitment by the publishers.

Second, inexpensive, powerful, fast, and reliable microcomputers are now readily available. Although Apple Computer dominates the educational computer marketplace, most of the other microcomputer manufacturers are interested in reaping the millions of dollars schools spend annually on computers and software.

Third, the growth of the educational software market has provided financial incentive for research and development efforts. Computer manufacturers are beginning to commit large amounts of resources toward the development and marketing of reading and language arts software. For example, IBM’s Writing to Read System (developed by John Henry Martin) is becoming increasingly popular in kindergarten and first grade classrooms. IBM has helped to develop many other programs for reading and language arts instruction; for example, the Reading for Meaning Series, the Reading for Information Series, and the Language Series. Another recent IBM program, PALS (Principle of the Alphabet Literacy System, developed by John
Henry Martin), is an interactive videodisk, personal computer, adult literacy program similar in concept to the Writing to Read Program. (For a complete listing of computer based education software and hardware companies, see Appendix A).

Fourth, schools and school districts are switching the focus of their computer purchases from hardware to software. This increase in demand for educational software should reinforce publishers' increased financial commitment to quality programs.

Fifth, the newer reading software allows the teacher or student some control of content. While the algorithms of programs cannot be readily changed by teachers or students, they do allow change to the content. For instance, a teacher who wants children to practice their basal reader vocabulary words with a computer can do so by using an authoring scheme (if one is available as a part of the microcomputer program).

In summary, the microcomputer reading software of the late eighties promises to fulfill many of the unmet promises made about earlier computer based instruction programs. Reading software is improving and will continue to improve, but we have a long way to go.

The references in this chapter describe computer based reading and language arts programs for both children and adults in classroom and clinic settings.

References
1966

Describes the purposes of the CAI reading project, its organization, its potential for research, equipment used, and commands necessary to create one complete lesson. Also explains the six strand reading curriculum

1967

Evaluates the Stanford reading project, listing six misconceptions inherent in the work of the project and discussing questionable research.

1968

1969

Describes the first large school system (Philadelphia) implementation of CAI, which included more than 200 hours of reading activities. Activities
included recognition of sentences, recognition and use of key words, labeling and categorizing concepts, seeing the relationship between sentences and sentence order, ordering and sequencing ideas and sentences, distinguishing general from specific topics, finding and understanding details, selecting topic sentences, drawing sound conclusions, and following directions. Also points out that 254 hours were required to create 1 hour of CAI.

1970

Reviews the INDICOM project, an elementary reading and mathematics project in Pontiac, Michigan.


1972

Describes the "strand" structure of a drill and practice program designed to supplement reading instruction in grades one to three. Also provides a flow chart and sample exercises with cost estimates.


Provides a detailed analysis of scores for forty-four matched pairs of subjects. Results indicated that five and one-half months of CAI yielded significant gains in reading among first grade students; boys were helped more by CAI than were girls; and significant results were obtained in sentence and paragraph comprehension, areas hardly touched by the CAI program.


Describes implementation of Computer Curriculum Corporation's reading curriculum using a minicomputer with 33 student TTY terminals.


Describes a program of automated remedial reading instruction available to grade six students as soon as they failed any classroom reading tasks. Children making use of this program outperformed controls in word accuracy and task completion.

1973

Describes an eight strand drill and practice curriculum. Also describes how monitoring student performance can allow the computer to prescribe more practice for either slow students or difficult items. Suggests a method for computing the amount of study time needed to reach a given score on a reading achievement test.

Discusses the development of a program to train adults to pass the GED (high school equivalency) test using the PLATO IV terminal.


Tells how CAI in reading proved effective in raising reading scores in a 1973 project using Computer Curriculum Corporation software and computers.


1974


Discusses three levels of optimization of instruction: decision making within an instructional strand (which items to present, how to present them, and when to schedule review), decision making about allocation of instructional time to the various strands or skills with reading, and decision making about distribution of terminal use time among students.

Golub, L. A computer assisted literacy development program *Journal of Reading*, 1974, 17 (4), 279-284.

Discusses LITE, a literacy program developed at Pennsylvania State University.


Presents the aims of the PLATO Elementary Reading Curriculum (PERC) and details the program development.

1976


Venezky, R., Perry, J., Chicone, S., and Pittleman, S. *Summary of studies for an on-line reading diagnosis system* 1977. (ED 138 967)

Yeager, R. *The reading machine*. 1977. (ED 142 990)

Describes the PLATO Elementary Reading Curriculum.

1978


Describes three studies conducted to evaluate various paradigms for assessing vocabulary knowledge on-line: synonym in context, synonym out of context, cloze, oral recognition, and self-screening. Authors conclude that no single format is superior for the assessment of vocabulary knowledge.

1979

Buckley, E., and Rauch, D. *Pilot project in computer assisted instruction in adult basic education*. 1979. (ED 197 202)

Reports a three year study that found CAI in reading "to be an effective supplementary learning medium for ABE students." Students used the ABE pro-
gram from Computer Curriculum Corporation, which contains word attack skills, vocabulary skills, literal and inferential skills, and work related study skills.

1980


Explains briefly the terms computer assisted instruction (CAI) and computer managed instruction (CMI). Presents a history of computer based reading programs and of bilingual and handicapped reading programs.


Describes a K-8 CMI reading program with some prescriptive CAI components initiated by Belvedere-Parkway Elementary School. The CMI program consisted of 329 education objectives and tests marketed through the Educational Development Corporation. The CAI component featured drill and practice and tutorial programs involving structural analysis skills. Teachers reported increased reading performance and positive attitudes toward the program and reading.


Contains two papers of interest to reading educators—The University of Akron's Computer Based Education Network: A Report on Activities and Results of a Five Year Study and Microprocessor Applications in Reading Instruction, Diagnostic Testing, and Evaluation.


Describes an early computer based comprehension activity using one of the first microcomputers to appear in the schools.


Discusses three early attempts to teach reading, Stanford, PLATO, and TIC-CIT. Describes several computer based reading programs, including DOVACK and the Talking Typewriter. Discusses computer based college reading programs and computer reading programs for elementary and secondary schools.


Provides a history of computer applications in reading up to 1980.

1981


Describes a system developed by John Henry Martin by which children can learn to read and write with a simplified alphabet and interactive computer programming. Martin discusses the aspects of his program being field tested.


Discusses a college CAI reading program at St. Cloud State University

1982


Discusses a rationale for using computer arcade games to teach reading and describes experimental games being field tested. The games include Speed: the rapid recognition of letter clusters in words, Racer, pronouncing displayed words, and Ski Jump, context plus slower and slower tachistoscopic word presentation.


Offers suggestions for selecting topics for computer based reading instruction, indicating that words, word meanings, and speed of processing are places to start.

Mason, G. *Advantages and disadvantages of the computer as a teacher of reading*. 1982. (ED 214 131)


Contains eight essays on computer based applications in English/language arts education.

Neufeld, H. *Reading, writing, and algorithms*. *Computer literacy in the schools*. 1982. (ED 211 959)


Uses Resources in Education (RIE) and Current Index to Journals in Education (CIJE) to form the nucleus for a review of computer applications in reading.


Provides a general treatment of the distinctions between computer assisted instruction and computer managed instruction and their applications in reading.

Paisley, W., and Chen, M. *Children and electronic text: Challenges and opportunities of the new literacy*. 1982 (ED 225 530)

Describes the introduction of a minicomputer in the 1975-1976 school year at Milton Academy in Massachusetts. Reading teachers used maze type activities with the computer.

1983


Describes instructional uses, especially for diagnosis and prescription of reading problems, as part of what teachers need to know about microcomputers. Also covers evaluation guidelines and sources of software reviews for teachers.


Describes a service of Computer Curriculum Corporation (ccc). Dial-a-Drill. Through the use of a home telephone, students can access an instructional computer. The computer provides six to ten minutes of drill and practice activities on arithmetic, spelling, and reading. The students interact with the computer through the numbers and symbols on the dials of their telephones. Describes a summer pilot project involving Dial-a-Drill.


Notes that computers have been involved in reading instruction since the early 1960s, but few are aware of earlier efforts. The authors discuss the realities of today’s microcomputers in reading instruction and suggest future advances.


Identifies current trends in microcomputing, including the word processing boom, cost effectiveness of computer hardware, greater quantity of educational software, and curriculum integration of CAI. Analyzes the effect of technical trends (new computer languages, expanded memory, and specialized microprocessors). Provides suggestions to aid educators in responding to these approaches.


Contains twenty-five articles on computers and English/language arts education.


Contains seven articles on computers and English/language arts education.


Comments on the state of CAI from an international perspective in 1983.

Gabriel, D. The mainframe computer in a basic reading and writing class. 1983. (ED 239 710)
Describes some instructional problems and advantages associated with mainframe computer use in the basic reading and writing classes at Cuyoga Community College.


Consists of an entire text that should be of interest to reading professionals. Sample chapter titles include *The Computer-Based Reading Classroom*, *Reading Readiness*, and *Word Identification*.


Advocates having English teachers become involved in using computers for instructional purposes and suggests why and how they should go about it.


Discusses drill and practice, tutoring, assessment, record keeping, prescriptions, interactive language programs, readability, language analysis, cloze passage generation, vocabulary list generation, test item generation, objectives production, inventories, word processing, videodisks, data banks, simulations, computer programming, staff development, research, and computer literacy.


Begins with some implications from reading research that apply to computer based instruction. The author believes that two important uses of computers in reading are to provide practice in word recognition skills and to provide better diagnostic information on student progress. The article discusses why these are important uses for the computer.


Focuses on the computer as a valuable tool for reading clinicians and remedial teachers and suggests ways computers can assist with instruction. Includes descriptions of the computer as diagnostic test administrator, accuracy trainer, game partner, and provider of review and repetition. Describes a variety of software.


Discusses the costs of computers, color quality, print displays, user friendliness, and software.


States that computer based reading programs should involve the interplay of word coding, conceptual knowledge, and comprehension strategies. Discusses how these three activities can be used in computer based reading programs that provide both instruction and practice.

Rauch, M. Using computer assisted instruction in a reading and study skills course. 1983. (ED 240 522)

Discusses a test wisdom and study skills program (CASSI) used with students at St. Cloud State University. The study skills program covers an introduction to study skills, motivation and achievement, time management, reading textbooks, note-taking, concentration, improving memory, procrastination, exams, and test anxiety.


Gives a brief history of CAL since the mid 60s. Suggests advantages of CAL in reading programs: individualized instruction, immediate feedback, increased motivation, and active involvement in the learning experience.


Explores the issue of limited availability of high quality reading, writing, and communication courseware. Recommends clearer design guidelines in reading and writing software and increased incentives for the courseware developer and teachers using the newly developed materials.


Summarizes and discusses computer based research (circa 1983) on reading comprehension, composition, and organization communication and information use. In addition to the discussions on computer based research, the authors make a strong case for the development of a model for computer/classroom/education. This model would provide guidance in the development of educational programs that could feature instruction on computer based interpersonal, organizational, and bibliographic communication resources. Provides twenty-six references and a lengthy list of on-line databases.

Standford, S., Jaycox, K., and Aten, A. Computers in the English classroom. 1983 (ED 228 654)

Includes four areas in a "primer" for teachers: a nontechnical explanation of how a computer works, computerized instructional strategies, computer applications in language arts instruction, and resources for software evaluation. Concludes with a detailed list of references.


Suggests that present (circa 1983) applications of microcomputers to education fall into three categories: computer assisted instruction, information
processing, and computer managed instruction. Describes the potential impact of each category as well as nine negative attributes of language arts software. Provides fifteen references.

1984


Includes fourteen articles on computers in English/language arts education.

Douglass, M. *Reading in the age of the computer*. Forty-Eighth Yearbook of the Claremont Reading Conference. 1984 (ED 251 823)

Collects twenty-six articles dealing with Reading in the Age of the Computer. Topics include the electronic environment, creative thinking via the computer, LOGO language, software evaluation, and CAL in writing and reading programs.


Discusses the computer based education philosophies of Suppes, Luehrmann, Bork, and Papert as they relate to reading and language arts.


Suggests ways schools and teachers can help support their computer programs, computer open house, lending, minicourses, TV programs, and so on.

Gerhard, C. *Reading and technology: Tangibles and intangibles*. 1984. (ED 252 826)

Discusses the relationships between technology and reading.

Jobe, R. *Explore the future Will books have a place in the computer classroom?* 1984 (ED 243 102)

Urges teachers to make a commitment to reading, to encourage sharing good books, and to make classroom reading periods an important part of the day’s instruction. Analyzes a representative sample of children’s books published in 1983 according to age, type, price, number of pages, and audience appeal.


Linville, W., and Waterman, D. *Now that you have a computer*. In V. Gibbs (Comp.), *Reading, the core of learning*. Proceedings of the Annual Reading Conference 1984. (ED 241 903)

Gives evidence of the proliferation of computer hardware and software in education. Indiana State University’s MICRONET, an educational network for schools and corporations, books, catalogs, and magazine articles on a variety of computer applications for reading instruction.
ety of computer related topics; professional associations that supply computer information, college and university computer courses; and classroom teacher involvement in both CAI and CMI. Provides addresses of companies offering computer catalogs.

Lynn-Mullen, J. Using literature to prepare students for the world of computers and technology. *Computers, Reading and Language Arts*, 1984, 2 (1), 33-34.

Explores how contemporary literature can familiarize students with technology and computers. Mentions a diversity of titles.


Describes how basals now have supplemental computer activities (testing, instruction, information management) that accompany the readers. Cites several examples.


Addresses some concerns about computer use with children.


Describes a system that produced individualized computer assisted reading instruction for college students. Program goals included improvement of vocabulary and reading comprehension as well as acquisition of study skills.


Provides a critical evaluation of the IBM writing program for kindergarten and first grade students.

O'Neal, F. An alternative model for computer-assisted instruction in an educational environment *T.H.E. Journal*, 1984, 11 (8), 113-117.

Describes the third year of operation for the Waterford School and speculates on the possible accomplishments of the fourth year (1984-1985). Fourth year research and development activities include the testing of a K-12 reading and writing curriculum.

Scanlan, N. Reading related skills and strategies for the computer age *Computers, Reading and Language Arts*, 1984, 2 (1), 16-18.

Offers approaches for teaching skills that can enable students to successfully use computers in "the computer age" Considers computer related concepts, levels of comprehension, problem solving techniques, study strategies, and employability skill training.

Solomon, G. Computers are for English too! *Computers, Reading and Language Arts*, 1984, 2 (1), 31-32.

Introduces the varieties of CAI available through PROJECT FTC—English through Computers at Taft High, South Bronx.

Suchor, C. 1984 report on trends and issues in English. 1984 (LD 239 290)

Summarizes reports on educational trends and issues by the National Council of Teachers of English commissions on composition, curriculum, language, literature, media, and reading. Raises various issues related to computer assisted instruction.

Explores the computer's potential in listening, reading, speaking, writing, and literature instruction. Observations include some benefits of CAI as well as potential problems.

1985


Discusses computer-based reading activities as they relate to reading readiness, word recognition, vocabulary, and comprehension. Also includes a software directory.


Contains nineteen articles including *Reading and the new technologies; The book in 2000; and Reading, writing and learning with microcomputers.*


Suggests seven ways teachers can use microcomputers for reading and language arts activities in their classrooms: make crossword puzzles (Crossword Magic), have students rewrite documentation for others to use, have students review software and publish the reviews, prepare computer bulletin boards, start a computer club, prepare computer book jackets for school books, and have students prepare questions about software for other students to answer.

Greer, S. *KoalaPad: Pictures have a place in your classroom*. *The Computing Teacher*, 1985, 13 (2), 14-29

Suggests how a KoalaPad can be used to support language arts and reading activities.


Discusses what language arts teachers might need or want to know about computer applications. Also mentions potential computer based extracurricular activities.


Features articles on computer applications in reading. Titles include *The use of computers in the reading program; Reading and computers. A partnership; and Rom. ram. and reason.*

Mason, G. *Communications received—an international view*. *The Reading Teacher*, 1985, 38 (7), 713-715.

Provides information about international efforts in computer applications for reading instruction and related areas.


Discusses from a philosophical standpoint the potential impact of computers on education as seen through the vision of two authors: Papert and Chandler. Papert is best known for LOGO and his hopes for LOGO as embodied in *Mindstorms. Children, computers, and powerful ideas.* Chandler has produced a book "written for all who share a concern for young children's learning and..."
the social impact of technology." Newman discusses both books and the views of the authors. Other portions of the article include an introduction to Microzine (Scholastic), a computer based bimonthly magazine that contains educational software activities, and to QUILL, a writing tool for children.


Discusses the IBM Writing to Read program as well as the WICAT individualized reading instruction system (IRIS).


Discusses who controls the learning environment in a CAL program: programmer, teacher, student. (TRAY is a program designed to develop various language skills in which the learners try to reconstruct an initially invisible text chosen by the teacher.)

Thompson, M. *Beyond the computer: Reading as a process of intellectual development*. *Computers, Reading and Language Arts*, 1985, 2 (2), 13-15, 43.

Investigates the role of computers in education, emphasizing that technology should never replace teacher-student interaction.


Tells how fifth and sixth graders serve as before school tutors for second and third graders using drill and practice programs.


Describes TICCIT (timeshared interactive computer controlled information television), which has been involved in computer based instruction for several decades. Today TICCIT is involved in on the job basic skills reading programs with the Army (with the Hazeltine Corporation) and English as a second language programs at Brigham Young University.


Discusses several innovative computer based applications that may have an impact on reading and writing instruction for adults. They include the word processing approach to language experience, finding the best language arts software, advancing comprehension strategy research, and learning to read and write with personal computers.

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**1986**


Suggests a training module on computers and reading for teachers.


Describes a categorization scheme involving learning about microcomputers, learning from microcomputers, learning with microcomputers, learning about thinking with microcomputers, and managing learning with microcomputers. Discusses each category.


Discusses computer books of interest to teachers of reading and language arts.


Provides sources of free reading and language arts software.


Explains that using computers can help motivate remedial and reluctant readers to want to read.


Discusses survey research that revealed an absence of any "shared priorities" by teachers reviewing TRAY for possible classroom applications. Evidently, teachers select reading and language arts software for some reasons different from others and the developers.


Examines the reasons why teachers adopt reading and language arts software. The researchers found that teachers have many reasons for adopting software: some good, some bad, and some unpredictable.

1987


Helps answer questions about where the computer will fit into the reading/language curriculum.


Presents an integrated approach to the use of computers for language arts activities.


Reports on worldwide computer efforts to teach reading as presented by a few of the participants at the Eleventh World Congress of the International Reading Association in July 1986.


Discusses several models of the reading process and relates them to computer technology.


Discusses features of a holistic program with examples of several types of holistic computer programs in reading and language arts education.


Tells how school districts can develop successful computer based reading and language arts programs.
LOGO references

1981
Describes the author's impressions of a two week workshop conducted by Seymour Papert on the use of the LOGO computer language.
States that since computers will be increasingly privately owned, there will be less conforming and more control of education by the learner who will buy programs in the open market. Better for the child to be a programer than to be programed.

1982
Hereford, N. Let's forget about drill and practice...computers are objects to think with: An Instructor interview with Seymour Papert. Instructor, 1982, 91 (7), 86-89.
Reiterates Papert's belief that children should not be drilled by computers; children should learn to program and control the computer.
Challenges several of Papert's assertions: medium can be a mode of instruction, electronics can reverse developmental processes, and the medium can design and implement instructional strategies.

1983
Describes how to use the list processing capacity of LOGO and provides a sample program to help explain various features.

1984
Kramer, S. Word processing in a LOGO environment. Electronic Learning, 1984, 3 (6), 70.
Proposes that word processors can be effective in the schools because they offer opportunities for creating safe learning environments, provide structure, treat errors as new ideas, and provide opportunities for students to share their work.

1985
Odom, M. The effects of learning the computer programming language LOGO on fifth and sixth grade students' skills of analysis, synthesis and evaluation. Dissertation Abstracts International, 1984, 45 (8), 2390A.
Describes a research project in which fifth and sixth grade students learned mit LOGO. Through pre and posttest data, it was concluded both analysis skills and evaluation skills increased significantly. Indicates a need for further investigation of programing activities that might benefit synthesis skills.

1985
Notes the impact of CAI (LOGO and speech synthesis) on learning styles (auditory, visual, and audiovisual). Results suggest improved achievement, regardless of the learner's style or computer's modality.

Focuses on kindergartners' oral language patterns while using computer. The researchers maintained that students' oral language interactions with a partner while using the computer were just as important as their interactions with the computer. Also, using the computer can be a very socializing activity between students.


Explains how LOGO was used in college composition classes to help freshmen develop writing abilities in Haiku.


Finds that LOGO has a positive effect on personal responsibility and attitude toward success in learning disabled junior high school students.


Raises a cautionary flag about the benefits now and in the future of many educational activities that surround LOGO and word processing. Assesses both the positive and negative aspects of using LOGO and word processing.


Describes how to use LOGO to create and manipulate lists and to put words into context. The LOGO list making capabilities can be used in various reading activities.

1986


Describes a study in which six year old children, some of whom used LOGO and some of whom did not, were compared on interviews, picture completion, map reading, and a test of laterality. There were no differences between the two groups.

1987


Criticizes recent developments in the teaching of LOGO as well as research pitting LOGO groups against non-LOGO groups as a test of the efficacy of LOGO. Papert refers to the recent developments in LOGO instruction and research as examples of technocentric thinking.

**Cloze procedure references**

1978


Provides a cloze text generating program with options on length of blank and deletion pattern.
1983

Describes a computer assisted cloze test used to determine text readability. After every fifth word has been removed from the prose selection, students complete the passage by supplying the missing words. Through computer presentation and scoring, cloze results can identify the students' independent, instructional, or frustration reading level.


1984

Suggests ways word processors can be used to create instructional cloze activities.

Literacy references

1984

Describes current attempts to combat illiteracy among U.S. Armed Services members. Might have applications in nonmilitary settings.

1985

Reports conference proceedings on six issues: quality software, software for levels 0-4, technology, instruction effectiveness, management, and access.

Language experience approach references

1970

Describes plans for ORACLE, a computer aided language experience reading program.

1982

Describes first grade students using the microcomputer to generate language experience stories. Students can type in their own stories or the teacher can do it for them. Students receive a copy of their story.

1983

Explains that language experience stories can be used with young children in a computer based word processing environment. Brief suggestions are provided on how to use word processing with language experience stories.

Computer applications in reading
1984
Smith, N. *The word processing approach to language experience*. 1984. (ED 249 465)
Identifies and summarizes key points of ten articles that give both theoretical background and practical suggestions for using word processing in the language experience classroom.

1985
States that microcomputers and language experience stories can be used in tandem by students at all grade levels. Authors describe how the computer can help students with language experience stories.
Presents using Terrapin LOGO 2.0 in LEAS as one way to help four year olds develop spelling skills.
Suggests that the interaction between teachers and students that are brought about by using word processing and language experience activities help to minimize many disadvantages of LEAS. The article also mentions what teachers should know about implementing computer based LEAS in their classrooms.

Special education references

1971
Describes a study in which, using the computer, twelve dyslexic children were differentiated from normal age and sex matched children based on spectral estimates of their EEG readings. The greatest differences were in the parietooccipital region during rest with the eyes closed.
Explains automated reading in print leading to character codes that can be processed to produce Braille, spelled speech, or synthesized speech.

1978

1980
Spring, C., and Perry, I. *Computer assisted instruction in word decoding for educationally handicapped children*. 1980 (ED 201 075)

1981
Lists and describes two uses of a technique in which keys are covered with word tags. Suggests that speech impaired people may use the technique.


Describes how reading clinicians are using computers in diagnosing and teaching students.

**1982**


Describes how children who can control only their eyes can have a voice and writing capabilities with a device developed by researchers at Carnegie-Mellon University.


Includes a section on CBELS (Computer Based Exploratory Learning Systems) and the author's own work on CARIS, with LOGO, and with computer mail (deaf children).


Describes the impact of CAI on the Hearing Handicapped Program at Jefferson County Public Schools, Colorado. A detailed evaluation form for hearing impaired software is included.


Presents some ways Speak and Spell and Spelling ABC were used with learning and behavioral disordered students.

**1983**


Describes a computer based reading comprehension program designed for learning disabled students. Examines the role of the instructor in productive CAI and emphasizes the necessity of choosing materials appropriate for students' needs.


Describes a three year project that developed an interactive computer videodisk system for language and reading skill instruction for hearing impaired students.


Explains some uses of "a prototype interactive computer controlled audiovisual system" with hearing impaired preschoolers. Examines CAI in simple reading tasks and the assessment of bimodal interactions/interferences.


Details practical applications of the computer in the school setting, including the reading clinic.

Reports findings of a study measuring effectiveness of CAI with learning disabled children. A comparison of the posttest data for experimental and control groups revealed no significant differences in achievement after one year of instruction. Suggests certain achievement assessments may be insensitive to achievement gains made by LD students.


Describes how junior high LD students receive reading, mathematics, and language arts CAI. Improved learning opportunities are combined with improved self image, independent thinking skills, appreciation of learning, and equitable instruction.

1984

Abegglen, S. The efficacy of computer-assisted instruction with educationally handicapped high school students. *Dissertation Abstracts International*, 1984, 45(10), 3109A.

Tells about educationally handicapped students who received computer assisted reading and mathematics instruction. A comparison of pre and posttest achievement scores suggests CAI is beneficial in raising those students' achievement levels.


Tells how word decoding skills were taught to mildly physically and mentally handicapped students via the computer with a touch sensitive screen. Significant gains were noted by students receiving CAI over an 18 month period.


Describes the process approach that allows students to learn grammar rules, spelling, and punctuation as they develop writing skills. Hypothesizes that learning disabled students can gain writing proficiency through integration of the word processor into the process approach. Positive achievement in reading and written language was made by LD students using the combined instruction.

Kirkland, E. *Writing to read: A computer-based language experience, writing and reading system, as used with handicapped children*. 1984. (ED 248 480)

Explains the Writing to Read program: “What I can say, I can write and what I write, I can read!” This computer based teaching system enables students to write words, sentences, and stories using the alphabet and 42 phonemic English sounds. Learning is continually reinforced as the child sees the word, hears the word, says the word, and writes the word. An observation checklist for identifying possible language and learning disorders is included.

Main, J. *Computer assisted teaching comparisons with handicapped: Final report*. 1984. (ED 256 865)

Explains that CAI programs in word recognition were used with low level, nonreading adults with some success.
Murphy, J. *The development and use of a language arts computer software program appropriate for special needs children*. 1984. (ED 254 348)
Reports a research report that indicates mixed results for drill and practice language arts (vocabulary, spelling, mechanics and expression) programs with handicapped students (second-sixth grades). Vocabulary and spelling skills improved; the other skills did not.

Describes research focused on CAI designed for the learning styles of deaf children at the Pennsylvania School for the Deaf. Graphic representations of pictures to illustrate word meanings, printed words, readily changeable keys, and access to new words and graphics give teachers opportunity to individualize courseware for student needs.

Prinz, P., and Nelson, K. *Reading is fun—with a keyboard, a hat, and an alligator*. *Perspectives for Teachers of the Hearing Impaired*, 1984, 3 (1), 2-4.
Describes using computers to assist students at the Pennsylvania School for the Deaf with communication skills and instructional involvement. Suggests enhanced reading skills and language usage can result from CAI with the hearing impaired.

Spring, C., and Perry, L. *Computer-assisted instruction in word- decoding for educationally handicapped children*. 1984 (ED 201 072)
Torgesen, J. Instructional uses of microcomputers with elementary age mildly handicapped children *Special Services in the Schools*, 1984, 1 (1), 37-48
Evaluates the current uses of computers to teach handicapped children

1985

Capalbo, W *A microcomputer software guide for special educators* 1985 (ED 252 197)

Jones, M *Success and the word processor* *Media & Methods*, 1985, 21 (7), 42-28.

