Effects of microcomputer technology
on young handicapped children

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ABSTRACT

Project ACTT (Activating Children Through Technology) is a handicapped children's early education program (HCEEP) model demonstration, housed in the College of Education at Western Illinois University. Its major goal is to develop, implement, and demonstrate an innovative microcomputer curriculum model using affordable and practical microcomputer hardware and software. The primary target population is composed of children from birth to six years of age who demonstrate moderate to severe structural and functional handicapping conditions that prevent them from interacting with their environment. The families of these children are also major targets for intervention and are partners in Project ACTT.
INTRODUCTION

Although microcomputer technology is not new, its application for handicapped children is relatively recent. It is known that handicapped children can benefit from educational use of microcomputers just as nonhandicapped children can—perhaps in even more dramatic ways. Curriculum materials for the microcomputer, paired with the potential of the intelligent machine itself, promise to facilitate the learning of the handicapped well beyond any other advance in instruction to date. However, application of the potential of the microcomputer to the education of young handicapped children is in its infancy. The experimental work that exists, such as that done by Brinker and Lewis, 1 is not yet practical in terms of cost. The development of practical, affordable applications is still to be completed. Appropriate software is virtually nonexistent, and alternative input devices, although available, must be adapted for use in programs for handicapped children.

Despite these difficulties, the potential of the microcomputer and its accompanying software holds great promise for young children, particularly severely handicapped children. Microcomputers are endlessly patient; they can be programmed to respond in many different ways to diverse forms of input and to function in an interactive fashion. The microcomputer may very well transform education programs for young handicapped children, just as it has affected the rest of society. In order for this transformation to occur, the appropriate software must be developed, hardware and firmware must be selected and adapted, and professionals must know where to begin.

Using Apple II microcomputers, Brinker and Lewis developed a contingency intervention system (based on Piagetian theory) to foster within handicapped infants the expectation that the world is controllable, and to lead them to user-specific behavioral movements to explore the contingencies available. Contingency intervention is defined as the arrangement of events that can be consistently controlled by an infant's behavior. The rationale is that handicapped infants often are at risk of being deprived of contingency experiences because exploration of contingencies depends on motor responses and available social contingencies, which are in many cases minimal, owing to the family's low expectations for the child. Children who do not have contingency experiences early in their lives may develop the attitude that their situations and the environments within which they find themselves are in no way under their control; that is, there is an external locus of control or they experience learned helplessness. This sort of psychological characteristic is extremely difficult to modify, particularly when the conditions that cause the attitude persist for a long period of time, as is typically the case for high-risk and handicapped infants. The results of this externality of learned hopelessness include retarded learning rates, lack of self-direction, limited goal-oriented behavior, and disturbed social interaction. All of these difficulties, of course, compound the problems of handicapped individuals.

Microcomputers have been used effectively to individualize instruction for elementary age and older children in a wide variety of teaching modes, including drill and practice, educational games, direct teaching, simulations, and problem solving. Many of these applications also can be used with younger handicapped children. The effectiveness of microcomputers lies in their multisensory potential; their ability to store, retrieve, and use data on children's programs; and their ability to actively involve children in the learning situation.

The use of technology in special education is, of course, not new. Manipulative devices and sensory equipment have been used for years with handicapped children. Hannaford and Sloane point out that, "As a profession, we have been quick to see the potential of these technologies for the learner with special needs." However, tape recorders, projectors, teaching machines, and switches are a far cry from the complex machine intelligence available with microcomputers. Additionally, microcomputers are the first technology that can be used by teachers of young handicapped children that also play an essential role in adult society in exactly the same form.

Although educational and intervention programs to serve young handicapped children, beginning as early as birth, have developed at an increasing rate over the past decade, until now no program has made full use of the technology offered by the microcomputer revolution. Inexpensive, powerful machines are now widely available in homes, businesses, agencies, and schools. However, most microcomputer applications in special education can be classified as used in management (for keeping records and charting students' development), assessment, strategies for physically handicapped individuals, and drill and practice for school-age children (Bennett, 1982).

