DOCUMENT RESUME

ED 244 447 EC 162 460

AUTHOR Behrmann, Michael M., Ed.; Lahm, Liz, Ed.
TITLE Proceedings of the National Conference on the Use of Microcomputers in Special Education (Hartford, Connecticut, March 10-12, 1983).
INSTITUTION ERIC Clearinghouse on Handicapped and Gifted Children, Reston, Va.
SPONS AGENCY National Inst. of Education (ED), Washington, DC.
REPORT NO ISBN-0-86586-149-8
PUB DATE 84
CONTRACT 400-81-0031
NOTE 225p.
AVAILABLE FROM The Council for Exceptional Children, Publication Sales, 1920 Association Dr., Reston, VA (Publication No. 275, $20.00).
PUB TYPE Collected Works - Conference Proceedings (021) -- Reports - Descriptive (141) -- Information Analyses - ERIC Information Analysis Products (071)

EDRS PRICE MF01/PC09 Plus Postage.
DESCRIPTORS *Computer Assisted Instruction; *Computer Managed Instruction; Computer Software; *Disabilities; Elementary Secondary Education; *Microcomputers

ABSTRACT

Thirty-four papers from a 1983 conference on the use of microcomputers in special education focus on specific applications of the new technology. An overview section, section 1, includes papers on computer literacy and daily living skills, considerations for marketing software, and the role of special educators in the information age. Section 2 addresses computers in special education management, with papers on such applications as data-based behavior modification and microcomputer networks for administration and instruction. Section 3, on teacher training, includes discussions on vocational assessment and instruction and testing of generic special education concepts. Among the instructional applications considered in section 4 are computer camps, career planning, Blissymbol drill programs, and handwriting instruction. Section 5 deals with computers as tools, with papers on speech-output communication devices and alternate interface devices for physically handicapped persons. The final section, section 6, lists commercial exhibitors at the conference. Resources are categorized according to four types: general, management, instructional, and tools. (CL)

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A product of the ERIC Clearinghouse on Handicapped and Gifted Children

Published in 1984 by The Council for Exceptional Children, 1920 Association Drive, Reston, Virginia 22091-1589.

ISBN 0-86586-149-8

The material in this publication was prepared pursuant to contract no. 400-81-0031 with the National Institute of Education. Contractors undertaking such projects under Government sponsorship are encouraged to express freely their judgment in professional and technical matters. Prior to publication, the manuscript was critically reviewed for determination of professional quality. Points of view or opinions, however, do not necessarily represent the official view or opinions of either the clearinghouse's parent organization or the National Institute of Education.

Printed in the United States of America.

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FOREWORD

The Proceedings from the Council for Exceptional Children's First National Conference on the Use of Microcomputers in Special Education reflects much of the state-of-the-art application of microcomputer technology. The need for basic workshops on microcomputer use and for information on practical applications of computers in special education was reflected by the overwhelming turnout at the March 1983 conference in Hartford, Connecticut. People from all over the United States as well as Canada, Australia, and Europe attended this conference. The turnout was so large that many presentations were repeated at least once and many twice during the conference.

Primarily due to the proliferation of low-cost computers in education and society, it is not surprising that there is an enormous demand for information regarding the applications and use of computers in the field of special education. These proceedings provide up-to-date information in a different format than other recently published books. These are specific applications rather than theory. It will serve as a sourcebook rather than a textbook.

Computer usage in special education is a natural extension of instruction because of the many similarities among the characteristics of computers, instructional methods used in special education, and the learning characteristics of handicapped children. These similarities include the ability to individualize and to provide needed repetition and the computer's infinite patience in drill and practice. The computer can also be programmed using the principles of applied behavioral analysis to provide consistent and systematic feedback and reinforcement for children. Another similarity is in the logical sequencing used in programming computer software and the special education instructional methods of skill sequencing and task analysis. The computer is an ideal medium for defining and objectively measuring progress toward mastery criteria in instructional tasks, allowing teachers to collect and analyze more data on student performance than previously possible within the parameters of their classroom.

These proceedings represent an initial attempt to provide special educators with current information regarding microcomputers and their utilization in special education. Presenters were asked to submit information for inclusion in this book. Two levels of submissions were available for presenters. They could either provide a brief abstract of their session or provide a more detailed paper for the proceedings. Commercial presentations and information from exhibitors were requested as well as information from program participants. ED numbers at the end of some papers indicate that the paper is also in the ERIC Data Base. ERIC documents may be ordered in microfiche or paper format from the ERIC Document Reproduction Service (EDRS) P.O. Box 190, Arlington, VA 22210.

In organizing the proceedings we have presented them thematically for several reasons. First, this format provides a practical means of information retrieval, because most readers will be interested in a particular application of microcomputers in special education. Second, thematic categorization of the papers helps provide a basis to compare and synthesize the information available in the proceedings. We have also chosen to present detailed papers at the beginning of each section followed by input and output briefs. The input and output portion of each section includes brief abstracts of information presented at the conference. The Table of Contents provides an overview of the thematic categories included in the proceedings. These sections are "Overview of Microcomputers in Special Education"; "Computers in Special Education Management"; "Teacher Training"; "Instructional Applications with Computers"; "Computers as Tools"; and "Commercial Resources."

The overview section presents broad topics of microcomputer applications in special education. It includes the two keynote presentations from the conference as well as other presentations of wide interest. The management section presents material directed toward computer-assisted management and computer-managed instruction; it should be of interest to both teachers and administrators. The teacher training section is directed specifically toward teacher literacy in the use of microcomputers, as opposed to "Instructional Applications of Computers," Section 4, which discusses training children in computer literacy and presents some of the instructional uses of microcomputers with exceptional children. The tools section discusses the use of computers as tools by handicapped individuals. Although teaching exceptional children to use the microcomputer as a tool could be incorporated in the previous section, the use of the computer as a prosthetic or adaptive tool differentiates this material from instructional applications in computers.

The sixth and final section of the proceedings is the commercial resources section. This section provides information from commercial developers and presenters related to their particular hardware and software and provides information on how to obtain these materials.

Michael M. Behrmann
Liz Lahm
March 1984

SECTION 1

INTRODUCTION: OVERVIEW OF MICROCOMPUTERS IN SPECIAL EDUCATION

Section 1 includes five articles providing generic information regarding computer use in special education. Included are the two keynote addresses, a discussion of the need for computer literacy in special education, an introductory paper regarding the uses of computers in special education, and finally some software marketing considerations for special education software.

The first article is the first keynote speech for the conference. Hofmeister begins by trying to place the microcomputer and the computer into perspective in the current social environment. He discusses the broad educational implications of computers and microcomputers in society and the impact of computers on the learning process. The major portion of this document addresses the special education applications of microcomputers, including tool applications of microcomputers. Topics included are (1) computer-assisted instruction, highlighting drill-and-practice programs and tutorial programs; (2) general implications of computer-assisted instruction; (3) management and administrative implications of computers in special education; (4) computer-managed instruction; and (5) computer literacy. The paper closes with a discussion of the computer and the changing role of the teacher in special education.

The second keynote presentation addresses the future of education and the microcomputer revolution. Bitter begins with a review of recent developments and the increasing momentum of technological change facing society. Current computer applications in special education are highlighted, using a variety of specific examples of programming implemented in the author's state. A discussion of computer literacy and the need to develop a school-based curriculum for computer literacy follows. In closing, thoughts on future innovations that are likely to affect education in general and special education in particular are presented.

The last three articles in this section address computer literacy, implementation, and software development. Cain discusses the importance of providing daily computer literacy skills activities for mildly and moderately handicapped individuals. He highlights how handicapped people use the computer as a communication tool, a prosthetic device, a problem-solving tool, and finally a recreational tool. In a series of presentations Taber and Hannaford discuss literacy, microcomputer systems, requirements for implementation of the microcomputer into educational systems, and specific uses for the microcomputer in special education. They include methods of evaluating microcomputer hardware and software. Fuchs looks at computer software marketing considerations for potential software developers. He notes the factors that commercial producers of software are aware of when reviewing software for possible commercial publication. These include marketing distributions, patterns for software, analysis of consumer demands for the software, analysis of what is quality, and how quality affects software. The implications of future developments in technology and planned obsolescence of today's software is also discussed.

THE SPECIAL EDUCATOR IN THE INFORMATION AGE

KEYNOTE PRESENTATION

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INTRODUCTION: THE UMBRELLA PHENOMENA

The major purpose of this conference is to share information on the applications of the microcomputer to special education. Before we can discuss microcomputer applications, we must place the computer in perspective. Contrary to many statements in the press and notwithstanding _Time's_ award (_Time_, 1983) to the computer as the machine of the year, the major phenomenon that we are witnessing is not a computer revolution. The major phenomenon is the birth of the information age. We represent the last generation of the industrial age. The pupils coming to school are the first generation of the information age. When today's eighth-graders take their place in society, 75 percent of them will be involved in information-related industries.

We are participating in a massive change in the structure of society. For those of us whose life span will include the transition between these two ages--the industrial and the informtion age--this is indeed a time of wonder, challenge, and confusion. Like the adolescent caught between childhood and adulthood, we are experiencing that strange mixture of excitement and confusion as some of our traditional reference points dissolve and we try to determine which of the new directions has substance and which are shallow seductive facades.

By assigning the information age the role of umbrella phenomenon, I in no way want to belittle or minimize the impact of the computer. The computer is the major tool of the information age. By a serious study of the computer we can get glimpses of the nature of the coming information age and of the potential impacts on us as individuals and society as a whole.

BROAD EDUCATIONAL IMPLICATIONS

One of the lessons that we have learned from P.L. 94-142 is that we are educators first and special educators second. We cannot hope to serve the handicapped population effectively if we lose sight of the overall mission of the educational profession. One of the primary impacts of the information age on the education profession as a whole is tied to a dramatic change in the way we approach the storage, retrieval, and application of information. We were raised in an age when much of the critical knowledge that we gained in school could be contained in a few textbooks. Most of this knowledge stayed viable for years after we finished the formal education process. The rapid expansion of our knowledge base is such that the notion of the textbook as a source of information for future use is both obsolete and debilitating for the pupils taught under such assumptions.

The challenge of all educators is to help our pupils survive in a world where the information that they will need does not exist. The preparation of pupils to access and apply information that does not exist is a task that is new to most educators.

As special educators, we face the same problems as regular educators. We do not know for sure what the societal challenges will be for the population of special education students presently in our charge. The advent of the industrial age created major changes in the life style of individuals in the late nineteenth century. These changes had a profound impact on the quality of life of the handicapped in society. With the industrial age came the emphasis on asylums, state hospitals, and centralized facilities. Such facilities were necessary to care for handicapped individuals whose traditional support systems had been dissolved or disrupted as the more flexible, rural life styles disappeared and previous caretakers moved to full-time employment in the factories.

What changes will occur as a result of the information age? We can only hypothesize. We can gain only glimpses. There are those who would suggest that the massive emphasis on technology and science associated with the information age will make society so complex that the power in society will be vested in that percentage of the population that has the knowledge and skills to manipulate information management tools such as computers. There are others who suggest that the technology will make life so simple that everything will be user-friendly; we will not have to think that hard, and the computers will take care of many of the stressful activities occupying our time. This latter vision chills the blood of some individuals concerned about the intrusive nature of the information age. They view the abdication of our faculties to think, plan, and search as an abdication of our humanity.

How can we prepare to fulfill our professional obligations in the face of such conflicting projections? As we receive these messages from the futurists, we should be wary of developing a sense of inevitability and helplessness. We should view the process as an evolution and not a revolution. There is one clear course of action that is open to us. If we build our information management skills, if we develop our ability to manage the tools of the information age, we will be much better prepared not only to develop and assess future courses of action, we will be able to direct the course of the future.

It is the development of these skills related to the computer that is the major reason for our participation in this conference. The term commonly applied to the acquisition of these skills is computer literacy. The possession, or lack, of such computer literacy as it applies to our own profession will determine whether we are passive recipients or active participants in the information age.

THE LEARNING PROCESS

It has been a well-documented fact that many of the handicapped individuals in our society assume their greatest visibility during their school years. There have been a number of explanations given for this. Some would say that it is a function of our statistical processes in that we tend to keep better statistical data on school-age pupils than other members of the population. Some skeptics would say that it is understandable in view of the special education profession's propensity for empire building. I prefer to think that a major reason for the visibility of so many handicapped individuals is that we have placed them in a substantial learning environment. Many of these individuals are handicapped because they do not adapt to the learning process as well as their peers.

A developing characteristic of the information age is an emphasis on a lifelong learning process. One of the more perceptive observers of technological impacts on society is O. K. Moore, the developer of the "talking typewriter" in the middle 1960s. With regard to the impact of the new technologies on society he and Andersen (Moore and Andersen, 1969) made the following observations:

> We think that one important result of this technological leap is that we are in transition from what we have called a "performance" society to a "learning" society. In a performance society, it is reasonable to assume that one will practice in adulthood skills which are acquired in youth. . . . In contrast, in a learning society, it is not reasonable to assume that one will practice in adulthood the skills which were acquired as a youth. Instead, we can expect to have several distinct careers within the course of one lifetime. Or, if we stay within one occupational field, it can be taken for granted that it will be fundamentally transformed several times. In a learning society, education is a continuous process--learning must go on and on and on. Anyone who either stops or is somehow prevented from further learning is reduced thereby to the status of an impotent bystander.
>
> We assume that the shift from a performance to a learning society calls for a thorough-going transformation of our educational institutions--their administration, their curricula, and their methods of instruction. Education must give priority to the acquisition of a flexible set of highly abstract conceptual tools. . . . What is required is the inculcation of a deep, dynamic, conceptual grasp of fundamental matters--mere technical virtuosity within a fixed frame of reference is not only insufficient, but it can be a positive barrier to growth. Only symbolic skills of the highest abstractness, the greatest generality, are of utility in coping with radical change. (pp. 583-584)

SPECIAL EDUCATION APPLICATIONS OF MICROCOMPUTERS

With the broad implications of the developing information age in mind, I would like to turn to the specific applications of the microcomputer in special education. In special education there are four major areas of application: (1) tool applications, (2) computer-assisted instruction (CAI), (3) computer-managed instruction (CMI), and (4) computer literacy.

Tool Applications

The tool applications that I particularly want to address in special education are those where the pupil uses microcomputer technology as a personal assistive device. Examples of this include the gifted child using the computer to help solve a mathematical equation; the learning disabled child using word processing and related programs to analyze spelling and grammatical errors; the visually handicapped pupil using electronic aids to translate print into synthesized speech; the deaf child and the speech-impaired pupil using the microcomputer to translate typed-in information into synthesized speech; and the physically handicapped child using microcomputer technology to activate muscles that have damaged neural connections.

These electronic personal assistive devices have made dramatic changes in the quality of life of a number of special education pupils. This is an exciting and growing field that has already yielded rich returns for comparatively modest investments. As Vanderheiden (1982) observed:

> The past few years have witnessed a tremendous increase in the number of individuals and small groups involved in the development of special aids for disabled persons. Microcomputers have given individual designers who don't have access to extensive laboratory and production facilities, the capability of developing sophisticated electronic aids. (p. 136)

The major contribution of these electronic aids has been to the sensory and motor handicapped members of the special education population.

Computer-Assisted Instruction

Without wishing to detract or minimize the value of the personal assistive devices to which I have just referred, it should be noted that the special education groups who benefit most from these devices represent approximately 7 percent of the school-age handicapped population. The visually impaired, the deaf, the hard of hearing, the physically and otherwise impaired, and the multiply handicapped comprise approximately 7 percent of the school-age handicapped population. The remaining 93 percent is made up of the learning disabled, the speech impaired, the mentally retarded, and the emotionally disturbed (U.S. Department of Education, 1982).