Presents a word processor's success story in a writing class for learning disabled high school students

Rosegrant, T. *Using the microcomputer as a tool for learning to read and write* *Journal of Learning Disabilities*, 1985, 18 (2), 113-115
Reports that several elementary students with reading and writing difficulties improved their skills with CAI.

Presents a software program that will help students learn letter configuration

1986

Finds that microcomputer delivery of reading instruction (reading a passage and answering questions) was more effective than workbook delivery of reading instruction. Analysis of attention to task behavior revealed that the microcomputer delivery was as effective as a workbook delivery of reading instruction.
Spelling references

1972
Describes a spelling classification program that uses a touch sensitive screen.

1976
Thompson, M. *The effects of spelling pattern training on spelling behavior of primary elementary students: An evaluative study.* Unpublished doctoral dissertation, University of Pittsburgh, 1976
Details research in which experimental second grade subjects were given CAT sound-letter correspondence training for twenty-four to thirty-five minutes, three times weekly, for a school year. The on-line CAT work was supplemented with workbook pages. Experimental subjects outperformed control subjects on all posttests, one of which was a test of ability to read whole words.

1980
Discusses the advent of affordable computer assisted means for spelling practice and instruction. Also describes potential dangers and new demands of computer based spelling activities.


1983
Edmonton Public Schools. *Using the computer to teach spelling*. 1983 (105 252 861)
Presents the results of a study using CAT in spelling with third graders. Students using the CAT spelling program learned to spell better than those who used conventional methods.

Presents research on the Computerized Test of Spelling Errors (CTSE). Suggests that the CTSE can be a reliable way to diagnose spelling problems.

1984
Discusses a program entitled “Computerized Spelling Remediation” and presents research evidence as to its effectiveness. The program uses an imitation plus modeling teaching strategy.

Describes commercial software spelling packages that permit teachers to change the content of the lessons and that can make a difference in the spelling achievement of first grade students experiencing difficulty learning to spell. Using Apple computers, first graders used spelling programs for twenty-five minutes a day for twenty days. Instruction featured placing
words in alphabetical order, word puzzles, unscrambling letter order of words, and writing words in sentences.

1986
Offers suggestions on what to look for in spelling software, colorful and interesting programs, voice synthesis to present words, a way to add new words, feedback, review of misspelled words, and recordkeeping.

Native American and bilingual education references

1977
Students use talking computer in Dallas bilingual program. Phi Delta Kappan, 1977, 59 (4), 234.
Describes an ESEA Title VII and Title IV-C program which uses a computerized voice synthesizer to reinforce reading and language arts programs.

1980
Describes the CAI project directed by the All Indian Pueblo Council. The project helped elementary Pueblo students to develop better reading skills through culturally relevant reading materials and the cloze procedure. A HP2000F computer was used to provide lesson materials employing a modified cloze procedure. The article describes how the program worked and gives a sample lesson.

1981
Describes funded program designed to teach speaking and reading of Ojibwe to Wisconsin Chippewas using PLATO

1982
Tells how 128 children received supplementary CAI in reading and mathematics using programs from Computer Curriculum Corporation. At the conclusion, the CAI group had high achievement test scores.

1984
Edeburn, C., and Jacobi, C. Computer assisted instruction for Native American students. 1984 (ED 252 336)
Provides an evaluation of the first year phase of the federally funded program Computer Assisted Instruction for Bilingual/Bicultural Students in Rapid City, South Dakota, area school districts. Summary data are provided.
Explains, through proceedings of the 1983 Indian Education Conference, the project design and planning for CAI in word recognition, reading comprehen-
sion, and mathematics for Native American, Native Alaskan, and American Indian students. Recommendations for project implementation are made by six resource persons in Indian education.

Ramos, N. The utilization of computer technology in a bilingual classroom. Dissertation Abstracts International, 1984, 45 (9), 2748A.

Urges the use of computer assisted instruction in bilingual education programs. Research data indicate significant improvement by limited English proficiency students who had received seven weeks of computer assisted English instruction.

1985


Discusses a CAI in reading project with Native Americans in Rapid City, South Dakota.

1986


Discusses six bilingual education demonstration projects using a computer. All the projects appear to involve reading as a component. Projects include both Spanish and Native American language instruction.

English as a second language
and foreign language education references

1984


Explains that the Department of Defense foreign language requirement stipulates students must show level three language proficiency, demonstrating near perfect reading and listening comprehension in the native language. Suggests CAI as a viable component of level three instruction, but adds the computer should be capable of sufficient text display, higher level interaction, storage of lesson files, and manipulation of lengthy passages.


Recommends CAI in teaching foreign language reading skills. Using the language's alphabet, syntax, morphology, vocabulary, and sound-symbol correspondence, the curriculum's design would take the nonreader to intermediate proficiency. Layered assistance (highlighting key words or phrases), student performance tracking, graphic/video support, and a motivating, appealing format should be consolidated into the program.


Describes a college level computer assisted foreign language project and cognitive and affective changes.

Holmes, G. The computer and limitations. Foreign Language Annals, 1984, 17 (4), 413-414
Asks whether the benefits of computer assisted language learning are cost effective in terms of time, energy, and money. Suggests that other media may better provide instructional foreign language activities.

Hope, G. *Using computers in teaching foreign languages*. 1984. (ED 246 695)

Provides suggestions for computer applications in developing foreign language skill. Aspects of building vocabulary files, classifying words, practicing words, grammar, writing, reading, speaking, and listening and culture are discussed (CMI including testing, placement, and grading) in the foreign language classroom is described. Detailed guidelines are included for evaluating software. An annotated bibliography on foreign language CAI is also available.


Discusses CAI in foreign language reading instruction as well as in other areas of foreign language curricula.


States that ESL students (K-eighth grade) can profit from CAI programs in English


Discusses a computer assisted college level authoring system for foreign language instruction.


Presents a thorough treatment of CALL (computer assisted language learning) as related to ESL (English as a second language) instruction. Provides techniques for integrating CALL into existing programs and specific subject areas. In addition, a number of sources for CALL software and information are listed.

Wyatt, D. Computer-assisted teaching and testing of reading and listening *Foreign Language Annals*, 1984, 17 (4), 393-405

Describes the computer's role in foreign language reading and listening skill development. Aspects of instruction (highly structured, traditional strategies), collaboration (interaction in student initiated activities) and facilitation (word processing) are considered.

1985

Hughett, H. *Introduction to computer aided instruction in the language laboratory*. 1985. (ED 225 170)


Describes a PLATO computer lesson on the Olympic games that simulates a written conversation between a French student and the computer. The format includes the student reading a text and typing a response.

1987


Explains how CAI can be used correctly and incorrectly with ESL instruction.
Evaluating and developing reading software

Despite an enormous increase in the number of programs in the marketplace, the majority of reading and language arts programs still emphasize drill and practice, largely because drill and practice programs are easier and less costly to create than are more complex programs. Simpler, less costly programs are also less likely to be pirated than are more costly programs. The cost of complex programs has led to extensive piracy in the schools, where personnel justify it as a necessary money saving activity. Because of piracy problems, some publishers are unwilling to risk costly research and development efforts. Copy protection schemes provide one answer to the problem, but software developers and publishers are looking beyond these costly schemes. Site licensing and software rentals are two potential solutions. Also, some newer software programs allow the buyer to make as many copies as desired, but copies can be made only from the purchased disk; programing features of the purchased disk—the “master disk”—do not permit copies to be made from other copies.

The future, however, might reveal that software companies have removed copy protection devices from their programs because the schemes are troublesome as well as costly, and they do not stop piracy. Consequently, the future for research and development of complex reading and language arts programs is uncertain.

Evaluating reading software

Each week some publisher announces a “new” program for reading or language arts instruction. The plethora of programs may be helpful for reading instruction, but teachers need help in learning about what software is available and in selecting the software most appropriate for their students. The publications in the following list provide information on reading
and language arts software. Following that list are the IRA criteria for the selection and utilization of nonprint media in the reading curriculum and questions teachers should ask the salesperson about computer based reading and language arts programs, which also can be useful to teachers who are selecting software.

Review sources
California Library Media Consortium, TECC Clearinghouse, San Mateo County Office of Education, 333 Main Street, Redwood City, California 94063
Chime Newsletter, Clearinghouse of Information on Microcomputers in Education, Oklahoma State University, 108 Gunderson, Stillwater, Oklahoma 74078
Classroom Computer Learning (formerly Classroom Computer News), 19 Davis Drive, Belmont, California 94002
Closing the Gap, P.O. Box 68, Henderson, Minnesota 56044
Computing Teacher, The International Council for Computers in Education (ICCE), University of Oregon, 1787 Agate Street, Eugene, Oregon 97403
Curriculum Review, 517 South Jefferson, Chicago, Illinois 60607
Educational Computer, 3199 De La Cruz, Santa Clara, California 95050
Educational Technology, 140 Sylan Avenue, Englewood Cliffs, New Jersey 07632
Educational Software Reviews, Scholastic, P.O. Box 2038, Mahopac, New York 10541
Electronic Learning, Scholastic, P.O. Box 2038, Mahopac, New York 10541
EPJE Micro-Courseware PRO/FILES, Educational Products Information Exchange Institute, P.O. Box 839, Water Mill, New York 11976
InfoWorld, 1060 March Road, Suite C-200, Menlo Park, California 94025
Journal of Special Education Technology, Association of Special Education, Utah State University, Logan, Utah 84322
The Mathematics Teacher, 1906 Association Drive, Reston, Virginia 22091
Media & Methods, 1511 Walnut Street, Philadelphia, Pennsylvania 19102
Media Review, P.O. Box 425, Ridgefield, Connecticut 06877
MicroSIFT Courseware Evaluation, Northwest Regional Educational Laboratory, 300 SW Sixth Avenue, Portland, Oregon 97204

Computer applications in reading
IRA Criteria for the selection of nonprint media for the reading curriculum*

Print media include printed material in book, pamphlet, magazine, or newspaper form. Nonprint media include any other means of conveying information including television, radio, computer, music, games, audiotape, film, videodisk, videotape, and cable TV.

1. Materials shall support and be consistent with the general educational goals of the school district.
2. Materials shall contribute to the objectives of the instructional program.
3. Materials shall be appropriate for the age, social, and emotional development and interest of the students for whom the materials are selected.
4. Materials shall present a reasonable balance of opposing sides of controversial issues so that students may develop the practice of critical reading and thinking. When no opposing side of an issue is currently

*Criteria recommended by the 1983-1984 IRA Nonprint Media and Reading Committee and approved by the IRA Board of Directors, May 1984
available, the nature of the bias will be explicitly discussed and explained to the students.

5. Materials shall provide a background of information which will enable pupils to make intelligent judgments in their daily lives.

6. Materials shall provide a stimulus for creative reading, writing, listening, and thinking.

7. Material shall reflect the pluralistic character and culture of society. Materials shall foster respect for minority groups, women, and ethnic groups.

8. Materials shall be of acceptable technical quality, such as clear narration, synchronized pictures and sound.

9. Materials should be selected on the basis of their aesthetic quality, providing students with an increasing appreciation of the world around them.

10. Materials should encourage affective responses and further humanistic concerns.

IRA Criteria for the utilization of nonprint media in the reading curriculum*

1. Teachers should be fully trained in the use of audiovisual equipment before operating it in the classroom setting.

2. Nonprint media should be ready to operate prior to its scheduled use to avoid losing valuable classroom instructional time. Room facilities should be carefully planned in advance (i.e., electrical outlets, adaptors, seating, extension cords).

3. Materials should be carefully previewed before their utilization in the reading curriculum. Background information, including new vocabulary and concepts, should be provided to support the new ideas to be mastered.

4. Prior to its use, specific goals and purposes should be established to help students identify the objectives and expectations of the learning activity.

5. Content should be discussed and student knowledge evaluated and reviewed to assure understanding of the ideas and concepts presented.

6. The utilization of nonprint media should stimulate students toward a further expansion of literacy and lifelong skills in reading.

*Criteria recommended by the IRA Nonprint Media and Reading Committee and approved by the IRA Board of Directors, May 1984
Questions teachers should ask the salesperson about computer based reading and language arts programs*

Each of the numbered requests listed is followed by additional questions. The purpose of these additional questions is to ensure that you get as much essential information about reading and language arts software as possible, as quickly as possible. A word of caution though; you might not get answers to many of your questions. Be persistent.

1. Tell me about the cost.
   - Is the program copy protected?
   - Is there an additional charge for backup copies?
   - Is there an additional expense for supplemental or resource materials?
   - Is there a single disk for the program or are multiple disks required?
   - Is there a provision for refunds or returns?
   - Is there a provision for upgrading the program if a new version is marketed?

2. Tell me which computer runs the program and if any special equipment is needed.
   - Does the program need a color monitor?
   - Does the program need two disk drives?
   - Does the program need a student data disk?
   - Does the program need a printer?
   - Does the program need a speech synthesizer?
   - Does the program need extra memory?
   - Does the program need anything else?

3. Tell me where the program might fit into my curriculum.
   - What grade level is appropriate?
   - What types of students could use the program?
   - What types of teaching styles would be compatible with the program?
   - What types of reading and language arts materials are compatible?
   - What time requirements are needed for the activities?

4. Tell me what the students read on screen or off screen
   - Do they read passages?
   - Do they read sentences?
   - Do they read individual words or phrases?
   - Do they read questions?
   - Do they recognize syllables?

*Based on Questions to ask about computer-based reading programs. The Reading Teacher, 1985, 39 (2), 250-252
Do they recognize letters?
Do they read program or activity directions?
Do they read or recognize anything else?

5. Tell me about the program content.
   Are there instructiona activities?
   Are there practice activities?
   Are there vocabulary activities?
   Are there comprehension activities?
   Are there study skills activities?
   Are there grammar activities?
   Are there syllable or alphabet activities?
   Are there game activities?
   Are there test activities?
   Are there other activities?
   Are there multiple activities on one disk?

6. Tell me about video presentations.
   Does the program present printed information with appropriate speed
   and legibility?
   Does the program present information appropriately spaced and sized?
   Does the program use graphics (with color)? What types? When?
   Why?
   Does the program use animation? When? Why?
   Does color interfere with print legibility?

7. Tell me about audio (and speech) presentations.
   Does the program use speech? When? Why? (synthesized speech—
   space-age voice or digitized speech—human voice)
   Does the program use nonspeech sound? When? why?
   Does the program allow me or the students to control or eliminate the
   volume?

8. Tell me about the program's stated reading and language arts objectives
   and goals.
   Are there objectives and goals for teachers (achievement, motivational, behavioral, management)?
   Are there objectives and goals for students?
   Are there objectives and goals that meet my state or local educational
   requirements?
   Are there objectives and goals that meet or correlate with objectives
   and goals of tests?
   Are there objectives and goals for others, such as parents, administrators, or supervisors?
9. Tell me what prerequisite skills are needed.
   What computer literacy skills are needed?
   What keyboard skills are needed?
   What spelling skills are needed?
   What entry level reading skills are needed?
   What entry level background knowledge is needed?
   What other skills are needed?
10. Tell me about reinforcement in the program.
    What behaviors are reinforced? Why? When? How?
    What control do I have over the reinforcement?
11. Tell me about the operation of the program.
    Can the students use the program with little or no help from me?
    Can the students or I change the contents of activities?
    Can the students or I change the format of the activities?
    Can the students or I receive on screen prompts or help about questions
        involving the use of an activity or its content?
    Can the students or I make mistakes or accidents pressing the keys
        without ruining the activity?
    Can the students or I correct our entries?
    Can the students or I work on unfinished sections of an activity without
        repeating completed sections?
    Can the students or I reread previous screens easily without restarting
        the activity?
    Can the students or I reread questions and change answers easily without
        restarting the activity?
    Can the students or I use the activities without unloading and reloading
        the program disk? (Are multiple disks used for one activity?)
    Can the students or I use the activities if the program disk is removed
        from the disk drive?
    Can the program administer pretests or posttests over activity content?
    Can the activities be used with groups as well as with individual stu-
        dents?
12. Tell me about reviews of the program and field testing.
    Are critical and descriptive reviews of the program available?
    Are there any reports on field testing data?
13. Tell me about supplemental or resource materials.
    Are supplemental materials available to allow the students or me to
        examine the contents of the activities before using them with the com-
        puter?
Are supplemental materials available that allow the students or me to examine any background information relevant to the content of the activities?
Are supplemental materials available that allow the students or me to examine information about the instructional strategies used in the activities?
Are supplemental materials available about other educational resources?

14. Tell me about scoring and recordkeeping activities.
   Does the program score or record activity performance or other information? How?
   Does the program permit students as well as teachers an opportunity to see scoring or recordkeeping data?
   Does the program store and allow the recall of information about students? What information is stored and why?
   Does the computer score or record other information?

15. Tell me what reading and language arts educational opportunities this program offers to my students that I cannot otherwise give them.

Chapter 3 provides references on software development and evaluation projects from local, state, and national sources; reading software evaluation guidelines; and suggestions on how to develop software.

References

1981
Kleinman, G., Humphrey, M., and Buskirk, T. Evaluating educational software. Creative Computing, 1981, 7 (10), 84-90

Discusses problems in trying to apply evaluation standards developed for mainframe software to microcomputer software. Suggests that evaluation systems be flexible enough to discern good quality regardless of the particular instructional vehicle. Divides software criteria into three categories: essential characteristics for instruction of any type, aesthetic characteristics, and characteristics dependent upon the learner and the objectives being taught. Argues that a review team rather than one individual should perform software evaluation.

1982

Cohen, V., and Blum L. Evaluating instructional software for the microcomputer. 1982. (ED 216 704)


Kimmel, S. How to write a software review. *Creative Computing*, 1982, 8 (8), 242-244.


Reports that less than 5 percent of the educational software has been reviewed critically. Also lists journals that review software.


Discusses the review process used by CONDUIT, which was incorporated in a later Microsirr evaluation form.


Suggests that instructional effectiveness, ease of use, and user acceptance should be considered in evaluating software.

1983


Offers suggestions for software selection: correlate learning objectives with software, consider learning objectives with software, depend on dealer support, consider software produced by major publishers, review software evaluations, understand the copy protection limits, and consider student interests and abilities.


Presents a guideline for evaluating software and a Software Evaluation Checklist.


Discusses the limitations and capabilities of reading software (circa 1983). The author believes the computer can provide enhanced instructional opportunities because it can motivate students and provide for individualization. Presents seventeen features of good reading software.

1984

Auten, A. *How to find good computer software in English and language arts*. 1984 (ED 250 692)

Presents sources for software reviews and evaluations: subscription publications, online sources, specific guides, and the suggestion “identify and befriend an independent distributor of software.”

Claims that some reading teachers are far more impressed by the computer’s ability to provide drillwork than they are by its higher level activities. Discusses computer advantages in drillwork, types of computerized drillwork, characteristics of good drill programs, and using computer drills in the classroom.

Bialo, E., and Erickson, L. Microcomputer courseware: Characteristics and designs. 1984. (ED 244 606)

Describes strengths and weaknesses found in 163 computer programs evaluated by the Educational Products Information Exchange (EPIE). Strengths were accuracy in fact, spelling, and grammar; uncontroversial content; avoidance of stereotyping; and good warranties. Weaknesses were lack of field testing in phases of program development, limited documentation for learner objectives, support materials, and teaching strategies; ineffective delivery techniques; poor audio quality; limited use of management systems; and little evaluation of student learning.


Offers suggestions for software evaluation, including consideration of the program’s objective, ability levels, instructional design, operating instructions, and appropriate reinforcement.

Caldwell, R. Evaluating microcomputer software in the English language arts. English Education, 1984, 16(1), 14-21

Discusses evaluation criteria for English education software, including a section on the implications of computers in English education.


Provides methods and sources that assist in software evaluation.

Janello, P. Software evaluation for the teacher of the English language arts. 1984. (ED 250 697)

Gives strategies for selecting instructional software. Areas discussed include documentation, organization and structure, feedback, pedagogical issues, previewing, and dealing with software publishers.


Presents evaluation criteria for selecting good reading and language arts software.


Lists nine tips: Choose quality software first, then compatible hardware; look for innovative formats; preview before purchase; consider if the “create” feature is functional; evaluate the quality and types of learner reinforcement; check for computer-learner interaction; be aware of software that reinforces reading skills, such as word processors, a drawing program, study techniques, simulations and games; evaluate the teacher aids, and keep abreast of new materials through software catalogs, journal articles, and computer stores.

Tells how teachers can find information about software they wish to use with their students. They can read computer books and magazines, attend conferences or sessions on computers, and contact salespeople and distributors. Provides information about each of these sources.


Suggests that computers can interest even the most apathetic students, but only if the teacher chooses good software. Suggests guidelines for software that can motivate. Select software that fits the standards demanded from other materials, fits in the curriculum, is easy to use, has lots of options, promotes socialization, and allows for pre and postactivities.

Wiener, R. Evaluating courseware: You don't have to be computer literate to effectively select CAI materials. Lifelong Learning, 1984, 7(7), 14, 16-17. 28.

Discusses the five types of CAI courseware: tutorials, drills and practice, demonstrations, simulations, and instructional games. Offers a checklist for evaluating program operation and content, desired student outcomes, and teaching/learning concerns.

1985


Presents a one page software review evaluation checklist and describes the best way to use this checklist.

1986


Reading software development project references

1981


1982

Northwest Regional Educational Lab. Comprehension power program. Micr0S1fT courseware evaluation. 1982. (ED 226 765)

Describes the Comprehension Power Program by Micr0S1fT Courseware. Includes instructional purpose, techniques, objectives, prerequisite skills, potential uses, and major strengths. Includes an evaluative table that rates content, purpose, instructional delivery, ease of use, and reliability.

Parker, S. A review of first grade software materials. 1982. (ED 225 562)

Attempts to locate and evaluate software for use with the first grade curriculum. Author rates nine math and five language arts programs according to
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technical, educational, and management criteria. Includes names and addresses of fifty software vendors, including seventeen that have first grade materials.

1983


Compared six critical reading software packages: Critical Reading by Borg Warner; Our Weird and Wacky World—Critical Reading by Educational Activities; How to Read in the Content Areas—Social Studies/Literature/Sciences/Mathematics by Educational Activities; Our Wild and Crazy World—Critical Reading by Educational Activities; Comprehension Power D-E-F by Milliken; and Tutorial Comprehension by Random House.


Describes twenty-five educational software programs published in 1983, including five language arts programs and software for social studies, computer literacy, science, math, and classroom management.


Explains the SBBR program available through the University of Georgia. Reading references are entered into the program according to main descriptors and subdescriptors, suggesting ease of access for reference retrieval.


Reviews the Reading Skills Courseware Series from Scott, Foresman.

Hornberger, T., and Whitford, E. The language of computers can be fun and games. *Computers, Reading and Language Arts*, 1983, 1 (1), 41-43

Presents four computer vocabulary activities: video attack match, vertical puzzle, video names, and unusual definitions.


Discusses four issues relevant to computer based reading/language arts programs as they relate to three computer activities—CULL, HANGMAN, and STORY MAKER. The four issues are level of text, role of feedback, learning by doing, and social environment of the program.


Discusses several word games used at the Lawrence Hall of Science at Berkeley: Hangman, George (Hangman in Spanish), Big Red (computer generated story based on Little Red Riding Hood), Password (guess a word from synonyms), Words (guess a word from letter clues), Snap (guess a word flashed quickly), and WFF (using letters in a logic game).


Reports a review of reading software that concluded word attack software is the most common, followed by comprehension and study skills.

Identifies The Puzzler as fulfilling eight criteria for quality reading software: a reading theory basis, development of reading strategies, higher level thinking, quality literature, creation of original work, easy to use program design, transfer to other reading strategies, and use of computers' unique features.

1984


Describes four software reading programs designed to assist special education students: Compu-Read, Critical Reading Lesson Series A-H, Reading Comprehension: What's Different? and Comprehension Power Program.


Identifies Suspect Sentences, Story Maker, M-ss-ng L-nks, and Jabbertalky as challenging, enjoyable software for language arts development.


Evaluates the IBM Writing to Read program in the Portland Public Schools.


Suggests drill and practice, tutorial, game, and word processing programs to improve student spelling skills. Highlights features that quality spelling software should possess.

Fredericks, A. Basals, computers, and the reading program. The Reading Teacher, 1984, 38 (3), 361-362

Describes several commercially available software programs that can accompany basal readers: PHI Beta Filer, Bank Street Writer, PAL Reading Curriculum, M-ss-ng L-nks, Comes First/Sequence, Meet the Computer—Beginning BASIC, Koala Pad, and Vocabulary Baseball.


Describes Close-Up, a program encouraging readers to take risks in order to develop better reading skills. As one word from a text is randomly chosen, students attempt to identify the text's topic, matching the word to one of the eight displayed titles. A scoring system structures the format, creating both a challenge and strategy for winning.


Reviews three language arts software programs as an illustration of what to look for in good and bad software. The programs are MECC, English Volume 1; English SAT 1; and Vocabulary Prompter.


Describes computer based gramatical instruction kit written in PROLOG. Notes that PROLOG's semantic complexity makes program malfunctions difficult to deal with.

Contains 275 abstracts of Department of Education discretionary computer education projects that were active during 1983. Many projects deal directly or indirectly with reading education. The catalog is divided into the following sections: developing student computer literacy, computers as instructional aids for students, computers for educators, research and evaluation, and multipurpose computer education projects.


Tells how a secondary reading lab instructor selected software for his remedial and developmental reading students. Includes a list of recommended software.


Discusses the creation of poetry in noninstructional and instructional contexts, including discussions about Compopoem.

Mason, G. *The micro can connect home, school and community—but it must be read*. 1984. (ED 245 194)

Observes types of reading and writing CAI used in a variety of school settings. Illustrates the significant impact that home and community resources can make on CAI in education. Describes a number of word processing programs and simulations that appeal to both children and their parents.


Explains that microcomputer utility educational programs can be an asset to any classroom reading program if teachers know how to use them. Utilities allow teachers to develop tests, instructional activities, puzzles, reports, games, and bulletin board displays. Presents several examples of utility programs.

Murphy, D., and Derry, S. *Description of an introductory learning strategies course for the Job Skills Educational Program*. 1984. (ED 244 108)

Describes a basic skills computer assisted curriculum developed at Florida State University for the Army Research Institute. The five steps included in the program are setting goals and self-pacing, mood management, reading comprehension, developing skilled memory, and problem solving.


Describes Technology Programs that Work, a product of the Technology Diffusion Network Project. Several of the programs related to reading are Basic Literacy through Microcomputers, Salt Lake City; Computer Assisted Diagnostic Prescriptive Program in Reading and Mathematics, Dillwyn, Virginia; and Computer Assisted Instruction, Merrimack Education Center, Chelmsford, Massachusetts.

Partridge, S. *Writing to Read*. 1984. (ED 254 820)

Evaluates the IBM Writing to Read program in North Carolina schools during 1982-1984.
Rauch, M., and Wogen, D. *Comprehension: Mapping information, a program for the Apple computer*. 1984. (ED 244 231)

Focuses on the effectiveness of mapping for comprehension and retention of expository information. Describes a program where students see a mapped or framework display of the main subject/topic, subcategories/ideas, and the details of the selected passage.

Rosegrant, T. *Using microcomputers to foster progress in reading and writing development*. In S. Leggett (Ed.), *Microcomputers go to school*. Chicago: Teach'Em, 1984.

Describes the talking screen textwriter (TST), which allows users to hear letter names, morphemes, and words used during and after they are typed into a computer. The speech comes from an ECHO II synthesizer. Provides several examples of the TST in use.

1985


Free software for reading and language arts teachers.


Discusses a 1984 study in which 163 microcomputer courseware programs were evaluated by the Educational Products Information Exchange (EPIE) Institute to identify strengths and weaknesses in design. Approximately 23 percent of the 163 programs involved language arts and reading software. Using these numbers as a reference, the evaluations revealed the following weaknesses: lack of field testing, lack of learner objectives, lack of goal/content match, lack of support materials, lack of warranty, lack of record-keeping, lack of a management system, and lack of evaluation of student learning. Provides additional information and program strengths.