PROJECT ACTT

Project ACTT (Activating Children Through Technology) is a handicapped children's early education program (HCEED) model demonstration project funded by the U.S. Office of Education and housed in the College of Education at Western Illinois University. The project's main goal is to develop, implement, and demonstrate an innovative microcomputer curriculum model using affordable and practical microcomputer hardware and software. The primary target population comprises children from birth to six years of age who demonstrate moderate to severe structural and functional handicapping conditions that prevent them from interacting...
with their environment. The families of these children are also major targets for intervention and are partners in Project ACTT.

ACTT is a rural project, developed and demonstrated in west-central Illinois. It incorporates the direct efforts of five agencies: Western Illinois University, McDonough County Rehabilitation Center, Bushnell-Prairie City Community Unit District #170, Colchester Community Unit District #180, and Hancock Central Unit District #338. The microcomputer curriculum intervention developed by the project is being used with the target population of children served in the McDonough County Rehabilitation Center 0-3 program and the 3-6 public school programs in the two school districts. Home visits are part of the service provided by the 0-3 project; however, children in this age bracket also are brought to the ACTT center for microcomputer intervention. The teachers in programs for three- to six-year-olds have been trained to use the microcomputers, and ACTT staff work in their classrooms at least once a week.

The ACTT project staff is using microcomputers with handicapped children as young as eighteen months and plans to work with even younger children. The present case-load includes children who function developmentally under 12 months of age. The major emphasis is on helping children develop a sense of autonomy and control over their environment—something that young handicapped children seldom experience. Families participate in the ACTT activities at different levels of involvement. New software is being developed and existing software is being customized for use with young handicapped children. Adapting selected hardware and peripherals to the needs of these children is also part of the ACTT project.

The ACTT Curriculum

The ACTT curriculum has been developed according to three priorities. First is the need to foster the child's expectations that he can control his environment. Various record-keeping software was also developed at this stage. Second, the curriculum had to provide a mode of communication. Finally, the curriculum was to develop selected preschool skills for children from birth to six years of age. At present, software in the first and second categories has been developed. Planning for the third is now in process; curriculum activities using commercial software are already available.

The ACTT curriculum is based on the knowledge that young handicapped children are limited in the amount of interaction they can have with their environment. The initial interaction, or lack of it, with the environment is crucial in the development of the child’s sense of autonomy and problem-solving strategies. Microcomputer technology provides the means for the young child to control aspects of the environment using switches, adaptive peripherals, and software that have been customized to meet individual needs.

Curricular objectives for the 0-3 population have been designed for use with the Macomb 0-3 Rural Project's Core Curriculum, a functional curriculum widely available throughout the country. Goals and objectives reflect a functional approach and include fine motor, gross motor, social, cognition, language (including an emphasis on pragmatics), and self-help skills. The curriculum was developed by a nationally recognized infant model project that has served hundreds of handicapped infants and their families since 1975. Microcomputer curricular activities are used with various adaptations as deemed appropriate.

Preschool curricular objectives have been developed by the ACTT staff. A progression of developmental behavior associated with acquisition of LOGO skills is currently being tested. Other objectives, related to a wide variety of preschool goals as suggested by Neisworth and colleagues in the HI-COMP curriculum, are related to cognition, problem solving, gross motor skills, fine motor skills, language development, social skills, and self-help skills. The ACTT curriculum is designed to be cross referenced with the HI-COMP curriculum and includes objectives and activities related to attention; concept formation; creativity; interacting with new activities; and experimenting with color, line, form, and space using computer graphics. Customized applications include the use of switches, keyboards, voice synthesizers, robots, and other peripherals. Specific adaptations that must be made with commercial software are part of the project's scope. Review of appropriate commercially available software is under way.