Of primary concern for the majority of the special education pupils in our case will be the relationship between the instructional applications of the computer and the needs of the special education pupil. The most prevalent application of the microcomputer in instruction is in computer-assisted instruction. CAI programs are generally discussed in two categories: drill-and-practice and tutorial programs.

Drill and Practice. Drill-and-practice CAI programs are the most used and probably the most criticized of the different types of CAI products. Some of the criticism is justified because many of the poorer software programs are drill-and-practice programs. Beginning CAI software programmers often begin with drill-and-practice programs because these programs are short and often do not require sophisticated programming skills. The result has been a large volume of poorly written products that confuse the naive user, anger the sophisticated user, and embarrass the authors as they become more skilled in CAI development.

Drill-and-practice programs are the flashcards of CAI; to the extent that there is a place for flashcard-like activities in the classroom, there is a place for good drill-and-practice software. Although few people would question the need for drill and practice in subject areas such as typing, some do object to the stimulus-response type of instruction in other curriculum areas. It should be remembered that to function at higher cognitive levels, certain preliminary skills must be automatic. Pupils cannot do quality creative writing if they are consciously fumbling with the subskills of spelling and punctuation. Long division cannot be done quickly and accurately if the subskill of subtraction is not mastered. Drill-and-practice programs have an important place and are most appropriately used (1) for subject matter that needs to be well mastered to facilitate the effective performance of higher level skills, (2) after the concepts related to the skill have been taught, and (3) just before the application of these skills to higher levels in the curriculum hierarchy.

The problems with drill-and-practice CAI are mostly problems of teacher management rather than computer-related problems. Drill-and-practice activities that are used as a substitute for the necessary teaching of the underlying concepts as well as drill that is not followed by meaningful applications of the skills are inappropriate uses of drill and practice, regardless of whether a computer is involved. The issues relating to the inappropriate use of drill and practice were well summarized in a study

> The results do not call the curriculum itself into question, but instead, they challenge a fundamental assumption of any drill and practice approach. That students bring with them to the drill experience some prior understanding of the exercise topics. These results would seem to be a strong argument for closer integration of classroom teaching with any curriculum that provides drill and practice, and for a careful analysis and assessment of the prerequisites necessary for children to obtain maximum benefit from a drill-and-practice curriculum. Perhaps with exposure to fundamental concepts and models prior to extensive drill-and-practice, such curricula can exert even greater positive impact on student achievement. (p. 31)

The overlearning of skills is an important practice in special education. We have been highly dependent on good drill-and-practice activities. The microcomputer holds the promise of adding considerably more instructional resources. Here lies a dilemma. The more attractive and effective the activity, the more it frees the teacher, and the more the teacher will be inclined to overuse it. Furthermore, the more a teacher overuses drill and practice, particularly as a substitute for tutoring in the concepts underlying these activities, the smaller the contribution that the drill and practice will make. A good CAI drill-and-practice program is like a sharp axe. When properly applied in skillful hands, it will make a major contribution. Improperly applied by those who do not fully understand its role and contribution in the instructional process, it will make a mockery of good instructional practices.

Tutorial Programs. One of the characteristics that we generally attribute to the good special education teacher is that of an insightful, empathetic, and effective tutor. CAI tutorial programs should, therefore, be of major interest to the special educator. CAI tutorial programs hold considerable promise for the special educator. Because the majority of special education pupils are served in regular class settings, where teacher-pupil ratio is not as advantageous as it often is in separate special education classes, any technology that has the potential of increasing the level of personalized instruction should be thoroughly explored.

There are three different types of tutorial programs. The most common approach is to use the theoretical structures and procedures from programmed learning materials. In a programmed learning approach the subject matter is organized into instructional sequences, usually in a hierarchical manner. These programs stress active responding by the student and make extensive use of feedback and the branching to previous material or alternative sequences when student mastery criteria are not being met on specific objectives.

Simulation. Another approach, these programs typically include some elements of the programmed learning tutorial approach. Central to the program is some simulation of an environmental event. It may be a chemistry experiment, the movement of travelers on the Oregon Trail, or the prediction of a volcanic eruption. Such simulation of real events can create a powerful instructional experience. One of the best examples of the value of simulation is that used for flight trainers. This program is used in the initial stages of instruction, as an alternative to actual airplane flying. This program saves personnel time, equipment costs, and pilot lives. Simulation-based tutorials are invaluable where real-life events are too expensive, too dangerous, or too difficult to create or observe.

tutoring systems or intelligent computer assisted instruction, these programs are popular in medicine, geology, chemistry, and education.

One of the most popular artifical-intelligence-based approaches is the knowledge-based expert system. The intelligence of the human tutor is built into the system through the identification of specific rules or heuristics. Typically these rules are identified through observing or interviewing an expert. Some of these systems contain over a thousand separate rules that were identified after months of interviewing and observation of experts. These programs are expensive to develop, and the memory and speed requirements of the host computer are such that few were designed for microcomputers. However, within the last few years several intelligent tutoring programs have been transferred to microcomputers.

I would like to exemplify further the difference between the traditional approach to CAE and intelligent tutoring systems. At Utah State University we are completing an interactive videodisk program to assess the math skills of mildly handicapped pupils. The system consists of a microcomputer, a videodisk, and a touch-sensitive color monitor. Attached to the microcomputer are two disk drives and a printer.

The computer presents questions in audio and color video on the screen. The pupil responds by touching an object or answer alternative on the screen. The computer monitors pupil responses and, when a pupil makes three consecutive errors in one curriculum strand, branches to another. The microcomputer can be programmed to conduct the assessment in English or Spanish. The logic is a traditional approach in that decisions are made based on a standard formula, e.g., branch to another strand after three consecutive errors.

After we collect sufficient information about how pupils perform in different curriculum areas, it will be possible to make the decisions much more "intelligent." The computer, rather than branching after three errors, would assess the probability of future questions being productive. This would be done by collecting information on the skills the student brought to the testing situation, performance to that point, as well as other variables related to performance. This pupil information would then be compared with the information stored in the computer on the behavior of other pupils who were previously tested. A decision would be made based on probability statistics, whether further testing in a given strand hierarchy would be productive.

In a similar manner the computer samples the pupil's performance on selected English and Spanish items and decides whether the pupil should be tested in English or Spanish.

One intelligent tutoring system with clear implications for special education is the "Buggy" program (Brown and Burton, 1981). This program helps individuals identify common arithmetic computational errors. Buggy and other intelligent tutoring systems offer promise for the following reasons:

1. They tend to focus on critical skills. Although not comprehensive like traditional programmed learning-based tutorial CAI programs, the skills on which they do focus are usually gateway skills.
2. Because these programs tend to focus on errors, they are of considerable interest to special educators who are looking for ways to clearly identify and remediate errors.
3. The development of an intelligent tutoring system requires an extensive study of tutor/pupil interactions. Information of this kind will not

General Implications of CAI

A few general comments regarding the total field of computer-assisted instruction are in order. First, I become concerned when I observe educators relatively new to computers becoming overly impressed with and intimated by CAI to the extent that they start to lose confidence in their instructional techniques. There is nothing in the research literature to suggest that computer-assisted instruction is the best form of individualized instruction. Indeed the literature (Hartley, 1977) suggests that although computer-assisted instruction is generally better than other approaches such as programmed learning and individual learning packages, it usually comes in second to structured tutoring approaches such as peer, cross-age, and aide tutoring.

For many people, computer applications in education are synonymous with CAI. This misconception is unfortunate for at least two reasons. First, it fails to recognize the issue of computer literacy and the need for the computer to be seen in its full societal role as a tool of the information age. Second, computer-assisted instruction is a developing area and subject to considerable variation in product quality. To advocate or criticize all computer applications in education on the basis of the present state of the art of CAI would be most unwise. Advocates of CAI must realize that we will do a disservice to both student and CAI by suggesting that CAI is the best and only approach to individualized instruction. Critics must be sensitive to the fact that CAI is still in its infancy; to condemn because there are some poor products may inhibit the development of the field and our chance to learn what contributions are possible.

COMPUTER-MANAGED INSTRUCTION

Of the several applications of the computer to education, computer-managed instruction (CMI) is probably the least visible and least discussed. Although the fortunes of CAI have fluctuated, CMI has been making quiet but substantial contributions to education. With its emphasis on the management of instruction-related information rather than the direct teaching of pupils, CMI may be the most cost-effective example of the application of computers to instruction.

A basic responsibility of all teachers, and the special education teacher in particular, is the development of an individual program for each child and the monitoring of the child's progress through that individual program. The use of the computer to support the prescription and monitoring of individual programs of study represents one of the oldest and most extensive applications of the computer in education.

Burke (1982) has defined CMI as "the systematic control of instruction by the computer. It is characterized by testing, diagnosis, learning prescriptions, and thorough record keeping." We can see in this definition a clear and strong relationship between computer-managed instruction and the special educator's IEP responsibilities.

I became most impressed with the potential of CMI after serving as an external evaluator for the GEMS project. GEMS is an anachronym for goal-based educational management system. It was developed in the Jordan School District, a large, rapidly developing, urban school district south of Salt Lake City.

objectives. For example, GEMS reading contained strands of phonics, structure, vocabulary, comprehension, study skills, and affective reading. Within these strands were some 200 goal units. Each goal unit was further divided into specific objectives. As the students completed units of study, they were tested; if mastery were achieved, they moved on. If mastery were not achieved, alternate learning strategies were identified and implemented. Because the computer contained all the preassessment and postassessment information on each pupil, the teacher could call for a range of computer reports on the progress of individuals or groups.

The reference to the computer providing an essential research base reflects a major value of CMI. By analyzing the progress of students through the specific curriculum units, staff at the school and district level were able to identify areas of weakness. The information was used to remediate these weaknesses. Alternative teaching strategies were developed; curriculum sequences were revised, instructional materials were changed, and in-service training programs were developed. The effect of these changes was then monitored by using the computer to analyze the achievement gains of pupils. Ineffective practices and materials were replaced. What resulted was a continuous process of intervention, evaluation, and program revision. In the GEMS project the effect of this process was substantial. Within a two-year period, the average reading comprehension score had jumped 10 percentile points, from 45 to 55, and the average vocabulary score jumped 21 percentile points, from 45 to 66. One of the impressive findings in the data was that all populations--the high performing pupils, the Title I, and those with learning problems--benefited.

The GEMS project was able to demonstrate impressive accomplishments at a modest cost and has been replicated in a host of other districts and states. It must be remembered that the presence of computerized banks of data on pupil achievement is of little value by itself. There must be a commitment by the teachers and administrators to use the data to help direct improvements. This sense of self-evaluation and professional accountability was present in the Jordan School District staff and was <u>the</u> major factor responsible for the success of GEMS. The computer was a tool--a tool that was used with skill and sensitivity to make a significant improvement in the achievement levels of thousands of pupils.

One of the interesting aspects of the GEMS project was the generalizability of the model, which followed a classical computer-managed instruction model and was designed basically for all students. The characteristics of the model and its implementation were such that it followed closely the requirements of an individualized educational program.

The success of a CMI program is highly dependent on the manner in which the staff view the data generated by such a program. There are two ways that we can approach that data. We can view the data as an end product in itself. For example, under P.L. 94-142 we have a requirement to monitor individualized education programs. The presence of data is evidence that monitoring has occurred. The other alternative is to view the data not as an end product but a stepping stone to program improvement. In special education we have a large number of computerized programs designed to facilitate the management of individualized education programs. Some of these computerized IEP programs have been instituted to reduce the paper work burden.

accountability and conducts the necessary record keeping for the establishment of individualized programs of study and the monitoring of these programs. An interpretation of the extra paper work complaint from such a teacher is essentially that an effective record keeping-system is already installed and the teacher does not wish to be bothered with additional record keeping.

Another interpretation of the extra paper work complaint comes from the teacher who is not conducting functional record keeping and feels highly uncomfortable with the accountability pressures associated with IEP paper work. The interpretation of the extra paper work complaint from this teacher is essentially one of "I don't want to be involved in any activities that will force me to be accountable for my instructional behaviors."

Given the existence of these two approaches, it should come as no surprise that the implementation of some computerized IEP programs has not facilitated the professional accountability spirit behind the law. In some implementations the computerized IEP has facilitated the segregation of record-keeping and classroom practices.

One advantage of many computerized IEP systems is that, for those who care to look, some interesting information can be found. Some skeletons in the professional closet become alarmingly visible. As a profession, we have some large gray areas in our practices relating to identification, assessment, placement, and program preparation. This has little to do with P.L. 94-142 but reflects rather the infant nature of special education as a discipline. If you care to analyze some of the computerized IEP records and compare them with classroom practices, you will find in certain school districts a rather alarming number of inconsistencies. You will find that screening information does not always match assessment procedures; that assessment information is not always consistent with pupil classification and program recommendations; and that classroom practices are not always consistent with IEP program information.

It is clear the computerized IEP does not always function as an implementation of the information age. It is somewhat analogous to a stone-age citizen using an outboard motor as an anchor for a raft. What we have done is move our paper records into the computer. We are treating the computer as an unintelligent file cabinet. The computer is perfectly capable of determining the degree to which the process of screening, assessment, classification, placement, and program implementation is a generally rational process. One would hope that the reason we have failed to use the intelligence of the computer to monitor the rationality of our activities is due mainly to our naivete regarding computers and not our lack of interest in evaluating the validity of our decisions. Having seen computer-managed instruction make a significant difference in the quality of life for thousands of children, I become saddened when I see computers being used as final resting places for valuable information that could be used for program improvement. In many ways the unopened file cabinet is preferable to the computer storing of information that is never used. At least with the unopened file cabinet we were not fooling ourselves that we were doing something significant or professional.

COMPUTER LITERACY

In the previous applications that we have discussed, the computer served as a tool--as a personal assistive device, as an instructional aid, or as an information management device. In computer literacy the computer is that presented by Hunter (1983) who defines computer literacy as "whatever a person needs to be able to do with computers and know about computers in order to function in an information-based society".

One of the primary roles of the special educator is to identify those critical survival skills that individuals need as they move into adult society. In analyzing the needs that an individual will find necessary to function effectively with computers in an information-based society, we find skills, knowledge, and attitudes important components of those needs. Another consideration with regard to these needs is that they will not be static and they will vary with time, place, and the individual.

There appear to be two major components of a computer literacy curriculum: computer use and computer awareness. Computer use is concerned with the mastering of technical skills necessary to interact with computers. The second element, computer awareness, is concerned with the development of understanding and attitudes that will allow the individual to function effectively in a computerized society. Both components represent challenging instructional problems for the special educator. The teaching of computer science is a major challenge because of the lack of resources in the form of trained staff, equipment, and a well-structured, validated curriculum. The teaching of computer awareness is also complicated because of the lack of resources and the often subtle nature of the learning process. The teacher already intimidated by computer technology will have considerable difficulty teaching the attitudinal objectives associated with computer awareness.

Information Access and Application

The major substance in a computer literacy curriculum does not lie in mastering some specific hardware manipulation skills. If it were just a motor skill requirement, we would indeed be fortunate because generally special educators have done well in the teaching of specific motor skills. The central thrust of computer literacy must be concerned with the individual's ability to access and apply computer-stored information. The skills that we use in moving information from person to person are insufficient for moving information between individuals and computers.

Before information can be processed by a computer, it must be structured in a form acceptable to the computer. This structuring requires that information be sequenced and that the outcome of all decision points be considered and planned.