Discusses five applications of computers for middle and high school students; utility programs, word processing, simulations, telecommunications/databases, and interactive fiction. Suggests that teachers must help students meet the reading demands of computer delivered text.


Examines software designed for increasing word attack skills and reading comprehension.


Describes thought-provoking software as any that allows the students to manipulate any two or more culturally valued symbol systems. Describes different types of thought provoking software: oral communication game, typing communication game, talking communication game, talking word processors, graphing equations, Turtle graphics and LOGO, Mathboxes, musical and spatial representation, Wizard of Where, and matrix sorting game.


Evaluating and developing reading software
Explains that commercially available software can be used to stimulate a student's interest in language. Directs the reader's attention to "participa-stories," such as Snooper Troops, Dragon's Keep, Window on Learning, and Deadline and suggests that teachers can create their own stories using an authoring language like SuperPILOT. Word processing and electronic mail are mentioned as other ways to stimulate language interest.


Describes HOTS (higher order thinking skills), a project to help schools develop a computer based thinking skills curriculum. HOTS uses readily available software (e.g., Moptown Parade, Bumble Games, Crossword Magic, Creative Play) that can be adapted for use in helping develop higher order thinking skills.


Presents two programs (with source code): controlled flash and speed flash. Both programs are used for vocabulary drill.


Describes five National Diffusion Network technology programs that work. Four of the five programs emphasize reading instruction—all use both Apple and TRS-80 computers in their programs. Also tells how to get information about National Diffusion Network computer programs and a catalog of NIE sponsored computer projects.


Reviews Vocabulary Builder, Vocabulary Grade 11, Word Attack with SAT data disk, Vocabulator, and PSAT Word Attack Skills

**Developing software references**

1979


1980


Discusses the strengths and weaknesses of drill and practice programs. States that more students should be involved in the development of software they will be using.

1981


Claims that lack of easy to use computer authoring languages is holding back the development of educational software.


Suggests that the guidelines provided for the users of computerized authoring systems will be more effective if they are based around nine event(s) of
instruction: gaining attention, informing learner of the lesson objective, stimulating recall of prior learning, presenting stimuli with distinctive features, guiding learning, eliciting performance, providing informative feedback, assessing performance, and enhancing retention and learning transfer. Provides a set of CAI guidelines based on these learning events.


Contains guidelines for software development


1982


Says that microcomputer software development focuses on paraphrasing—deciding which sentences best describe the same idea.


States that CAI offers remedial students a climate that fosters learning, specificity to individual needs, self-pacing, instructional clarity, and individual and immediate feedback.


Provides a quick look at how to develop and evaluate software, offering several examples to show that developing and evaluating computer based programs are more difficult than other forms of instructional materials.

Visniesky, C. and Hocking, J. Choosing a microcomputer for use as a teaching aid. 1982. (ED 214 608)

1983


Explains that tachistoscopic reading activities are one way computers can help remedial reading instruction. Tells how completing tachistoscopic reading activities can help students gain a sense of accomplishment and self-worth.


Presents one teacher's attempt to design software that features higher order, open ended questions for literature classes.


Offers a process for developing CAI software. Steps include identification of student needs and instructional goals, preparation of materials to include learning objectives, criteria for mastery, instructional delivery techniques, and resource materials, and determination of procedures for evaluation and revision.

Evaluating and developing reading software

Lists three strategies that may assist in producing quality CAI software: a consideration of the total instructional process, application of sound pedagogical principles, and material evaluation and revision.


Introduces some theoretical constructs that appear to exist in the acquisition of language as they relate to reading and language arts software development.


Calls for software that capitalizes on the student's imagination and interaction with other students and teachers. Insists that quality software is student controlled, self-paced, easily managed, and integrated across subject areas.


Discusses how to write a software program that lets students practice using fact and opinion comprehension activities.


Lists beginner competencies: basic computer literacy, software evaluation, and planning for CAI. The intermediate level involves competency in word processing and computer management systems. Advanced competency allows the teacher to create original software using an authoring system or BASIC.


Criticizes the premise of some software that “reading can be achieved by drilling students on discrete skills.”


Offers a step-by-step strategy for integrating computer technology into a school district's reading curriculum. Describes needs assessment, planning, implementation, and evaluation.


Includes some ways teachers may help students learn to program: Designate key computer commands, develop a short (less than 25 lines) program; and review the interaction of commands in the program.

Focuses on paper and pencil research involving extrinsic and intrinsic reinforcement and instructional objectives that may be important for those designing, evaluating, and using reading software.
Computers in teaching reading and reading assessment research

Computer based reading research is of at least three distinctly different types: examining ways to use computers to teach reading, examining ways to assess reading and reading processes, and examining psychological and physiological aspects of reading processes.

Using computers in teaching reading

Investigations using computers to teach reading and language arts were first undertaken at the Stanford University Institute for Mathematical Studies in the Social Sciences under the direction of Richard Atkinson and Patrick Suppes. Early results were encouraging but expensive. By the late 1970s expectations and interest about mainframe, time sharing reading instruction had diminished because of the cost of computing and the lack of instructional flexibility. Yet from the two decades (1959-1979) of mainframe, time sharing, computer based instructional research, a clear picture emerged that the computer can teach reading, can save instructional time, and can be an enjoyable way to learn. In computer literature, this picture has been referred to as the CAI phenomenon.

In a metaanalysis of computer based instruction in basic reading skills (Roblyer, 1985), the research cited consistently reported that students showed slight (one-third of a standard deviation) advantages in achievement gains, learned information in less time, and seemed to enjoy the activity more than when taught by more traditional approaches. It is important to note that the CAI phenomenon studies involved drill and practice programs (perhaps with limited tutorial elements) presented by mainframe, time sharing computers or minicomputers. Today’s minicomputer based reading programs may or may not support the CAI phenomenon; it is too early to tell. But present research does not include an ongoing assessment of the phenomenon with varied microcomputer programs.
However, other forms of reading research with microcomputers continue. Readers are reminded that reports of research annotated in this chapter include many studies comparing computer-based instructional methods, usually based on the assumption that computer-based methods are preferable. Therefore, few readers should be surprised that computer-based methods usually are reported to result in superior performance by experimental groups—a self-fulfilling prophecy.

Computers and the reading process

There are many researchers using computers to investigate the myriad of psychological and physiological processes involved in reading. Most of their reports are referenced in this chapter or earlier editions of Computer Applications in Reading. These reports are so diverse that using the term “computers and the reading process” seems the only way to categorize them.

Reading assessment research

Recent developments in technology have demonstrated the computer's potential to provide decision-making capabilities for educational and psychological assessment. Reading is just one area of assessment that can profit—and needs to profit—from these developments. For many reasons, all areas of educational and psychological assessment need to profit from advances in computer technology. The most compelling reason is demand. The demand for reading assessment continues to grow while the time and resources teachers and other professionals can devote to assessment continue to decline.

A continuum

Any computer-based assessment program (reading or otherwise) can be placed on a decisionmaking continuum bracketed by the terms active and passive. Active implies decisionmaking and passive implies lack of decisionmaking. Using the ends of the continuum as points for discussion, the active end suggests programs that duplicate assessment activities of teachers, diagnosticians, and measurement specialists—everything from test design to interpretation. The passive end suggests programs that only score tests—programs devoid of decisionmaking. In a sense, the movement toward active assessment features can be quantified by the breadth and depth of decision making available in the program.
It is the movement away from the passive end of the continuum and toward the active end that is of concern to today's reading educators. Despite attempts to use active features in computer based reading assessment programs, for the most part, today's programs are predominantly passive.

Forms of computer based reading assessment

There are many computer based reading assessment formats. Despite the passive nature of these programs, their diversity makes it difficult to decide just what is meant by computer based reading assessment. At least five plausible program categories are suggested: test scoring, test, test generator, instructional system, and instruction/practice.

Test scoring programs. Test scoring programs may process student reading test results, store the result, and produce reports containing the test results. Interpretations, analyses, and prescriptions are usually done by teachers.

These programs usually are not associated with any materials or approaches and are the most passive form of reading assessment. Examples of test scoring programs are Instructional Management System Plus (National Computer Systems), and Scan-Tron.

Test programs. Test programs may process student reading test results, store the result, and produce reports containing the test results, and provide computer based tests. These programs may assess one reading skill or many. They also may provide a simple accounting of number right versus number wrong or complex interpretations of reading performance with suggested prescriptions containing instructional materials and techniques.

Test programs are not inherently associated with any reading materials or approaches. Generally, teachers have little control over what reading skills are measured or how reading skills are measured with these programs. Examples of test programs include Computer Based Reading Assessment Instrument (Kendall/Hunt), Reading Style Inventory (Learning Research Associates), and Diascriptive Reading (Educational Activities).

Test generator programs. Test generator programs may process student reading test results, store the results, produce reports containing the test results, and provide computer based tests. However, these features are available only if the test generator program permits the activities and if the teacher programs the activities. Quite simply, teachers write their own tests. These programs use a test shell—a menu based computer program that allows teachers to select the testing features. Teachers may develop any test format provided in the program. In addition, test generator pro-
grams usually provide several scoring options. However, interpretations, analyses, and prescriptions would be likely to be done by the teachers without computer assistance.

Test generator programs or teacher made tests are not inherently associated with any reading materials or approaches. A few examples of test generator programs include SuperPilot (Apple Computer), Tutorial Quiz Master (Random House), Exams II (Shenandoah Software), Create-A-Test (Cross Educational Software), Quizmaster (Logical Systems), and QuickTests (Seven Hills Software).

**Instructional system programs.** Instructional system programs are associated with materials and approaches. These programs accompany published materials (including all major basal reader series) and are often referred to as computer based management programs. Instructional system programs may process student reading test results, store the results, produce reports containing the test results, and provide computer based tests. However, the reading tests will probably not be presented on screen. The recording, analyzing, and prescribing aspects of the programs almost always are done by computer. Teachers usually have very little control over what reading skills are measured, how they are measured, or analyses and interpretations of reading performance. Examples of nonbasal instructional system programs include Scholastic Reading Comprehension (Scholastic), Tandy E5TC (Radio Shack), and CSR (Educational Software Products).

**Instruction/practice programs.** Instruction/practice programs are not specifically designed as reading assessment programs, but student performance is one component of the program. Evaluation of student performance, whether before, during, or after an activity, is more for the benefit of the student than for diagnostic needs of teachers. In a sense, any reading program that includes an evaluation or scoring component is using computer based reading assessment. Usually, only rudimentary scores (number right versus number wrong) are provided, and interpretations, analyses, and prescriptions are absent.

**Research: Some issues and a few answers**

Despite a paucity of research, some issues involving relationships between reading assessment and computer technology have been investigated. Obviously, these are not the only issues facing computer based reading assessment—just the first to be investigated.

A first issue concerns whether any portions of the assessment procedure should be off screen. For example, in at least one research study...
text was presented on screen followed by the comprehension questions off screen. Strictly speaking, this is not computer based reading assessment; it is computer aided paper and pencil reading assessment. If assessment is totally computer based, another concern is whether text and questions should be presented on the same screen. If the questions are presented on the same screen as the text, reading comprehension assessment can become study skills assessment (i.e., find the answer to the question). While only one study (Schloss, Schloss, & Cartwright, 1984) has investigated this issue, results indicate that computer based reading assessment may be more effective when the text and the questions are not presented on the same screen.

A third issue is how to measure reading comprehension in a computer based environment. Of the available computer based reading assessment studies, most have measured comprehension in a text and comprehension question format. Most of these studies have used familiar types of questions (such as multiple choice) plus a few examples of less familiar formats (sentence arrangement, fill in the blank). The predominant forms of computer based reading assessment are likely to continue to be passages and questions, but other assessment formats also will be required.

The fourth and fifth issues concern the relationship between on screen reading comprehension performance and reading rate. With regard to on screen reading and comprehension performance, Askwall (1985); Blanc, Murphy, and Schneiderman (1986); Hansen, Doring, & Whitlock (1978); Heppner et al. (1985); Muter et al. (1982); and Olsen et al. (1986) present research suggesting that on screen reading does not result in much different comprehension performance than does off screen. At this point in the development of computer based reading assessment, we can tentatively conclude that on screen reading of text will not affect reading comprehension performance, either positively or negatively.

Concerning the relationship between on screen reading and reading rate, Hansen, Doring, and Whitlock, Heppner et al., and Muter et al. report research indicating reading rates that are substantially decreased for on screen reading. However, Askwall and Olsen et al. suggest that less time is needed for on screen reading. Some of these contradictory findings concerning comprehension performance and reading rate can be explained by the different research paradigms and computer technologies used in these studies.

A sixth issue concerns student attitudes toward computer based reading assessment. Unfortunately, no research directly relates to reading assessment. However, psychological assessment does provide some
guidance. Based on the research of Burke and Normand (1986), Cliffe (1985), Klingler et al. (1977), and Schmidt, Urry, and Gugel (1978), it appears that teachers can anticipate few negative reactions to computer based reading assessment in either reading clinic or classroom settings.

It is important to note that these and other similar issues relate not only to reading assessment but also to the general reading requirements of computer use. A person either does or does not understand the textual dialogue of the computer. A computer you can converse with is still in the realm of science fiction. In today’s computer reading environment, the computer assumes almost total understanding by the user; few programs provide clarification when misunderstandings occur.

Advantages and disadvantages of computer based assessment

Common sense tells us there are advantages and disadvantages in using computers in reading assessment. Currently, we can only hope the advantages outweigh the disadvantages, but continued development of computer based reading assessment should justify greater optimism.

Advantages

- Unlimited patience
  Computers are never tired. For example, assessment can proceed at any pace determined by the teacher and student (Duthie, 1984; Madsen, 1986; Space, 1981).

- Unlimited ability to store and recall test results and interpretations
  Computer based reading assessment results, interpretations, and prescriptions can be readily available in narrative as well as graphic formats. Storage and recall of results can be important for diagnosis, particularly if a perplexing problem surfaces that is not common to most assessment situations. In these cases, previous results, interpretations, and prescriptions can be quickly consulted to help decisionmaking (Madsen, 1986; Space, 1981).

- Limited examiner bias.
  The negative effects of poorly trained test administrators should be reduced with computer based reading assessment. The computer follows its program; divergence is impossible. This effectively ensures standardization and reduces examiner bias (Angle, 1981; Elithorn, Mornington, & Stavrou, 1982; Herr & Best, 1984; Sampson & Pyle, 1983; Space, 1981).

- Limited response bias.
  Psychological assessment studies indicate that people react favorably to computer based assessment. Response accuracy can be improved over
conventional testing procedures. This should be true of computer based reading assessment. In addition, readers using computer based counterparts of paper and pencil tests should have little trouble acclimating to the computer testing environment (Angle et al., 1977; Duthie, 1984; Greist & Klein, 1980; Harrell & Lombardo, 1984; Lushene, O'Neil, & Dunn, 1974; Moore, Summer, & Bloor, 1984; Rumelhart & Norman, 1980; Sanders, 1985; Schmidt, Urry, & Gugel, 1978; Slack & Slack, 1977; Space, 1981).

- Limited assessment demands on professionals
  Computer based reading assessment should save time and money and eliminate many mechanical tasks for reading professionals. It also generates more information from fewer questions (Byers, 1981; Gedye & Miller, 1969; Space, 1981; Stout, 1981).

- Unlimited use of paraprofessionals in assessment
  Under the direction of professionals, and with proper training, paraprofessionals can assume many computer based reading assessment tasks.

- Unlimited use of peripheral assessment devices
  As an example, computer based assessment devices could almost automatically measure variables such as reaction and response times (Dunn, Lushene, & O'Neil, 1972; Madsen, 1986; Space, 1981).

- Unlimited adaptability
  Computer based assessment can lead to easier individualized testing, an especially important feature for students with special assessment problems such as cerebral palsy (Beaumont, 1982; Evan & Miller, 1969; Katz & Dolby, 1981; Kelley & Tuggle, 1981; Lucas et al., 1977; Meier & Geiger, 1986; Stout, 1981).

- Unlimited use of assessment procedures in research
  Computer based reading assessment can lead to easier collection, organization, scoring, and analysis of data in all forms of reading research (Space, 1981).

- Unlimited use of graphics for assessment
  The use of computer based graphics (including animation and film) should enhance reading assessment capabilities, particularly for young or poor readers.

Disadvantages

- Dehumanization and depersonalization
  This can be a problem for both students and teachers because of the limited human relationships inherent in computer based reading assessment. For example, the teacher may feel a loss of control or understanding during assessment (Hirsch, 1981; Space, 1981).
• Costs of hardware and software
  Costs are high for computer based reading assessment. Costs to users usually can compensate for expenses by reductions in time and expenses for professional services. However, costs will remain high for developers (Lesse, 1983; Space, 1981).

• Computer literacy requirements
  Students and teachers using computer based reading assessment must learn to use the computer, its software, and its supporting peripheral devices.

• Mechanical failures
  Computer based reading assessment can be halted by malfunctions and breakdowns in hardware, software, and peripherals.

• Limited computer based assessment research
  As computer based assessment continues, research is needed to answer questions about differences between conventional and computer based assessment.

• Confidentiality and right of privacy
  Computer based assessment might be more vulnerable to breaches of confidentiality than conventional testing because results are often stored on memory devices such as floppy disk or hard disk where many may have access (Herr & Best, 1984; Meier & Geiger, 1986; Sampson & Pyle, 1983).

• On screen presentation of text and questions
  There are many problems relating to the presentation of reading tests on screen, including rereading text, reading questions and answers, changing questions and answers, and text presentation rate. In addition, ergonomic variables such as screen size, legibility, and lighting can affect the presentation of text and questions (Bevan, 1984; Blank, Murphy, & Schneiderman, 1986).

• Resistance by professionals and others
  Professionals and paraprofessions must be trained in the proper use and application of computer based reading assessment, including problems of overdependency and misuse (Butcher, 1978; Byrnes & Johnson, 1981; Loesch, 1986; Matarazzo, 1983; Meier & Geiger, 1986; Space, 1981).

• Limited decisionmaking features
  Computer based assessment instruments are simply computerized versions of existing instruments; they do not fully exploit the power of the computer. The strength of an assessment program should lie in the depth and breadth of computer based decisionmaking.

• Nonexpert based interpretations
  Computer based interpretations, analyses, and prescriptions are only as
good as the programer who wrote them. Teachers using this information must always question its validity. If incorrect information and algorithms are used, the interpretations, analyses, and prescriptions may be of little value (Madsen, 1986; Space, 1981).

Computers and the reading process

Using computers to investigate the psychological and physiological processes in reading is becoming commonplace, particularly in physiological research. However, the number of research studies presently available is limited. Most of the available research is listed in the references of this chapter, chapter 10, or the references in earlier editions of Computer Applications in Reading.

While the research may be limited, the psychological and physiological processes under investigation are quite diverse. The leader in microcomputer based research has been the Center for the Study of Reading at the University of Illinois. (For a complete list of the Center's Technical Reports and Reading Education Reports, write to the Center for the Study of Reading, 51 Gerty Drive, Champaign, Illinois 61820.)

The references in this chapter are divided into four sections: computer assisted instruction in reading, psychological and physiological research, reviews of reading research, and reading assessment. Readers interested in additional references on psychological and physiological processes in reading references that apply directly to legibility should consult chapter 10.

Computer assisted instruction in reading references

1970

Describes a study in which college students were pretested on attitudes toward CAI, then assigned either outside reading or 45 minutes of computer assisted instruction. Students had more positive attitudes toward CAI than outside reading, particularly if they had few errors during CAI instruction.

1972
Thompson, B. Effect of CAI on the language arts achievement of elementary school children Dissertation Abstracts International, 1972, 33 (8), 4077A.

Compares language arts achievement of 200 intermediate students, half of whom received daily CAI in word meaning, spelling, and general language usage. Achievement posttests at a lower level of abstraction (paragraph meaning and general language usage) showed significant gains as compared to spelling and word meaning posttests having a higher level of abstraction.
1973

Indicates that young adults spent more time at computer terminals than a comparable group spent with programed reading texts. Attitudes toward CAI reading were more positive than those of the group taught with programed texts. However, there were no significant differences in reading achievement between the two groups.

1974

Fitzgerald, B. *An analysis of computer assisted instruction in the reading program at Carl Hayden High School*. *Dissertation Abstracts International*, 1974, 35, 4069A.

1975

Describes how sixth graders were pretested on reading skills such as using a telephone directory and locating topics in an encyclopedia. Experimental group students then received CAI covering the reading skills and control group students received non-CAI instruction. Results favored the CAI group.

1976

Tells how undergraduate students studied Bloom's mastery learning strategy at the PLATO IV terminal. Some studied alone and some studied in groups of two, three, or four. Groups selected one of their number to respond by using the keyboard. There were no differences in achievement, but the pairs took more computer time than single students or groups of three or four. This time seemed to have been used for discussion of concepts presented.


Discusses CAI geography and history lessons that incorporated some aspects of tutorial/dialogue instruction.

1977

Describes a study of 121 third and fourth grade students who received computer assisted reading instruction in twenty or forty minute time periods. Suggests that total CAI time, session length, or session frequency do not affect posttest reading achievement scores.


Suggests the effectiveness of CAI as a practicable instructional technique in reading achievement. Followup studies indicated a positive correlation between achievement and CAI two years after the year of instruction.

1978


Studies the effect of delayed feedback on retention in computer assisted reading. One hundred twelve college students took a 30 minute, multiple choice, computer assisted test and received the correct answers either immediately after each item, at the end of the test, 24 hours later, or not at all. Delayed feedback was better than immediate feedback on comprehension performance.

1979

Bath Elementary School Staff. *Results of computer assisted instruction at Bath Elementary School*. 1979. (ED 195 245)

Describes a pilot project in which excellent gains in reading resulted from 20 minutes spent daily at the computer by 100 sixth graders. The displays appeared one letter at a time and seemed to speed up the slower readers.


Reports that “initial performance data from eight demonstration projects in adult basic education centers indicated that learners gained on the average one entire year in reading after less than 12 hours of instruction.” Dropout rates of only 5 percent were reported.

1980

Argento, B.J. *Alternative education models—preliminary findings of the Job Corps educational improvement effort*. 1980. (ED 206 868)

Provides a detailed treatment of the Job Corps Educational Improvement Effort targeting the basic education program. Discusses both traditional and innovative approaches, including a limited discussion of CAI and CMI and their places in an educational delivery system.


Describes use of the CDC PLATO Basic Skills Reading Program in Bexar County, Texas. The program made gains in math but not in reading. Suggested that reading materials were not adult enough and that tutors should work at terminals with tutees.


Reports positive cognitive and affective gains in teachers from a computer simulation of reading diagnosis.


Explains how research data from 88 third to eighth grade students receiving PLATO instruction in reading and math were used to predict overall changes in the rate of student learning, the effects of entry level variables, and the frequency of mastery learning test failure. Provides technical data.


Reports a study of 30 junior high school students that suggests CAI had a positive effect on reading achievement. In addition, CAI's impact may encourage attitudes of responsibility and realistic decision making in the learning process.


Describes an investigation of the relationship among CAI and school attendance, achievement, and library use. Data for 154 students suggest no significant correlation between reading achievement and CAI.

1981


Tells how programmed prose, a computer program for the PLATO IV terminal connected to ERL by phone line, generated Bormuth's passages for repeated reading and various cloze deletions. Students were tested on passages with a two choice maze activity for each deletion. Results were favorable for fluency, but not for other skills.


Poses two questions: How well did intermediate students achieve in a CAI curriculum and was their achievement predictable using Bloom's theory of school learning? Achievement data indicated Blacks and Hispanics experienced greater reading achievement gains than Whites, while Blacks exhibited more positive attitudes than either Whites or Hispanics. Indicates cognitive entry behavior as a factor in predicting later performance. Statistical data are used to explain achievement variation.

Kelly, H. *Simultaneous computer delivered audiovisual word cuing: Same vs. different target-related cues with two levels of cloze redundancy*. *Dissertation Abstracts International*, 1981, 42 (4), 1448A.

Consists of a technical report recommending visual cuing treatment for general practice in computer assisted instruction. In reading cloze tasks, data indicated the superiority of visual cuing to both audiovisual same word (AVS) and audiovisual different word (AVD) cues.

1982


Describes the PLATO Corrections Project, begun in 1975, which was designed to offer computer based instruction to adult correctional centers in
Illinois. Suggests that instructional formats in paraphrasing and finding information are effective, with evidence of retention over an extended period.


Describes a four year longitudinal study of students who received regular drill and practice instruction with materials prepared by the Educational Testing Service in one of four Computer Assisted Instruction (CAI) curricula: mathematics (grades 1-6); reading (grades 3-6); language arts (grades 3-6); and reading for comprehension (final year only). The focus was on how CAI drill and practice, which reinforced classroom work, helped the weaker students learn the basic skills.


Easterling, B. The effects of computer assisted instruction as a supplement to classroom instruction in reading comprehension and arithmetic. *Dissertation Abstracts International*, 1982, 43 (7), 2231 A.

Concludes that supplementary computer assisted instruction, used twice weekly in 15 minute sessions for 16 weeks, does not significantly improve total reading and math comprehension of fifth graders as measured by the California Achievement Test.

Edyburn, D. The effects of two levels of microcomputer graphics on reading comprehension. 1982 (ED 218 593)

Explains that computer graphics (TRS-80 color) "did not appear to increase the general reading comprehension of seventh graders on a programmed textual selection." Computer graphics did have a positive effect on attitude toward CAI. Reviews the literature on the relationship between comprehension and graphics.


Kester, D. Is microcomputer assisted basic skills instruction good for black, disadvantaged community college students from Watts and similar communities? 1982. (ED 219 111)

Investigates the effectiveness of CAI at Los Angeles Southwest College. Technical data suggest that students who received computer based supplementary basic skills instruction experienced significant gains in reading. Urges further research to determine CAI's effectiveness with particular student populations.


Describes the implementation of a computer assisted basic skills program at Cabrillo College, California. Includes a number of resources that might assist others in such a process.

Merritt, R. Achievement with and without computer-assisted instruction in the middle school. *Dissertation Abstracts International*, 1982, 44 (1), 344 A.

Describes a study designed to compare the differences in students receiving traditional instruction and computer assisted instruction. Variables surveyed...
include achievement, anxiety, self-concept, attitude toward teacher, and attitude toward school. Data indicated significant reading and mathematics achievement gains by the experimental groups, although only one of the four computer assisted groups gained significantly in the other variables.

Portland Public Schools. Evaluation report on three new instruction programs: Help one student to succeed, prescription learning, and computer assisted instruction. 1982. (ED 234 088)

Evaluates three instructional programs used by Portland Public Schools in 1981-1982 with Chapter I populations: HOSTS (Help One Student to Succeed), a person to person structured tutorial program; Prescription Learning, a multimedia management program using computer instruction, and CAI, targeting reading and mathematics. Provides detailed results profiling each program.

Weaver, P. Perceptual units training for improving analysis skills, 1982 (ED 219 739)

Describes a computer based training program designed to instruct students in the detection of a target multiletter unit as it appears in a series of stimulus words. Notes performance gains in this task and transfer to other tasks related to word recognition.

1983

Bright, G. Explaining the efficiency of computer assisted instruction. AEDS Journal. 1983, 16(3), 144-152

Discusses the CAI phenomenon—CAI versus control group research will result in findings that indicate slight achievement gains for the CAI group over control counterparts. Points to research evidence for the phenomenon’s existence. Also explains the implications of the phenomenon for CAI development.

Frederiksen, J. A componential approach to training reading skills. 1983 (ED 229 727)

Describes three computer systems that target key processing components involving word analysis and contextual understanding. Significant improvement was noted in the target skills, with evidence of transfer to related reading processes.