Switch-activated toys have been used to foster cause-and-effect concepts in children from birth to three years of age. These toys are connected to the computer in an effort to monitor responses, add additional capabilities to the switches, change reinforcers, and help the children become accustomed to using a switch—a skill that leads to more sophisticated computer use. Several software programs have been developed to teach children to use switches to control visual features or sound in a program. In addition, some commercial software has been customized by adding preboot disks for single-switch input. A program used in conjunction with a voice synthesizer, which "says" the name of an object when the child touches the appropriate picture on a graphics tablet, also has been developed.

A variety of commercially available software, including LOGO, and project-programmed software is used with the 3-6 population to reinforce the concepts of environmental control and problem solving. Special switches are used by children who cannot manipulate the keyboard. Children operate a robot with a customized version of Instant LOGO and a modified graphics tablet.

The 3-6 population has used LOGO extensively because it is designed to help children acquire skills that are important to ACTT goals. Adaptations to allow for alternate input have been developed, but all children do not need to use them. A number of precomputer activities also are used prior to starting children on the computer. A detailed LOGO curriculum is now being developed.

The effects of the ACTT curriculum on the children are being examined carefully. Videotapes of sessions with severely handicapped and 0-3 populations are taken for later analysis. The project is implementing single-subject design studies to determine the various factors that hinder or help each child's progress. Questions related to child preferences for varying software and firmware characteristics, as well as
optimal time and content of computer sessions, are being studied.

In addition, an observational instrument, the BIT (behavior interaction tool) was developed for use with individual children or groups of children and is currently being field tested. A program to record and analyze behavior has been coded for the Epson HX20. Data files are sent by modem for storage on a mainframe. Results are expected to provide important information about what young handicapped children actually do when they use a computer. The BIT allows collection of data regarding individual child behavior, child-peer behavior, child-adult behavior, and adult behavior.

Physical Equipment

The Apple II+ and Apple Ile were selected for use in the ACTT environment. The decision to use them was based on the variety of available peripherals and software. Resources dictated the choice of only one type of computer because funds were not available to purchase different computers and their accompanying software. Because some applications involve internal machine modifications it was important to purchase equipment that could be interfaced easily with various peripherals for specific purposes. A series of input-output boxes has been constructed to make use of the potential of the gameport for alternate inputs. These boxes can be used to accept single or multiple switch input in place of game paddle or single-key control.

One of the microcomputers used with the I/O box also includes an Adaptive Firmware card, an Echo II or a Votrax, a Unicorn keyboard, a graphics tablet, and a Gibson light pen. A RAM card with 64K memory has been added. This computer does not hold all peripherals at one time, but all are available if needed.

In preschool classrooms the computer ordinarily is set up in a corner, much as any center-of-interest activity would be. Its use becomes one of a number of choices children make during the day. Children often work in groups of two or three, helping each other decide what direction to make the turtle go as they work with LOGO. An effort to use the computers in ways that encourage social interaction is a major consideration in any ACTT activity.

Teaching Strategies

Although some ACTT activities involve direct instruction, many involve setting up a situation in a way that will lead the child to control his own learning. LOGO activities necessitate changing teaching style. Many more divergent questions directed toward problem solving and descriptive comments are asked when children use LOGO. A great deal of planning goes into the development of instructional activities.

The developmental level of computer use seems to involve precomputer activities, transition into computer activities, computer activities, and follow-up activities related to curriculum integration. Teaching strategies may differ from one level to the next.

An essential instructional condition involves the child's control of the computer. This means the teacher does not spend all the time demonstrating while the child watches. In fact, the reverse is true. Frequently, one child operates the computer with advice from other children. Preschool children are often grouped according to various factors. Staff believe will help them to work well together in this manner.

Case Studies

David, a five-year-old with cerebral palsy, is confined to a wheelchair. He has head control, good speech, and a cheerful sense of humor, but he does not have functional hand control, nor does he pick things up and hold them. His vision is restricted in ways his parents, teachers, and other professionals have not yet determined, but David can control a Topo robot with Instant LOGO and a Koala Pad to move Topo around the room in ways he plans ahead of time. He knows that he is in control; he can stop and start the robot at will. With an adaptive keyboard, David can write stories with Storymachine, and he can play Dragon's Keep if someone reads the text to him. Using special software, he can touch the keyboard to make sounds; either music or synthesized speech. He can work through the First Words program by himself. He is learning, with his mother and often with his father, to work through a variety of computer activities to help him learn to use the computer as a tool and to function within the kindergarten setting.