One way to determine if the information is structured for computer interaction is to see if it can be represented as an algorithm. This procedural, or algorithmic, thinking is the gateway skill for computer programming. Procedural thinking is also necessary for informed interaction between the user and the computer. Individuals who understand algorithmic structures are in a much better position to meet their own needs as they interact with computers. The uninformed individual is forced to interact in a reactive manner and is usually at the mercy of the software. Adaptions to individual needs that were not considered or well planned by the software developer are not available to those who do not have the broad algorithmic concepts underlying much of our software design.

The fact that many of the individuals who have seriously studied priorities in a computer literacy curriculum have identified this procedural thinking as an extremely high priority gives no great comfort to the special educator. Those of us who have worked with the mildly handicapped are all too familiar with the difficulty that these pupils teachers. For the moderately and severely handicapped, we face similar challenges. Many of the daily personal survival skills that we included in our curricula--skills related to shopping, use of transport, personal budgeting--are all changing as computerization begins to impact on every facet of community life.

Computer Literacy for the Teacher

Up to now we have considered computer literacy from the special education pupil's point of view. What does this mean for the special educator? We, like the pupil, must build our own computer literacy skills. Some of these skills will be the same for us as for our pupils. Others will be peculiar to our own particular role. This is an area of considerable confusion for many special education teachers. Where do we start?

I would like to suggest that you prepare your own individual computer literacy program. The program should have two components: (1) a listing of skills that you wish to acquire and (2) a listing of activities that will facilitate the development of these skills.

You should list your skills in order of priority. The following example lists a set of skills in order of priority:

1. Develop competency in a word-processing program and use word processing for communication with parents and for managing classroom assignments.
2. Develop competency with a simple data base management system and apply these data base management skills to classroom record keeping.
3. Screen, select, and evaluate CAI software.
4. Learn some elementary computer language skills.

You will notice that I listed experience with a computer language as a relatively low priority. Some teachers feel that they will not be able to do anything with their computer unless they learn a computer language. This is an extremely erroneous notion. We have a wealth of powerful software available to the classroom teacher. Much of this software can be used by individuals with no computer programming experience. Word-processing software and data base management software are extremely practical, flexible classroom programs that can be learned quickly and require no computer programming experience.

Some computer programming experience has value but not for the purpose of having teachers write their own computer programs. Few teachers will have the time to develop the skills needed to prepare quality computer programs. It is much more important that the teacher be an intelligent user of existing quality software programs. Teachers who have the aptitude, time, and interest to develop computer programming skills, should by all means develop programs. The field is in need of programs developed by individuals who are both good teachers and good computer programmers.

COMPUTERS AND THE CHANGING ROLE OF THE TEACHER

Because much has been made of computer-assisted instruction, some individuals in the teaching profession feel that the computer represents a threat. Nothing that I have observed in present practices or future trends suggests that this is even a remote possibility in the near future. If anything, the heavy involvement of computers in the classroom will make the teacher an even more precious commodity. Let us look at this issue in

Virtually all the successful CMI programs are designed to support the teacher as decision maker. This point can be made by comparing the traditional, standardized districtwide group achievement testing and CMI-generated achievement monitoring. Standardized group testing often diminishes the role of the teacher as decision maker. Standardized group testing data are often late and not tied directly to the materials and specific curriculum objectives in a classroom. The data often have little decision-making value for the classroom teacher. CMI pupil achievement information is provided quickly and is tied closely to the specific objectives and instructional practices in the classroom. It is decision-making information that is timely and relevant. The role of the teacher as decision maker is enhanced by such information.

With regard to computer-assisted instruction programs replacing the classroom teacher, all the research information points to the contrary. CAI has generally done much better in a supplementary, rather than an exclusive, role in instruction. The involvement of CAI may modify some teacher activities but will certainly not diminish the importance of the teacher. If anything, we have created an even more complex instructional environment because teachers, in order to be able to select and apply CAI software intelligently, need all their present skills plus those skills associated with this new technology. We will have a problem holding teachers. The more teachers build their computer skills and the more they become adept at information management practices with these new technologies, the more attractive they will become to business and industry. We can anticipate an even larger drain as more teachers look to other professions that will pay more for their technical skills.

As I look ahead and try to predict the developing role of the special education teacher in the information age, I see exciting new directions with considerable substance. The highest immediate priority is the development of computer-managed instruction. Computer-managed instruction is a decision-making and planning tool. Such planning must precede the application of computer-assisted instruction. Computer-assisted instruction is, at this point, too undeveloped to make an immediate contribution to either special or regular education. In the long run, as we learn more about the instructional process, CAI will indeed make a major contribution.

CONCLUSION

I would like to close with an observation on our role as individuals. Robert Mager (personal communication, 1972) once made the observation that an educator should regularly experience the role of the learner to remain sensitive to those instructional behaviors that support and confound the instructional process. For most teachers the development of their own computer literacy skills will place them in the role of the learner. For the educator committed to the instructional caste system, this learning role will be aversive. It is hoped that the professional special educator will view the learning role as an opportunity--a chance to share in the excitement, a chance to serve as an enthusiastic role model, a chance to learn from pupils, a chance for teacher and pupils to glimpse the future as partners in the same learning venture.

ED#232348

Alderman, D. L., Swinton, S. S., & Braswell, J. S. Assessing basic arithmetic skills across curricula, computer assisted instruction in compensatory education. The ETS/LAUSD Study, Princeton NJ: Educational Testing Service, 1978.
Brown, J. S., & Burton, R. R. Buggy (research edition) software program for the Apple microcomputer. Lexington MA: Ginn & Co., 1981.
Burke, R. L. CAI sourcebook. Englewood Cliffs NJ: Prentice-Hall, 1982.
Hartley, S. Meta-analysis of the effects of individually paced instruction in mathematics. Unpublished doctoral dissertation, University of Colorado at Boulder, 1977. (University Microfilms 77-29, 926, Ann Arbor, Mich.)
Hunter, B. My students use computer curriculum plans for grades K-8. Reston VA: Reston Publishing Co., 1983.
Moore, O. K., & Andersen, A. R. Some principles for the design of clarifying educational environments. In D. A. Goslind (Ed.), Handbook of socialization theory and research. Chicago: Rand-McNally, 1969.
Stevenson, G., Edwards, P., & Bianchi, E. Program statement: GEMS. Report submitted to the Office of Educational Dissemination Review Panel, December 1978.
U. S. Department of Education, Report to the Congress: Fourth Annual Report to the Congress on the Implementation of P.L. 94-142. Washington, D. C.: U. S. Government Printing Office, U. S. Department of Education, 1982.
Time, January 3, 1983.
Vanderheiden, G. Computers can play a dual role for disabled individuals. Byte, 1982, 7(9), 136-162.

THE FUTURE OF EDUCATION IN THE MICROCOMPUTER REVOLUTION

KEYNOTE PRESENTATION

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INTRODUCTION: INCREASING MOMENTUM OF TECHNOLOGICAL CHANGE

Dan Isaacson, in a 1981 issue of Classroom Computer News, related the microcomputer era to the automobile as follows:

> Detroit 1903--Henry Ford announces a production breakthrough: one million Model T's to be produced this year. And it will cost the consumer one hundred dollars. Washington, D.C., 1904: Federal agency hearings were held today on why nine-hundred-thousand Model T's are still in dealer showrooms. The dealers are concerned. Washington, D.C., 1904: The American Automobile Association responds in today's hearings. AAA made the following points: A) Ford's new technology dumped too many cars on the market before drivers were trained to drive them. B) Drivers could not be taught because there were too few trained driving instructors. C) Having an automobile is very exciting, but gas stations are too far apart. D) Drivers run out of gas between the stations. Building more gas stations would be useless since refined petroleum supplies are too low. And, even if we started today, we'd need five to ten years to design and build enough oil refineries to supply the demand. E) Not enough chemical engineers are trained to design and build the needed refineries. F) The public is apathetic about this new technology since life has existed without it for 4,000 years. The public believes it is too complicated and cumbersome to be more than a temporary fad.

Technology is said to have made prisoners of the people of the twentieth century. We in the United States became painfully aware of our addiction to high technology while sitting in long service station lines and in our cold offices in the mid- to late 1970s. Would there be no energy crisis if we were not such gluttons for energy and the material benefits that it makes possible? Unless we harbor suicidal aims, we cannot accept a do-nothing alternative. We cannot turn back the tide of technology without passing a death sentence on the majority of inhabitants of the planet. Fortunately, there is no need to eliminate technological progress. For, as we have done so often in the past, we will continue to develop our resources. We will develop technology to save us from the energy crisis and microtechnology to propel us to new heights of accomplishment and abundance. Let us take several cases in point.

It took 35 years from the discovery of the vacuum tube in the 1880s to the development of the practical radio. The X-ray tube took 18 years to develop. Television took 12 years and the nuclear reactor 10 years. Surprisingly, the atomic bomb took just 6 years.

about. Microelectronic technology should be looked at in relation to other technological development. We have seen this technology grow from something that did not exist in the 1930s to truly impressive proportions in the 1980s. The first idea of the digital computer was conceived around 1939. Atanasoff gets some credit for its development, as well as Aiken and others. But the idea has evolved since the early 1940s to the technology of 1983. Each year, computers are faster and cheaper and have more capability. Take a look at the speed of output during the computer generation that used the vacuum tube. Then look at the innovation of the transistor in the late 1950s, which was the second generation. Everyone remembers the era with the transistor radio and how it affected them. The third generation was the integrated circuit, where the hand-held calculator went from $500 to $5 or $6. The fourth generation, large-scale integration, is the reason for this conference on microcomputers. The costs for 100,000 computations went from $1.45 in the vacuum tube generation, to 25 cents in the transistor generation, to 10 cents in the large-scale integration era. Now 100,000 computations with very large-scale integration cost less than 1 cent.

CURRENT EVOLUTION IN TECHNOLOGY

In his recent book, Megatrends (1982), John Naisbitt outlines three stages for technology. First, the new technology follows the line of least resistance. In other words it is applied in ways that least threaten people. For example, the small component inside a computer, which makes it work (the microprocessor), was introduced in toys. Who could really object? It was also introduced in robots that did tasks considered too unsafe or dirty for humans. What has actually happened is that we have created a generation of computer-comfortable kids.

Naisbitt's book describes the second stage as a time when technology is used to improve previous technology. This is the stage we are in now, and this stage lasts a long time. During this stage, the microprocessor is used to improve current tools. You are seeing cars, manufacturing, microwave ovens, word processing, and many other applications that use microprocessors to enrich our lives. So the second stage improves existing technology.

Stage three will probably have the greatest effect on special education. The technology itself will give rise to new and unimagined directions. Voice synthesis is one development growing from technology. Others will include many benefits for the handicapped.

We are just at the forefront of the computer movement. In November 1980 Business Week pointed out that technology will continue to improve and smaller and smaller components will be put into smaller and smaller areas for less cost. Business Week predicted that one chip will hold 300,000 transistors by 1985. This had been accomplished by 1982. The next projection was that all autos would use microelectronics, which is evident in most 1983 cars where microelectronic components are used to increase engine efficiency. The third point was that 10 percent of the homes in the United States would have computers. Today about 27 million homes have some type of computing device.

Projections for 1985 to 1990 indicate that electronic implants will control artificial body parts ("Machine Made Body Joints," 1983). Write-ups concerning machine made body joints have appeared in many newspapers and magazines. The artificial, microelectronic-controlled body parts will be unbelievable. Most doctors will install microcomputer diagnostic systems in their offices. Numerous medical advances have

Semiconductor chips will soon hold 1 million transistors ("Coming Generation of Supercomputers," 1983). We are up to 600,000 right now. All autos will be equipped with microelectronic warning devices. Toyota has a car that tells when it is time to check the oil. Cars are being equipped to communicate. Toyota has put together the EX-11. This is the "thinkingest" car currently imaginable ("Japan's Thinkingest Car," 1983). Many of the innovations in the next few years will result from microtechnology.

Toyota's experimental EX-11 is not started with a key but by pressing dots on an electronic combination lock. A voice synthesizer murmurs the Japanese equivalent of good day. Next, a plastic card is inserted into the dashboard and the seat adjusts automatically. As it is backed out of the driveway, the rear sonar sounds an alarm if the car comes within two yards of an object. There are sensors all around the car.

Cruise control radar slows the car down if it gets within a certain distance of the car ahead of you. The windshield wipers and headlights turn on automatically, of course. Optical transistors on the front fenders sense oncoming traffic headlights and courteously lower the beams. Creature comforts such as computer-controlled suspension systems compensate for distribution of passengers, and it automatically adjusts. The car is aerodynamically sound, with tremendous fuel economy. Tests are also being made with other ideas such as a videoscreen that projects street maps when a button is pressed (Garr, 1983).

Think of innovations in homes, such as robots. Then continue the visualization into the 1990s or the year 2000. I am confident that technology will be able to provide both vision and hearing capabilities for the impaired. I see the potential to provide these capabilities through digital information. We already can speak through a digitized system. The same technology that enables us to photograph Saturn is being extended to provide sight for the blind. Researchers are working on a computerized implant that sends information to the brain to permit the deaf to hear. Although not perfect, the system is being steadily improved.

Business Week projects that in the 1990s computer-assisted medicine will be in the home. You will be able to type in your symptoms, and the computer will communicate with your doctor to determine what's wrong with you. Of course, it will order all the medicines that you need with a doctor's approval. Along the same lines you can get a home psychiatric disk. You ask questions and the computer "solves" your problems. I do not know how effective it is, but at least you have a chance to vent your feelings and get interaction. These programs market for around $40 or $50.

Finally, *Business Week* projects education becoming actively involved with computers. The point, of course, is that the business world doesn't believe that education will use computers until the 1990s. Isn't this always the story with education? I hope that meetings like this and information engendered by them will help us to get involved with this technology and to take advantage of it.

Obviously technology will continue to improve. *Business Week* projects that homes will have electronic mail and robots will become common to industry. Cars will drive themselves with the push of a button. Of course, the projections go on and on.

In preparation for this conference we decided to get an overview of what is happening in special education in relation to computer education in Arizona. Recently, at a computer literacy seminar, 250 people responded to a survey that Donna Craighead of Arizona State University conducted (1983). The survey included the following information. For the question "Do you use a computer in your classroom?" the respondents fell into the following groups: elementary school teachers, high school teachers, junior high teachers, and special education teachers. The results were as follows: elementary, 56 percent, junior high, 57 percent, senior high, 52 percent, and special education, 69 percent. Special education scored above all the other groups. The next question was to determine what teachers are doing with the computers in terms of special education classrooms. The results indicated that more than 70 percent of the respondents used a computer for gifted education. Other uses were as follows: instructional materials, 68 percent; remediation of learning disabilities, 59 percent; sequencing skills, 41 percent; neurological remediation, 26 percent; record keeping, 23 percent; communication with the disabled, 15 percent; and therapy, 13 percent.

What computer education is all about and its potential is best described by Chris Evans in his book, The Micromillenium (1979). He said that the computer's role is tremendous. It will be unequaled. It will be like having as private tutors the wisest, most knowledgeable, most patient people on earth. It will be like having an Albert Einstein to teach physics, a Bertrand Russell to teach philosophy, a Sigmund Freud to teach the principles of psychology. And they will all be available when and where they are warranted. As you think about this and become familiar with microcomputers, it becomes evident that this will be possible.

Applications and computer literacy are the two topics that are of major concern. There are numerous applications. The National Council of Teachers of Mathematics recently held seminars on computer literacy. During these seminars we found a need for ideas to apply the computer in the classroom, as well as knowledge for doing all the things it is possible to do with the microcomputer. Unfortunately, when it comes to classroom needs, they always seem to be future needs.