Tells how three computer games were used in this study for the training of component reading skills—Speed Game, Racer Game, and Ski Jump Game.


Looks at some PLATO and TICCIT education projects.

Hunter, S. The impact of the microcomputer labs, 1983 January to June, 1983 (ED 248 875)

Discusses two computer labs, one in a high school and the other in an elementary school.

Describes the effectiveness of CBI on cognitive and affective student outcomes.

Lundgren, C. An experimental study of the effects of two methods of teaching English grammar on achievement and attitudes. *Dissertation Abstracts International*, 1983, 44 (6), 1672A.

Compares effectiveness of programed text instruction and CAI in English grammar skills and attitudes toward subject matter. Results indicate programed instruction was more effective than CAI in grammar skills achievement, while no significant difference in attitudes was apparent between the two groups.


Summarizes a few of the more salient research efforts on CAI in reading and suggests that a knowledge of the history of CAI research can help teachers avoid many of today's CAI problems. Cites several examples of earlier CAI research.


Describes a study of 55 eleventh grade students that suggests traditional, programed, and computer assisted instruction are effective ways to teach usage of reference materials in high school. Also indicates that programed instruction produces more homogeneous performance results than the other methods used.


Tells how 101 LEP Iraqi-Chaldean middle school pupils participated in this exploratory study designed to measure the effectiveness of computer assisted language instruction. Significant gains in English language reading achievement were made by students receiving computer assisted and individualized instruction, when compared to pupils receiving traditional group instruction.

Ortmann, L. The effectiveness of supplementary computer-assisted instruction in reading at the 4-6 grade level. *Dissertation Abstracts International*, 1983, 45 (1), 140A.

Analyzes pre and posttest reading scores of 340 Chapter 1 pupils to determine the effectiveness of supplementary computer assisted instruction. Suggests this instructional mode may contribute to increased reading achievement for some students. In addition, research revealed ethnicity and sex are not reliable predictors of achievement in reading.

Pitts, M. *Monitoring: Longitudinal unobtrusive measurement with computers*. 1983. (ED 233 309)

Describes a project designed to measure the effectiveness of computer based comprehension strategies for passages with "embedded comprehension obstacles." Posttest results revealed no significant difference in scores of control and experimental groups, although those receiving CAI tended to use a wider variety of comprehension strategies.

Poplin, R., and Vinsonhaler, J. *Computer-based simulated cases as a tool for teaching reading diagnosis*. 1983. (ED 233 303)

Reports findings of study to determine the impact of CAI on students' reading achievement and attitudes toward reading; students' preferred mode of instruction; and responsiveness of CAI to students' intelligence levels. Based on research data, CAI and traditional methods seem equally effective with average students while below average students might benefit more from CAI.

Pulver, C. The effects of small group and computer assisted inference training programs on fifth-grade students' comprehension of implicit causal relationships. *Dissertation Abstracts International*, 1983, 44 (12), 3640A.

Suggests that both small group and computer assisted instruction aid fifth grade students in comprehension of implicitly stated causal relationships.


Researches effectiveness of CAI in identification of the main idea of expository passages. Explains interventions used with remedial reading students including strategy training and classification skills. Technical data recommend these techniques as being both effective and useful in reading instruction.

Taylor, V. Achievement effects on vocabulary, comprehension and total reading of college students enrolled in a developmental reading program using the drill and practice mode of computer assisted instruction. *Dissertation Abstracts International*, 1983, 44 (8), 2347-2348A.

Assess the effectiveness of traditional instruction and CAI in a developmental reading class for entry level college students. Control groups received traditional instruction only while experimental groups received a combination of computer assisted instruction and traditional instruction. Nelson-Denny Reading Test scores indicated that CAI groups rated higher in comprehension and total reading than did control students. In contrast, control students rated higher in vocabulary scores.

Turner, G. A comparison of computer assisted instruction and a programmed instructional booklet in teaching preselected phonics skills to preservice teachers *Dissertation Abstracts International*, 1983, 33 (8), 4077A.

Concludes that both computer assisted instruction and programmed instruction are effective techniques for improving phonics achievement of preservice teachers. Teacher attitudes associated with phonics instruction were more positively affected by CAI.


Reviews a computer program entitled READTIME, looking at three criteria: technological novelty, psychological design, and pedagogical importance. Discusses types of activities in READTIME—individual word games and various text reading formats.

1984

Summarizes study of 103 first grade students who received traditional as well as computer assisted reading instruction. Pretests and posttests in word analysis revealed no significant differences in achievement between the CAI and the control group.

Ashmore, T. Evaluating CAI material for the microcomputer. 1984. (ED 252 180)


Explains that seventh graders received a special critical thinking curriculum made up of the following software: Rocky's Boots, Inference and Prediction (teaching logical reasoning), Analogies, Word Analogies (teaching verbal analogies), Snooper Troops, Critical Reading (teaching inductive/deductive reasoning), and Problem Solving Strategies (teaching problem analysis). The curriculum appears to have had a positive impact on the development of critical thinking skills.

Bradley, V. Reading comprehension instruction in microcomputer reading programs. *Dissertation Abstracts International*, 1984, 44 (10), 3023A.

Reviews 38 reading comprehension lessons from Basic Learning Systems Tutorcourses, the Control Data Basic Reading Series, the Random House Tutorial Comprehension Series, and the Scott, Foresman Reading Skills Courseware Series, revealing that the Random House and BLS programs had the most comprehension instruction, while the Scott, Foresman program had the least. Surface features, including documentation and instructional design, were present in the four programs, with Scott, Foresman having significantly more features than the other three programs.

Bryg, V. The effect of computer-assisted instruction upon reading achievement with selected fourth-grade children. *Dissertation Abstracts International*, 1984, 45 (9), 2817A.

Compares the reading achievement levels of 132 fourth grade students who received either traditional or computer assisted reading instruction for a fifteen week period. Indicates significant gains made by the experimental group. Recommends matching appropriate software to reading curriculum objectives.


Cortez, M., and Hotard, S. Loss of achievement gains over summer vacation. 1984. (ED 251 495)

Focuses on summer vacation regression. May and September math and reading achievement scores for Chapter 1 remedial students receiving CAI indicated a half year regression in mathematics skills but observed no significant skill loss in reading. Suggests that reading comprehension techniques have more carryover compared to computational skills used in mathematics.

Cuppert, T. An analysis of community college reading programs since the passage of CLAST legislation in Florida. *Dissertation Abstracts International*, 1984, 45 (9), 2819A.

Examines the effects of the state mandated College Level Academic Skills Test on community college reading programs in Florida. Recommends a variety of strategies for increasing student reading achievement levels, including heightened use of computer assisted instruction.

Indicates the need for correlating instructional patterns with student learning styles and aptitudes. Technical data showed those students who learned best through CAI were concerned with abstractions rather than concreteness and were more oriented to objects or things, with less orientation to people.

Ewing, R. Computer-assisted Chapter 1 instruction. *Dissertation Abstracts International,* 1984, 45 (7), 1934A.

Tells how 257 low achieving Chapter 1 sixth grade students received supplemental CAI in reading and language arts. An equal number of moderate and high achieving students received similar instruction without CAI. Results indicate gains for the CAI group as compared to the predicted gains for the non-CAI group.

Fiedorowicz, C. Component reading skills training with different types of reading disabilities. *Dissertation Abstracts International,* 1984, 44 (9), 2921B.

Describes a study involving reading disabled students who received computer assisted training in their skill deficit. Emphasis on accuracy and speed in letter, syllable, and word recognition. Concludes CAI is effective in reading skill improvement and training can transfer to other achievement measures.

Glidden, W. *The Coast Guard’s CAI approach to basic math and reading skills.* 1984. (ED 249 365)

Explains that with the philosophy that career opportunities could be provided for all recruits, the Coast Guard developed BEEP (Basic Educational Enrichment Program). Designed to provide remediation, this program uses PLATO’s basic skills curriculum integrated with Navy developed conventional materials. Thus, far, BEEP graduates have demonstrated significant increases on the Armed Services Vocational Aptitude Battery (ASVAB) verbal and arithmetic sections.


Describes a program in which fourth and fifth graders completed the drill and practice curriculum of Computer Curriculum Corporation (ccc) covering reading and language arts—grades three to six. Among other things, the researchers investigated the effects of CAI on students’ attitudes; many of the students were “disadvantaged.” Selected results indicate that “two years participation in CAI by educationally disadvantaged students was associated with greater levels of attributing their success internally and viewing themselves as good readers who do well in school.” Includes other results about CAI reading and CAI math results.


Focuses on the requisite conditions for successful computer use in Malaysia’s teacher education program. English comprehension skills, mathematics skills, and spatial abilities are significant predictors of success for those who might use PILOT and LOGO languages.
Hoffman, J. Reading achievement and attitude toward reading of elementary stu-
dents receiving supplementary computer assisted instruction compared with stu-
dents receiving supplementary traditional instruction. Dissertation Abstracts
International, 1984, 45 (7), 2050A.

Provides conclusions based on pre and posttests: gender contributed to stu-
dent attitude toward reading; CAI was more effective with males, while tradi-
tional supplementary vocabulary and comprehension instruction was more
effective for females; both traditional and computer assisted instruction were
effective in supplemental vocabulary and comprehension instruction; males
receiving supplemental CAI in vocabulary and comprehension performed
significantly better than males receiving supplemental traditional instruc-
tion; and females receiving supplemental traditional instruction achieved sta-
tistically significant gains.

Leton, D., and Pertz, D. The use of computer-automated reading in reading in-

Describes a program in which beginning level reading books were used to
generate teacher produced, computer based reading programs. Twenty first
and second grade compensatory education students received reading instruc-
tion via traditional or experimental format. Notes significant gains made by
the second grade experimental group. Explores the school psychologist's
role in assisting with CAI.


Claims that of the four interventions presented, peer and adult tutoring is the
most cost effective approach for improving mathematics and reading perfor-
mances by elementary students. Least cost effective interventions include
reducing class size and increasing the school day's length. Computer related
costs place this instructional approach second to cross age tutoring in cost
effectiveness.

Levin, H., Glass, G., and Meister, G. Cost-effectiveness of four educational inter-
ventions. Project Report No. 84-A11. Stanford, CA: Stanford University,

Explains that four methods of educational intervention were used to improve
reading performance in the most cost effective manner: reducing class size,
increasing length of the school day, computer assisted instruction, and peer
and adult tutoring. Adult tutoring was the most effective means of improving
reading performance, but also the most expensive. The least costly method
was peer tutoring, followed by CAI.

Levy, C. A comparative study of the reading achievement of pupils exposed to com-
puter-assisted reading instruction, prescriptive reading instruction, and tradi-
tional reading instruction. Dissertation Abstracts International, 1984, 44 (10),
2970A.

Compares reading achievement of 300 randomly selected elementary stu-
dents who received CAI, traditional reading instruction, and prescriptive
reading instruction. Suggests traditional methods are more efficient in in-
creasing total reading and vocabulary scores of fourth and fifth grade stu-
dents, while traditional and computer assisted methods are more efficient for
increasing reading comprehension scores. Includes technical data.

Provides results of a study to determine the effectiveness of IBM's Writing to Read system. Data revealed strong positive reaction to the program by both teachers and parents, that kindergartners and first graders developed skill at independent sentence writing, and that kindergartners performed well on standardized reading tests.


Attempts to determine the impact of CAI on traditional reading and mathematics instruction. Students received either direct computer assisted reading and mathematics instruction, computer experience, or no computer instruction. While math posttest scores showed significant improvement for computer groups, data suggested the need for further research in determining the effectiveness of computer assisted instruction.


Describes effective drill and practice strategies with reference to reading skills instruction.

Moskowitz, C. Reading teachers' reactions to a field test of a computer assisted instruction reading program in a microcomputer laboratory setting in a middle school. *Dissertation Abstracts International*, 1984, 45 (10), 3118A.

Uses interviews, questionnaires, and observations to determine teachers' perceptions of microcomputer assisted instruction in a developmental reading program. Reactions attest to the computer's versatility in instruction and management, as well as indicating a need for heightened awareness of teachers' new role as coinstructors with the computer.


Provides a thorough treatment of system costs for CAI implementation. Concludes "CAI can be viewed more in terms of an investment yielding real returns."

Roth, S., and Beck, I. Research and instructional issues related to the enhancement of children's decoding skills through a microcomputer program. 1984. (ED 248 461)

Examines the software program Construct a Word, which emphasizes decoding and word recognition skills. Discussion includes theory and research behind the program, instructional goals, program components, and field test results.

Sedlacek, C. A study comparing achievement and attitude differences in fifth-grade remedial reading students taught using computer-assisted instruction and conventional management programs. *Dissertation Abstracts International*, 1984, 45 (7), 1980A.

Explains that three groups of fifth grade students received reading instruction using CAI or a traditional format for twelve weeks. All groups made significant increases in vocabulary, comprehension, and attitude. However, the increase did not result in significant differences between the groups.

Describes a computer based reading program for freshman biology students at Bunker Hill Community College in Massachusetts. Possible areas of weakness in the content area were revealed by a pretest. Remediation occurred via the computer. A posttest signaled mastery or the need for further study. Significant improvements in comprehension and understanding were noted in students receiving CAI.


Contains valuable information for anyone interested in designing good drill and practice software, including reading and language arts software.


Tells how CAI in reading and language arts was used in a summer remedial program. Results were positive in both achievement and attitude.


Reports results of a study involving 300 fourth graders demonstrating the effectiveness of CAI in math and suggesting the need for further research in determining the computer's role in reading instruction. Indicates CAI did not produce significant correlation between achievement and the elements of student selected learning style.


Tells how eighth grade students received instruction in library media skills via lecture, independent reading, or computer based courseware. Statistical analysis revealed CAI and lecture produced identical student reading achievement, surpassing those results gained through independent reading.

1985


Tells how low achieving seventh graders learned vocabulary words in computer versus direct instruction treatments. The computer group did not outperform the direct instruction group on vocabulary measures.

Copperman, K. An experimental study to compare the effectiveness of a regular classroom reading program with a computer-assisted instruction program in reading comprehension skills in grades two through four. *Dissertation Abstracts International*, 1985, 46 (5), 1234A.

Finds no significant difference between student performance on reading measures in CAI reading instruction versus normal classroom reading instruction procedures.


Explains that WICAT Systems hardware and software were selected for use in the Garland, Texas, Independent School District. WICAT uses a minicompu-
ter that drives 30 terminals. Discusses the first year the school district used the WICAT materials. In reading, elementary students used the computers twice a week for 20 minutes a day. After a year, ITBS reading scores increased 9 percent in grade three and 6 percent in grade five.


Describes how high school students in two studies used researcher developed materials to learn about study skills (CAI Study Skills Modules). The materials covered time management, memory improvement, note taking, textbook reading, examination taking, report writing, oral reporting, scholastic motivation, interpersonal relationships, and improvement of concentration. In the CAI portion of the study skills instruction, the computer presented the text. Both studies showed that researcher developed materials improved students' knowledge of study skills as presented in the modules.


Describes the Job Corps Comprehensive Computer program. The program uses mostly PLATO software in reading and math remedial efforts with eighteen year olds reading at the sixth grade level. Initial results at one site indicate that the computer program enhanced achievement by as much as one reading grade level, as opposed to noncomputer remediation. Reviews previous CAI research with educationally/economically disadvantaged students.

Levy, M. An evaluation of computer assisted instruction upon the achievement of fifth grade students as measured by standardized tests. *Dissertation Abstracts International,* 1985, 46 (4), 860A.

Explains that CAI is an effective means of teaching reading to fifth graders. Students in the CAI groups spent more time on task than students in non-CAI groups.

Reed, S Effect of computer graphics on improving estimates to algebra word problems. *Journal of Educational Psychology,* 1985, 77 (3), 285-298

Computer based simulations were used to improve learning in algebra word problems involving average speed, volume, and mixture. The researcher found that the level of complexity of the simulation had an effect on learning. In particular, learning by coaching simulations were best, followed by learning by doing and learning by viewing. Includes other possible applications of simulations to text comprehension.


Investigates the effects of computer mediated text on comprehension processes using expository text with fifth and sixth grade students. The computer based manipulation schemes involved reading text on-line and providing definitions of key words, simpler versions of a text, background information, and main ideas. Teachers supplied the definitions, main ideas, background information, and simpler versions of the texts. The computer delivered the teachers' information to the students upon request. Authors found that "computer mediated text can influence reading comprehension."

Computers in teaching reading and reading assessment research 87

Describes three studies involving university students, finding that student performance is positively affected by questions and highlights in CAI modules; student mastery is heightened when questions address specific concepts; while questions seem more productive, highlighting is preferred over questioning and appears to produce higher motivation; and questions and highlighting are more effective when they occur on a separate screen from the information.


Tells how first graders were taught sight words with and without a computer. The students who followed normal classroom procedures learned more words than the students using the computer.


Tells how eleventh graders studied social science/psychology content through interrogative statements requiring answers. Learning time means "wait time," how long the student was permitted to wait before selecting an answer to a question or having an answer/example provided. Content sequence means whether review/reinforcement included interrogative statements previously identified correctly or incorrectly. Concludes that, for immediate or delayed recall, learning time and content sequence are important variables.


Describes how researchers used drill and practice phonics software (The Reading Machine) to determine if the instruction led to gains over noncomputer groups. First graders in the experimental group used the software 45 minutes a week along with the Addison-Wesley Basal Reading Program. Control groups followed the phonics instruction in the Basal. Results indicated a one-third standard deviation increase for the experimental group over the control group in phonics knowledge.


Describes three experiments designed to test the appropriateness of microcomputers as aids to learning and studying. Finds that computer based underlining activities and a computer generated lexicon made available during a test can help to curb the deterioration of information; that the subjects' performance (both immediate and delayed recall) was influenced positively by the extent to which the passage contained redundant information; and that although the subjects using computers clearly outperformed the noncomputer using group, the cloze procedure seemed to be less useful than the other study procedures in aiding college age subjects to recall expository factual prose.

Case studies of microcomputer applications in an elementary school bilingual classroom, secondary special education classroom, and adult literacy classroom. All classrooms used reading and language arts software for instruction and practice. A discussion of the findings focused on problems related to software, teachers, and students.


Finds no difference in performance outcomes between using a tutor or a microcomputer equipped with a speech synthesizer to teach words


Explains that computer assisted cooperative instruction (using a simulation entitled Geography Search) was superior, in quality and quantity of student performance, to computer assisted competitive and individual instruction.

**Psychological and physiological research references**

1970

Leton, D. *Computer program to convert word orthography to phoneme equivalents*. 1970. (ED 038 266)

Describes computer simulation of reading skill acquisition. The research aim was to convert orthography of English words to phoneme equivalents for computer programming. The conversion was done at the preprimer and primer levels of the Lippincott basal readers.

1972


Describes a computer program that comprehends printed text by comparing it to a memory bank of stored factual semantic information.

1973


Describes computer analysis of electrically recorded eye movements during reading.


Describes SIMUREAD, a computer program designed to aid in reading research.

Describes computer processed word lists that might be used to supplement or replace other word lists.

1975

Behavior Research Laboratory, Washington University, St. Louis. *Visual search activity: A tool for the evaluation and development of computer assisted reading instructional programs*. 1975. (ED 112 362)

Describes how eye movements of readers using the plasma panel of the PLATO terminal were analyzed by computer. Competent readers made fewer saccadic movements per line and had shorter fixation times. When reading for detail, competent readers changed only by increasing their fixation times. Less competent readers made more fixations when reading for detail.


Claims that good readers made longer fixation pauses when reading to generalize than when reading for detail. Poor readers did not.


Tells how the author replaced letters in the visual periphery with Xs and found that little information is gained from peripheral vision.

1976


Explains that computer recordings of word by word reading times showed prolonged pauses at phrase boundaries for subjects reading for delayed recall, but not for subjects reading for immediate recall.


Reports on an experimental program that uses the video presentation of printed syllables simultaneously with an oral presentation of the syllables. Suggests applications.


Tells how, using computer controlled text displays, the authors found visual information to be derived from no more than four letter positions to the left of the fixation during reading by high school students. However, the students derived information from more than four letter positions to the right of the fixation.

1977


Finds that the fixations for main verbs are longer than for other words in the sentences.
1978

1979
Reynolds, R., Standiford, S., and Anderson, R. Distribution of reading time when questions are asked about a restricted category of text information. *Journal of Educational Psychology*, 1979, 71 (2), 183-190.

1980

1981

Computers in teaching reading and reading assessment research


Finds that most of the visual information required for reading is acquired during the first 50 milliseconds of a fixation.

1982

Blohm, P. I use the computer to ADVANCE advances in comprehension-strategy research. 1982. (ED 216 330)


Discusses the role of plan recognition and generation in relation to artificial intelligence.


Discusses the advantages of microcomputer-administered research.


Suggests that computer controlled text manipulation with simultaneous recording of eye movements may enable reading diagnosticians to determine whether specific reading skills are developing normally and, if not, what deviations may need remediation.


Discusses ten features of media selection models, including display formats, learner characteristics, settings, and task demands.


Focuses on research involving dynamic books. Dynamic books provide “electronic transformation of information that could potentially offer multiple paths through complex information and help us actively in searching.” A prototype dynamic book was tested with students with favorable results.

1983


Investigates the impact of computer displayed text and traditional printed text on student performance. Examines the effects of chunking (breaking text into meaning units), which seems to contribute to improved reading rate and comprehension. Suggests the display device makes no difference in student performance.

Reports two studies, one with college students and the other with sixth graders, on the effect of all capital versus mixed capital print on reading rate and accuracy. Results indicated that college students read mixed print significantly faster, but all capitals more accurately. However, for sixth graders, the type of print did not affect rate or accuracy.


Describes project where essential word attack skills were identified through a computer program designed to recognize and tally English word syllables. Indicates the cruciality of word attack skill instruction for children.


1984

Glock, M. *Understanding picture-text instruction*. 1984. (ED 241 911)

Explores how procedural information is perceived, understood, and acted upon. By combining a computer based delivery system with “hypertext” (user receives additional information with a touch of the screen), errors in processing were reduced dramatically.


Examines the impact of graphic design and layout on computer displayed text legibility.


Discusses the computer's role in accessing sensory, short term, and long term memory. Includes distinct features and outcomes of computer based interactive video (CCBV).


Considers the impact of computer displayed text on learners' attention, retention, and response accuracy. Viewer fatigue is noted after prolonged reading periods using the CRT. Additional studies investigate effects of text density, scrolling (movement of text across the screen), letter size, uppercase versus lowercase letters, and graphic displays.


Investigates effects of LCD (line only text) versus CRT (multiple line text) formats. Reading was not a problem with either, but the author suggests that the reason for reading could influence performance with LCDs.

1985


Compares reading on a CRT using a forty column display versus reading text on paper. Reading times were almost identical for CRT versus paper, and comprehension appeared unaffected.
Gould, J. Reading is slower from CRT displays than from paper: Some experiments that fail to explain why. Yorktown Heights, NY: IBM Research Center, 1985.
Suggests some reasons why CRT based reading is slower than non-CRT based reading.
Finds that fifth graders did not have significant comprehension performance differences when reading "typed" text, "tachistoscopic" (with computer display) presented text, or "film" presented text.
Thompson, M. Beyond the computer: Reading as a process of intellectual development. Computers, Reading and Language Arts, 1985, 2 (2), 13-15, 43.
Speculates on the consequences and contributions of computers in the study of the reading process.
Describes a program that permits investigators (using an IBM PC with light pen and real time clock) to analyze many features of how people study text passages.

Reviews of reading research references

1980
Reviews computers for reading instruction and modes of CAI: drill and practice, tutorial, problem solving, games, and simulations. Describes several CAI systems and reviews CAI effectiveness research.

1982
Addresses several questions about computer assisted instruction in classroom settings: achievement outcomes, affective/motivational outcomes, social outcomes, what the research can't say, and what the research should say.

1983
Reviews recent studies on how computers can help students learn.
Argues that reviews of research (including computer applications) indicate that various forms of media do not influence learning under any conditions. Should interest reading educators concerned with the variables surrounding uses of computers in education.
Says that CAI appears to have the most chance of being effective in reading and language arts when it is used with specific types of students, is fully integrated into the classroom curriculum, and is used in a proper setting with appropriate scheduling.


Reviews over fifty major CBI projects in education.


Summarizes major CBI research projects (1959-1982), including several reading research projects.


Explains that, in military training, including reading to understand technical content, computer assisted drill and practice instruction has been unable to demonstrate superior gains in achievement over noncomputer groups. However, CAI appears to have been a cheaper way to provide drill and practice activities.

Zuberman, L. The foundation and development of computer assisted instruction in the field of reading from its inception to the present. 1983. (ED 252 183)

Reviews seventeen research studies and four surveys in seeking answers to common computer based reading questions.

1984


Reviews seven reading and research journals for a fourteen year period, then notes major computer related issues, including motivation, CMI, student performance, and individualized instruction. Suggests a "dearth of empirical information" concerning the degree to which computers can significantly affect the instructional delivery system.

Thompson, R. Computer assisted reading instruction research. 1984. (ED 243 091)

Offers five implications of CAI for teaching: computers can be useful in computer assisted reading instruction; CAI will not replace the teacher, but will assist in performing teacher instructional tasks; CAI can affect reading achievement as much as teacher directed instruction; poorly designed CAI can have the same negative effects as lacklustre teacher prepared lessons; and with widespread computer use in education, computers are no longer just for experts—classroom teachers must be involved.

Tolman, M., and Allred, R. The computer and education. What research says to the teacher. 1984. (ED 252 173)

Focuses on the computer's impact in education and the opportunities offered by its use. Explores classroom applications (CAI, CMI, testing/recordkeeping, instructional games) and curricular applications (social studies, language arts, mathematics, science). Includes the computer as a motivational tool and shows positive effects of CAI with exceptional students.

Zuberman, L. On reading and CAI: A review. 1984. (ED 252 183)
1985

Provides a two part text on research in computer based education. The first part reviews premetaanalysis and metaanalysis of research studies. Recommendations for future research are included. The second part of the text includes the reference lists for each of the studies reviewed and the references used by the author in text comments.

1986
Reviews the research on the problems that plagued TV based learning studies and discusses how to avoid similar problems with computer based learning studies.

**Reading assessment references**

1967

1969

1972

1974

1977
1978


Describes a minicomputer program that creates tests.


1979


Describes a minicomputer program that helps teachers create reading tests.

1980


1981


1982
Finds favorable test results between paper and pencil versus computer delivery.

1983

1984
Schloss, P., Schloss, C., and Cartwright, G. Location of questions and highlights in the same page or a following page as a variable in computer assisted instruction. *AEDS Journal,* 1984, 11, 113-122.

1985

107

Computer applications in reading


1986

Describes the CARA diagnostic program, which asks questions about variables related to reading performance (e.g., language background, attendance) of a student. The program presents conclusions based on the information gathered through the diagnostic questions.

Both reading and writing involve the manipulation of text, and both involve the sharing of meaning. Any analysis of the processes responsible for reading and writing reveal some interplay between the two language activities, despite the fact that reading is considered a receptive activity and writing a productive activity. One cannot write without reading what is written. Clearly, attitudes and achievements in writing are shaped by reading, and reading attitudes and achievements are shaped by writing. As James Squire so aptly pointed out in the Ginn Occasional Papers #1 (Ginn, P.O. Box 2649, Columbus, Ohio 43216) “How can a seventh grader be expected to write a research report if he has never read one? Can a fifth grade child write an interview, a business letter, or a diary if he is not sufficiently familiar with the particular genre to understand the particular ways in which it requires language to be used?”

The interaction of reading and writing explains why reading teachers of the eighties are devoting more of their time to teaching writing. Such instruction offers the promise of increased comprehension ability through increased attention to wording and the structure of compositions.