Cheryl, a six-year-old who has not yet been diagnosed accurately, has frequent seizures, is often unaware of the surrounding environment, and has poor language skills. However, she uses precomputer activities in a way that may lead to greater communication with the outside world. Although they started with switch-controlled toys, Cheryl and her mother now use an adaptive keyboard and produce music or sounds. Cheryl pays attention to these activities for increasing amounts of time, smiles frequently, and demonstrates more receptive language than she was thought to have. Additionally, her sense of humor shows in her play with the switch-operated toys. She appears to understand that her hand pressure on a switch results in the movement of a toy rabbit or the barking of a toy dog.

Jerry, an eighteen-month-old who has cerebral palsy, cannot sit unsupported, but he can press a switch to change the Stickybear images on the screen. Anne is two and one-half years old and has little language, but she appears to have near normal physical development and is able to touch a picture on an adaptive keyboard and hear a voice speak the name of the object. Her mother is learning to use a light pen so she can help Anne draw on the screen. Anne's sense of affecting her own environment is not often apparent, but the computer's immediate feedback may help her feel that she does, indeed, make things happen.

Four-year-old twins John and Mark both have cerebral palsy. John is visually impaired and Mark is blind. Both twins function physically at a developmental level below one year, but they are socially aware and respond happily to other people. They have learned to use switches to make things happen on the computer—sounds, music, toy movement.
John presses a switch and watches Stickybear. Mark works with two switches, listening to two different kinds of sounds. The twins' mother works with an ACTT staff member weekly and their father comes to sessions when he can. Both parents believe that the computer is already helpful to their children and that it will be even more useful as they grow older. Meanwhile, the twins are confident they can do something to affect their own environment.

CONCLUSIONS

Young handicapped children can control their environment through computer use. Early intervention using the computer as a tool to help the child gain autonomy, develop problem solving skills, and acquire a sense of cause-and-effect is part of the curriculum being developed by Project ACTT. Materials presently in the production stage will be widely disseminated to help others accomplish similar work. Data collected will provide important information about the effects of technology on young handicapped children and their families. Careful application of the findings may be beneficial to a whole generation of children in the information age.

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REFERENCES

Panel: Hardware/software standards in education—a manufacturer's perspective

Chair:
DAVID SPRAGUE, Western Illinois University, Macomb, Illinois

Members:
JOSEPH CASHEN, Acorn Computer Corporation, Woburn, Massachusetts
H. JAMES WATTS, Apple Computer, Inc., Cupertino, California

Personal computers are becoming commonplace in our nation’s schools. Most schools purchase systems based on educational software support; yet ironically, after the purchase, the two principal uses of the computers are for computer literacy and computer programming. What does this imply for the substantial third-party software base for personal computer manufacturers? Previously, manufacturers targeted schools as an indirect channel for reaching the home computer buyer. Currently, a hardware manufacturer’s school support programs are as vital as the personal computers available in making the school sale. What does this mean for hardware/software standards?

What are the standards for educational hardware/software for the future? Who will determine them? Representatives of leading personal computer hardware manufacturers discuss the next generation of personal computers used in education.