Special Education Applications

I will outline a few special education application needs. First, the ability to store and retrieve curriculum resource information is needed. Information must be input to get information back. Second, testing systems, i.e., diagnostic testing and automated test construction reporting devices, are necessary. The testing capabilities of microcomputers are unbelievable. A great deal of research has been done with error patterns in mathematics. I do not know if it will become commercially available in the near future, but a program such as "Buggy" by Xerox is superb. This particular program is on subtraction. It takes problem responses and compares every step of the child's responses to various known problem error patterns. Buggy has been under research for several years, and this type of diagnosis will be really helpful for the teacher. These types of programs have the ability to determine what steps are being taken and what errors are being made.

At Arizona State University I received a research grant from the Apple Foundation with the goal being to determine whether traditionally taught remedial mathematics can be replaced by the computer for adolescents. We developed a program that generates a unique test for each student, i.e. no tests are ever the same. The computer collects all the information as the students work on the test. After the test a program that follows the based on the students' capabilities.

Recently I had the pleasure of working on a learning disabled microcomputer project developed by Marley Watkins in Arizona. This project used a microcomputer program for math diagnostic work as well as drill and practice. This program was designed to adjust to the ability level of the student. It's called the Math Machine. The program is several years old, but it has a built-in reward system. This project worked with unmotivated learning disabled (LD) students. These students became involved immediately. Each child spent ten minutes per day on the computer. Although statistical results indicated that the level of learning did not change, the classroom had an extra helping hand, thereby allowing the teacher to work with more individuals.

CAI tutorials are attempting to use the high-drama-effect of popular games. Tutorials are expensive to develop. Simulation games of various situations will be an integral part of the future. We tend to criticize games, but I know of a 12-year-old student playing an adventure game who wrote up many sheets of paper (flow charts) to master that game. The charts indicated logical reasoning and branching skills that had been developed by playing computer games, so we should be careful about rejecting computer games offhand. The branching and creativity that adventure-type games may develop are worth examining.

Another facet of computing that is important to the educational world is computer-managed instruction. However, you must have your act together to make it work. It is obvious that everyone must participate for CMI to be meaningful.

Microcomputer characteristics are promising for special education applications. A computer's patience and ability to be repetitive are nonthreatening to students. The highly motivating computer allows for individualized instruction and encourages creativity. It can offer positive reinforcement and enhance pupils' self-images. It frees overburdened teachers from routine tasks and allows them to give individual attention to each student. It is the extra helping hand. When it is properly developed, programmed instruction is incomparable in its branching capabilities.

Computer Hardware

The hardware manufacturer holds the key to what we want to do in education. I've worked with developers of some of the common hand-held calculators. If you can convince them that they will make money, manufacturers will provide the necessary material to accomplish special education goals. They can develop chips that can do almost any specific task. We not only have a community apathy problem; business leaders believe education cannot provide money needed to pay for specialized chips and thereby make such development worthwhile.

Technologically it is possible to do a lot of things in your classroom. But those things must wait until the hardware developers see enough need for that particular application. The development of Lisa, a computer with built-in chips instead of software to do programs such as VisiCalc, communications, and word processing, was announced by Apple Computers in January 1983. The programs are built right into the machine. What education needs can be done. It is a matter of financing the development and rewarding the developer. Apple has $50 million invested in Lisa. Would education pay for similar developments?

Computer Software

We need to look at problem solving. We need software that is neither threatening nor dogmatic. We want programs that include visual and auditory aids for use by special education. We must get more involved in this area and encourage the application of realistic situation concepts. The development of software will be important in the years ahead. But, software development will require more expert programming capability than most educators possess.

Recently *Electronic Learning* asked me to name the five most innovative programs of 1982. I listed ten. One good program showed how the computer could be used. The next was a good drill-and-practice program. Another was a good simulation program. There is an exemplary program in each of those areas. Of course, the model programs take much research and development. This is the difference between a good program and an average program. I hear someone saying, "Well, I'm going to take this package that's based on a book." I suggest that you use a book rather than the computer. Remember the capabilities of the machine as you evaluate software. If you want a software program for printed pages, you are doing the wrong thing. Computers have tremendous graphic capabilities. The time sharing of the 1970s when we could not do graphics was not effective. We could learn as much but it was not significantly effective. It was difficult to project anything graphically on a hard-copy printer with time sharing. The present reality is one of low-cost graphic capability, sound capability, color, an ability to branch, and a means of presenting various concepts. That is why much research of the 1970s is probably not relevant. Research is just starting to appear. These are going to be exciting times. We will have research results and I think that they will be very positive. Some of the early results that I have been associated with are very positive.

COMPUTER LITERACY

How do you define literacy today? Literacy of the twelfth century was the ability to compose and recite in Latin; later a knowledge of English was required. The printing press came into use in the fifteenth century, and then literacy meant reading and writing. In the mid-nineteenth century to be truly literate required reading the right materials. I imagine people in the 1970s would have said that literacy was reading, writing, and arithmetic. What is it today?

According to Benjamin Compaine (1983) literacy evolves as follows. First there are a handful of specialists who have an idea. Next there is an impact on institutions. Third, the new development becomes the preferred medium of businesses, cultures, and politics. The computer generation has gone through the first two stages and is embarking on the third stage. Our cycle is that the microcomputer is becoming inexpensive and simple to use. Just as people once were handicapped if they did not learn to read, people today must learn about computers or feel handicapped. You cannot participate in computer literacy without being part of today's elite.

I have worked on a computer literacy curriculum for many years. It was published in *Electronic Learning* (Bitter, 1982). In my model, I have defined computer literacy as programming the computer as well as computer awareness.

The scope and sequence of this curriculum gives ideas for computer literacy in grades kindergarten through 12. It is not software-oriented. Software is an application while computer literacy is another area of the curriculum. Computer literacy affects many people. For example, let us take careers. Experts project that by 1987, 80 percent of all jobs will be information-related. The students with whom you are working will go out into an information world. We are seeing unemployment already. Take, for example, the changes in writing up a newspaper story. A journalist from the newspaper would be here tape recording highlights of the sessions. The information would then be entered into a microcomputer as it is typed into a word processor with a visual display terminal (VDT). The reporter would then pick up the telephone, dial the newspaper, and relay the information to the office, where it would go into the main computer. The editor would revise on the main display screen, and the story would go directly to press with neither pencil nor paper involved. The point of this example was that many people lost their jobs because employers did not retrain employees for the computer age.

Software is something that can get a person acclimated to using the system. The programming language, LOGO, is a means of communicating with the machine. Sylvia Weir, one of the developers of LOGO, has done some very successful research using LOGO with autistic children. One of the cases was a boy who spoke for the first time after playing with the LOGO remote control turtle. LOGO seems to show promise for special education and programming. Most microcomputers have LOGO available. If you consider computers that do not have LOGO, I think you are missing an opportunity to let children become creative and get involved in controlling the computer (Bitter & Watson, 1983).

I named Bank Street Writer as one of the most innovative pieces of software of the year. It has the ability to communicate in the word-processing role. It is user-friendly, which means that the user can communicate with the computer. Bank Street Writer makes word processing possible for your students. Software of this type is going to have tremendous impact in the schools and in all the associated areas. It will affect writing and the ability to think and communicate. Those kids who work with Bank Street Writer do not have to worry about omitting a sentence or striking out a word and getting negative feedback. As students think of new words or ideas, they can insert them without fear of messing up their writing paper. Special education people need to get involved with word processing for computer literacy.

BASIC is a high-level programming language. BASIC is a common language available on all microcomputer systems. Some people say that BASIC is not for students, but whether it is or not depends on how they approach it. A BASIC book that I wrote in 1970 is totally different from a BASIC book that I have just completed (Bitter, 1978). I have abandoned mathematical approaches and symbols and have gone to a nonsymbolic introduction for communication in the computer language.

Computer literacy has other aspects as well. Recently I received the following letter.

> I'm writing to tell you of my experiences using a computer in the classroom with 5- and 6-year-olds. I have taught kindergarten for 28 years all over the country so I feel I know my subject area well. I am a beginner with a computer and I have found it to be the most exciting and reinforcing learning BASIC course. I then took a computer with me for the summer and started to see what I could do with it. I checked around at various stores to see what was available for young children and found indifference, rudeness, and little knowledge among sales people. Since little was available for young children I was not allowed to look at tapes before purchasing them. I decided to spend the summer writing my own programs that would correlate with math and reading programs in schools.

It is exciting to see everything that is possible. I do not know how to pass along all that is really possible. Some people have so many negative feelings about computers that it gets in the way of their using them. But it is up to you whether you want to take advantage of as many computer-type opportunities as you can.

THE FIFTH GENERATION: COMPUTERS OF THE FUTURE

The future is the fifth generation of computers. The innovations in the future will have an impact on education.

Dr. Jastrow of NASA indicates that human size computers will match the storage capacity of the human brain. Billions of facts will fit into the a briefcase-sized volume by 1995. The date has been changed to 1987. The problem with computing is lack of memory. The more we can remember, the more effective our programs will be. The more information there is in memory, the more effective the whole program will be. Memory will give computers the capabilities needed for future applications.

The fifth generation will probably be the thinking machine called artificial intelligence. Computers will continue to be faster and smaller and will have the ability to "think." What does that mean? An example is a doctor's office, where information is entered to keep track of the medical cases. As you go in for treatment, the computer is queried for help or remediation possibilities. The computer suggests choices with probability of positive treatment for each. Another form of an intelligent machine is a computer chess program. In 1956 a computer won 50 percent of the matches while today it wins 99 percent. Experts project that by 1984-1985 it will win all of them. The computer examines all possibilities and stores previous information and knowledge for decisions.

Artificial intelligence or expert computer systems can make judgments on preprogrammed knowledge. They have the wisdom or knowledge to help the nonexpert. What will be developed is a nontutorial equivalent of human reasoning. Examples today are similar to adventure games such as "Dungeons and Dragons." Some of these programs will give you a prize or trip if you can figure out how to get a solution to the problem. Real-time computing ability will provide opportunities for electronic mail and access to data and will make many library functions obsolete. Along this same line Dr. Birnbaum of Hewlett Packard recently described a long-term storage device called the digital optical recovery device. It is similar to a videodisk. The laser is used to burn a hole in the platter. This represents zeros in a space measuring one micron in diameter. It will hold one trillion bits of information. That's up to 50,000 pages. In other words an entire encyclopedia will fit, with room left over. The disadvantage is that the information can never be changed once it is inserted. Popular Computing defined the fifth generation as follows: to associate, infer, and understand ("The Fifth-Generation Computer, 1982). With no keyboard, the computer is able to understand spoken language and perform whatever function you ask of it, gleaning needed information from a knowledge bank or from other computers with which it may be in contact. It will act more like an intelligent assistant than a machine. It will design a budget or help you choose a new car. It will perform other tasks that you assign it.

By the year 2000 we will have very large-scale integrated circuits and wide-band communications. Microcomputers will be communicating with other computers through satellites, or it might be similar to a radio where you dial the program or data needed. Our present circuitry is too slow for this capability; biological enzymes will eventually be used. Computers will be using the English language for communicating with the computer. Instead of writing BASIC, LOGO, or Pascal, you will type the information into the computer in English; experts talk about that concept being available by 1986 or 1988. Computers will be tied to large data bases. The social implications and the big issue will be what is on the computer about you and me and who is getting access to it (Bitter & Camuse, 1983).

Voice recognition has many possibilities. Your responses are told to the computer. After that, we will be able to teach computers. In other words you can teach them what you want them to do and they will carry it out. They will recognize your voice and commands (Bitter, 1983).

Gilbert Schiffman gave an appropriate analogy for educational computers. His analogy was that a group of statisticians once compared the efficiency of various animals in motion. They used the criteria of what animal can get from point A to point B with the least amount of energy exerted; the condor won. The human being came in about one-third down the list. Then the scientist re-rated us on a bicycle. We became twice as efficient as the condor. Computers can work the same way as the bicycle as amplifiers of human ability.

In closing, keep this in mind. A computer has no conscience. It feels no passion. It has neither life of its own nor any sense of value. It is neither a poet nor a philosopher. A computer, in short, is a machine: not a human, a fool, or a tyrant.

ED#234333

REFERENCES

Bitter, G. BASIC for beginners. New York: McGraw-Hill 1978.

Bitter, G. The road to computer literacy. Electronic Learning, September 1982, October 1982, November/December 1982, January 1983, February 1983.

Bitter, G. Computers in today's world. New York: John Wiley, 1984.

Bitter, G., and Camuse, R. Using a microcomputer in the classroom. Reston VA: Reston Publishing Co., 1984.

Bitter, G., and Watson, N. Apple LOGO primer. Reston VA: Reston Publishing Co., 1983.

Business Week. November 10, 1980.

Compaine, B. The new literacy. Science Digest, March 1983, pp. 16-19, 112.

The coming generation of supercomputers. Science Digest, March 1983, p. 74.

Craighead, D. Statewide microcomputer forum survey results. Unpublished research paper, 1983.

Evans, C. The micromillenium. New York: Viking Press, 1979.

The fifth-generation computer, Popular Computing, August 1982, p. 48.

Garr, D. Toyota's EX-11. Popular Science, May 1983, p. 56.

Isaacson, What's holding back computer use in education, Classroom Computer News, May-June 1981.

Japan's thinkingest car. Science Digest, March 1983, p. 74.

Machine made body joints. Science Digest. March 1983, p. 89.

Naisbitt, J. Megatrends. New York: Warner Books, 1982.

COMPUTER LITERACY--DAILY LIVING

COMPETENCIES FOR THE HANDICAPPED

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INTRODUCTION

Electronic technology is making a dramatic impact on education. Increasingly, computer literacy is being viewed as a legitimate curriculum area. Many school districts and state education departments are beginning to include computer literacy as a graduation competency requirement.

Society is becoming increasingly computer-dominated, not only in employment related areas, but in daily living, recreation, and communication. The ability of the mild and moderately handicapped person to function in this society is in good measure dependent on the ability to use this technology as a daily living tool.

COMPUTER LITERACY IN DAILY LIVING

Computer literacy for the special education student, therefore, must not be viewed as merely a program enhancement; it must become a core program permeating all curriculum areas and extending throughout the student's educational career. Daily living proficiency for this population must be redefined to include technological proficiency. Computer literacy is an essential daily living competency.

Our special education students must learn about the social, educational, vocational, and recreational uses of computers in society. Instruction in such a core program requires both information about how to use the variety of computing devices found in our daily environment and substantial hands-on practical experiences. A computer literacy program for the mild and moderately impaired should focus on a functional understanding of

- the computer as a communication tool,
- the computer as a prosthetic device,
- the computer as a problem-solving tool, and
- the computer as a recreational tool.

Communication

An essential element of any computer literacy program for handicapped students is the concept of the computer as a communication tool and a linguistic device. The ability to use the computer effectively as a daily living tool is related to an individual's ability to communicate directly with the computer and, through a computer, to others. Thus competencies in this area are related to the pupils' proficiencies with the language system of the computer.

As with oral language, computer linguistics includes both expressive and receptive literacy objectives. Computer linguistics should not be confused with computer programming. Computer linguistics refers to a far more basic concept, that is, how a person "talks" to and "receives" information from a computer.

The concept of expressive computer linguistics is significantly different from oral language. A computer is a memory and sequencing device, one that actually performs the transmission of information. The content of what is communicated is separated from the actual process of communication. Thus, the individual can focus on what is being communicated rather than on the actual process of communication. Expressive computer linguistics has implications for two basic daily living competencies for the handicapped:

1. The ability to "communicate with" a computer using a variety of data entry and control devices. Here the emphasis is developing functional proficiency on a variety of computer devices so that commands can be given and data can be entered. Among the variety of data input devices that should be included in such an instructional sequence of practical experiences are calculators, digital watches, touch tone telephones, computer gaming devices, computer keyboards including prosthetically altered devices, electronic pencils, voice-activated devices, and acoustic-coupled or modum-linked telephone systems.
2. The ability to use the computer to "talk" with other people. This competency stresses skills needed to communicate through a computer. Word processing provides the individual who has impaired abilities in written expression with a compensatory tool that helps overcome the problem. Because the computer performs the actual task of expression, the individual can focus on what needs to be expressed. In all instances of expressive communication, the computer is a passive tool, one that leaves the individual in total control of the process.