The role of word processing programs

Using the word processor for reading and writing instruction can result in fresh insights for both students and teachers, and fresh insights seem necessary. The American National Assessment of Educational Progress (The Writing Report Card) reported that students in the United States are not mastering the writing skills necessary for describing, reporting, interpreting, or analyzing facts and events. Some might even say that the writing skills of students in most countries of the world are in danger of extinction or, perhaps more optimistically, that today’s students are taking advantage of more nonwriting opportunities to communicate.
It is possible that technology, in the form of telephone and television, is to blame for much of the decline in our children's writing and reading skills. Stephen J. Gould commented (New York Review of Books, February 27, 1986) that the telephone is the greatest single enemy of scholarship; for what our intellectual forebears used to inscribe in ink now goes once over a wire into permanent oblivion. On the other hand, it is possible that technology, in the form of word processing, videotext, and teletext communication, will also encourage and improve the reading and writing of our students.

A caveat does seem warranted. Technology alone will not improve our situation. Improved communication skills, whether in reading or writing, still require teachers with good communication skills and motivated students. Access to a word processor does not necessarily produce a good writer or reader. Educators concerned with computer applications in reading should learn how to use word processors in teaching writing and reading.

The research articles, the testimonials, the treatises, and the editorial comments listed or annotated in this chapter support the following advantages and disadvantages for the use of word processing in reading, writing, and language arts instruction.

Advantages
1. Students can quickly write their ideas on paper.
2. Students can easily edit their written ideas, moving and saving bits of information.
3. Students can see how a text would look as a finished product and easily change formats.
4. Students can increase collaborative writing efforts.
5. Students can increase their tolerance (physically and psychologically) for errors and writing problems.
6. Students can be encouraged and motivated to write more.
7. Students can keep copies of their writing activities on disk. In addition, teachers and schools can keep a permanent record on disk of a student's writing progress through the grades.
8. Students with penmanship problems can be encouraged to write, and their writing can be read by others.
9. Students can be encouraged to expand their computer literacy beyond word processing.
10. Students can be encouraged to do writing beyond what is assigned in school.
11. Publishers are putting more instruction in programs through on screen help, such as spelling checkers and outliners.
Disadvantages
1. Students must have access to many computers or many opportunities to use a few computers. Unfortunately, computers, word processing software, and printers cost more than pencils and paper.
2. Students must learn how to type using a computer keyboard (although, to some, keyboarding is relatively insignificant in terms of the overall writing process).
3. Students must learn how to use a word processor, which may be a difficult and time consuming task for some. Unfortunately, students who learn one word processor often prefer to use that one despite attempts at change.
4. Students will need to learn how to use a printer.
5. Students will probably need to learn special word processing programs that can provide help during prewriting, writing, and rewriting activities (i.e., on-line dictionaries, outline processors).
6. Students must learn that word processing programs cannot meet all their writing needs.

Teachers working with word processors and reading may find three recent journals of interest: *Research in Word Processing Newsletter* (South Dakota School of Mines and Technology, Rapid City, South Dakota 57701; *ACE Newsletter* (Jack Jobst, Humanities Department, Michigan Technological University, Houghton, Michigan 49931); and *Journal of Technical Writing and Communication* (Baywood Publishing, 120 Marine Street, Farmington, New York 11735).

Chapter five contains word processing references as well as references related to interactive fiction and literature, computer assisted composition, and the word processing-reading connection.

References
1975

1980

Describes and lists a program to generate descriptions of aliens—sort of a story starter for young science fiction writers.

1981

Cites Xerox Research Center research on the use of word processors.
Reviews and criticizes interactive fiction because of limited vocabulary and small choice of outcomes.

Describes the College Expository Writing Program that is providing remedial basic skill instruction at the University of Colorado, Boulder.

Discusses interactive fiction and calls it "dialogue adventure."

**1982**

Lists and gives sample runs of two poetry programs, POET and BARD, which date back to the 1960s and 1970s.


Arms, V. *The computer kids and composition*. 1982. (ED 217 489)
Describes a program of computer based technical writing instruction at Drexel University. Engineering students use the word processor for weekly assignments, research projects, proposals, and final reports. Positive attitudes toward writing, via the word processor, have been noted among students.


Features discussions on how computers can improve students' writing through the generation of ideas, electronic mail, text analysis, and word processing. In addition, describes two exploratory studies that investigated LEAS with first graders and sentence combining with sixth graders. Concludes with a list of nine desirable features of word processors for improving writing skills.

Cronnell, B. *Computer-based practice in editing*. 1982. (ED 220 869)
Describes procedures for CAI in text editing. After students review rules of capitalization, spelling, usage, and punctuation, they receive practice in choice (correct rule application); correction (sample sentences depict rule being studied); and dictation (oral presentation of sentence, with student entering the sentence on the computer). With feedback on each section, students can progress at their own pace or receive individual help.

Reports on the state of word processing for classroom use in 1982 and provides historical perspective on the subject of early word processing in schools. Discussions range from issues surrounding computers and writing to the drawbacks of word processing.

Describes a computer assisted writing component for middle school students. Enumerates activities (programming, word processing, text editing) used to "stimulate vigorously the systematic language and attitudinal growth of children."
Humes, A. Computer instruction on sentence combining. 1982. (ED 239 580)
Kelly, T., and Anandam, K. Teaching writing with the computer as helper. 1982. (ED 214 583)
   Discusses the state of the art in CAI, CAI in prewriting activities, the composing process and CAI, and selection of courseware. Includes summaries of courseware demonstrations.
Martin, M., and Trombino, J. What a word web we can weave, when we practice... “Spider” - an idea spinning program. Classroom Computer News, 1982, 2 (5), 45-47.
   Describes and lists a program for simulating and then editing and printing creative writing.
   Explores the history and current developments in computer assisted literature and provides computer generated poetry and narrative prose.
Nancarrow, P. Integrating word processors into a freshman composition curriculum. Unpublished manuscript, University of Minnesota, 1982.
Wresch, W. Prewriting, writing, and editing by computer. 1982. (ED 213 045)
   Describes four recently developed computer programs to assist students in the writing process. The prewriting phase uses a series of questions intended to help the student think in depth about the subject. In the writing phase, CAI demonstrates how preliminary information can be structured into a composition. Text editing is facilitated by a program that searches out key facts and courseware that evaluates sentence length, word choice, and grammatical structure.

1983
Arms, V. The computer and the process of composition. Pipeline, 1983, 8, 16-18.

Bruce, B., and Rubin, A. What are we learning with QUILL? In M. Kamil and R. Leslie (Eds.), *Perspectives on computers and instruction for reading and writing*. Rochester, NY: National Reading Conference, 1983.


Suggests the word processor did not significantly affect the final outcome of revision. However, the correction process seemed quicker and more comprehensive.


Claims microcomputers and their accompanying programs can help young students learn to read and write and can improve the reading and writing skills of older students. Points out that computers can function as an information retrieval system, interactive text, automated dictionary, writing coach, text editor, editorial assistant, message system, and publication system.


Explores how computers can produce greater flexibility in the composing process by freeing writers from fundamental tasks such as information storage and retrieval, spelling corrections, recopying, and text editing.


Describes how one teacher used a word processor in a junior high school English classroom.


Discusses the word processor's effectiveness in assisting students with limited writing skills. In a writing project with ten hearing impaired teenagers, it was found that students were quick to learn word processing skills and were positive about the learning experience. Offers suggestions for implementation of computer assisted remedial instruction in writing.


A thoughtful critique of computer based composition instruction that maintains software that criticizes and corrects student writing (e.g., EPISTLE, Writer's Workbench) leaves much to be desired for classroom applications.
Hocking, J. *The impact of microcomputers on composition students.* 1983. (ED 229 791)


Kane, J. *Computers for composing.* 1983. (ED 230 978)


Describes a project using BASIC, in which gifted fifth grade students composed original stories to share with classmates. Both student programmers and those reading the finished products were enthusiastic about the project. Also notes improved writing skills and the stories' high interest levels.


Discusses Writer's Assistant, a program for enhancing students' writing skills.


Discusses an experiment using word processors with the text invisible as the writer composes. Results were favorable.


Focuses on the word processor's benefits in facilitating the mechanical process of writing. Offers suggestions for implementing CAI in the writing classroom.


Evaluation criteria for word processing programs should address compatibility with existing hardware and students' needs; ease of use, with clear easy to understand directions and documentation; quality of visual display, noting line length, spacing, letter size; and opportunity for preview by both teacher and student. Provides a three page evaluation form.


Explains that word processing for composition instruction should work in most classrooms, discusses why, and offers several references to support the optimism.
Claims that three methods of organization may help students tighten their writing via the word processor. Discusses computer capabilities of outlining, prompting (checking for coherence), and abstracting (highlighting topic or thesis sentences).


Strickland, J. *The computer as a tool for the invention stage of writing*. 1983. (ED 236 693)


Reviews research on computers and writing and suggests what computerized writing instruction should include: a component to ease the mechanics of revision, a means of more quickly recording thought flow, a memory to hold the writing, a mechanism for sharing writing, a means to reduce writing apprehension, an editing ability, a prewriting program to stimulate thought, and on-line aids during writing and revision.


1984


Points out the word processor's effectiveness in student writing assignments. Ease in making corrections plus displayed and printed text are noted as instructional features.


Discusses the effects of using a word processing program (QUILL) on classroom social organization as well as individual development of literacy skills.


Elias, R. *Will computers liberate the comp drudge?* 1984. (ED 241 954)


Provides suggestions for using word processors, including writing, editing, formatting, and filing tips.


Provides a short review of Story Tree, Story Maker, and Compupoem, programs that help students develop expressive, expository, and persuasive writing techniques.


Compares ten positive conclusions to ten negative conclusions for supporting the use of word processors in the classroom.


Discusses an integrated writing, grammar, and spelling program that helps students become better writers. The EDITOR program operates as a writing tutor focusing on the details of writing (phrasing, grammar, punctuation). Provides a description of EDITOR and how it operates.


Provides a compendium of what to look for in a word processor for classroom use. Also includes a comparative listing of the features of thirty-five word processors.


Leggett, S. “They laughed when I sat down at the piano...” or learning to write made easier by using the word processor. In S. Leggett (Ed.), *Microcomputers go to school*. Chicago: Teach'em, Inc., 1984.


Madigan, C. *The tools that shape vs. composing by hand vs. composing by machine*. *English Education*, 1984, 16 (3), 143-150.

Mason, G. *The word processor and teaching reading*. *The Reading Teacher*, 1984, 37 (6), 552-553.

Explains that word processing can help reading instruction by promoting writing and hence creative writing as well as editing. Provides brief discussions on ways the computer can help editing and creative writing as well as writing in other areas.


Reports on using the computer to help children take control of their own literacy training through writing. Discusses fifteen references that could help teachers who want to integrate computers into their classrooms and schools for literacy training through writing.

Reviews an innovative language arts program entitled The Puzzler. Discusses the advantages of the program, which includes as a goal the emphasis of meaning rather than decoding. According to its developers, The Puzzler is designed to support comprehension instruction on predicting, confirming, and integrating. Also discusses some of the benefits of word processing and mentions a brainstorming program called The Write Idea.


Claims that a great deal can be learned from watching young children's and adults' first attempts at using a word processor. Recounts experiences with both groups.


Tells how word processing can help liven up classroom writing assignments.


Describes pitfalls to the use of computer assisted composition in teaching or enhancing writing skills. Discusses a few drawbacks of a computer assisted composition program called Text Analysis.


Explains that student reactions to word processing are important elements in its classroom success and discusses how some sixth graders reacted to word processing.


Describes one month in a first grade classroom using Story Writer, a word processor under development for use with first graders. Includes examples of student writing.


Compiles ten attributes to be considered when selecting a word processor for children. Suggests strategies for introducing the word processor into the curriculum.


Describes research in which above average and below average students were combined in pairs for word processing activities involving Apple Writer. Students participated in sentence combining lessons and exercises for 45 minutes, twice weekly for eight weeks. The research reports no gains on posttests but does suggest that word processing can be used successfully to teach sentence combining in upper elementary grades.


Explains how an eighth grade language arts class produced a newspaper using a word processor.


Provides strategies for researching and writing a term paper. Compares using the word processor and the typewriter.


Discusses the problems and potentials of computer based writing programs.


Discusses QUILL, a microcomputer word processing program designed to teach writing.


Describes the experiences of six and seven year olds using Bank Street Writer.


Describes word processing's potential for assisting individual writing skills. Discusses instructional reading activities (cloze procedures, readability evaluation, speech synthesizers, touch sensitive screens) and their effectiveness with the adult disabled reader.

Willer, A. Creative writing with computers: What do elementary students have to say? *Computers, Reading and Language Arts*, 1984, 2 (1), 39-42.

Summarizes eight sixth grade students' opinions of word processors after a ten day period of use. Group consensus was overwhelmingly positive for computer assisted writing.

Wolff, F. Word processing is a tool for comprehension. *The Reading Teacher*, 1984, 37 (8), 799.

Word processing can be used with upper elementary students for sharing and revising written work as well as clarifying and defending what was written.


Contains thirteen chapters related to computer based composition programs.


Describes Writer's Helper, a word processing program to enhance the pre-writing, writing, and editing process.

1985


Describes QUILL, a commercial program that serves as an information storage and retrieval system, an electronic mailbox, and a writing planner. Relates the experiences of students in Hartford using QUILL during Black History Week.

Tells how word processing with remedial language arts high school students led to improved quality and quantity of written work as well as better group participation in writing assignments.


Features sections on how and where computers fit in a writing program; how to begin using word processors; and using word processors in prewriting, writing, and editing.


Discusses Story Tree and Adventure writer.


Daiute, C. Writing and computers. Reading, MA: Addison-Wesley, 1985


Duin, A. Computer literacy: The impact of the information age on education. Forum in Reading and Language Education, 1985, 1 (2), 1-25

Comments on computer literacy and its impact on society and education. Discusses computers, composition instruction, and research that appears to be one of the first comprehensive reviews of both the positive and negative aspects of using word processing to teach writing.


Advises that simplistic word processing programs may lack features that students use as they acquire more sophisticated skills. Evaluates Bank Street Writer, Cut and Paste, Homeword, Apple Works, Apple IIe, and Screen Writer.


Hutson, B., and Thompson, D. Moving language around on the word processor: Cognitive operations upon language. Quarterly Newsletter of the Laboratory of Comparative Human Cognition, 1985, 2 (7), 57-64

Describes a project involving groups of college students learning to write with word processors using WordStar, Grammatik, and Spellguard.


Presents a few simple basic programs needed for students to write sentences without using a word processor. Includes a Texas Instruments Extended Basic program on verbal analogies.

McNinch, G., and Hall, G. The word processor in the reading learning center. Computers, Reading and Language Arts, 1985, 2 (2), 32-33, 29

Presents two elementary level, computer based word processing activities. The first involves recognition and reorganization of sequence through time order. The second features manipulation of character traits through vocabulary.
Michaels, S. Classroom processes and the learning of text editing commands. *The Quarterly Newsletter of the Laboratory of Comparative Human Cognition*, 1985, 7(3), 70-79.

Discusses how to use the text editor in QUILL as well as experiences using the text editor with students and teachers.


Discusses adventure games (i.e., interactive fiction). Provides some interesting advantages and disadvantages of using adventure games like Zork, *In Search of the Most Amazing Thing*, Sherwood Forest, Rendezvous with Rama, Amazon, and Fahrenheit 451.


Reports on the latest crop of word processors. Evaluates enhanced word processors, including Magic Slate, Milliken Word Processor, QUILL, and Writing Wizard; word processors with graphic capabilities, including Bank Street Storybook, Kidwriter, and Storymaker; and the idea processor, represented by ThinkTank.

Richards, M. Word processors...the new centerpiece of language arts. *Instructor and Teacher*, 1985, 2(6), 82-86.

Recommends the word processor as a high tech tool for improving the language arts curriculum. Provides five minilessons to assist students in basic writing and editing operations: inserting or erasing words and characters; moving the cursor; moving or rearranging text; and performing the search/replace operation.


Describes how a microcomputer, Bank Street Writer, and a printer can help remedial readers expand their vocabulary, comprehension, and story sense skills.


Presents four types of word processing activities: cloze, rearranging sentences, finding character attributes, and writing sequels. Also includes four teacher recommended programs: Missing Links, Plato's Cave, Story Tree, and Microzine.


Discusses use of word processors as aids for prewriting, writing, and postwriting activities. Also includes five activities that can be used with word processors to teach and enhance writing instruction.


Finds that students learn word processing best from demonstrations and hands on experiences.

Explores the relationship between reading and writing with specific reference to word processing. Includes discussions on using the language experience approach as well as text and graphics with word processing.


Suggests some important instructional techniques (i.e., modeling and monitoring) for teaching revision skills.


Describes many of the best interactive fiction and literature programs available as of June 1986. Also discusses the difference between interactive fiction (e.g., *Where in the World Is Carmen San Diego?*) and interactive literature (e.g., *Treasure Island*).


Suggests that word processing can be integrated into all subject areas and tells how one school did it.


Describes word processing applications in the classroom and home.


Discusses electronic mail using QUIL and classroom newspapers using *The Newsroom* and *Newspaper Maker*.


Describes a college level class in word processing


Contains a theory and research section; however, most of the content is devoted to computer writing suggestions.


Discusses how individuals can create their own computer assisted instruction programs for composition.
Reviews research on word processing and writing. Section titles are Surveys of Research on Word Processing and Writing, Studies of Attitudes toward Word Processing, Studies of Composing Behavior, Studies of Collaboration, Studies of Revising, Studies of Reading and Writing, and Implications for Instruction.

Presents three uses of word processors with reading and writing activities: One activity involves inserting "forgery text" in a passage and inviting students to detect the forgery, a second involves students entering comments while they study a text or poem (through the insertion of text in a file containing the text or poem), and the third involves synonym substitution.

Highlights the texts *Teaching Humanities in the Microelectronic Age* and *Language in Use*. Discusses Fr Ed Writer, a public domain word processor for the Apple Computer.

Reviews research studies on spelling checkers and text editors available from ERIC/RCS.
Readability formulas have been used in reading instruction and research for many decades. They are designed to help teachers, writers, and publishers evaluate reading materials to meet the instructional needs of students. Many of the commonly used readability formulas have been computerized. To use a computer version of a readability formula, the teacher must type in a passage. The computer program then counts any number of reading variables, including letters, words, lines, sentences, and punctuation marks, before computing the estimates of readability.

For example, the Fry readability formula calls for counting words and estimating syllables. The Raygor formula calls for counting words with more than five letters. The Dale-Chall and Spache formulas require counting letters, checking against a word list in memory, and computer addition of a mathematical constant. Virtually any readability formula or graph can be computerized, but there are some problems.

First, computerized versions of readability formulas are no better than their noncomputerized versions. A readability formula, whether computerized or not, is still unable to quantify the special, interactive relationships between reader and text. Readability formulas do not measure the content of text as much as the text itself, counting only surface features and ignoring other variables.

Second, while computerized versions of readability formulas can give rapid estimates, teachers cannot easily enter text for analysis. Each readability program has specific text entry directions. These change from program to program and are associated with the features (good and bad) of the word processor on which the readability formula is being run. The text entry directions must deal with such features of written text as hyphenating, apposition, ellipses, dashes, ending sentences, underlining, capitalizing, and signalling proper nouns—features of the written language that are not quantified in readability formulas but that do affect comprehensibility.
Unfortunately, many computer based readability formulas do not provide adequate directions, and users are left to solve text entry problems on their own. Therefore, word processors are often inadequate for dealing with many features of written text.

Third, the more complex the readability formula, the less accurate the results. For example, anyone using computer based versions of the Dale-Chall or Spache formulas must necessarily make visual checks to determine if roots of some words are on the appropriate word list. This is not easy. The user must understand special rules for determining whether a word can be considered to be included on a particular word list. Furthermore, some situations cannot be predicted until a user analyzes a text. No computer based formulas are broad enough to yield results exactly the same as those derived by a reading specialist. At present, manual procedures are more accurate than computerized versions of readability formulas.

Chapter six reviews the available research on computer based readability and text analysis. The following references present both the advantages and the disadvantages of using computers in readability assessment.

References
1963

1968

1969


1970

Compares Flesch Reading Ease scores based on syllable counts by humans with computerized scores based on vowels per word, consonants per word, and letters per word (in place of syllables). A correlation of .92 was found between scores based on syllable counts and scores based on vowels per word.

Jacobson, M., and MacDougall, M. Computer management of information and structure in computer supported instructional materials. *Educational Technol-
ogy, 1970, 10, 39-42.
Uses readability measures to evaluate texts and make changes in text content.

1973
Tells how the automated readability index (ARI) was used to create three versions of a story at different reading levels. The ARI appears to have resulted in story versions appropriate for the intended audiences.

1974

1975
Explains the ease of use and accuracy of calculating textbook readability levels by computer.
Points out that there is no need to count syllables, since word length in letters is a better predictor than word length in syllables. The formula described uses both letters and sentences per 100 words.
Moe, A., and Arnold, R. Computer assisted readability levels of twenty-five Newbery books. Reading Improvement, 1975, 12, 59-64.
Uses the computerized versions of the Lorge formula and the Fry graph to estimate the readability of Newbery books.
Describes computer text analysis to determine comprehensibility. Discusses research groups involved in text analysis research. As of 1975, the authors felt eleven measures of comprehensibility were possible, including Guilford's semantic units, evaluation of symbolic implications, and cognition of figural units.
Considers all formulas reliable estimates of readability.

1976
Uses the Harris-Jacobsen readability formula to estimate comprehension scores of twelfth graders.
Describes an attempt to develop a program for detecting and editing redundancy in text.
1979


Describes a computer based readability analysis scheme that uses the Fry graph and Flesch formula.

1980


1981


Describes Writer’s Workbench system of text analysis developed by Bell Laboratories. The Gettysburg Address and a section from *A Tale of Two Cities* are analyzed with the system.


Describes a study in which the MMPI was analyzed by computer for word and syllable counts in as many nonrecurring samples as possible. Readability estimates equal ninth to tenth grade.


Describes TAEI (Navy’s Training Analysis and Evaluation Group) efforts to develop programs helping authors to write simply. Authoring routines automatically format and compose text and merge stored graphics with it. Editing routines include flagging uncommon words, suggesting substitutes for awkward or difficult words and phrases, and indicating the readability.


1982


Discusses Writer’s Workbench and its attempts to evaluate documents and produce better written prose.


Describes the Navy’s Flesch-Kincaid readability formula and the need for improved technical writing. Also refers to Bell Laboratories’ use of the Writer’s Workbench.

118 127

Computer applications in reading


Presents the source code for a readability formula that uses several different formulas.

1983


1984

Brown, R., and Byrd, C. Reading expectancy and regression formulas 1984. (ED 240 538)

Explains that microcomputer programs can be used to “develop a regression equation that will more accurately predict class performance than rule of thumb formulas.”


Serves as required reading for anyone interested in designing text for better comprehension. Especially of interest to reading educators who may want to design or evaluate comprehension software.


Presents the RIXRATE computer based readability formula along with its source code so it can be copied. The RIXRATE formula uses word and sentence length data as variables for determining readability. A comparison with a few other short formulas indicates there is some degree of uniformity among the formulas.


Computer based readability software packages are now commercially available and offer reading analyses, including many formulas. Authors caution the user to remember that readability data, whether computer derived or not, should be considered as ballpark indicators of readability levels.

1985


Presents advantages and disadvantages of using a computer based readability formula called the RIXRATE. While RIXRATE is faster and less tedious than most noncomputer efforts at readability, Duffelmeyer suggests that teachers not abandon good judgment as they review computer based readability results.


Rep... research that sought to investigate the accuracy of the Minnesota Educational Computing Consortium (MECC) readability program, which is a
part of the set of programs call School Utilities Volume 2. The program includes the Spache and Dale-Chall readability formulas.


A computer based version of the FOG (by Gunning) readability formula is presented with source code so the program can be copied. The FOG formula measures percentage of three and more syllable words in determining readability. (No comparisons are made to other computer based readability formulas in the discussion.)


1986

Hague, S., and Mason, G. Using the computer’s readability measure to teach students to revise their writing. *Journal of Reading*, 1986, 30 (1), 14-17.

Reveals that computer based readability formulas and word processing can be used in tandem to support classroom rewriting activities.

1987


Discusses many of the problems facing computer based readability estimates and reviews some readability programs.
Increasing numbers of preschools and kindergartens are using curricula in which microcomputers play significant roles. Many of these preschool programs are intended to allow children to discover how to control computers rather than to use the computers to teach or provide reading readiness for the children. At the University of Maryland's Center for Young Children, where a computer was used in 1981-1982, some young children quickly took control of Tasman Turtle, a computer controlled robot, while others seemed less well equipped to deal with it. The Maryland Center program allowed children to experiment with on screen LOGO and DELTA DRAWING. Parents were involved in all phases of the computer project. The impact on reading interests, attitudes, and acquisition was not evaluated.

Programs at other centers often have gone beyond exploring LOGO. At the University of Pittsburgh, young children use LOGO, but they also use drill and practice programs in counting and in number and letter recognition. Still other centers use computers for checking children's mathematics and for teaching children to control the computer using BASIC (Ross & Campbell, 1983). Some centers even involve young children in controlling robots with computer programs (Shanahan, 1983).

As one might anticipate, there has been a lack of agreement on how to introduce children to computers; indeed, there is even a lack of agreement on whether to introduce young children to computers at all. Some experts maintain that age six is too late, while others maintain that six is too early. Despite these disagreements, emerging research conducted at the University of Wisconsin's Laboratory Preschool suggests that the social interaction outcomes resulting from introducing computers into classrooms are very positive. Experiences suggest that girls may be more likely to take control of computers when the opportunity is presented to them at early years.
ages. And, since children discover the world through play, experts in many preschool settings recommend that their first experiences with computers be with games.

A number of experts have suggested that computers be used in the language experience approach to beginning reading (Casey, 1984). Recommendations to this end appear in journal articles and in books detailing the multiple uses of word processing programs in teaching. Some of these publications recommend that the teacher should type in the children's stories, while others suggest the children do so, learning keyboarding (typing) as they go along. Many fear children will practice errors in typing as little hands attempt to master the adult sized keyboard with or without typing instruction (Dacus & Dacus, 1983).

Very few comprehensive microcomputer programs for introducing beginners to reading have been developed because of the intensely individual nature of learning to read and the heavy speech requirements for beginning reading instruction. The relatively few computers that can be found in first grade classrooms is another compelling reason; the chance for profit seems small at present. Nevertheless, one massive effort has led to the development of Writing to Read, an instructional program combining computer taught letter phonics tutorials and games (with speech) with a language experience approach in which children type their own stories on electric typewriters (often employing invented spellings), make letters and words in clay, and read quantities of children's books (Hawkins, 1982).

In spite of the few comprehensive beginning reading programs, the availability of speech producing peripherals is beginning to foster the development of many new reading programs for young children. The increasing accessibility of speech for microcomputer programs in beginning programs has great promise for the future. Already prototype programs can pronounce words the beginning reader indicates are unknown (Clements, 1985). Others can provide audiovisual demonstrations of phonic blending and the additions of affixes and inflectional endings. These current developments suggest that teachers of reading readiness and beginning reading someday may have roles different from their present roles.

Chapter seven contains references that describe computer based reading readiness and beginning reading efforts in many diverse locations.

References

1981

Describes some preschool programs (circa, 1981).


Piestrup, A. *Preschool children use Apple II to test reading skills programs*. 1981. (ED 202 476)

Tells how fifty-five three and four year old children learned terms (above, below, left, right) needed to operate a computer and care for the diskettes during a three week tryout at a nursery school at Stanford University. Used as an activity center, the computer was accepted by all children and teachers.


Describes how children three to four years old used microcomputers to learn visual discrimination skills.

1982

Clements, D. *Microcomputers in early education; Rationale and outline for teacher training*. 1982. (ED 223 328)

Outlines Teaching with Microcomputers – the Early Years, a college course designed for early childhood educators.