Panel: Designing computer-based learning systems

Chair:
MARILYN D. WARD, Western Illinois University, Macomb, Illinois

Members:
STEPHEN FRANKLIN, The University of California—Irvine, Irvine, California
KATHERINE HARSHBARGER, Western Illinois University, Macomb, Illinois

The Educational Technology Center at the University of California—Irvine is one of the leading projects in the world for research and development of computer-based learning material. Stephen Franklin discusses strategies for designing curriculum materials to use with computer-based learning systems. This material is the result of work by Alfred Bork, Stephen Franklin, and others at the Center. Harshbarger and Ward provide commentary on those strategies, based on experience in using software with students.
Panel: Corporate policies and government legislation—support for education

Chair:
HAL BERGHEL, University of Nebraska, Lincoln, Nebraska

Members:
ROBERT LINEBARGER, Brigham Young University, Provo, Utah
KURT MOSES, Academy for Educational Development, Washington, D.C.
H. RAY SOUDER, Northern Kentucky University, Highland Heights, Kentucky

This session will deal with the impact of the Information Revolution on our educational systems. It will consider such issues as to what extent this revolution alters our educational mission, whether current corporate and government policies are supportive of this mission, and what future policies will be needed if this mission is to be realized.

Panel: Confidentiality, employment agreement and the mobile employee

Chair:
A. A. J. HOFFMAN, Independent Consultant, Forth Worth, Texas

Members:
ROBERT L. GRAHAM, Jenner and Block, Chicago, Illinois
ARTHUR E. PARRY, The Wyatt Company, Dallas, Texas
JAMES R. STALLARD, United Telecomputing, Inc., Kansas City, Kansas

In our increasingly mobile and entrepreneurial society, companies seeking to protect their trade secrets and other proprietary information must repeatedly contend with departing employees. In turn, employees seeking to expand their employment opportunities are increasingly required to sign confidentiality agreements and employment contracts, which limit both their mobility and their ability to start their own ventures. This panel discusses these developments, with special emphasis on recent legal developments governing employment contracts and confidentiality agreements. Such agreements will be of increasing prominence as employers and employees struggle with the tradeoffs inherent in developing proprietary, competitive advantages in a free society.
Panel: Educational delivery systems—use of networks

Chair:
SYLVIA CHARP, Past President, AFIPS, Upper Darby, Pennsylvania

Members:
RICK MACE, Bell of Pennsylvania, Bala Cynwyd, Pennsylvania
JOHN PATTERSON, Temple University, Philadelphia, Pennsylvania

With the increasing use of networks at the precollege and college levels for both administration and instructional purposes, a need exists to understand better the merging of computing and communication technology. Services to students, faculty, administrators, and researchers can be made available both on and off campus.

Panelists will discuss local networks and metropolitan campus networks and their uses of fiber technology and packet switching. Architectures designed for Carnegie-Mellon University and Temple University will be examined, and applications in school systems will be explored.

Panel: Tutorial on structure editing—developments in modern student programming environments

Chair:
DENNIS R. GOLDENSON, Carnegie-Mellon University, Pittsburgh, Pennsylvania

Members:
RAVINDER P. CHANDHOK, Carnegie-Mellon University, Pittsburgh, Pennsylvania
DAVID GARLAN, Carnegie-Mellon University, Pittsburgh, Pennsylvania
MARK TUCKER, Carnegie-Mellon University, Pittsburgh, Pennsylvania

The use of integrated programming environments based on structure editing is an emerging technology that has now reached the stage of being both demonstrably useful and readily implementable. This session contains several related presentations, including an overview of structure editing, mechanisms of implementing programming environments, and their user interfaces. The panelists demonstrate working systems with extensive semantic checking and graphics interface for PASCAL and LAREL THE ROBOT.
Panel: Legal issues in software

Chair:
STEVEN BROWER, Wood, Lucksinger and Epstein, Los Angeles, California

Members:
HENRY W. JONES, III, Vaughan, Phears, Roach, Davis & Murphy, Atlanta, Georgia
BRENT E. WHOLEBEN, The University of Texas—El Paso, El Paso, Texas

This panel discussion addresses current issues in the use and sale of hardware and software. The panel specifically covers the following: The legal implications of providing security, and not providing it, on computer systems; software licensing in Europe; and legal liability issues in educational use. The panel also discusses issues raised by attendees.
END USER COMPUTING

MARVIN EHLERS, Track Chair
Natural Gas Pipeline of America
Lombard, Illinois