The computer is a particularly powerful expressive communication device when it is interactively linked via telephone or cable television systems. Prosthetic adaptations to the keyboard permit physically handicapped individuals to communicate with others. Physical barriers to communication are removed and distance limitations are negated.

Receptive computer linguistics uses the computer to "receive" information from another computer or from other people through an interactive computer system. A technological society implies an increase in the quantity and quality of information available to members of that society through computer-based communication.

Data can be received from a computer in visual, tactile, or auditory modes. Information can be presented in one modality exclusively, sequentially in each sensory format, or multisensorially. Expressive computer linguisitics allows handicapped individuals to select and control the transmission of information from a computer, and the mode of presentation.

Prosthetics

Another objective of a computer linguistic literacy program for the handicapped is to develop the ability to use the dynamic qualities of the computer to "compensate" for physical, neurological, and emotional limitations. The computer is a compensatory device that facilitates the functioning of many disabled people. Future technological developments can be expected to expand the potential of such prosthetic applications dramatically.

The computer is a communication tool that can remove physical barriers. Interactive telephone and cable television systems permit an individual to perform daily living activities such as banking, shipping, and research from one's home terminal. Prosthetic terminal devices such as braille printers, the superphone, touch-sensitive screens, and voice-activated terminals allow those with sensory and physical impairments to communicate with others and to exert greater control over their immediate environment. Finally, the computer is the only communication device that leaves the receiver and expressor in complete control of the entire communication process.

Problem Solving

The ability of the handicapped to function in an increasingly technological society is directly related to the ability to use the computer as a daily living tool to solve problems. Therefore, a major objective of a computer literacy program for this population should be to develop the ability to use the computer as a problem-solving device.

Problem solving, in part, is the ability to apply learning information and concepts to new situations. It is personal and active and involves the realities of cause and effect. The computer is the only medium that can truly interact with an individual in a cause-and-effect process. Commercial software permits a user to apply proven problem-solving structures to personal situations. Variables can be altered so that a potential solution is personally relevant. The program user is able to participate in and control every level of the problem solving sequence. Such software does not tell an individual what to do in a given situation; rather it helps a person reach a decision about how to solve a problem.

Computer simulation programs permit the user to try out a variety of potential solutions to a problem before selecting a personal course of action. The cause-and-effect dynamics of each potential solution can be experienced without personal risk. Because these programs are interactive, they provide the user with continuous feedback and self-monitoring. These simulation abilities of the computer truly make it a window to the world by allowing risk reduced personal decision making.

Recreation

A final area of training in a computer literacy program for the handicapped should deal with the use of the computer as a recreational and alternative sporting tool. A number of studies dealing with the needs of independent and semi-independent handicapped adults have identified limited recreational outlets as a prime problem of this population. Physical and emotional barriers often preclude participation in many activities taken for granted by nonhandicapped people.

Computer technology can provide many stimulating recreational alternatives for handicapped people. It is the only truly interactive technical recreational media. Two developing areas of computer technology hold great potential for meaningful sport and recreational alternatives for this population.

The first of these is computer gaming. Self contained games and software programs for microcomputers are inexpensive and easy to operate.

Their format allows people to compete against themselves, the computer, or others. These games can be intellectually stimulating and most importantly are fun.

The daily living competency to be developed in this area is the ability to use computer gaming devices as "sport" and leisure time activities. Sport simulations allow the physically handicapped to "play" tennis, golf, football, basketball, and other sports. Other programs provide intellectually challenging interactive recreational experiences on the home computer. The commercial development of new recreational programs is rapidly increasing, and therefore the handicapped can expect continued growth in the variety of new and inexpensive software.

A second way of using the computer as a recreational alternative involves the home computer as a terminal. Through telephone or cable television linkages, the handicapped can communicate with friends, shop, study, read, and simulate. Physical barriers are removed, travel limitations negated, and emotional risk is minimized.

CONCLUSION

A computer literacy program for the handicapped should be based on the development of daily living competencies that prepare this population to function in an increasingly technological society. Computer technology represents no threat to the handicapped. It is a technology for all and a normalization agent for many. The computer is a tool that can overcome barriers and can expand the horizons of this population. Special education computer literacy must have as a basic program objective the design of instructional programs that prepare the handicapped to benefit fully from the technology of our society.

INTRODUCTION TO THE MICROCOMPUTER

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INTRODUCTION

A few years ago, maybe a few more, computers were thought of as the gigantic, complex monsters of big industry that quickly and accurately stored and manipulated large quantities of mathematical data. Due to the development of such things as the silicon chip that monster has shrunk in size until it has reached portable proportions. And its price has made it affordable not only to small businesses but to educational systems and the home as well.

However, for many who have purchased the microcomputer, it is still an untamed monster that plays games with its owners. Owners do not understand its capabilities--or how to get it to do much of their bidding.

All of us in special education must learn about the microcomputer and understand its potential. We must keep up with both informational and technological changes involving the computer revolution. If we do not lead, others will--those who do not understand the needs of the handicapped. Special educators must lead if we want directions to be both educationally and cost effective.

COMPUTER LITERACY

Actually, all of us are already to a greater or lesser extent computer literate. No one is or is not computer literate any more than any of us are completely literate in English. Think of computer literacy on a continuum where most of us are clustered somewhere toward the lower end. What does computer literacy involve? The minimal competencies include some knowledge of history, moral and ethical issues, operation of the microcomputer, elementary programming, and capabilities of the microcomputer.

In general, at least a summary of the history of the development of microcomputers is necessary to understand where we have been and where we are going. Included in this area would be the four major phases or stages of development. The first stage, sometimes called generation computers, consisted of large, bulky, relatively slow computers. The second stage found computers not as large and bulky because of the development of the transister. Development was stimulated by the needs of the armed forces in World War II. The third stage followed closely on the heels of the second with the development of the silicon chip, allowing for the creation of the microcomputer, which is relatively inexpensive, very fast, and extremely small compared to its ancestors of only a few score years ago.

The impact of the microcomputer on education creates issues with which special educators (actually all eductors) must be concerned. The microcomputer will change the lives of all of us, and we must prepare our students to live in a computerized world. The social and psychological effect of communicating with machines, the lack of socialization with other human beings, the "control" of human lives through decision making, the artificialization of our bodies with computerized organs are only a few of the issues that fall within the social and psychological category. Within the vocational category, issues such as loss of jobs or the possible extinction of low-level jobs, plus the possibility of using modems to permit the transfer of the office from a building far away to the home, are only two of the issues.

Computer literacy also involves the operation of the microcomputer from being able to load a prewritten program to being able to create a program. Some programming knowledge is desirable for educators to understand the capabilities of the microcomputer in order to evaluate programs as well as to create them. Understanding the capabilities helps in the determination of educational effectiveness of programs as well as the uses that would be most educationally effective.

A microcomputer executes instructions given to it in sequential order through a computer program written in a specific language understood by that computer. The language most often used by educators to communicate with a microcomputer is called BASIC or the "Beginner's All-Purpose Symbolic Instruction Code." This language is considered to be a high-level language because it is relatively close to English. This communication is then translated into a low-level language, which is understood by the computer.

INITIATION OF THE MICROCOMPUTER INTO SYSTEMS

In order for the educator to become computer literate and for educational systems to integrate microcomputers effectively into their systems, it is necessary to look at the whole picture. This includes: needs assessment; investigation; designation of responsibility; coordinating a plan for implementation into the curriculum and administration design, setting up a community-wide communication system, planning in-service education to increase computer literacy, designing a financing plan, and initiating a formative evaluation plan.

The needs assessment is the first phase in the process. The uses for the microcomputer from both an adminstrative and educational standpoint need to be determined along with possible personnel who can play specific roles. This information allows for the tentative determination of equipment needed and the finances needed to purchase equipment and implement the plan effectively. The needs assessment is not a one-time activity but an ongoing activity because the more "literate" the staff becomes, the more realistic and accurate the needs assessment becomes.

A number of sources are available from which members of the committee as well as other members of the school staff and community can gain information for the needs assessment. Many periodicals provide information. Some computer companies and stores are providing courses, as are many local school systems, community colleges, and universities. Many communities have started user groups and welcome the novice microcomputer user. Quite often those who know little about the microcomputer are banding together in this type of group to determine their needs and to find solutions to questions that they are facing. In-service education is available from many sources: professional organizations and conferences, hardware companies, software companies, colleges and universities, local organizations, in-house personnel from school systems, and private consultant firms.

Sources of funding should also be determined early in the planning. Funding may be available from foundations, federal and state governmental agencies, and local school districts. However, many systems will need to look to the community for finanacial assistance. A committee can be formed for this purpose. First, this committee needs to establish its goals and objectives. Then it needs to develop a plan to involve important community members on the committee as well as a plan for fundraising. It is important to frequently inform the community about what is going on with the microcomputer project. It is amazing what sources surface from within the community when needs and purposes are appropriately publicized.

In the early developmental stages, a formative evaluation plan needs to be established to validate decisions during each stage of the project. These evaluations will determine if the project should proceed as planned, if changes need to be made, and if the time line is appropriate.

If all the phases of the program are perted out, it is easier to make evaluative decisions at each stage in the project. This also communicates purpose to all persons on the committee and in the community.

EVALUATION OF MICROCOMPUTERS

The importance of evaluating software before purchasing hardware cannot be stressed too strongly. Educators do not have time to develop their own software, and the limited amount of educationally effective software that is available is hardware-specific--that is, it will probably only run on one specific machine (i.e. Apple II, Atari, Pet, etc.)

There are two ways to evaluate software: internally and externally. Internal evaluation of software--evaluation of software from within the system--is probably the most effective and valid because it is easier to determine if the software meets the assessed needs. Three areas should be covered in the evaluation: instructional content, educational adequacy, and technical adequacy.

INTERNAL EVALUATION

Instructional Content

A number of areas should be evaluated under the category of instructional content. It is important to determine if the audience for which the program was developed is similar to the audience that will be using the program. The documentation should also be evaluated. Is it clear how to use the machine? On what educational model was the program developed? Is there an adequate description of the program, its goals, and objectives? Is there an evaluation plan to determine whether the objectives have been met? What are the prerequisite skills necessary to complete the program successfully? Does the program fit into the curriculum and into the way in which the curricular subject is approached? Is the program motivating? Is, the type of instruction appropriate for the type of program (drill and practice, etc.)?

Educational Adequacy

The second category of software evaluation is educational adequacy. Does the program proceed from simple to complex? Has there been a task analysis done on concepts? Are there examples? Is learning tested? Is there appropriate branching? For example, in tutorial programs, branching should allow the learner to branch upward if successful or downward if unsuccessful--to a level on which the concept is broken into smaller and more concrete steps as it is retaught. Programs should used reinforcement principles where correct answers are rewarded and wrong answers are neither reinforced nor punished. Programs should be both interactive and personal. New words should be broken into syllables and explained in text, especially if they have not been listed in the prerequisite skills area of the documentation. Directions for interacting and answering questions should always be available to the user, either on the frame or through pressing a key that calls up the directions. The use of graphics, sound, inverse print, blinks, flashes, and speed should enhance the presentation of the materials and not be distracting.

Technical Adequacy

The third area of software evaluation is technical adequacy. It is most important that the program runs to completion and that the student cannot inadvertently disrupt it. Students should be able to run the machine independently in most instances. The screen format should also appear uncluttered, presentation varied, text-centered, phrases appropriately broken, text doublespaced, and there should not be too much information presented on a frame at one time. Testing should be on the concepts presented and not on typing, spelling, or synonyms--unless that is what is being taught. There should be appropriate language control so that students cannot type in profanity, etc. It is also important to check on the software company policies for replacement and previewing. Naturally the machines on which the software will run needs to be determined.

EXTERNAL EVALUATION

Many times educators can learn much about the value of programs through external software reviews. Many organizations and magazines are contributing evaluative information for educators through published results of their evaluation. Within the covers of the Computing Teacher, MICROgram is a thorough evaluation of software packages. This evaluation is based on a wedding of EPIE and the Consumers Union. MicroSIFT from the the Northwest Regional Educational Laboratory also does thorough evaluations of software as each package goes through four stages from sifting of promising programs to an in-depth evaluation.

HARDWARE EVALUATION

Besides evaluating software before the purchase of hardware or microcomputer, a number of areas should be considered regarding the microcomputer itself. Naturally, one important consideration is cost. In considering the cost, be sure to determine exactly what is included--which pieces of equipment, required "extras", financing. Also determine your needs and requirements for use of the microcomputer when considering price, because you may not need a "Rolls Royce". Ask questions to find out information about service options--is a local dealer available, is the service reliable, is the service speedy, what does the warranty include? Other areas to consider include portability, availability of color, graphics resolution and availability of animation, editing capabilities, program-loading speed, music generation, options, available peripherals, documentation, keyboard (layout, size, number of keys, type of keys), specific languages that can be used in programming, newsletters and journals, and memory. In considering memory it is important to ask the amount of usable RAM instead of just the amount of K; the amount of memory that can be used for programming and the K measurement are not necessarily the same.

CONCLUSION

The area of evaluation cannot be considered too lightly. Too many school systems have purchased microcomputers without adequate evaluation, only to find that there was little software available for their machine and that no one on their staff had the expertise or programming skills to develop software.

USES FOR THE MICROCOMPUTER IN SPECIAL EDUCATION

Uses for the microcomputer can be broken into a number of categories: administrative uses, general instructional uses, and uses primarily designed for specific categories in special education. All of these uses should be based on research designed to determine their efficacy.

ADMINSTRATIVE USES

Many uses center on the development of the individual educational plan (IEP). Assessment can be carried out and error analyzed on the microcomputer. Other assessment results can be added from sources such as other tests, expert input from anywhere in the world, and observation. Based on all information, the computer can determine not only the goals and educational objectives but the appropriate methods, materials, and approaches to employ with that specific individual. Other information for the IEP can easily be added, updated instantly, duplicated, and transmitted over a modem to distant places.

Research data can be easily transmitted to a central source such as a research center or university, where data can be stored and analyzed. The size of research groups can be greatly enlarged at little expense of time or money--thus making the groups more representative of the population.

Reports can be generated and updated quickly, including proposal writing, and reports for financial reimbursement (including the calculation of formulas). Furthermore, reports including permanent files can follow the student instantly on a move to another school district.

Schedules, both administrative and student, can be developed, changed, and conflicts noted within seconds. Grades can be instantly determined so that special education teachers can easily keep track of all students who are mainstreamed.

These administrative uses are not intended to be an all-inclusive list but one that can stimulate educators to think about their own needs before purchasing hardware or software programs.

GENERAL INSTRUCTIONAL USES

A number of uses for the microcomputer fall under the category of general instructional uses. The first type of program, called computer-managed drill and practice, is designed to reinforce or overlearn what has been learned. Going over multiplication tables, learning capitols, and practicing placement of punctuation are a few examples of this type of program. A second type of program is the computer-managed concept instruction, where the learner is presented information leading to concept development. This type of program is similar to the computer-managed tutorial type of program except this latter type is designed for reteaching those segments of a concept or skill that were not learned when the concept was presented in initial instruction. A fourth type of program involves computer-managed simulation in which the learner is placed in situations that would otherwise be dangerous and expensive or involve an extensive

amount of time. Computer-managed problem solving can be similar to simulation-type programs, in fact may involve simulations; however, they are designed primarily for the learner to find the solution to problems, for example, dealing with social consequences, decision making, or values clarification. All four of these types are often found within the same microcomputer program, depending on the goals and objectives of that program. For example, a particular concept could be taught, drill and practice could be used to reinforce a particular skill within that concept, and then an application section (simulation and problem solving) could allow the learner to implement the knowledge presented within the concept.