Hawkins, P. Retired educator + IBM + 300 talking personal computers + 600 selectric typewriters + 10,000 kindergarten and first grade students = a test of the theory that children could learn to read by first learning to write. *IPD News*, 1982, 1 (3), 1-7.

Describes IBM's Writing to Read program and a sequel involving cassette tapes and comic strips for teaching reading to functionally illiterate young adults.


Describes a pilot study at Stanford University that found preschoolers can use microcomputers to develop reading readiness skills. The study showed preschoolers are not afraid of the microcomputer and gains in achievement can be expected.


Suggests programming activities appropriate to the developmental ages of children, based on Papert's work. Recommends single finger turtle graphics commands for the very young.


Describes fifteen teacher controlled programs covering prereading and reading skills and five language arts oriented exploratory programs that are child controlled.


Describes how New Mexico State University personnel encountered opposition to teaching keyboarding to young children and eventually set a minimum of fourth grade for the children they taught.


Presents (with short annotations) a list of computer information books for young readers. The author seems to feel that many of the computer books available for children are difficult for children to read and understand.


Suggests software, lists simple little programs (two for the Commodore 64 and two for the Apple), and tells how to use them with young children.


Suggests programs parents might buy for preschoolers and states cautions.


Contains sections on the impact of computers on teaching methodologies, on children's toys and games, and on the ethical development of children.


Details the disagreements between experts over using computers with young children.


Murphy, B. Educational programs for the very young. Creative Computing, 1983, 9 (10), 107-118.

Recommends a number of programs


Describes development of a company specializing in software for young children.


Describes a tryout of computers and software in a Montessori first grade. Children loved checking math solutions and learning BASIC commands.


Describes how two young children learn to use the computer in their home.


Reports an interview with a researcher employed by the University of Wisconsin's Laboratory Preschool.


Describes programming Big Trak robot with kindergartners.


Discusses using student generated LOGO graphics, as sources for story narratives with preschoolers.


1984


Describes a speech in which John Henry Martin elaborates on the field testing of Writing to Read by IBM.


Reports work in progress to answer questions about roles of microcomputers in the preschool curriculum, their effects on children's learning styles, their uses in play, and the equity in their use.

Casey, J. Beginning reading instruction: Using the LEA approach with and without micro-computer intervention. 1984. (ED 245 192)

Describes a program in which kindergarten children received a reading lesson using the language experience approach in two different contexts. In the first, children's stories were transcribed on paper. Computer display, plus voice synthesis, were used in the second context. The resulting discussion was "more enthusiastic, involving and produced longer and richer language contributions from all participants."

Provides information about using computers with elementary school age children. The publisher suggests both parents and teachers use the book as a commentary on educational issues surrounding computers and young children. All chapters would be of interest to reading professionals, especially Words Which Dance in Light, about word processing, writing, and children. Appendixes include Choosing software: A checklist; Relevant books; Relevant journals; Major software sources; and Useful addresses.


Discusses some disadvantages of using computers with three to seven year olds. Further speculates that the computer may not have much to offer children who are under eight years of age.


Discusses some aspects of using LOGO with young children.

D'Ignazio, F. *Computing to read.* Compute, February 1984, 124, 128, 129.

Discusses how the computer helped a four year old learn to read and write without formal instruction.


Provides a complete report of the evaluation of the Writing to Read educational system with kindergartners and first graders. Results indicate the system had a significant impact on writing achievement of young children. The impact on their reading achievement was apparent in kindergarten classes, but less so in first grade classes, especially among low scoring children.

Ohanion, S. *IBM's Writing to Read: Hot new item or same old stew? Classroom Computer Learning,* 1984, 4 (8), 30, 33.

Powell, B. *Five-year-old authors.* Family Computing, 1984, 2 (6), 58-60.

Rotenberg, L. *Booting up for reading: Two nationwide programs that use computers to teach reading.* Teaching and Computers, 1984, 1 (8), 16-19.

Describes IBM's Writing to Read as implemented in Cary, North Carolina, and the Individual Reading Instruction System (IRIS) of the World Institute for Computer Assisted Teaching (WICAT).

Sheingold, K. *The microcomputer as a medium for young children.* In P.F. Campbell and G.G. Fein (Eds.), *Microcomputers in early education: Conceptualizing the issues.* Reston, VA: Reston Publishing. 1984

Explores concerns about microcomputers for young children and suggests uses and teachers' roles.

Strasma, J. *Commodore clinic.* RUN Magazine, 1984, 1 (1), 14

Names preschool programs for the Commodore 64 computer.

Describes a North Texas State University study indicating that most children prefer to approach the computer with friends and that introducing the computer did not change existing social patterns in the preschool classroom.


Shows three, four, and five year old children reacting to a computer in their classroom.


Suggests that LOGO can be observed as a sort of Rorschach test revealing how children structure their tasks in order to accomplish them. States that girls deal with formal systems differently but just as competently as boys when allowed to discover how to manipulate the computer.


Warash, B. Computer language experience approach. 1984 (ED 244 264)

Discusses a computer based language experience program at West Virginia University Child Development Lab. Preschoolers use LOGO graphics to construct computer drawings, then dictate their accompanying stories to the teacher for transcription. Observation indicates children are more involved and verbalize significantly more with the computer drawings as compared to the hand drawn works.


Describes a research project involving ten three year olds and their mothers. It was found that significantly more verbal interchange between parent and child occurred when reading a traditional alphabet book, as compared to playing a computer alphabet game. Suggests that software for preschoolers be designed with a stimulus for rich verbal interchange.

Zajonc., A. computer pedagogy? Questions concerning the new educational technology Teachers College Record, 1984, 85 (4), 569-577

Questions the need to use computers with young children because computers are unable to nurture those "capacities and structures" upon which childhood development depends. Also mentions that computers are perhaps best left to older students (twelve years) during concrete operational stages

1985

Borgh, K., and Dickson, W Two preschoolers sharing one microcomputer: Creating prosocial behavior with hardware and software In P. Campbell and G. Fein (Eds.), Young children and microcomputers Conceptualizing the issues. Reston, VA. Reston. 1985


Contains many chapters of interest to reading professionals, especially The ABCs and Beyond, which contains sections on supporting young children's writing, writing computer programs that write English, books that talk to you, readiness skills, sight vocabulary and spelling, reading for comprehension, examining language arts and reading software critically, and what research tells us about teaching language arts with computers

Reports a three month study that investigated the relationships that might exist between preschool children's interests in microcomputers and cognitive as well as behavioral characteristics. Results indicate that preschoolers need some representational knowledge (as opposed to concrete) competency. In addition, those young students who exhibit single minded, sequential, abstract play attributes may enjoy greater success using computers than those who do not possess such attributes.

1986

Beaty, J., and Tucker, W. *The computer as a paintbrush: Creative uses for the personal computer in the preschool classroom.* Columbus, OH: Merrill, 1986.

Contains chapters on the computer as a playmate, alphabet block, abacus, building block, crayon, paintbrush, chatterbox, the computer in the preschool classroom, and choosing software for the preliterate child.


Compares software featuring cognitive-developmental principles to traditional software. The software was designed to teach letter recognition and number judgment. "It appears that the software designed in accord with cognitive-developmental principles significantly enhanced learning compared to software not so designed."


Investigates the effects of microcomputer use on preschoolers' knowledge of basic reading readiness concepts and on their attitudes toward the microcomputer. The results indicate no effect on prereading skills by microcomputers and relatively low levels of interest in microcomputers.

1987


Includes introducing children to books and computers, finding software for beginning readers, and using text programs and word processors with young readers.

137
While most of the excitement about computer use in helping children read is generated by the new instructional software, there is some excitement about our increased ability to keep track of children's progress and to provide appropriate materials by use of the computer. Databases are the filing, storage, and retrieval programs that may improve our instructional capabilities and gauge the success of our endeavors. One very promising database is The Nebraska Reading Retrieval System, a state sponsored computer program designed to share expert opinions and materials knowledge with Nebraska's teachers. Another is the Educational Products Information Exchange (EPIC) database of educational software. This database, when printed out as The Educational Software Selector (TESS), is probably the most complete listing of evaluations of educational software to be found.

The databases most used by school reading educators are computerized reading management systems. These systems provide a variety of tests and computer programs that both score the tests and create files for school districts, buildings, or classes in such a way that reports are quickly available to provide summaries of student reading performance at all three of these levels or for each student for whom scores have been entered.

Computerized reading management systems are of five general types: commercial mail in or networked mainframe programs, commercially developed microcomputer programs supporting no particular set of teaching materials, microcomputer programs supporting a basal reading series, mainframe and minicomputer instructional program, including a management system, and microcomputer programs developed as part of school district projects.
Commercial mail in or networked mainframe programs

Among the mail in or networked programs are the Croft Computerized Management System, Learning Unlimited Systems, and Individual Criterion Referenced Tests (icrt from Educational Development Corporation). Teachers using such systems send completed test response cards or answer sheets to collection points and receive printout class lists, prescriptions, and groups needing particular skills by mail in ten days to two weeks. Usually both pretests and posttests are provided. Prescriptions are usually stated both in materials prepared by the authors of the system and materials customized at the request of the school district using the system.

Commercially developed microcomputer management systems

Among the commercial computerized reading management systems are AIDS (Assisted Instructional Development System); gesi (Instructional Management System by Gulf Educational Systems); crms (Computer Based Reading Management System by Educational Activities); K Thru College (Soft-Mark); camP (Computerized Assisted Management System); Fountain Valley Teacher Support System—Computerized Management System; miMicro (Microcomputer Managed Information for Your Criterion Referenced Objectives); MimS (Microcomputer Instructional Management System); the Talley Special Education Management System; Skillcorp's CMS Reading; and The System (James Rennix), a Commodore computer based program for managing records of Chapter I students. Most of these use card readers to input test information from criterion referenced reading skill tests provided as part of the management system. These programs write prescriptions that include numerous supplementary reading materials as well as the materials input by the users.

Mainframe and minicomputer programs including a management system

Three companies offer reading programs that operate with computers much larger than micros. Used in schools, these programs are made available to students at terminals connected to a central (host) computer. The Dolphin Reading Program (Timeshare Division, Houghton-Mifflin) offers
remediation in reading skills arranged to match those presented in the Houghton Mifflin Reading Series. The many programs available from the Computer Curriculum Corporation (ccc) not only make use of computer delivered diagnostic tests to determine level of student entry into the various skill strands, but also monitor student responses so placement levels are automatically changed to correspond to student success or lack of it. A third company marketing reading programs, cdc (Control Data Corporation), has several versions of their Basic Skills Reading Curriculum for remedial or literacy work at reading levels three to eight. These are available at terminals connected to PLATO networks, most of which are based on university campuses. Like the ccc programs, those from cdc also offer online pretesting, constant monitoring, upward or downward reassignment based on performance, and posttesting. Programs from both cdc and ccc are being redesigned and reprogrammed to run on microcomputers.

Microcomputer programs developed as part of school district projects

An increasing number of schools are using local and federal funds to create reading management systems to fit their own needs. Two programs have met the standards of the National Diffusion Network (NDN), a federally funded agency created to disseminate information about outstanding educational efforts nationwide. The first of these, Mastery Management, was developed by the CAM Demonstration Evaluation Center of Hopkins, Minnesota, Public Schools. Originally created for tracking student progress in reading and mathematics, this system is easily modifiable for storage and retrieval of a variety of school data. It resembles a list of blanks for 900 students, with 40 tidbits of information written after each name.

The second, Computer Assisted Diagnostic and Prescriptive Program (CADPP), was developed by the Buckingham County Schools to help teachers create prescriptions in math and reading. The prescriptions call for use of materials available in the classroom to which the child is assigned and entered into the computer's memory by the teacher. It is designed to run on the Apple II computer and to generate prescriptions and progress reports for children in grades three to nine.

Several other Lighthouse projects selected for diffusion by NDM include a cmi component. Among these are I CARE, which manages CAI and audiovisual remedial reading instruction vocational students (grades 9-12) in Blue Mountain High School, Schuylkill Haven, Pennsylvania. Another
is the Computer Assisted Instructor Program of the Merrimack Education Center in Chelmsford, Massachusetts. At the Merrimack Center, the self-managing instructional packages of the Computer Curriculum Corporation are supplemented with more traditional instruction managed by a locally developed CMI program. A third is the Demonstration Reading Program at Sierra Junior High School in Bakersfield, California. It bases comprehension instruction on the PRI, McGraw-Hill's program for writing prescriptions based on computer scored tests. A fourth is Project Clover, which involves the use of MSRTS (Migrant Student Record Transfer System) for maintaining records on migrant school children in 49 states, Puerto Rico, and the District of Columbia. Teachers input information on their present students and request information about newly arrived students. The information may be about health, standardized test scores, interests, book levels, and state mandated performance test scores.

A fifth, HOSTS (Help One Student to Succeed), started as a remedial reading program in Vancouver, Washington. It is now used in more than 150 schools in at least twelve states. The major role of the computer in HOSTS is in scoring tests and prescribing instruction from its six disk database. The instruction is carried on by volunteer tutors.

A large number of school districts are using computers to aid in the management of their reading programs. Often these efforts lead to combinations of locally produced computer programs with commercially available programs. For example, the Spencerport, New York, School System is using ICRT (Educational Development Corporation) to generate pupil prescriptions and at the same time is creating (with a local software company) a computer program for generating compensatory Individual Educational Plans (IEPS) capitalizing on the information made available by the ICRT program.

The references in chapter eight provide an overview of the major attempts to development computer managed reading instruction across the past two decades. Much more research is needed, particularly in the area of computer managed instruction for microcomputers that use inexpensive, teacher adaptive software.

References

1970

1974
Describes a program in which delinquents in a Georgia Youth Development Center were randomly assigned to experimental or control groups. The experimental groups earned significantly greater reading scores. The experimental group was taught with PLAN, a computer managed reading and mathematics program developed for Westinghouse Learning Corporation.


Describes a program in which the Gilmore Oral Reading Inventory (McGraw-Hill) and an interest inventory were administered to fifth graders. A group of classroom teachers and a group of reading teachers then picked books and remedial materials for each pupil tested. A computer program prescribed from these same data. The computer generated prescriptions closely matched the reading teachers' prescriptions.

1976


Compares basal reading instruction with and without computer managed instruction in forty classrooms. Results favored the non-CMI classrooms.

1978


Describes the history and development of computer managed instruction prior to 1978; one of the most substantive works on CMI.


Describes an experimental project at Northwestern University involving the application of computers to the operation of a preservice program for teacher preparation in reading. Using a competency based model, the computer managed the students' entry into and progress through a series of on-line, interactive tutorials by assessing their initial behaviors, assigning lesson plans, guiding use of bibliographical database, and monitoring progress.

1979


1980


Describes a metaanalysis on the literature concerning the effectiveness of CAI and CMI.

1981


Examines the advantages and disadvantages of using microcomputers for CMI.
Discusses CMI, including some CMI programs commercially available in 1981.

Describes the evolution of the Wisconsin wis-sim CMI project to microcomputers.

1982
Finds the HOSTS (Help One Student to Succeed) program leads to more favorable results than supplementary CAI in reading and mathematics for Chapter I students. HOSTS uses computer databases to generate prescriptions implemented by volunteer tutors.

Describes a study in which intermediate students were divided into three groups: control, split day scheduling, and computer managed. No statistically significant differences in reading achievement were found among the groups, each using the same basal reading program with the varied methods of instructional support.

1983
Meyer, L. Evaluation research in basic skills with incarcerated adults. 1983. (ED 237 954)
Provides findings of a study to determine effectiveness of traditional vs. computer managed instruction in basic skills programs for incarcerated adults in Illinois. Significant gains for both control groups were reported after three months of instruction, with language scores increasing most dramatically, followed by math gains. Reading comprehension showed lowest gains.

1984
Explains how computers were used to record and tabulate data on several aspects of children's literature.

1985
Describes HOSTS materials as providing testing and prescriptions in six major skill areas at six grade levels. These are implemented through a computerized database of teaching materials.

Describes tutoring program at Loma Prieta, California, where computers use test results to generate prescriptions for tutors. The computers search for materials to prescribe from a database stored on six Apple disks.

Discusses different integrated learning systems (iLs) and focuses on several companies that sell them.


Describes how publishers have incorporated computer based management and instructional systems into their basal reading series and provides examples.
Speech technology and reading

Some of the most exciting advances in computer technology have been in the area of speech production and recognition. Several inexpensive microcomputer peripherals, which have become available in the past five years, finally make practical the application of speech technology to computers. These devices are particularly significant for the field of reading since they make it possible for even nonreaders to communicate and learn from a computer. As a consequence, the computer's capability for providing direct instruction in reading has been vastly improved.

Speech production

The most successful speech peripherals for microcomputers are in the area of speech production rather than speech recognition. Many hardware peripherals are available for producing speech. These devices differ greatly in terms of speech quality, voice types, and overall utility. There are two general approaches to providing speech output with computers: speech digitization and text to speech synthesis.

Text to speech synthesizers use mathematical and grammatical models that have been developed for all of the phonemes in English. The computer reads individual letters in a word to form the phonemes. The phonemes are then strung together, or synthesized, to form words. The advantage of this type of approach is that anything that can be spelled phonetically can be spoken.

Phoneme based synthesizers have widespread applications. For instance, visually handicapped persons can type individual letters into the computer and the letters can be fed into a synthesizer and spoken back as whole words. This makes it possible for the visually handicapped to write fluently using a word processor, correcting normal typographical errors as they occur based on the audio feedback. It has allowed many visually handicapped people to move into computer related occupations.
Another exciting application of speech synthesis can be seen in a recent program entitled Talking Textwriter (Scholastic). This program uses text to speech synthesis in the context of a simple word processor. Young students use the word processor, then with a simple command whatever they have written will be spoken by the computer. Not only does this reinforce students, but it provides them the opportunity of reviewing their spelling. Words that are misspelled when read back by the computer will be mispronounced. This helps students identify where a spelling error has been made. They can adjust the spelling until it sounds and looks correct.

There are some distinct disadvantages, however, to text to speech synthesizers. The audio quality of synthesized speech is often poor, particularly when more than one word at a time must be spoken. Most synthesizers use only one model for a particular phoneme. This means the voice is always the same, usually that of a male adult. Female voices, children's voices, or unfamiliar patterns of male voices are not possible. Also, because the algorithms focus on the phonemes, the subtle tonality and stress patterns of words and sentences cannot be taken into account. Consequently, speech quality is reduced.

Speech digitizers are another type of speech peripheral. Digitizers do not base their output on models of the human voice, but on human speech that has been recorded and converted to a digital signal. Consequently, with digitizers it is possible to distinguish many voices. Also, because the speech is recorded rather than modeled, it will reflect more accurately the inflections and intonations of the original speaker.

Not all digital voice systems are created alike or sound alike. Currently, there are only a few microcomputer peripherals that will play back digitized voice. Voice quality and quantity vary greatly depending on the frequency with which the voice is sampled during the recording process, chip type, and the encoding/decoding algorithms employed. Some types of voice digitizers use a lot of the computer's memory but provide good audio quality, while others use less computer memory and have poorer audio quality. The differences in the memory requirements of these devices are not insignificant. Many sample speech at a rate of 4,000 bytes per second, which means that the average floppy disk can hold about 25 seconds of speech. Since much of the disk must be used for the program itself, often only 10-15 seconds of speech are available. One of the first major reading series to use this type of speech digitizer was the IBM Writing to Read program. While this program uses audio to help teach phonics, the application of audio is highly limited because of the high sampling rate of the digitizer.

More recent digital speech devices use a sophisticated electronic technique, linear predictive coding (LPC), to compress the audio data so it can
be stored at a rate of 200 bytes per second. Consequently, LPC digitizers can store up to 6 minutes of continuous audio on a floppy disk. The tradeoff is that the audio quality is slightly reduced. Several publishers have developed software using this type of device. The smaller memory requirements make it much easier to fit the audio into a variety of educational applications. The Houston Independent School District Department of Technology has developed two major software series in language arts that make use of LPC speech. One series, Harmony English as a Second Language, uses audio for modeling English. The other is the Language Literacy System, a large K-2 software package for teaching reading and writing.

Regardless of type, speech digitizers have clear drawbacks for some applications. First, the speech must be prerecorded. Therefore, if a student types a word into the computer, it will not be pronounced unless it was previously recorded. This limits spontaneous interaction with the computer. Second, it is often more costly to develop software using digital speech because of the time and effort involved in recording and editing the soundtracks. Consequently, many software manufacturers have been reluctant to develop software for this peripheral.

Since each approach to speech production has limitations, an obvious way of improving speech peripherals is to combine the two types of approaches into a single peripheral. Not surprisingly, microcomputer speech boards have been developed that contain both digital and synthesized speech chips. Programs are just beginning to take advantage of their combined capability. Given the greater flexibility such composite speech devices provide, it appears likely that many educational publishers will begin to use them.

Speech recognition

The concept of freely conversing with a machine is one of the most intriguing in all of science fiction. Unfortunately, for the most part, this concept remains fiction. Nonetheless, there have been significant advances in this area.

Speech recognition devices attempt to sample auditory data and match the data with models for specific vocabulary items or, in some cases, specific phonemes. In order to do this the computer must first learn the distinguishing characteristics of a particular speaker's voice. The speaker is asked to say certain words several times while the computer analyzes the person's voice qualities. These qualities are then incorporated into the model used to analyze all subsequent utterances. Even with this modeling, most microcomputers can handle vocabularies of only 100 to 300 words with accuracy.
The primary barrier to the successful development of accurate speech recognition devices is the complexity of human language. There is tremendous variance in the acoustical features of human voices both within and between speakers. A single word, even when spoken by the same person, can lead to literally thousands of different wave forms across different frequencies, depending on the pitch, stress, and volume of the speaker. Correctly interpreting data is still a problem for even the most sophisticated computers. Most devices presume certain things about the speaker in order to limit the complexity of the data. They often presume the speaker to be an adult English speaker. The more a voice deviates from the audio pattern of an English speaking adult, the more difficult recognition becomes. Consequently, most speech recognition devices tend to be much less accurate at recognizing young children or speakers with strong accents.

Another major drawback to voice recognition devices is that most are highly susceptible to interference from other noises in the environment. The susceptibility of voice recognition devices to errors caused by external noise has been one of the biggest reasons why school applications of this technology have been so scarce. School classrooms are inherently noisy.

More than hardware

Even though speech hardware has become increasingly sophisticated, software applications are still in their infancy. This should not be surprising. When sound capability was added to movies, it was still many years before producers consistently used sound to its full effect. Much needs to be learned about how and when to use audio with software.

An early study (Mock, 1976) on the use of audio combined with text in educational television suggests that the effects of audio vary with reading ability. In addition, Mock suggests that the timing of the audio relative to the presentation of text is crucial to the reader’s visual attention. Research is needed on the use of audio with computers to see if the findings from educational television transfer.

The future of speech technology for reading instruction

Taken as a whole, the future of computer assisted speech technology for the field of reading is excellent. The promise of the technology for reading instruction has been demonstrated by a steadily increasing volume of application software. This software has been used to address the obvious elements of phonics and all phases of reading instruction. Speech periphe-
erals may soon play a major role in beginning reading instruction. Until now it has been difficult to create instructionally effective software for primary and preschool children. Students have been caught in a dilemma. If they cannot read the directions, they cannot operate the computer. If they cannot operate the computer, they cannot use it to learn to read. Speech technology offers a way out. The computer can literally talk the student through the use of a program. This means that even totally illiterate users can make full use of computer assisted instruction. Consequently, computers equipped with speech devices could have a tremendous impact on all forms of instruction at the primary level and with adult illiterates.

Chapter nine reviews the available research on computer applications in reading using speech.

References

1976

Explains that eye movement recordings were used in a study of eight to ten year old children to determine the nature of visual attention while viewing selected segments from an educational television program. Findings suggest that voice overs should be delayed until the student has had the opportunity to orient to the text.

1981

States that after forty years of research, the automatic recognition of speech by computers remains a Utopian goal. Current devices have small vocabularies and little ability to deal with fluent sequences of words. Explains Bell Laboratories' prototype system involving word decoding and decision making about which word (within sentence syntax context) and which sentence within a semantic context called "word concept." Predicts continued progress.


1983

Describes all of the major approaches to speech synthesis, then provides a do it yourself model for making your own speech synthesizer. This article is for the more technically oriented.


Explains clearly how voice synthesis works. One of the few articles that discusses voice technology specifically in relationship to schools. Includes a section of ten questions to ask when selecting a voice synthesizer and a source list of available speech peripherals.


Reports three experiments indicating that synthetic speech is more difficult to understand than natural speech because it places increased processing demands on short term memory.

Bergheim, K. Micros prick up their ears. *InfoWorld*, 1984, 6 (32).

Explains how the recent availability of new speech chips has led to a resurgence in the use of speech peripherals with computers.


Serves as an excellent resource for those with or without a technical orientation. The readers guide directs readers to the most appropriate chapters.


Contains much useful information on applications of speech technology for the handicapped. Designs specific applications of the technology for different types of handicaps and lists resources.

Hillinger, M. Issues in the design of speech-based phonics software. Unpublished manuscript (available from Houghton Mifflin, TSC Division, P.O. Box 683, Hanover, New Hampshire 03755), 1984.

Describes the development of the Sound Ideas reading software that used the ECHO Plus Speech Synthesizer.

Mella, M. More than a whisper of hope for computers you can talk to. *Business Week*, December 17, 1984, 92-93.

Describes recent development by IBM of a speech to text device. This type of speech peripheral makes it possible to dictate directly into a computer and have the speech converted to text. Notes that many manufacturers of speech peripherals have been operating at a loss, but are continuing to obtain funding because of the increasing promise of the technology.


Describes the Harmony English as a Second Language courseware developed by the Houston Independent School District. This is one of the largest
bodies of courseware to use digital speech technology with microcomputer software. Discusses the methodology used in the courseware and the advantages of using digital speech technology for this type of application.


Describes recent advances in the application of voice input devices. Worth noting are references to the use of voice input devices for automated phone systems.


Provides a brief theoretical overview of speech synthesis and then compares five different types of commonly used speech chips.


Argues that current speech technology methods are insufficient to handle the demands of fifth generation computers. Describes a new type of signal processing approach called CoreTechs.

1985


Describes three forms of computer based speech: digital, text to speech synthesis, and the software speech. Discusses advantages and disadvantages of each type of system for educational applications. Includes names and addresses of suppliers of educational speech software and hardware.


Explains the state of the art in text to speech systems, with summations of recent research and suggestions for future directions in voice input/output research. An interesting note is that comprehension of synthesized speech is found to improve dramatically with a small amount of practice, although it seldom equals comprehension of normal speech.


Explains that the speech synthesizer can provide immediate feedback, repetition designed for individual needs, opportunity to integrate new information at learner's pace, assistance in record keeping, and individualized instruction.


Discusses a voice based learning system, the Scott Instruments Voice Entry Terminal (VET).

Describes computer based research into the voice apparatus with which we create speech and some of the implications and applications of this research into computer produced speech.

Discusses speech peripherals in reading instruction and the IBM Writing to Read program, which uses speech.

Olson, R., Foltz, C., and Wise, B. Reading instruction and remediation with the aid of computer speech. *Behavior Research Methods, Instruments, and Computers*, 1986, 18, 93-99

Discusses the speech capabilities of the Talking Text Writer (Scholastic) and Writing to Read (IBM).

Compares the intelligibility of eight computerized synthetic speech systems with natural speech. Systems include both mainframe and microcomputer devices or programs. The best system equalled natural speech only with initial consonant phonemes, producing an overall error rate of only 3 to 4 percent for isolated monosyllabic words
It is estimated that by the year 2000 there will be more than 20 million users of video display terminals (VDTs) or cathode ray tubes (CRTs) in the United States alone. This should not startle anyone in the reading community. Visual display terminals in many forms have been with us for a quarter of a century. However, few reading researchers have addressed the question of whether reading text printed on an electronic display is different from reading text printed on paper.