Another type of instructional type program is called user-managed problem solving. With this type of program the learner is developing a program. Lower functioning students have been known to learn problem-solving skills by using relatively simple authoring system, such as LOGO whereas higher functioning students can program using BASIC or languages involving more extensive programming skills.

USES IN SPECIAL EDUCATION

Many uses for the microcomputer have been, and continue to be, developed for handicapped individuals. In reading this section the reader should use imagination to determine further possible uses for specific special education catagories. Naturally, uses mentioned under one category could well be employed under other categories, based on the individual needs of the student.

Physically Handicapped

Within the area of the physically handicapped, peripherals and programs have been developed to assist the individual with mobility, communication, and sensory compensation. For example, learners can input information by voice, joysticks, rocking levels, eye contact, and adapted keyboards or keyboard menus. Information that has been processed by the machine can then be outputted on a screen, on a printer, or through a voice synthesizer. The information could be entered and processed, or it could be sent hundreds of miles to another source or person. Electronic mail, electronic banking, electronic shopping, and electronic control over household and personal tasks can be accomplished using the microcomputer. Medical intervention in order to administer medication at the moment it is needed and prosthetic devices such as a prosthetic arm operating on nerve impulses are also possible.

The electronic eye can allow the blind and visually handicapped to "see" objects within their environment. This "seeing" is not the way that sighted persons see, but it nevertheless allows for brain interpretation. Braille can be typed in or received by a blind person, followed by that information being translated into print or voice for another person. Sighted persons over many miles can communicate with blind persons through a brailler attached to a microcomputer.

The electronic ear can permit auditory interpretation of this type of information within the brain of the deaf and hard-of-hearing individual. Speech can be taught to deaf or speech-impaired persons through biofeedback on a vocalization trainer on which sound waves are seen on a screen as they should appear and as the hearing-impaired person is saying them.

The category of homebound pupils is a natural for the microcomputer, because a modem can extend the distance of instruction, allowing the teacher to instantly be with each student and allowing for instant feedback based on student input. The modem also can extend the expertise of the instructor and allow for resource persons to enter the student's home or hospital situation without leaving their own localities.

Emotionally Disturbed

Emotionally disturbed stude-ts, and those who are autistic, can find in this medium a patient machi/e with which they can communicate and learn in a nonthreatening interchange. Videotherapy, such as that employed at a Veterans Administration center to train reflexes, dexterity, coordination, judgement, and academic skills including reading, can be employed with students who fall within these categories of disability.

Learning Impairments

Mentally retarded and learning-disabled students may find the microcomputer, with its ability to branch to varying levels of reading and conceptualization, very beneficial within the mainstreamed situation of the regular classroom. The microcomputer is also extremely patient and can work with students who process information slowly. In fact, they can be used to increase learning speed, reading tracking speed, auditory discrimination, auditory memory, visual memory, visual discrimination, and figure-ground. The presentations can be multisensory or involve blocking of specific modalities, as necessary for the learner to best process the information learned. Reinforcement can be immediate, delayed, constant, variable--as necessary for the particular individual. By instructing mentally retarded or learning disabled students in elementary programming, for example, using a system such as LOGO, problem solving can also be developed through the microcomputer.

Gifted and Talented

With gifted students the expertise of the classroom can be expanded, as can time, space, and cost. Branching can be used here, too, to branch the learners to levels of abstract reasoning and problem solving, or even to remediate weak areas. Computer programming can be used with these students to increase their problem-solving skills.

RESEARCH OF EFFICIENCY OF MICROCOMPUTERS

Research is at times a rather perplexing endeavor. Thousands of educators are involved, spending millions of dollars to provide "answers" to persistently recurring questions, only to conclude what seemingly was already "known" by those actively involved in the research area. Educators want answers; research frequently results in more questions. Educators want absolutes; research provides indications. Educators want large definative studies; research provides bits and pieces. Yet research, while seemingly not providing everything that is wanted, can provide a great deal of information to help in the educational endeavor. It must, however, be viewed from the perspective that what will emerge from most research efforts will be only one or a few additional bits of information. These must be interpreted in light of other existing and emerging information to glean an understanding of the area being studied. This most certainly is true of research dealing with CAI and the handicapped.

There are also a number of impediments to research and the use of microcomputers: insufficient funding, confusing diversity of languages and hardware, poor quality of CAI materials, educators' lack of knowledge of how to use CAI effectively, and attitudes among educators about CAI and research in general.

However, some general conclusions may be drawn from the research regarding the effects of CAI on achievement based on some relatively consistent results. The reader should keep in mind that early research centered on comparison research and relatively few of the studies were well designed and tightly controlled. A summary of those general conclusions follow:

1. The use of CAI has generally been shown to improve learning or has not found to be different from traditional approaches.

2. The effects on achievement have tended to occur independently of the type of CAI used, the type of computer system, the age range of the students, or the instrument used to collect the data.

3. When CAI and traditional instruction are compared, those students using CAI had equal or better achievement in less time.

4. Students have a positive attitude toward CAI; this is frequently accompanied by increased motivation, longer attention span, etc.

5. Tutorial and drill types of CAI seem more effective with lower ability students than with high- or middle-ability students.

6. Many learners who have been "hard to reach and hard to teach" by other methods become actively involved in CAI.

7. Most of the research that has shown CAI to be effective has made use of adjunct CAI in which the teacher was readily available.

8. CAI is helpful to students in reviewing learned material.

9. Retention rates may be lower than for traditional instruction.

Specific research in special education is relatively scarce; what has been done is more evaluative and descriptive than tightly controlled research studies. Furthermore the majority of the special education research found in the literature is centered on the hearing-impaired with some studies dealing with diverse types and ages of handicapped learners. Results available on CAI in general indicate results in special education that parallel those found with other populations. The thrust that is emerging seems to be not if CAI can be used, but rather how it can best be used.

How it can best be used is definitely in need of research--especially as the special educator employs imagination in determining the possible ways in which the microcomputer can be adapted and programs can be developed to assist the handicapped individual in communication, mobility, and sensory compensation.

SOFTWARE DEVELOPMENT

It is important for the educator be informed so as to assist in the process of developing software from the design of the program, through the script writing, and through the programming stage. The rationale for learning this process lies with the lack of adequate educationally effective software in many curricular areas, and with the individual needs of students within the mainstreamed and the special education classroom.

In order to obtain information about this developmental process, the educator needs to understand the function of languages most commonly used to communicate with the microcomputer. There are three directions that the educator can take to obtain this kind of information: take a course in BASIC (Beginners All-Purpose Symbolic Instruction Code), learn to use programming systems that are easy because of their simplicity and closeness to the English language, or learn the process in designing and writing the frames for a program that will be programmed by an experienced programmer. Each of these directions will be discussed.

BASIC

First, if possible, it is a good idea for the educator to take a course in BASIC designed for educators (not programmers) so specific effective educational designs can be covered. For example, in one situation a high school teacher, who teaches programming, developed and taught a course in BASIC to teachers in his school system. This course was effective because teachers not only learned programming, they also learned to develop educational programs that were both administrative and instructional. This type of course teaches the logic and problem solving necessary to better understand the capabilities of the machine--regardless of which microcomputer is used (Apple, Atari, Pet, etc.). This information can be used for programming, for providing information to a programmer to complete the programming portion in a courseware development, and it can be used in assisting the educator in evaluating commercial software.

SIMPLE PROGRAMMING SYSTEMS

An easier direction, or one that takes less time but allows the educator to program courseware designed for individualization, is that of using programming. In considering programming systems, consider them along a continuum from simple to complex and from least flexible to most flexible; the easier the system is to use, the less individualization or flexibility is available. Authoring systems include LOGO or Genis I. With LOGO, a triangle called a turtle is moved by command around the screen, leaving a line in its path as desired. Commands are simple and in English, for example, FORWARD, LEFT, SAVE, DRAW. Associated with commands are numbers; a ONE equals a space if going in a straight line or fifteen degrees if turning. The degrees are the same as those on a traditional clock; three equals forty-five degrees, six equals ninety degrees. Commands in the Genis system are slightly more complex, using T for text, A for answer, M for match.

Authoring languages offer relatively more flexibility with commands such as TYPE, ACCEPT, MATCH, JUMP, COMPUTE. In using an authoring language, be sure that the screen displays are easy to understand, that students respond frequently, that all answers are planned for regardless if they are right, wrong, or inappropriate, that branching is used and the steps in the task analysis are appropriate for the audience, and that graphics are used for reinforcement of the concept and are not distracting.

WORKING WITH A "PROGRAMMER"

The third direction that the educator can take in developing a program is to design a program and write the frames so a programmer can then put the information into the machine. The key element is for the educator and the programmer to be in constant communication to determine the most educational as well as most appropriate computer program design, and for each party to understand exactly what the other is saying. It is relatively easy to make changes before the actual programming stage, but next to impossible after the program has been completed without creating major problems. For example, changing one line of a program can cause far-reaching effects where they are not expected and the program will then bomb.

The stages through which the writer should proceed when working with a programmer follow. In fact, if the educator is doing programming, these stages should be followed. First, develop the goals and educational objectives for the program. These can be modified after completing the research, which is the second stage. Based on the research, the initial design for the program should be developed. This design should be based on whether the program type is drill and practice, concept instruction, or concept application. At this point a simplified outline can be developed.

After discussion between the writer and educator and the programmer as to length, design, and appropriate presentation for the microcomputer, the educator can develop the in depth outline which should be discussed with the programmer. At this point the program can be put into script form; for example, on 4 by 6 cards, based on the formatting capabilities of that particular microcomputer (number of lines, number of characters per line, etc.). While writing the cards, or after completing the cards and laying the cards down in consecutive order, an educational flow chart should be developed with squares for text frames and diamonds for question or interaction frames. Arrows or lines should be drawn to show the exact flow of the program, or which frame follows which. In the case of question frames, each possible response should have a specific arrow or line showing which frame is based on which response. In other words, where does the program go if the response is right, wrong, or inappropriate (neither right nor wrong)? After being checked by the educator and the programmer, the frames can be placed on frames designed in blocks for each character space on the screen at any given time.

The last step before giving the information to the programmer is to edit the script (frames) for content, continuity, and errors. After the programmer completes the programming, the program should be run many times to be sure that each pathway as designed on the educational flow chart runs as desired. At this point, about the only editing that can be done to the text is catching gross errors in punctuation and spelling usually based on typing in the program, not the writing.

Regardless of which method is used to develop the programs desired, it is important to understand the capabilities of the microcomputer and correlate them with educational principles, educational design, and the individual needs of the learner.

SOFTWARE MARKETING CONSIDERATIONS

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The need to orient computer software for education thoughtfully, based on instructional and curricular needs, is outlined against a keynote question: Is the quality of the educational product that we are producing today good enough for users and buyers of that product tomorrow, and can we produce a better product in less time, for less cost?

Computer technology in education is here to stay; it will force changes in the delivery and methods by which teaching and education are practiced. Seven factors affect the marketability and publishability of computer software for education: computers as an in-place technology in education, marketing and distribution patterns for software, consumer demand, quality timelessness, basic skills, and the future.

INTRODUCTION

The increasing use of technology, especially computer technology, by educators requires us to learn from the experience of others so that we do not paint ourselves into a corner. Advanced computer technology will change the way that we educate our students and the way that we relate and work with students. It will require us to change, to learn new skills, and to manage our skills differently from the way that we have been taught--differently from the comfortable ways of the past.

We can learn part of this from the experience of the American automobile industry. It is recovering from its worst decline in its history because it did not respond to the need for change early enough. The decline was brought about by the industry itself, due to a confluence of factors that it could not control but did not want to recognize and deal with fully at a time when everything else seemed to be all right. Information available to industry analysts in the late 1960s and early 1970s profiled the factors: rising oil and steel prices, management and labor practices needing revision, increasing foreign automobile sales, and government regulations requiring production line changes, changes partly inspired by products available from foreign manufacturers.

Depite all of this information, the U.S. automobile industry resisted change and did not make the significant decisions required before sales started to plummet. It was a classic pattern of an industry: a set of people not willing to change and make the investment required. It was easier to take the profits than the tax credits. It was productivity now at the expense of long-term, stable productivity in the future. It was management and the labor force that wanted continuing productivity and salary increases without adjusting to the advances in technology produced by others. The results, as we know, have been disastrous. Thousands of automobile workers are unemployed, small business firms supplying and relying on the major automobile manufacturers have been put out of business, others are hanging on by a thread, and the resultant loss of tax revenue combined with increased expenditures for unemployment compensation are dramatically increasing the federal deficit.

The automobile industry does not stand alone; it has reflected what many of us do by practice. We resist change, under the guise of adapting to it, when we know that a more fundamental modification to our current practice is needed to meet the challenges of the future adequately. The electronic revolution, just beginning, is going to necessitate fundamental changes in our educational practice and thought.

As educators, we need to look at the signs around us--signs that to varying degrees parallel those that have been predominant in the auto industry. The basic elements required to make our educational system function are increasing in cost; our management and labor practices need revision; foreign competitors, in the form of the electronics industry, are beginning to produce technological products that will compete with our traditional practice of producing teachers who convey information to students; and government regulations continue to shape the way in which we go about the business of education. It is time that we asked ourselves a serious question: Is the quality of the educational product that we are producing good enough for the users and buyers of that product tomorrow, and can we produce a better product in less time, with less cost? Computer technology will force us to do it.

The changes that we must initiate will reshape and create our roles as educators directing technology, rather than educators searching for ways to make technology useful. One of the most practical ways that we can do this is to keep a tight grasp on content and how we communicate content to students, whether handicapped or nonhandicapped. Computer technology is technology, nothing more or less. What we do with it and how we use it are important, but what we put into it, how we influence and shape the content of the computer program, the software, is initially important. Otherwise we have the proverbial garbage in, garbage out. The medium is not the message unless we allow it to be. The medium of the computer should not be more important than the quality of the computer program. Unfortunately, producing quality has never been easy. Quality, to use a phrase, is job one.

SOFTWARE MARKETING FACTORS

We at LINC have been dealing for some time with the medium and the message issue in the various formats of print, audiovisuals, telecommunications, computer software, and advanced electronic technology. We have also dealt with the processes required to arrange for the commercial production and distribution of innovative products that use different formats. In the process we have learned something about the factors that make a product marketable, regardless of its format, whether it is a book, a computer program, or an electronic device. In all of this, the single most important factor is not the medium, but the message, and how easily it can be used and communicated to others. Computer software is not an exception. Let us look at the market factors that surround computer software and what will influence its marketability and publishability.

Factor 1: Computers as an In-Place Technology

There is no doubt that computers have been around a long time. It is almost an embarrassment to see us, as educators, making such a fuss over them, because they are not a new technology. What has happened that is exciting with computers is miniaturization--the ability to have your own personal computer. The distinctions between microcomputer, very small computers, minicomputers, small computers, computers not so small, and mainframes--the big ones--are diminishing. It is possible to have a mainframe computer on your desk top, ready for personal use. The HP-9000 is an example; it will compute one million instructions a second.

As of December 1982, approximately 9,350 school districts had microcomputers for classroom use. About 25,000 school buildings had microcomputers, and the relationship between the size of the student enrollment and the number of computers required by the school was proportional. Increasing numbers of teachers are becoming computer literate; many are beginning to write their own software and courseware. It is projected that by the end of 1983 the number of schools to have acquired computers will have doubled. By 1985 most schools will have an installed computer base; by 1987 only a few schools will not have a computer.