An essential element of this question is legibility. During the early part of the century questions about how print could be made most readable were of widespread interest. How big should type be? How can eye fatigue be reduced? How should children's books be printed? Excellent summaries from this era of legibility research can be found in Tinker (1963) and Watts and Nisbet (1974). Today, technical and societal changes are once again pushing questions of legibility to the forefront.

Radiation and fatigue effects

Many frequent users of video display terminals are concerned about radiation and fatigue effects. Studies by the National Institute of Occupational Safety and Health (NIOSH) and by individual researchers (e.g., Terrana, 1980) show that users of video display terminals are not exposed to excessive radiation. However, studies by Gunnarsson and Soderberg (1983), Jelden (1981), Oestberg (1974), and Sauter et al. (1983) show that concerns about visual fatigue may be legitimate. All of these studies report that reading from VDTs causes more visual fatigue than reading from print.
Computer based comprehension

The question of whether VDTs negatively affect reading comprehension has not been fully addressed. Chapman and Tipton (1985), in looking at VDT reading with television, found a significant reduction in comprehension as compared to paper print. Muter et al. (1982), however, found no significant difference in comprehension. In a related issue, researchers consistently find that reading rate is significantly slower for text presented electronically (Hoover, 1977; Muter et al., 1982). This finding may simply reflect subjects' lack of familiarity with the medium or it may be related to the fact that most electronic displays contain about one third the amount of text of book pages. Line length also may be a factor, since 40 character lines were used in these studies. Kolers, Duchnicky, and Ferguson (1981) found that reading speed on a CRT was 17 percent faster with 80 characters per line than with 40 larger characters per line.

The type of visual contrast on an electronic display may be significant. Print is usually displayed with negative contrast, dark text on a white background, while VDTs usually have positive contrast, illuminated text on a dark background. Bauer and Cavonius (1980) and Radl (1980) reported improved performance with negative contrast displays. One should be careful, however, in generalizing from these or any other results involving VDTs. As luminosity increases, other aspects of the display, such as flicker sensitivity, change. Most VDTs flicker at approximately 50 cycles per second, and this flickering may be disruptive and may trigger seizures in epileptics.

One of the critical distinctions between electronic display and conventional print is that electronic displays are dynamic. The displays exist in four dimensions—height, width, depth, and time. The designer of electronic displays must be concerned not only with how text is printed, but when. The human visual system is extremely sensitive to temporal factors. Sudden changes in the visual display, such as flashing letters or words, immediately attract attention (Smith & Goodwin, 1971). These changes have the potential to either improve or reduce legibility depending on how they are used. Smith and Goodwin found that search time was improved by the use of dynamic cues such as flashing letters. However, anything that can attract attention can also distract if it is used inappropriately. In a series of eye movement studies, O'Bryan and Silverman (1974) found that the visual attention of poor readers was frequently misdirected by the animation of graphics adjacent to the text being taught. In some cases the distraction was so powerful that young beginning readers never fixated on the text.
In conclusion, the legibility of electronic displays is of increasing concern. Use of VDTS is increasing and the physical construction of display terminals is changing rapidly. Efforts are underway to develop small, portable, “flat screen” displays for use with small computers. New approaches to creating electronic displays, such as liquid crystal displays (LCDs) and electroluminescent screens, are challenging cathode ray tubes. Each of these devices creates an image that differs markedly from those of cathode ray tubes. Consequently, much of the previous research on VDT/CRT legibility may not transfer. However, the economic importance of these devices has already started new research in the area of legibility.

Chapter ten presents references that should help to clarify some of the issues surrounding legibility, reading, and computers.

References

1963
Contains a detailed discussion of studies of legibility going back to the turn of the century, as well as Tinker's own exhaustive research in this area. The classic reference in the field of legibility.

1968

1971
Studies time required to search a display of random digits for a target item. Subjects were able to identify a target item 50 percent faster when it blinked.

1974
Reports a study in which several segments of videotape from an educational television show were shown to 30 children aged nine to eleven, divided into two groups—poor readers and nonreaders. Film recordings of eye movements were made. Qualitative analysis was performed by overlaying a 1/16 second fixation onto drawings of segment scenes. The purpose of the lessons was to teach basic sight vocabulary. Most screens contained cartoon or live characters who depicted a word or sentence shown at the bottom of the screen. The study showed that the children's eye movements were consistently drawn away from the text and to the animated characters whenever they moved. Silhouettes without faces proved substantially less distracting than silhouettes with faces. It was also noted that the character speaking drew all of the eye movements.

Discusses effects of room illumination on visual fatigue. Finds that for people wearing eyeglasses, a viewing distance of about 13 inches tended to reduce visual fatigue from eye convergence and accommodation, while 20 inches was recommended as a viewing distance for those with normal vision.


Discusses legibility research and legibility factors as they relate to children’s reading.

1975


Reports a study that found that subjects acquire word length information on a CRT display of text at least 12 to 15 character positions to the right of the fixation point. This seemed to influence saccade length. Specific letter and word perception was accurate no more than ten spaces to the right of the fixation point.


Reports a study using computer controlled displays and computer data gathering that found main verbs to be fixated longer than other words in sentences.

1976


Finds that when subjects are shown computer controlled pictures and print, print that conflicts with pictures on the same screen takes longer to read.

1977

Hoover, T. *Empirical study of reading and comprehension as a function of CRT display*. 1977. (ED 161 002)

Reports research in which college students read and answered questions about four passages displayed on CRT. Two passages were presented with text on every line and two were presented with text on every other line. No differences in rate or comprehension were found, although rates were not high and comprehension scores were very low.

1978


Presents a detailed, technical discussion of the effects of color in electronic displays.


Summarizes research Rayner and his colleagues conducted on eye movement. In most of the studies, readers read from computer controlled CRT displays, so findings are relevant to that medium.
1979
Merrill, P., and Bunderson, V. Guidelines for employing graphics in a videodisc training delivery system. 1979. (ED 196 413)
Gives guidelines for use of color, line, motion, and pictures (as opposed to text) and presents questions for research.
Moore, M., Nawrocki, L., and Simutis, Z. The instructional effectiveness of three levels of graphics displays for computer assisted instruction. 1979. (ED 178 057)
Reports research with CRT reading of text supplemented with one of three levels of graphics. Low level graphics (such as line drawings or boxes around text) as helpful as medium or high level graphics were.

1980
Describes research in which subjects were asked to read nonsense words and then type them into a terminal or to detect discrepancies between what was presented on the terminal and what was printed on paper. The text was presented either in positive or negative contrast. Subjects preferred the negative contrast (dark text on an illuminated light background).
Discusses display devices exhaustively. Contains an excellent chapter on the ergonomics of using video display terminals, as well as a checklist for determining the effectiveness of displays.
Contains a good (but somewhat dated) collection of research on human factors in office design. The role of room illumination in relation to visual display terminals is discussed in detail. Includes a number of specific recommendations teachers could use to determine the optimal location of microcomputers within a classroom or lab. In general, recommends setting the computer on the higher illumination or brightness setting so the illumination of the screen is slightly higher than that of the room in general.
Reports research in which adults transcribed letters from CRT displays for five minutes using two different types of contrast—illuminated letters on a dark background (positive contrast) and dark letters on an illuminated background (negative contrast). Subjects preferred negative contrast displays.
Analyzes radiation emissions from CRTs used as computer terminals, showing that X-ray and radio frequency emissions are no higher than natural background levels.
1981


Compares the proofreading performance of 28 typists with two types of display. One display used a conventional format of 20 lines of 80 characters each. The second used a format consisting of a single line of only 32 characters. After a moderate amount of practice, no difference was found in text editing performance.


Reports a study of 201 college students using CAI. Reading fatigue was reported by 21 percent of the students after 30 minutes of instruction.


Reports research in which eye movement was recorded as college students read texts presented on a CRT in two different spacings, two different character densities, and at five different scrolling rates. Reading speed was 17 percent slower with 40 characters per line than with 80. Pages scrolled at rates 10 or 20 percent faster than the preferred scrolling rate appeared to lead to more efficient scanning with no significant reduction in comprehension.


Provides a complete bibliography on this topic.


Reports two studies of the physical effect of eye fatigue on a CRT and on hard copy. In the first study, two subjects spent four three hour sessions reading. Eye fatigue was measured by indicated durations to move from a near point and focus on a far point (and vice versa). Fatigue was not visible in the hard copy group. In the second study, subjects were measured for two four hour sessions. Measurable eye fatigue was present for the CRT group after two hours.

1982


Measures the ability of adult subjects to recognize six combinations of colored letters on colored background. The luminance of each color was found to be a major factor affecting legibility. Concludes that a light color should not be mixed with another light color (white and yellow); that the dark colors (red and blue) should be paired with a light color; and that the medium colors (green and magenta) should be paired with colors from one of the other groups.


Contains one of the most comprehensive collections of research on VDTs.


Reports on thirty-two subjects who read short stories for two hours. Half of the subjects read from a CRT display and half from a book. Both groups were seated comfortably on a couch for the viewing period. Comprehension was found to be the same for both reading groups, but subjects reading from the CRT displays read 28.5 percent slower than those reading from books.

1983


Reports on twenty-four subjects who proofread from a CRT on one day and from hard copy on another. Physical measures of participants' vision were made, as well as a subjective survey of visual comfort. Proofreading times and accuracy also were measured. There were no significant differences in vision or in ratings of visual fatigue. Proofreading accuracy was no different for the two conditions, but subjects did proofread the paper copy 20 to 30 percent faster.


Studies employees at the Swedish Telecommunications Administration. The amount of time spent at CRTs was varied between two levels, normal and intensified. Both subjective and physiological measures of visual fatigue were made. Near point accommodation and convergence, indicators of visual fatigue, were greater on days when CRT use was heavy. Verbal reports of fatigue on those days increased.


Includes findings from NIOSH studies as well as analyses by many top researchers in the field. Appendix A reviews the research methodology employed in most of the major studies to date and concludes that the findings of most studies are questionable due to poor research techniques. One of the most current and thorough books on the topic of VDTS.


Studies the relationship between video terminals and health. The National Institute for Occupational Safety and Health compared 248 office workers using display terminals with 85 office workers doing similar work with printed material. Both physical and subjective measures of stress were recorded. There was little evidence of higher stress among those workers using the CRTs. Most subjective reports of eyestrain were related to inadequate lighting.


Discusses videotext systems. The videotex manual has attempted to establish display guidelines to improve legibility. The chapter on display standards describes these display guidelines in great detail.

Describes the visual field in terms of spatial and temporal frequency. One of the first attempts to integrate, in detail, the role of temporal conditions to create a unified description of perception. Shows that in order to process motion in displays only a limited amount of information need be processed. Defines a region called the “window of visibility” that defines the limits of visual sensitivity.

1984


Salomon, G. Television is “easy” and print is “tough”: The differential investment of mental effort in learning as a function of perceptions and attributions. *Journal of Educational Psychology,* 1984, 76, 647-658.

1985


Compares three methods of displaying text on a television screen: scrolling, page by page, and slow reveal (letters print one at a time as if being typed). Display time was held constant for all three methods. No significant differences in comprehension were found. A posthoc study showed that comprehension improved by a third for students reading the same passages on paper.

Daniel, D. *Construct of legibility in the reading environment of a microcomputer.* 1985, (ED 225 908)

Contains an extensive review of previous legibility research in an attempt to determine the relevancy of legibility research to reading from a visual display terminal. A new model for defining legibility in the context of a computer is introduced. Argues that in order to adequately define legibility in the dynamic medium of a computer, a four dimensional construct must be used. Factors of height, width, depth, and time interact to form new parameters of legibility.


Consists of an outstanding collection of research on communication between humans and computers. Includes much of the groundbreaking research being performed at the University of York in the United Kingdom. Chapter 2
contains one of the most current treatises on reading electronically presented text. The chapter on how to use speech communication is one of the few papers in the field of artificial speech that looks at when and how to apply speech.

Computer technology develops in leaps and bounds. The development of the transistor was one leap, the advent of the microcomputer another. Now, the field is poised on the verge of another leap into the optical era. That move could have profound impact on reading education.

Laserdiscs

Optical storage has been with us since the late seventies. Optical disks were first introduced as a medium for storing video information. They were 12 inch diameter plastic disks into which millions of pieces of information had been embedded using a tiny laser. More than 50,000 video frames could be stored on a single disk. This meant that 30 to 60 minutes of video could be stored on the disk, one frame at a time, and then played back just like movie film. Laserdisk players were introduced in 1978 as a consumer item for playing movies.

Interactive videodisks

An offshoot of the analog optical format is the videodisk. With a videodisk, digital data are added to a disk that can be read by a computer. This information contains instructions controlling the playback of video and audio data, allowing segments to be branched based on student input. Videodisks have found a strong niche in industrial training. However, the cost of videodisk production remains high, particularly when film footage must be created. In some types of training, flight simulation for example, the industry can afford to underwrite the cost of developing the material. Public schools, however, require low cost materials. Although a few excellent instructional videodisks have been developed for schools, major educa-
tional publishers generally do not produce videodisks. The volume of available videodisk courseware and players in schools is far below that needed to have a major instructional impact on public education. Moreover, new optical disk formats, particularly CDI (compact disk interactive), are now providing alternative optical formats for instruction.

Compact disks

In 1983 a slightly scaled down optical disk, called a CD ROM (Compact Disk Read Only Memory) was introduced in Europe and the United States. Like its cousin the laserdisk, CD ROM is an optical storage medium designed to hold a vast amount of information. The development of compact disks represented an important breakthrough in storage technology because they were designed to store digital rather than analog data. Computers are digital devices. Consequently, compact disks can be used to store text rather than just video.

The first type of digital data to be encoded on compact disks was audio information in the form of music. Digital audio made it possible to achieve very high levels of musical fidelity. In addition, optical disks are touched only by a light beam during the read process, and therefore do not wear as do traditional records. Consequently, when commercially produced audio compact disks were introduced in 1983, they received rapid acceptance. Compact disks are expected to outdistance records and cassettes as the primary medium for storing music.

CD ROM

Though capable of storing vast amounts of data, early versions of the compact disk suffered from some basic limitations. The digital information was occasionally misread by the player. An error might occur only once in every 10,000 bytes of information. While such a tiny error would be completely inaudible in an audio signal, it would wreak havoc in a computer program. Consequently, few computer storage applications were attempted. This problem was quickly overcome and, in 1985, both Sony and Phillips introduced compact optical disks specifically for use in the computer industry. This format of the optical disk was called CD ROM. CD ROMS contained digital information like CD audiodisks, but used a complex system of error correction to ensure incredible accuracy.
Each CD ROM disk has the capacity to store over 600 million bytes of information, or approximately 250,000 pages of text. This incredible volume of storage constitutes a dramatic leap in storage capacity for small computers. Optical disks will enable microcomputers to access huge databases of information, as large as those of most mainframe computers. Moreover, the information can be searched and retrieved in a matter of seconds.

In late 1985, Grolier introduced one of the first commercial CD ROM disks. Grolier had put its entire encyclopedia on one compact disk, with room to spare. Any item, anywhere in the encyclopedia, could be searched and accessed in less than two seconds. All that was required were a standard microcomputer and a CD ROM player. The price for the compact disk itself was less than $200.

In 1987, Microsoft introduced Bookshelf, a CD ROM library of ten reference works (dictionary, almanac, etc.) for IBM or compatible personal computers. The Bookshelf sells for less than $300.

Compact disk interactive

In March 1986, the first major technical conference on CD ROM technology was held in Seattle. This conference was to be a critical benchmark for CD ROM technology because Sony and Phillips made a startling announcement. They announced a new format for an entirely new type of machine. They called this format CDI (compact disk interactive). CDI was intended to be a truly interactive format, combining all the capabilities of CD ROM and CD audio. In addition, CDI would have the capability for both still and running video. The most exciting aspect of this technology was that a CDI player was not a computer peripheral. It might best be described as a Trojan Computer. The device would look like a CD audio player and would play CD audio disks. However, a fully equipped microcomputer was housed inside. By running a cable to the TV set, whole libraries of information as well as video could be viewed. The information could be accessed and manipulated using a simple hand controller, already found on current audio players.

CDI machines are not expected to be completed and available to the public until sometime in late 1987 or early 1988. As of this writing, they are only a set of technical specifications. However, given the record of the companies involved and the existing success of optical technology, there is little reason to doubt that this technology will arrive.
A new publishing medium

In looking at the cost of compact disks as a publishing medium, it is important to look at the cost of the medium as opposed to the cost of the information. In 1986, several major factories for premastering and mastering compact disks were created in the United States. These facilities can stamp out one compact disk in less than five seconds at a reproduction cost of less than $5. That is equivalent to publishing 250,000 pages of information flawlessly at a printing cost of less than one cent for every 5,000 pages.

Though optical reproduction is highly cost efficient, one should not conclude that books, encyclopedias, databases, and other forms of information will suddenly become dramatically cheaper. The information itself must be paid for first. For example, a medical textbook might still cost as much in optical form because of the value of the information. However, in situations where a copyright can be obtained inexpensively, or where reproduction rights need not be purchased—as in the case of public documents—the cost of publication is dramatically reduced.

The promise

In the second edition of Computer Applications in Reading, we hinted that computers may take the place of books in the distant future. With the advent of optical technology, the future looks considerably closer. We have taken a dramatic leap beyond the electronic book, to the electronic encyclopedia, perhaps the electronic library. Major reference works such as ERIC, the Library of Congress Card Catalog, and the Readers Guide to Periodicals have already been put on CD ROM disks. If these and other references are put in CD ROM or CDI format, the impact upon schools could be dramatic. Given the reproduction costs previously described, it is reasonable to assume that an entire reference library could be put in a single classroom (if not at every student’s desk) for a low cost. Students would have access to enormous volumes of information that could be instantly searched and retrieved. This could potentially change the entire nature of student research in schools.

Textbook use in public schools may be affected as well. It is debatable whether putting textbooks on-line would make them more affordable. The information still must be paid for. However, because optical textbooks would be interactive, they would be significantly more powerful as learning tools. One company has already created (not yet released for sale) a segment of a textbook that uses interactive optical technology to teach the his-
tory of the J.F. Kennedy presidential administration. Key terms, when pointed to in the text, are defined using text and audio. A picture, when pointed to, suddenly comes to life showing an actual film clip of President Kennedy. By pointing at a reference in the text to Kennedy's famous Berlin speech, the student can suddenly hear and see the actual speech.

Limitations

There are still a number of factors that inhibit the use of CD ROM and CDI technology. First, for optical technology to affect large numbers of students, low cost CD players must become available. The development of CD players for noneducational purposes could make this a reality. Second, low cost, portable, high resolution monitors will need to become available. Finally, a sufficient body of low cost educational optical courseware will need to be created to justify the cost of schools purchasing CD devices.

Getting information on optical technology

The CD optical technology industry is new, and detailed information is difficult to find. Only vague references have been made to optical technology in educational journals. The best single source of information on CD ROM technology at this time is CD ROM The New Papyrus (Lambert & Ropiequet, 1986). This hefty textbook was published in association with the first international conference on CD ROM technology sponsored by Microsoft. The text contains both general and technical papers presented at the conference. Another good source of information about optical technology is an industry newsletter entitled CD Data Report (Langley Publications, 1350 Beverly Road, Suite 115-124, McLean, Virginia 22101).

As optical technology emerges, several computer magazines are beginning to devote space to this topic. The entire April 1986 issue of Byte magazine was devoted to optical technology. More consumer oriented magazines such as Video Review and High Technology are beginning to carry reports on optical technology.

Because optical technology is so new, no formal research studies can be cited as to its educational effectiveness. But optical technology creates the potential for putting enormous quantities of reference information in a student's hands. Yet many students currently do not know how to use reference materials in conventional text formats. How should we teach them to deal with electronic versions of these reference materials? How should these electronic reference materials be designed so that students can easily...
use them? Recent research in the areas of artificial intelligence, ergonomics, and information science may be helpful in answering these questions.

Chapter eleven contains references about optical technology and its possible applications to education and reading.

References

1985

Presents a fairly technical analysis of problems of retrieving large text documents from large electronic data bases.


1986

Explains clearly and concisely CD ROM and CDI technology. Discusses the potential effects of cheap mass optical storage on the business and consumer markets.


Provides a brief history of the development of the compact disk.


Provides a definitive source on CD ROMs. Contains information about CD ROM, videodisk, CDI, theoretical issues about the design of electronic media, and electronic text as instructional text.


Discusses the possible uses of CD ROM disks for educational applications.


Provides a brief overview of CDI technology and plans to develop CDI products.


Reviews CD ROM technology, including WORM (write once, read many).


Discusses file structure as it relates to CD ROM development. Given the enormous number of files a CD can hold, the design of the index to those files is critical.
Brewer, B. "Read when you are, CD-I." PC World, 1987, 5 (4), 252-255.
Present the many features of CD-I, including audio, video, and interactive with a personal computer.

Discusses the concept of hypertext as a means to access the large amounts of data found in CD-ROM devices. Hypertext is "a text storage system in which the documents and their context... are indexed not alphabetically or numerically but by association—the way we think."

Reviews the latest development in the fields of interactive video, CD-ROM, and CD-I in education.

Discusses Microsoft Corporation's Bookshelf, a CD-ROM database that uses a personal computer and word processor to access information from such sources as The American Heritage Dictionary, The World Almanac, and Chicago Manual of Style.
Past editions of this book included predictions about the future of computers in reading. Our initial predictions were from the vantage point of 1978 (first edition). In 1982 (second edition) we tried again. Nearly everything we predicted came to pass sooner than we had predicted.

However, a few of our predictions were wrong because we did not anticipate the problems the schools would face in using computers for reading education. First, teachers and administrators are struggling to stay abreast of computer based education developments and ahead of student and parent inquiries. Many teachers and administrators are unaware of available reading programs. Second, software developments have not kept pace with hardware developments. Hardware developments follow the rules of science and the mandates of business economics; software developments follow the educational economics of school board and the preferences of buyers who may or may not be knowledgeable about computers and software. Finally, we are seldom able to match the capabilities of the computer to the diverse needs of learners. Our computer based reading programs have been slow to address what we know about the learning and teaching processes in reading. Even though these problems will not disappear soon, we are enough encouraged by our many successful predictions to venture a few more.

A prediction: More simulations

A simulation is a model of a physical system that operates with clearly defined rules. Using a computer based model of the physical system, students can conduct experiments that help them understand the behavior of the system. When students become able to optimize the operation of the system, it is assumed learning has occurred.

Today's simulations, with respect to reading education, can be grouped into three categories: simulations that cannot readily support the reading
curriculum, simulations that can support the reading curriculum, and sim-
ulations that do support the reading curriculum.

The first type of simulation might possibly support the classroom cur-
riculum if it contained more accompanying texts or other noncomputer in-
structional support materials. This simulation does not directly relate to
anything found in the curriculum; it is often gamelike. To make such simu-
lations usable, teachers must help students meet reading demands, develop
suitable instructional strategies, create supportive materials, and figure out
how and where the simulation might support some part of the curriculum.

Although the second type of simulation can support the reading curric-
ulum, it is not so designed. This type provides text based materials such as
student manuals, teacher's guides, handouts, and worksheets to support the
simulation content. However, the teacher must determine how and when to
use it in the curriculum.

The third type of simulation is designed to support the reading curricu-
lum or any other curriculum of the school. Text based materials and the
computer simulations they accompany are carefully coordinated parts of
the curriculum. Students use such a simulation as they would any other
curriculum based activity. Unfortunately, few simulations are available that
have text based coordination with the curriculum because simulations that
are an integral part of classroom texts have not been produced.

Simulations often increase the work of content area teachers and read-
ing educators. Not only must teachers help students meet the reading de-
mands of their classroom text, but also the reading demands of the
additional text for the simulation presented on the screen, its documenta-
tion, and any instructional support materials. In spite of this, most experts
predict that there will be an increase in the use of simulations as reading
tasks to be accomplished in school.

A prediction: More artificial intelligence in reading

Artificial intelligence (AI) researchers attempt to engineer thinking
and learning and to simulate or model intelligent functions of humans. One
function they are trying to simulate is reading. There are at least two rea-
sons why this is a most difficult task.

First, we are still struggling to understand how humans read. Since
reading professionals and cognitive scientists do not understand many of
the reading processes, they cannot create a program to emulate those proc-
esses. One day computers may "read," but not until we discover more about
how humans read.
Second, computers store and manipulate information electromagnetically with basically unitary processing; humans store and manipulate information electrochemically, completing many processing functions at once. Although new multiple processing computers have been developed, they are still very limited in capability when compared to the human brain.

As mentioned earlier in this text, many educational publishers claim to have AI components in their programs. Clearly, today's computers are not genuinely able to think and learn. The computer merely reconstructs the programmer's algorithms when a problem is presented.

We predict that claims about the use of artificial intelligence will increase. Reading educators should use their critical reading and reasoning skills in interpreting these claims.

A prediction: Programming and authoring

If teachers wish to create or modify programs to meet the instructional needs of their own students, they have four choices: hire a programmer, learn a programming language, learn an authoring language, or purchase a program that contains an authoring option.

The first option is unlikely; seldom is creating or modifying a program an easy task, and good programmers are expensive. Furthermore, quality instructional computer programs with text and graphics take a lot of time and effort to produce—not to mention the time required to learn a programming language such as LOGO, BASIC, or Pascal. Of course, teachers may choose to use an authoring language such as SUPERPILOT. While authoring languages are easier to use than programming languages, learning how to use them to develop a program requires a great deal of time. However, schools can purchase software programs that offer authoring options in the programs. Authoring options permit a teacher to delete, add, or modify the content of a program, and they are relatively easy to learn. For example, an elementary teacher can use an authoring system to enter the weekly spelling or basal reader lesson words into a drill and practice vocabulary program. Since most teachers seem to want to add, delete, or modify the contents of their program to meet the instructional needs of their students, we predict that more educational software publishers will include authoring options in their programs.
A prediction: More telecommunications and satellite communications

As computer use increases in the schools, computer based telecommunications and satellite communications will become more readily available.

Telecommunications

To use the most common form of telecommunications, microcomputer users can plug a modem (modulate/demodulate device) into the computer and a nearby telephone jack, dial and connect with a host computer, and then exchange information with the host computer and other computers connected with the host computer. Teachers and students using modems and microcomputers can receive and exchange information on virtually any topic.

One type of telecommunication, the on-line database or teletext, can be reached through subscription to a database or teletext service. This type of telecommunication service can provide students access to general, all purpose information (e.g., political, business, sports) and bibliographic information (e.g., magazines, newspapers, journals). Since information is generally delivered in text format, students who have trouble reading their texts may have more trouble reading information from telecommunication sources. The largest telecommunication source accessible from the classroom is CompuServe, which provides access to many educational forums and databases: learning and physical disabilities, educational research, EPIE, foreign language, LOGO, Academic American Encyclopedia, and educational travel, to name but a few.

In the future, reading and content area teachers can expect their duties to include helping students learn to read and use on-line databases and forums.

Satellites

Satellite communication is just beginning. One example of satellite communication is software distribution via satellite to schools. Television stations will broadcast the software to a satellite, and schools or school districts will access the software with satellite receivers (dishes). (For more information see Electronic Learning, 1978, 6 (6), 6.)
A prediction: Robots in reading

It seems appropriate that the third edition of Computer Applications in Reading should end with robots (from the Czech word *robota*, which means forced labor or slave). In the earlier editions we speculated on the future, but we made no mention of robots. However, since reading teachers have always used every means imaginable to teach reading, it should surprise few readers that robots may someday be used to teach reading.

If you have doubts about robots in reading, consider these recent events: an orchestra in Japan featured a robot guest organist, two robots played Ping Pong in San Francisco, a robot sheared 200 sheep in Australia, and a robot in California listened to music being played and then printed out the score.