The rate at which the number of computers in the schools is growing is slow compared to the fast pace of computer software and courseware development. More than 700 publishing and software houses either develop, produce, or distribute software. This does not take into account the number of educators producing software or the number of students and parents producing software. The importance of this marketing factor, the proliferation of computers in the schools, is the growing computer base to use whatever software is produced. Therefore, if you produce a software program, it is probable that it can be used by more and more educators and students.

Factor 2: Marketing and Distribution Patterns for Software

A preliminary analysis of a poll of producers and distributors of software by LINC in the late fall of 1982 showed the following marketing and distribution trends:

- 80 percent of software publishers still use direct mail supported by catalogs, fliers, ads, exhibits, etc.
- 50 percent of the companies have some kind of sales representative or dealer network. This is increasing, because one of the most effective ways to sell software is an on-site demonstration, and software sales are considered building-level sales.
- An increasing number of local computer retailers (Computer Land, Radio Shack, Atari, Sears, etc.) are becoming involved in the school and home market.
- 20 percent of companies have a preview policy to protect from unauthorized copying of disks.
- Only a minority of companies give unrestricted previews.
- 15 percent are experimenting with the demo disk concept, sometimes charging for a demo disk.
- Companies using direct mail consider warranties and guarantees an alternative to a preview policy; however, 20 to 25 percent of companies do not have a specific return policy: You buy it, you own it. Industry standards are beginning to emerge.
- 75 percent of companies guarantee their diskettes will "boot up," and 50 percent offer warranties that the courseware and software will play and operate.

- Warranties range from ten days to two years, thirty days is common. Ninety days to six months is offered by a number of companies; ninety days will probably become the standard.

- Companies are experimenting with backup and inexpensive replacement diskettes when the original disk needs to be replaced, updated, or revised. The implication for this marketing factor is that as the industry learns how to market and distribute software effectively, the distribution of software products will be as widespread and well-used as the distribution of print or A-V products.

Factor 3: Consumer Demand for Software

Consumer demand for software is affected by three constituents: the software publisher, producer, and distributor; the purchaser; and the user.

The software publisher, producer, and distributor, as stated, views the market for software as a building level sale. Some believe that as states and large school districts consider the notion of software libraries, like state and district level film libraries, the volume of software sales will decrease while the price per copy will increase. This happened to the film industry. If this does occur, many software publishers will reevaluate their production schedules and their marketing strategies.

The demand for software under these conditions will create an occasional use market for software, limiting much software to the supplemental materials category. In response, publishers will develop material as they perceive the market through the acquisition practices of software libraries. Publishers will seek areas to which they can adapt software to match nonsoftware products that they produce and distribute. This is happening and will continue. The result is the computerized workbook, the computer animated word list, the computer form of the programmed text. School acquisition practices and product line continuity are invisibly influencing consumer demand, creating an environment where the educator does not get to choose what corresponds to student abilities but is presented with a predetermined selection of software that is influenced more by economics than instructional needs. The problem is that individual educators either do not have the opportunity to, or cannot, articulate what the expected level of instructional quality is in a piece of software. This is not unique to software, but until individual educators make such a statement, they, as consumers of software, will have varying degrees of success in influencing and making known their demands.

On the other hand purchasers of software are having the greatest amount of influence on consumer demand for software. Software acquisition decisions are primarily being made by media center personnel, curriculum coordinators and supervisors, department heads, library media specialists, but not enough teachers. At a recent regional conference of the National Education Association in the Northeast, 50 percent of the software purchased was reported as not being used by the teachers. Not enough teachers have a voice in the software purchase decision. The consumer with the most influence is one step away from the classroom where the real consumers, the students, exist. This situation must be corrected if consumer demands for software are to be realistic.

Students have little influence on software demands and therefore on what type of software is produced, marketed, and distributed. Change in this area is on the way for several reasons. First, when enough software is available on any specific topic so that students can choose among software options, it may be possible to match software to specific student learning styles and needs. Second, student respect for teacher competence in using computers and software will inherently influence teacher selection of software in response to student expectations of the instructor; therefore students will affect software selection through this influence on teacher behavior. Third, students will strive for computer literacy and better performance levels using computers and software to gain peer recognition, as well as teacher praise, which will produce a type of consumer pressure similar to what students had on instructional television. Last, the development of computer clubs as school student organizations will enable students to influence software acquisition collectively.

Consumer demand for software ultimately will influence software development to the maximum. Articulating the demand differences between administrators, specialists, teachers, and students will probably be, as in the past, more of a political process than an educational process. The relevance of consumer demand as a marketing consideration is to understand, when you develop your software, how it will affect the acceptance of the software. Do not think that consumers will not buy a piece of junk. They will--if there is nothing else available.

Factor 4: Quality.

Quality sells. Whatever you develop, do it right or do not do it at all. Educators are looking for quality courseware and software, and they are learning fast about the characteristics of poor quality in software. According to a recent article in the Wall Street Journal, software consumers are becoming more discriminating buyers. Given that all other things are equal, people will not choose to buy something of inferior quality if, for the same price, they can have something better. Do not mistake junk for quality.

Factor 5: Timelessness.

Software that will retain its educational usefulness and relevancy over long periods will be sought after by budget-pinched schools. The ability to be used over and over again, without revision, is a key marketing factor. Schools do not want to be trapped into buying new software programs every year to replace the ones used the previous year. Schools do not want to look on software as consumables but rather as extensions of the computer hardware. As such, timelessness--the ability to use the software for as long as you can use the hardware--will find a receptive market in the school. Do not mistake software that uses student time to no end as timelessness. It is time-consuming junk.

Factor 6: Basic Skills.

Software and courseware that help students achieve minimum competency standards--the basic skills--will be attractive. Do not think software that teaches the obvious is a basic skill. It is teaching the students what they already know.

Factor 7: The Future.

The software of today will be the forgotten ware of tomorrow. Computers use software like lungs use air: a constant inhale and exhale, constantly using more, consuming what it captures, and disposing of what is not needed. Advances in computer technology will dwarf the ability of the individual to develop software singlehandedly. Most software will be developed by software companies, and eventually software as individual diskettes or pieces of courseware will not exist except for highly specific applications. "Information ware," time-shared data banks containing the total of human knowledge and information, will be available on a circulation, usage, or computer readership basis. You will get anything you want, but pay only for what you need. Computer programs will automatically delete all superfluous information not relevant to a user's need or request. Portable operating systems will allow students to "plug in" to any computer terminal within transmitting distance wherever they are. Increased storage of digitized information will allow you to carry around and access an encyclopedia; keyboards will be obsolete; commands to the computer will give way to interactive conversations.

Ultimately no one will write computer programs or software, as no one today "writes" language. The emphasis will be on managing the data and the environment in which they are presented, specifying the interrelationships between sets of information in order to protect objectivity, so users will be able to draw their own conclusions from the data and meet their own needs by being guided into understanding information that can be useful to their lives.

CONCLUSION

In the final analysis, the concerns about how we use and make computer software in the future will be our concerns today. The marketing consideration for the future is to concentrate on what you know how to do now, to communicate your skills, your knowledge, your message, in a way that someone else can use it. This is the education process; it is the essence of what makes any piece of software marketable--the unique, creative, intellectual way that you develop it so that it is useful to someone else.

Succinctly put, make your software an original; do not copy someone else's. Computers can do that for you. It is the creator of the software who thinks, not the computer that runs it. You, the author, are the greatest asset of the software, now and in the future. Do not abdicate control of the content of software programs to someone who does not know the subject. To do so will result in an inferior software program that will greatly reduce its marketability and publishability; but if you do not know how to design a computer program or to program it, get help from computer profesionals. They know how to program better than you do. Practice on your own, not on consumers.

ED#231145

SECTION 2

COMPUTERS IN SPECIAL EDUCATION MANAGEMENT

INTRODUCTION

Two categories of management applications in special education are discussed in Section 2. The first addresses data management as it relates to instructional management and student performance (computer-managed instruction), while the second looks at concerns of the special education administrator outside the classroom (computer-assisted management). In the first category, Miller and Ragghianti provide an overview of the use of microcomputer technology for cost-effective special education management. They discuss using computer-managed instruction to monitor individual student performance, as well as providing the basis for data used in computer-assisted management at the district level.

Wesson presents a software program, DBPM, developed to enable teachers to select measurement systems unique to the curriculum they are using, and that allows the teacher to monitor the performance of individual students. Graphic presentations of student performance data assist the teacher in analyzing the effectiveness of the instructional program. The article discusses the research and development processes carried out in producing this software, including the evaluation of teacher satisfaction, teacher utilization of the information, and its effect on student performance.

The final article in this section discusses data-based management systems. Tinsley reviews some of the different types of administrative data management programs available, such as electronic spread sheets and word processing, along with some of the problems associated with special education data base applications. Further discussions address the benefits of an integrated program and modular approach for administrative data, such as payroll, personnel, budgeting, etc. Tinsley concludes with a series of questions that need to be asked by the special education manager in evaluating the worth of an integrated system for particular special education application.

The four briefs that follow in the input and output section discuss three additional topics related to computer-assisted management. First, the concept of telecommunications and its application in special education through SpecialNet are briefly described. The second brief illustrates a local area network that can be implemented within a school system in instruction, curriculum development, administration, and local area telecommunications, including electronic mail and data base access. The third brief outlines some of the national resources available for special educators, including some available through SpecialNet, and others that will subsequently be available through the ERIC system. The final brief discusses an applications program that provides a curriculum management system, a teacher planning system, and an administrative planning system in an integrated software package.

A SOFT-SELL FOR HARDWARE:

THE USE OF MICROCOMPUTER TECHNOLOGY FOR

COST EFFECTIVE SPECIAL EDUCATION MANAGEMENT

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A knowledge of microcomputer technology is rapidly becoming a necessary job skill. This creates a critical need for schools to provide computer programs to prepare students for today's job market. It also provides new management techniques for school administrators. This presentation focuses on the computer as the manager of instruction and includes an introduction to computer terminology, considerations for the selection of hardware and software, effective data collection and information management, and the potential for, and possible methods of, structuring computer-based special education management systems.

We are not computer whizzes, but we recognize that the computer age is here. The electronic capabilities that allow the imprinting of thousands of complex circuits on a silicone chip smaller than a postage stamp and the replacement of hundreds of moving parts by one microprocessor have ushered in this era of the microcomputer. As a result, the microcomputer is invading the educational system at all levels. Educators must become involved in the development of this technology for educational applications.

In developing educational computer literacy, three areas need to be examined. These include the use of the microcomputer as the object of instruction, the medium of instruction, and the manager of instruction. How to operate the computer, how the computer operates, and the impact of a rapidly changing computer technology on society constitute the computer as the object of instruction.

The computer as the medium of instruction had its beginnings in, and still has its major emphasis on, computer-assisted instruction (CAI). Other applications include inquiry, simulation, and problem solving, all involving the use of more sophisticated instructional applications.

Finally, the computer can be the manager of instruction by aiding the teacher or administrator in storing and retrieving pertinent student data. Analysis of the data can also be accomplished with the computer. The computer allows us to be managers of data rather than just collectors of information.

This presentation focuses on the computer as the manager of instruction and includes two parts. Part One is an introduction to basic computer terminology. Part Two addresses considerations for the selection of software and hardware, effective data collection and information management, and the potential for and possible methods of structuring a computer-based special education management system.

Our purpose is to share some of what we have learned, especially those concepts that will aid you in advising your districts in the selection of a computer system. Most important, we challenge you to plunge into the world of the microcomputer and discover its seemingly limitless potential.

INTRODUCTION TO BASIC COMPUTER TERMINOLOGY

Computerese has been defined as a peculiar dialect, spoken and written by computer initiates for the gratification of their egos. It is also necessary to have a basic understanding of this dialect when talking with local computer salesperson or communicating with children. The next section gives a brief definition of some of this ego-building lingo, but the terms are further explained under the major headings of data measurement, hardware, and software.

Data Measurement

A microcomputer is simply a series of boxes connected by wires. By itself this computer is incapable of relating to humans. Instructions and data are necessary for an interrelationship. However, there is a limit to the amount of data that the computer can handle at one time, so a system for data measurement is necessary.

The terms associated with data measurement are bytes and bits. Bytes, or characters, numbers, letters, or spaces, are the fundamental units for communicating with the computer. For example, the letter A, the number 3, a ?, or a space constitute a byte. The statement "The computer age is exciting!" is equal to thirty bytes. Bits are the computer's fundamental units or the smallest units of data with which a computer works. They are the binary system of zeros and ones. Eight bits are approximately one byte, so the letter K is simply a series of eight zeros and ones arranged in a given order.

Hardware

Hardware refers to the actual physical equipment of the computer. The following lists the terms associated with hardware in a more meaningful framework:

I. CPU--Mainframe
   A. Processor
   B. Main memory
      1. ROM
      2. RAM
      3. Bus
II. Ports
III. Peripherals

CPU and mainframe are terms referring to the internal hardware components of the computer. These components include the processor and main memory. The processor performs the calculations and interprets the data; its size is measured in bits. Main memory stores the data and instructions that the processor needs, and receives the results of the processor's work. Its size is measured by the number of bytes that it can hold.

There are two kinds of main memory: ROM, or read only memory, and RAM, or random access memory. ROM is the memory where information is permanently stored. It contains the wake-up instructions that turn the

computer on. Information and programs are stored in RAM. This is the memory with which the user interacts. It is important to remember that when the power is turned off, all data in RAM are lost.

In summary, the processor size is measured in bits while main memory size is measured in bytes. An 8-bit system with 64 kilobytes of main memory refers to the size of the processor (8 bits) and the size of main memory (64 kilobytes).

Bus refers to the internal wires along which data travel. The bus size must match the processor size.

Ports or plugs are the outlets on the computer that allow the addition of peripherals or external devices. The number available is important, as one port is needed for every peripheral added to the CPU.

External devices or peripherals send information to or receive information from the computer. They include secondary storage devices and input and output devices. Because main memory is limited in size, and data are lost when the power is turned off, secondary storage is necessary if data are to be stored. These devices include floppy and hard disks, cassette tapes, and punched cards.

Input and output devices allow the user to get information into and out of the computer. Input devices include the CRT (cathode ray tube, or screen) and the keyboard. Output devices include the CRT, which allows the user to see what is being entered as well as what is already in the computer, and printers, which provide a hard copy of the data in the computer.

Software

Software is the set of instructions that command the computer and allow the user to interact with and take advantage of the computer's talents. Terms associated with software will be presented in the following framework:

1. Application programs
    a. Word processing
    b. Data base management system (DBMS)
    c. Accounting systems
2. Source programs
    a. BASIC
    b. COBAL
    c. FORTRAN
3. Operating system

Application programs contain a set of instructions that tell the computer how to do a specific task. They include word processing, which is a method of recording, editing, and storing written reports, letters, and JEPs; data base management, which is a program that handles the storage and retrieval of data entered under specific headings; and accounting programs, which allow the user to enter figures and formulas to be used in the calculations that the computer performs.

Source programs, also known as high-level language or programming language, include BASIC, COBAL, and FORTRAN. The computer takes this source program and translates it into the binary system for processing.

The operating system is the traffic cop of the computer. It keeps the data flowing between the CPU and the peripherals. The application program must be compatible with the operating system.

Summary

Bits and bytes refer to data measurement. CPU, processor, main memory, ports, and peripherals all refer to the hardware, with the size of the processor being measured in bits and the size of main memory being measured in bytes. The number of ports controls the number of peripherals that can be attached to the CPU. Application programs, source programs, and operating systems are terms that refer to the software that allows the computer to perform specific operations desired by the user.