We predict much greater use of robots in reading programs of the future as they approach "human equivalence" (a term coined by the robotist Hans Moravec at Carnegie Mellon University). It takes only a little imagination to see students programming robots to compete in classroom treasure hunts. Of course, students will have to program the robots to read clues, predict solutions, and relate the proper sequences of instructions. We think students will love it and improve their own reading in the process.

Simulation references

1979
Describes the development of simulations for use in reading assessment using the PLATO IV terminal and Tutor authoring language.

1982

1983
States that computer based simulations and problem solving software can help students develop higher level thinking skills when teachers learn how, when, and with whom they should be used.
Snyder, T., and Dockerman, D. Getting to "Aha!" *Electronic Learning*, 1984, 3 (8), 26, 28
Claims that computer based simulations, most of which require students to read text that accompanies the simulation, can be successful for many reasons. Discusses some aspects of a simulation's effectiveness in the classroom.
Discuss the history of educational simulations, their theoretical foundations, and instructional advantages. Describes The Oregon Trail, Change Agent, Tribbles, and The Human Adventure.

1984
Explains that simulations offer much for reading, language arts, and English teachers. While most simulations are for science and social studies, they still involve language activities. Reading teachers can help students better use simulations by assuring that students can read and understand the text.


1985
Hallgren, R. Systematic development of a computer simulation program. Electronic Learning, 1985, 5 (2), 17-20

1986
Introduces the reader to the simulation “Where in the world is Carmen San Diego.” This simulation provides practice on the reference skill of locating information and the reading comprehension skills of attending to detail, recognizing cause and effect, and drawing inferences.

Reviews The Voyage of the MINI (Holt, Rinehart and Winston). This interactive videodisk program contains some of the first simulations present with video (film). Reading teachers will find the videodisk presentations of interest, as well as the student guides and workbooks.

Artificial intelligence references

1979

1981

1982
Discusses the links between artificial intelligence and practical as well as theoretical issues surrounding teaching children to read.


1984


Offers educators an easy to read explanation of AI concepts and presents some examples of AI programs.

1985


Discusses AI and its potential impact on reading as well as what teachers can do to help foster future development of AI principles in reading software.


Covers expert systems as well as language and image processing as they relate to education.


Presents an evocative interview with a seminal figure in artificial intelligence and a critic of some computer applications in the schools.

1987


Questions the ability of AI programs to totally emulate intelligence if they cannot imitate human intuition

Programing and authoring references

1979


1981


Describes a system of task analysis called structural learning theory, then relates this theory to attempts to develop microcomputer based authoring systems.


Defines what an authoring language is and describes briefly eight authoring languages currently available (circa 1981).
Discusses educational concepts bearing on the ease of interaction between users and their computer programs. Concepts reviewed are typographical cuing, advanced organizers, paced output, contextual clues, and conceptual hierarchies.

1982
Discusses the hierarchy of computer languages from machine code to the authoring language PILOT, then compares this to a hierarchy of educational and psychological theory. Concludes that both authoring languages and specific instructional templates are required for the development of true authoring systems.

1983
Explains how computer programing may help students develop comprehension skills such as details, sequence and organization, perceiving relationships, comparison and contrast, and predicting outcomes.
Suggests several books teachers can use to learn more about writing computer programs.
Illustrates the use of flowcharts to help students learn sequential organization of ideas, recognize main idea, identify supporting details, understand flowcharting arrangement, and recognize critical words.

1984
Presents a step by step plan for writing and programing an interactive adventure story with upper elementary students. Includes ideas on teaching plot setting, scenario, and developing characters.

1985
Explains that learning to program can lead to learning beyond programing if programing is part of a coherent, integrated curriculum.
Discusses the parallels between LOGO activities and writing prose.

Presents an instructional approach on how to teach BASIC for purposes of programming reading software.


Explains that teachers can write CAI programs in many reading instruction areas. Demonstrates a compound word program.

**Telecommunication references**

1982


Discusses the use of E-mail (electronic message systems) for instruction.

Robinson, B. *Reading and the video screen*. 1983. (ED 257 429)

Discusses the potential of teletext and interactive cable television to help educators. Includes forty references

1983


Explains how a statewide database allows teachers and schools to exchange reading information and activities for corrective and remedial purposes.


Provides information about on-line databases for school use.


Describes the use of computer based skill banks, material banks, assessment banks, and banks for prescriptive suggestions.


Reviews the state of teletext and videotex Teletext refers to noninteractive information sent to television viewers (subscribers) Teletext refers to interactive on-line systems

168
Pollard, J., and Holznagel, D. *Electronic mail*. 1984 (ED 248 880)

Provides an overview of telecommunication opportunities available to schools that have computers.

1985

Provides a general overview of today's electronic information services.


Discusses how databases can be used to encourage thinking skills.


Discusses how information is transmitted in an electronic message environment.


Presents the major electronically accessible resource databases, including CompuServe, Delphi, Dialog, EduNet, MDC, System Development Corporation, and In-Search.

1986

Analyzes E-mail traffic between an instructor and students. Suggests some implications for E-mail in schools. Includes many E-mail references.


Describes many educational forums and databases available from CompuServe.

Robot references

1983

1984

Describes using a programmable robot (10Po) to help teach and reinforce language skills, including reading and writing.
Appendix A

Sources of reading and language arts software

Academic Hallmarks
6328 Box 998
Durango, co 81301

Acorn Software Products, Inc
634 N. Carolina Avenue, SE
Washington, dc 20003

Active Learning Systems
P. O. Box 1984
Midland, mi 48640

Activision Home Computer Products, Inc.
2350 Bayshore Frontage Road
Mountain View, ca 94043

Addison-Wesley Publishing Company
2725 Sand Hill Road
Menlo Park, ca 94025

Advanced Ideas, Inc.
2902 San Pablo Avenue
Berkeley, ca 94702

Advanced Technology Applications
3019 Governor Drive
San Diego, ca 92122

Adventure International
P. O. Box 17329
Longwood, fla 32750

Agency for Instructional Technology
P. O. Box A
Bloomington, in 47402

Agriculture Computer Services
P. O. Box 5034
Oregon City, or 97045

Ahead Designs
699 N. Vulcan
Encinitas, ca 92024

Alphanetics Software
P. O. Box 339
Forestville, ca 95436

American Educational Computer
2450 Embarcadero Way
Palo Alto, ca 94303

American Micro-Media
P. O. Box 306
Red Hook, ny 12571

American Peripherals
122 Bangor Street
Linden, ny 11757

American Software Design Company
7450 Ivystone Avenue, S
Cottage Grove, mn 55016

Amidon Publications
1966 Benson Avenue
St. Paul, mn 55116

Andent
1000 North Avenue
Waukegan, il 60085

Anthistle Systems/Programming
563 Patricia L- rave
Oakville, Ontario
Canada L6K 1M4

Apple Computer, Inc.
10260 Bandley Drive
Cupertino, ca 95014

Aquarius People Materials
P. O. Box 128
Indian Rocks Beach, fl 33785

Artwork Software Company, Inc.
150 N. Main Street
Fairport, ny 14450
<table>
<thead>
<tr>
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<tr>
<td>Ashton-Tate</td>
<td>3600 Wilshire Boulevard</td>
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<td></td>
<td>Los Angeles, CA 90010</td>
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<tr>
<td>AT&amp;T Bell Laboratories</td>
<td>6 Corporate Plaza</td>
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<tr>
<td></td>
<td>Piscataway, NJ 08854</td>
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<tr>
<td>Alari, Inc.</td>
<td>1265 Borregas Avenue</td>
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<td>Athena Software</td>
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<td>Automated Simulations</td>
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<td>Avante-Garde Publishing Corporation</td>
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<td>A/V Concepts Corporation</td>
<td>30 Montauk Boulevard</td>
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<td>A.V. Systems</td>
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<td>Bannum Dunbar, Inc.</td>
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<td>Bantam Software</td>
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<td>Basics &amp; Beyond, Inc.</td>
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<td>B.E.A.R., Inc.</td>
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<td>Bede Software, Inc.</td>
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<td>Behavioral Engineering</td>
<td>230 Mount Hermon, Suite 207</td>
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<td>Bureau Of Business Practice</td>
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Bytes of Learning
150 Consumers Road
Toronto, Ontario
Canada M2J 1P9

C & C Software
5713 Kentford Circle
Wichita, KS 67220

Captain Software
P.O. Box 575
San Francisco, CA 94107

Cardinal Software
13646 Jefferson Davis Highway
Woodbridge, VA 22191

CASA Software
2103 34 Street
Lubbock, TX 79411

CBS College Publishing
383 Madison Avenue
New York, NY 10017

CBS Software
One Fawcett Place
Greenwich, CT 06836

CCC
(see Computer Curriculum Corporation)

Center for Educational Exper/Dev/Evaluation
218 Lindquist Center
University of Iowa
Iowa City, IA 52242

Chalk Board, Inc.
3772 Pleasantdale Road
Atlanta, GA 30340

Chariot Software Group
3101 Fourth Avenue
San Diego, CA 92103

Charles Mann & Associates
55722 Santa Fe Trail
Yucca Valley, CA 92284

Chicago Systems, Inc.
P.O. Box 429
Western Springs, IL 60558

Classifies Software
8986 S. Overl. II
DeSoto, KS 66018

Class 1 Systems
17909 Maple
Lansing, IL 60438

Classroom Consortia Media
57 Bay Street
Staten Island, NY 10301

Coeur d'Alene Schools
311 N. Tenth Street
Coeur d'Alene, ID 83814

Cognitronics Corporation
25 Crescent Street
Stamford, CT 06906

Columbia Computing Services
8611 S. 212 Street
Kent, WA 98031

Combase, Inc.
333 Sibley Street, Suite 890
St. Paul, MN 55101

Command Data Computer House
320 Summit
Milford, MI 48042

Commodore Computer Systems
1200 Wilson Drive
West Chester, PA 19380

Comp Ed
P.O. Box 35461
Phoenix, AZ 85069

COMPress
P.O. Box 102
Wentworth, NH 03282

ComputAbility Corporation
101 Route 46 E
Pine Brook, NJ 07058

Compu-Tations
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Troy, MI 48099

Computer Applications Tomorrow
P.O. Box 605
Birmingham, MI 48012

Computer Assisted Instruction, Inc.
6115 28 Street, SE
Grand Rapids, MI 49506

Computer Curriculum Corporation
P.O. Box 10080
Palo Alto, CA 94303

Computer-Ed
1 Everett Road
Carmel, NY 10512

Computer Island
227 Hampton Green
Staten Island, NY 10312

172
Computer Using Educators (cuE)
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Redwood City, CA 94063
Computing Adventures, Ltd.
P.O. Box 15565
Phoenix, AZ 85060
Compuware
15 Center Road
Randolph, NJ 07869
Concept Educational Software
P.O. Box 6184
Allentown, PA 18001
Conduit
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Oak Dale Campus
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Control Data Publishing Company, Inc.
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Bloomington, MN 55420
Coronado Courseware
P.O. Box 85271, Suite 171
San Diego, CA 92128
Cove View Press
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Arcata, CA 95521
Creative Curriculum, Inc.
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Huntington Beach, CA 92649
Creative Publications
Warehouse
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Oak Lawn, IL 60453
Cross Educational Software
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Ruston, LA 71270
CSR Computer Systems Research
P.O. Box 45
Avon, CT 06001
CTW Software
1 Lincoln Plaza
New York, NY 10023
Cuenjay
P.O. Box 791
Livermore, CA 94550
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Arlington, MA 12174
Cybernetic Information Systems
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Schenectady, NY 12309
Data Command
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Kankakee, IL 60901
Datamost
20660 Nordhoff Street
Chatsworth, CA 91311
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Aurora, CO 80013
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Rancho Palos Verdes, CA 90274
DCH Educational Software
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Lexington, MA 02173
DCM Products
(through Radio Shack)
DEC Computing
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West Lafayette, IN 47906
DesignWare
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San Francisco, CA 94107
Digtal Marketing Corporation
2363 Boulevard Circle 8
Walnut Creek, CA 94595
Disney Electronics
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San Diego, CA 92120
Diversified Educational Enterprises
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DLM Teaching Resources
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Dynacomp, Inc
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Rochester, NY 14618
Dynatek Information Systems
586 Concord Avenue
Williston Park, NY 11596
EAS, Inc.
108 Morgate Circle
Royal Palm Beach, FL 33411
E. David & Associates
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Storrs, CT 06268
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San Rafael, CA 94903  

Microrim  
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Redmond, WA 98052  

Microsoft Consumer Products  
10800 N.E. Eighth, Suite 819  
Bellevue, WA 98004  

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Millennium Software  
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Mindscape, Inc.  
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Minnesota Educational Computing Consortium  
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Greensboro, NC 27406  

Personal Bibliographic Software, Inc  
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Personal Business Systems  
4306 Upton Avenue, S  
Minneapolis, MN 55410  

Personal Software, Inc.  
592 Weddell Drive  
Sunnyvale, CA 95086  

P.I.E.  
1714 Illinois  
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PLATO/WICAT Systems, Inc  
8800 Queen Avenue, S  
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The Porter Company  
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Pittsford, NY 14534  

Potomac Micro Resources, Inc  
P.O. Box 277  
Riverdale, MD 20737  

Powerbase  
(through Radio Shack)  

Precision Software  
3452 North Ride Circle  
Jacksonville, FL 32217  

The Professor  
959 N.W. 53 Street  
Fort Lauderdale, FL 33309  

Program Design, Inc.  
P.O. Box 4779  
Greenwich, CT 06830  

The Psychological Corporation  
7500 Old Oak Boulevard  
Cleveland, OH 44130  

Radio Shack Education Division  
1400 One Tandy Center  
Ft. Worth, TX 76102  

RAF Software (Rank and File)  
(through Radio Shack)  

Random House School Division  
201 E. 50 Street  
New York, NY 10022  

Raptor Systems, Inc  
324 S. Main Street  
Stillwater, MN 55082
Computer applications in reading
The Small System Center
P.O. Box 268
New Hartford, CT 06057

Society for Visual Education
1345 Diversey Parkway
Chicago, IL 60614

SoftEd
511 Sycamore Circle
Ridgeland, MS 39157

Softape
10756 Van Owen
North Hollywood, CA 91605

Soft Shoppe
P.O. Box 5223
Mesa, AZ 85201

SOFTSWAP
San Mateo County Office of Education
333 Main Street
Redwood City, CA 94063

Software Productions
1287 W. King Avenue
Columbus, OH 43212

Software Research Corporation
3939 Quadra Street
Victoria, British Columbia
Canada V8X 1J5

Software Technology for Computers
153 California Street
Newton, MA 02178

South Coast Writing Improvement Project
University of California
Santa Barbara, CA 93106

Southwest EdPsych Services
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Phoenix, AZ 85001

Spin-a-Test Publishing Company
3177 Hogarth Drive
Sacramento, CA 95827

Spinnaker Software Corporation
1 Kendall Square
Cambridge, MA 02139

Springboard Software, Inc.
7807 Creekridge Circle
Minneapolis, MN 55435

SRA
(see Science Research Associates)

Sterling Swift Publishing Company
7901 South IH-35
Austin, TX 78744

Stockard Microcomputer Software
1744 Willow Point Drive
Shreveport, LA 71119

Stoneware
1930 Fourth Street
San Rafael, CA 94901

Sunburst Communications, Inc.
39 Washington Street
Pleasantville, NY 10570

SVE
(see Society for Visual Education)

Synergistic Software
5221 120 Avenue, SE
Bellevue, WA 98006

Sysdata
7671 Old Central Avenue, NE
Minneapolis, MN 55432

Systems Design Lab
2612 Artesia Boulevard
Redondo Beach, CA 90278

Tamarack Software, Inc.
P.O. Box 247
Darby, MT 59829

Tara, Ltd.
P.O. Box 118
Selden, NY 11784

Teacher's Pet Software
P.O. Box 50065
Palo Alto, CA 94303

Teacher Support Software
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Gainesville, FL 32605-7125

The Teaching Assistant
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Huntington Station, NY 11746

Teach Yourself by Computer Software
2128 W. Jefferson Road
Pittsford, NY 14534

Teck Associates
P.O. Box 8732
White Bear Lake, MN 55110

Telephone Software Connection
P.O. Box 6548
Torrance, CA 90504
Ventura Educational Systems
3440 Brokenhill Street
Newbury Park, CA 91320

Versa Computing, Inc.
3541 Old Conejo Road,
Suite 104
Newbury Park, CA 91320

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(see Disney)

Weekly Reader Family Software
(see Xerox Education Publications)

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Wichita, KS 67201

Windham Classics
(see Spinnaker Software Corporation)

Woodbury Software
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Old Bridge, NJ 08857

Word Associates
55 Sutter Street, Suite 361
San Francisco, CA 94104

World Book Discovery, Inc.
5700 Lombardo Centre, Suite 120
Seven Hills, OH 44131

Xerox Education Publications
245 Long Hill Road
Middletown, CT 06457

Yale University
Department of Anthropology
New Haven, CT 06520

Zephyr Services
306 S. Homewood Avenue
Pittsburgh, PA 15208

Zweig Associates
1711 McGaw Avenue
Irvine, CA 92714
Appendix B

Integrated learning systems

An educator and a businessperson are largely responsible for the early developments of large scale integrated learning systems in computer based reading: Patrick Suppes of Computer Curriculum Corporation—ccc—and William Norris of Control Data Corporation—PLATO. Together, these men have spent hundreds of millions of public and private dollars developing computer based activities across the educational spectrum. This appendix is about the companies and projects they represent.

References about the efforts of CDC, PLATO-WICAT, and ccc in computer based reading can be found throughout the previous editions of Computer Applications in Reading and in other chapters of this text. In the past few years, four other companies have developed integrated learning systems for reading: Houghton Mifflin/Tsc-Dolphin (Box 683, Hanover, NJ 03755), Wasatch (1214 Wilmington Avenue, Salt Lake City, UT 84106), Cemcorp (1300 Bay Street, Toronto, Ontario, Canada M5R3K8), and Ideal Learning (327 South Marshall Road, Shakopee, MN 55379).

Computer Curriculum Corporation

In the area of integrated learning systems, the Computer Curriculum Corporation has been a perennial leader. Suppes is the company's cofounder (with Richard Atkinson) and president. ccc, like PLATO, is devoted to research, development, evaluation, and delivery of computer based instruction.

ccc programs are delivered by the MICROHOST (minicomputer) Instructional System, which has its own student terminals. However, the system can use as student terminals any Apple IIe, IBM PC, Sony SMC-70, or Atari ST microcomputer.

The MICROHOST system individualizes instruction by monitoring each student's progress and providing exercises at a difficulty level matching the student's success level. Teacher handbooks provide information about the
structure and content of the course, directions for using the course, suggestions for monitoring student progress, sample exercises, bibliographies, and skill objectives.

ccc courses cover many grade levels and contain thousands of exercises of two basic types: strand and lesson. In strand structured courses, each strand consists of a series of exercises in a specific skills area. The student's daily work contains exercises progressing from simple to difficult strands. In lesson structured courses, daily work focuses on one particular topic.

Individualized instruction is achieved by analyzing student progress, by diagnosing concept knowledge, and by selecting and generating appropriate exercises. All exercises use computer delivered reinforcement and help prompts.

CCC courses in reading

Audio Reading, Grades 1 and 2 (strand structured)

Presents exercises in beginning reading skills covering letter identification; patterns; sight words; and word, sentence, and passage comprehension. Uses digital speech for audio instruction and motivational messages.

Basic Reading, Grade 2 (strand structured)

Provides reading exercises on single and multiple sentences as well as sentence combining to form stories. Introduces basic sentence patterns and gradually increases sentence complexity.

Reading, Grades 3-6 (strand structured)

Focuses on reading skills at the sentence level. Provides exercises in vocabulary, comprehension, and study skills activities.

Reading for Comprehension, Grades 3-6 (strand structured)

Provides reading exercises on vocabulary, comprehension, study skills, and paragraphs. The paragraphs strand integrates skills developed in other strands and uses reading selections from content area topics and different types of prose.

Reader's Workshop, Grades 3-6 (lesson structured)

Develops reading skills using selections from various content areas and different types of prose. Activities feature a number of on-line resources during a lesson. For example, a student can use an on-line illustrated glossary or ask for tutorial help.

Practical Reading Skills, Grades 5-Adult (lesson structured)

Focuses on functional reading skills with practical, everyday materials such as charts, maps, schedules, menus, labels, and advertisements. Some
subject areas include entertainment, health, transportation, and consumer sources.

**Critical Reading Skills, Grades 7-Adult (strand structured)**

Provides exercises on vocabulary and comprehension skills featuring an offline textbook with 150 selections from various content areas. Extensive tutorial messages guide students in analysis and interpretation of the text content.

**Adult Reading Skills, Adult (strand structured)**

Develops vocabulary, comprehension, and study skills in content of interest to adults. Features elementary reading skills for adult.

**CCC courses in language arts**

**Language Arts, Grades 3-6 (strand structured)**

Provides exercises about verb use, subject-verb agreement, pronoun use, and other elements of grammar for elementary students.

**Fundamentals of English, Grades 7-Adult (lesson structured)**

Presents exercises about language at the sentence unit. Activities include run on sentences and sentence fragments.

**Adult Language Skills, Adult (strand structured)**

Provides exercises about language use for adults.

**English as a second language, Grade 4-Adult (strand structured)**

Provides instruction in English vocabulary and grammar through listening, reading, and writing activities. Digital speech system allows students to hear exercises and explanations in English.

**Writing: Process and Skills, Grades 6-Adult (module structured)**

Consists of two modules, Writing Process and Writing Instruction. Writing Process develops writing competency by guiding students as they generate ideas, organize, write, evaluate, and rewrite their own compositions with CCC's word processor Wordshop (Wordshop is a trademark of CCC.)

**CCC courses with Dial-A-Drill**

Dial-A-Drill courses provide instructional activities with a digital speech system by telephone. Students respond by using a touchtone phone keypad.

**Dial-A-Drill Reading, Grades 1-4 (lesson structured)**

Gives students practice in four reading skills areas—word patterns, vocabulary, comprehension, and study skills. Students are guided through lessons in eight workbooks by telephone directions.
**Dial-A-Drill Practical Reading, Grades 5-Adult (lesson structured)**

Develops functional reading skills with practical, everyday materials, including schedules, menus, labels, advertisements, directions, and applications. Some subject areas include entertainment, health, transportation, consumer, and study skills. A student workbook contains all the graphics, most of the exercises, and a glossary.

**Dial-A-Drill Spelling, Grades 2-8 (strand structured)**

Gives students practice in spelling words frequently taught in grades 2-8.

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**PLATO / WICAT**

PLATO/WICAT Systems was a joint venture of WICAT and United School Services of America, a subsidiary of Control Data Corporation. As such, PLATO/WICAT Systems offered computer based products and services for grades K-12 that were not available from either WICAT or PLATO (CDC). The PLATO/WICAT partnership began in February 1985 and ended October 1986 (See Electronic Learning, 1987, 6, 9-10). Both companies intend to continue services to the approximately 150,000 students using the 325 PLATO/WICAT integrated learning systems. Many of the programs described may not be abandoned, but will be available from WICAT and CDC separately or, perhaps, cast in other formats for use elsewhere.

PLATO/WICAT used a System 300 minicomputer to run its own software and support thirty student workstations. The System can provide computer assisted instruction, testing, computer managed instruction, administrative applications, and an authoring language entitled WISE. In addition, it can provide audio, graphics, and animation to support instructional activities. As mentioned, the System 300 comes with its own student workstations. However, schools can obtain adapters to use IBM PC, IBM PCjr, or Apple IIe/c computers as student workstations.

In September 1985, PLATO/WICAT announced the Local PLATO Delivery System (LPDS). If features an IBM PC/AT compatible computer (with hard disk) that can support up to thirty IBM PC compatible computers as student workstations or workstations that come with LPDS. All PLATO/WICAT System 300 and LPDS programs allow up to thirty students to work at various activities or lessons within a curriculum such as Primary Reading or Reading Comprehension.
PLATO / WICAT System 300 software

Primary Reading, Grades K-3

The primary reading curriculum features 285 lessons covering over a thousand skill activities. Each activity lasts a few minutes and features both teaching and practice. The lessons use audio, graphics, and printed presentations of material. Skill activities include letter discrimination, picture sequencing, letter identification, letter sounds, sight words and sentences, and sentence and paragraph comprehension. Help prompts are available in audio and printed formats. Student performance summaries are also available.

Reading Comprehension, Grades 4-8

The reading comprehension curriculum features 565 lessons presented in the context of newspaper articles and stories. Skill activities include drawing inferences and conclusions, providing justification for conclusions and inferences, judging the validity of an argument, determining the relationship of parts of a story to the whole, interpreting data in nontext formats, and identifying appropriate summaries of a text. Help prompts and student performance summaries are available.

Language Arts, Grades 3-6

The language arts curriculum features over 300 activities in three components: language arts skills, sentence combining, and spelling.

There are two parts to language arts skills: Choose It and Proof It. In Choose It, students use irregular verbs and frequently confused words. In Proof It, students practice proofreading punctuation and generalized capitalization. Sentence combining has students combine two or more sentences into one. Spelling programs help make the repetitive task of spelling more inspiring by using audio and graphics. Student performance summaries are available.

Writing, Grades K-6

The writing curriculum features two components: Writing 1 and Writing 2. Writing 1 has three activities: Calendar, Listen and Do, and Make a Story. Writing 2 also has two activities: Creative Writing and Informative Writing.

The writing curriculum helps students learn to organize information, formulate ideas, and communicate ideas in writing. Word processing, combined with audio and graphic prompts, helps students learn to write for various purposes.

In addition to the curricula described, PLATO/WICAT System 300 offers an English as a second language curriculum.
PLATO / WICAT Ipds software

Basic Skills/Basic Reading Skills, Grades 3-8

Two hundred fifty-four lessons cover 112 skills with activities on word structure, vocabulary, and comprehension development. The curriculum is organized into nine courses: Making New Words (Parts 1 and 2), Understanding New Words (Parts 1 and 2), Understanding What You Read (Parts 1 and 2), Thinking About What You Read (Parts 1 and 2), and Judging What You Read. Student performance summaries are available.

High School Skills/High School Reading Skills

Seventy lessons are organized into five courses; Practical Reading, General Reading, Prose Literature, Poetry, and Drama. Thirty-nine skills are presented in a variety of activities covering vocabulary, identifying main ideas and supporting ideas, and making inferences. Student performance summaries are available.

PLATO/Control Data Corporation

In 1959 and 1960, researchers at the University of Illinois developed a computerized teaching system named Programmed Logic for Automated Teaching Operation (PLATO). PLATO first used the ILLIAC I computer and then, with the support of Control Data Corporation, switched to a CDC mainframe computer. Thus, the PLATO/CDC link was forged. PLATO computer based activities in reading and mathematics flourished throughout the 1970s and early 1980s. No other company has devoted as much of its resources to research, development, evaluation, and delivery of computer based instruction, both in reading and other curricular areas. Some estimates place the money spent by CDC on computer based instruction at the one billion dollar mark.

Commercial introduction of PLATO software was through a Control Data Corporation Education Company for main frame and minicomputers in 1976-1977. It was not until the early 1980s that PLATO software became available for many popular microcomputers. (For those interested in the history of PLATO reading software, see Volumes 1 and 2 of Computer Applications in Reading.)

Today, most PLATO software is available in the following formats: (1) mainframe, online, time sharing; (2) a minicomputer system entitled CDC Education Workstation; and (3) microcomputers.
PLATO courses in reading

*Reading Readiness, Grades K-3*

Provides activities on memory skills, visual discrimination, word detail, and letter naming.

*B basic Skills Reading Instructional Series, Grades 2-9*


*High School Skills/Reading Instructional Series, Grades 6-11*

This PLATO series covers nine curricula areas. The multiple disk series features groups of activities including: Practical Reading 1 and 2; General Reading 1 and 2; Prose Literature 1, 2, and 3; Poetry; and Drama.

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