While no one can fully understand the computer from reading a vocabulary list, this brief lesson in computerese should aid your inputting of computer lingo.

CONSIDERATIONS FOR THE SELECTION OF SOFTWARE AND HARDWARE

The search for the right microcomputer should begin by analyzing how you will use the computer. The specific uses that you have in mind will help determine both hardware and software needs. There are several questions that you need to answer. These fall into three main categories: what, where, and who.

Questions to Analyze Computer Uses

1. What processes do you want to use the microcomputer for: predicting, forcasting, and budget computations, or word processing for letters, mailings, and IEPs or student information files?
2. If a school site is intended for microcomputer placement, will the same hardware be used for both computer assisted instruction and administrative uses? Some hardware may be inappropriate for both uses.
3. How much data must the system be able to handle? Central office data needs will be quite different from those of a school site.
4. Will the same hardware be used throughout the district for both school site and central office uses?
5. Who will use the microcomputer--secretaries, teachers, administrators, psychologists?
6. Will multi-user time sharing be used? An example of this could be at a high school with a large special education department. A CPU would be hooked up to several screens and keyboards with a printer or two. The screens and keyboards could be used by teachers, psychologists, secretaries, department heads, etc.

A common mistake made by school districts is buying hardware first and then trying to find software that will run off that machine. The system is only as good as the software used. Therefore, software should be selected before purchasing hardware.

Evaluating Software First

There are some basic questions to be answered when evaluating software. These can be grouped under four main headings: ease of use, documenting, dealer support, and flexibility.

Ease of use. Is the software user-oriented? A well-designed software package should take between two and six hours of training to master. Many software packages include practice disks and training lessons. The personnel who will actually use the software should try it out before purchase.

Second, is the software menu-driven? The menu lists the choices and gives instructions on how to execute the desired choice. Figure 1 depicts an example of a menu from Profile II, a data base management system.

PROFILE II MENU

0. Directory
1. Define Data Formats
2. Define Screen Formats
3. Define Report Formats
4. Define Label Formats
5. Define Selection Formats
6. Expand Existing File
7. Inquire, Update, Add
8. Print Reports
9. Print Labels
A. Select Records
X. Exit

FIGURE 1

For example, if you wanted to set up a file of students in your special education program, you would choose 1, define data formats. The microcomputer would then lead you through setting up your fields. Field 1 would probably be last name or last name, first name. Subsequent fields would include parent's name, address, school, handicapping condition, etc. The set of fields on each student would make up a record. All of the records would comprise a file. If you wanted a report of students by type of program, you would select 3, define data formats. Once the report format was set up, you would choose 8, print reports.

Documentation. Does the software selected have complete concise documentation including an easy-to-understand operator's manual? It is necessary to sit down at the microcomputer and try to follow the steps outlined in the manual before buying the package. What seemed clear to the programmer who designed the package may be frustratingly unclear to the novices who buy the package and try to use it on their own.

Do software brochures and demonstration materials show the data capacity of the system? How much main memory will the software package use? How much room on the disk is taken up by directions to the computer? Some software packages may leave little room for the amount of information that you want to put in. All compatible hardware should be listed. On what machines can you use this software? Examples of reports should also be shown in the manual. You need to know if this software package can generate the kinds of reports that you need.

Dealer support. Does the software dealer offer support even after the sale is made? Replacing defective merchandise, correcting program errors, providing updates if new improved packages are developed, providing effective training programs, and clearly spelling out maintenance provisions are areas to consider. Keep in mind that payment terms are a key part of the negotiations for installation. In other words the system should be installed and operating before final payment is made.

Flexibility. Are the input and output and processing capabilities of the package flexible enough to accommodate your changing needs now and in the foreseeable future? Is it possible for nontechnicians such as yourself to modify the structure of the reports?

Ratings of software are published in computer journals and research service guides such as Data Pro. Another good source of information is another user. Ask the dealer for names of people using the package. Check with other districts using the software to see how well it works for them and any difficulties that they may have encountered.

Selection of Hardware

Once the software has been selected, hardware choices are narrowed. Important considerations in selecting hardware include capacity, storage, input and output, and service.

Capacity. This refers to the size of both the central processing unit (CPU) and main memory. For administrative uses the CPU should be a 16-bit system. Main memory should be at least 48 to 64 KB.

Storage. The most commonly used storage devices for microcomputers are floppy disks. Hard disks are becoming available, however. The basic differences between floppy disks and hard disks are durability, storage capacity, and expense. Floppy disks must be handled carefully. Dust, heat, finger marks, and warping caused by improper storage can damage the disks. Hard-disk systems are sealed systems and are therefore less susceptible to damage.

Floppy disks come in two sizes: 5 1/4 inches and 8 inches diameter; 5 1/4-inch disks have a storage capacity of 75,000 bytes; 8-inch disks have a storage capacity of 315,000 bytes. Hard disks are available in 8-inch and 14-inch diameters and have a storage capacity of 75,000 to 315,000 bytes. For example, one special education student's records including IEP data could contain 10,000 bytes. A 5 1/4 inch floppy disk would hold only about seven such records; 5 1/4-inch or 8-inch floppy disks used to store large amounts of data could conceivably create a new filing problem and require a file to find a file.

Hard-disk systems are initially expensive but, in light of the rapidly developing and constantly changing computer technology, one can assume that reasonably priced hard-disk packs will be widely available for microcomputers in the next few years.

Input and output devices. The type and number of input and output devices needed is an important consideration when choosing hardware. The ports or connecting plugs on the computer itself (the CPU) determine both the number and type of devices that can be used. Input considerations include the type of keyboard and location of specific keys. The keyboard should be as close as possible to an actual typewriter for ease of use. Output devices include the CRT (screen) and printers. The number of positions on the screen (columns by rows) is important to consider. Some screens show only part of a line of print. There are basically two types of printers: dot matrix and letter quality. Dot matrix printers may be adequate for your needs if reports, mailing labels, and lists are all that is needed. Letter-quality printers produce a higher quality printed copy, and you may want this type of printing for letters. However, letter-quality printers are typically slower.

Service. As with the purchase of software, the availability of service including warranty, maintenance, update provisions, and guaranteed delivery date must be considered. Warranty provisions and maintenance contracts need to be negotiated before the system is purchased to assure maximum computer uptime.

In summary, in selecting software and hardware,

1. Define specifically for what use you want to use the microcomputer.
2. Research available software and hardware.
3. Buy the most reliable software and hardware that meets your present and projected needs.

DATA AND INFORMATION NEEDS IN SPECIAL EDUCATION

Before one can address the actual uses of computer technology in special education administration, a close look must be taken at the components of good data collection and information management. The computer alone is not a data-processing system. An efficient management program will combine present data collection methods with computerization. An effective data collection and information management system must incorporate the information needed to administer an accountable special education program. Some basic considerations include the following:

1. The data collection procedures should be directly related to identification, assessment, and placement procedures.
2. The system should be designed to meet the record keeping and data needs of both direct service and supervisory personnel.
3. The system should be able to accommodate changes in information needs among special education programs.

Information should be designed to incorporate several planning or reporting functions. The following are examples of information needs in special education administration that can be met more effectively with computerization than with manual processing. In other words, all the files of information that are kept by direct service and supervisory personnel in numerous file cabinets and 5 by 8 card files could be stored in the microcomputer and accessed as necessary.

Types of Information That Can Be Computerized

Masterfile: lists of all special education students and lists by categories, schools, etc.

Scheduling: for schools, transportation, resource programs, related services, and personnel

Reporting: for example, interim progress reports on IEP goals for parents and regular class teachers.

Attendance Reports

Research: This could include relationships between variables such as type of placement, age at entry into special education, ~~handicapping~~ condition, etc.

Student Identification: Files of basic information so that the reports on ethnicity, federal employees, federal housing, free lunch, etc., could be accessed directly from the microcomputer rather than from endless forms for the teacher.

Historical Data: Including medical and psychological

Student Directory: Emergency phone numbers, etc.

Mailing by Activity: Mailing lists, mailing labels, and letters can be generated on the microcomputer. The microcomputer could identify all students whose reevaluation date is upcoming, insert the appropriate items in the blanks in a letter, and address the labels. Figure 2 is an example of such a letter.

Dear

It is time for the annual review of ______________________ IEP. Please indicate the most convenient time for you to attend a meeting at the school. ______________ will be reevaluated before the meeting. If you have any specific requests, please indicate them on the bottom of the appropriate form.

The following people will attend the meeting:

____Classroom Teacher	____Resource Specialist
____Counselor	____Administrator
____Itinerant Teacher	____Psychologist
____Adaptive P.E.	____Social Worker

Please indicate your 1st, 2nd, and 3rd choice of meeting times. If you have any questions, please call 222-8097.

DATE	TIME
________	________
________	________
________	________

REMARKS____

FIGURE 2

Record Keeping: The multitude of records kept on special education students by a district can be put into the microcomputer and accessed as needed.

Testing: Results are easily accessible and readily available in one place.

Types of Data Analysis Available

Given the amount of data available with this student system, one would be able to compile the information necessary for compliance monitoring and for ensuring compliance, such as:

1. lists of incomplete records (unsigned IEPs);
2. child counts cross-referenced by age, program, and handicapping condition;
3. audit trails for program projections and reimbursement; and
4. budget and program projections and reimbursement computations according to state and federal formulas.

It will also allow analysis for management information required not only by administrators but by teachers and specialists as well.

Building a Computer Management System

A total management system should be the goal, not the immediate objective. To build a computer management system, schools may begin with one or two applications specific to their needs.

For example, a school or district could purchase a data base management system and a word processing system, both of which are software. The necessary hardware would include a CPU with 48 to 64 kilobytes of main memory; a CRT with an 80 by 24 column screen, so that an entire line of text can be seen; a printer--either dot matrix or letter quality; and disk drive expansion unit or a hard-disk system.

With this configuration a district could begin transportation scheduling, student files, or individualized program records. The word processor could be used to write letters to parents and generate curriculum guides. The two working together could generate more comprehensive reports and information analysis. It is important to remember that in order to do this efficiently, ample secondary storage is critical.

The cost of this configuration is presented in the following list. The price ranges reflect the sophistication and quality of the product.

1. Software
   A. DBMS--$100 to $1000
   B. Word processor--$100 to $800
2. Hardware
   A. Computer--$2,500 to $8000
   B. Printer--$300 to $700 for Dot Matrix
      $2,000 for Letter Quality
   C. Disk Drive Expansion--$850 to $3,000
   D. Hard-Disk System--$2,000 up
3. Additional costs
   A. Paper--$40 per box
   B. Disks--$5.95 for 5 1/4-inch
      $7.50 for 8-inch
   C. Printer ribbon--$15
   D. Cables--$50
   E. Maintenance--about 10 percent of the purchase price
   F. Furniture--as needed

An important rule to remember when budgeting for a computer system is to plan to spend 50 percent of the total cost of the hardware on software. The system will be only as good as the software that runs it.

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RESOURCES

The Council for Exceptional Children. Hot topics. Reston VA: The ERIC Clearinghouse on Handicapped and Gifted Children; The Council for Exceptional Children, 1981.

Data Pro. How to buy software packages. (D09-100-001--D09-100-007) Delran NJ: Data Pro Research Corporation, 1979.

Data Pro. Microcomputer specifications. (M09-050-201--M09-050-206) Delran NJ: Data Pro Research Corporation, 1981.

Healy, W., Pikus, A., Roth, F., and O'Relley, E. Comprehensive assessment and service evaluation, Information system for language, speech and hearing programs in the schools, Needs Project 11. Washington DC: American Speech and Hearing Association, 1976.

Norman, C. The new industrial revolution. The Futurist, February 1980, p. 30.

Parker, S., Friars, E., Gelmann, N., and Kownacki, W. Special education management by information. Washington DC: NASDSE, 1980.

Pogr, Stanley. How computers work. Paper presented at Microcomputers in Education Institute, San Diego State University, July 27, 1981.

Roman, T.M. The path to successful computerization. School Business Affairs, May 1980, pp. 16-17.

Stallard, C. Computers and education for exceptional children: emerging applications. Exceptional Children, October 1982, pp. 102-104.

DATA-BASED PROGRAM MODIFICATION:

A DISK FOR MONITORING STUDENT PROGRESS

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INTRODUCTION

This presentation describes a microcomputer disk developed by Data Based Associates (DBA), a private organization. DBA consists of special educators, school psychologists, and research scientists with extensive experience in teacher training, consultation, and computer applications. The software developed by DBA is entitled "Data Based Program Modification" (DBPM). DBPM enables a teacher to select a measurement system unique to the curriculum which allows the progress of each student to be monitored. Data generated from routinely scheduled student performance samples, one to three minutes in duration, are examined through graphic analysis or simply entered into the DBPM computer software package. Although the computer package is not necessary for progress decisions to be made, it offers the advantage of an instantaneous printout that informs the teacher of the effectiveness of the current instructional program.

If the instructional program is not likely to meet the projected goals, the computer program will recommend that the teacher make a change in instruction. A printout of student performance over time along with simple, evaluative statements is available, providing school personnel with a hard copy. For administrators, DBA provides a service to aggregate information across students for the purposes of program evaluations and summaries.

The remainder of the presentation describes the research and development process supporting DBPM, the procedures used, and additional services available through Data Based Associates.

RESEARCH AND DEVELORMENT

In recent years greater demands have been placed on educators, especially special educators, to be accountable for the quality of educational decisions and the ways in which decisions are made. A number of criteria to be followed in assessment and decision-making procedures have been outlined in P.L. 94-142. Implementation of this part of the law has proved difficult due to the absence of technical knowledge that would enable schools to comply with the intent of the law as well as the procedures outlined in the law. In response to this problem, a program of research and development was established; its goal was developing a functional system for developing and monitoring progress on IEP goals P.L. 94-142 intended.

One objective of this research and development program has been to empirically determine the effects of teachers using the formative evaluation system on student achievement in reading, spelling, and written expression. If we are to achieve substantive as well as procedural compliance with the law (Deno & Mirkin, 1980), we must determine whether using the formative evaluation system increases teacher success in developing student programs. In answering this question, our focus has been on the IEP adjustment decision that teachers make once special education is being provided for a student. The formative evaluation system is an assessment device for monitoring the effectiveness of the IEP. The hypothesis is that if an adequate system of formative evaluation is developed, teachers may use this system to monitor student progress and the effectiveness of their instruction. If student progress is not adequate, then teachers judge their instruction ineffective and modify their instruction in an attempt to improve the student's progress.

The rationale underlying this hypothesis rests on a set of assumptions. First, the success of special education is defined by the extent to which students' academic and social behaviors are improved. Second, for any mildly or moderately handicapped student, it is impossible to reliably identify special educational alternatives that will be more effective than the regular classroom program. Given the first two assumptions, the initial IEP then must be viewed as a guess about what might be helpful to the student rather than a plan that is guaranteed to help. If the IEP is only a guess, then there is no alternative but to continuously evaluate the effectiveness of the IEP and to modify it when it is unsuccessful. Under such conditions teachers should be able to increase the success of special education by systematically measuring student progress toward the achievement of program goals and then adjusting student programs to enhance that progress. In a responsive system such as this, student performance data function as the most useful vital signs of whether a program is working or should be changed. An evaluation system, when effective, allows teachers to empirically test their best hunches about how to help students.

One desirable characteristic of a formative evaluation system is that it can be useful for monitoring the effects of any type of instruction. For example, whether the teacher chooses DISTAR, a basic sight word method, or any other approach to teach reading, the monitoring system should accurately measure the student's progress in reading, and it must be unbiased with respect to various theoretical approaches to teaching.

Stage One

In order to accomplish the goal of the research and development program, a three-stage plan was designed. Stage One included (1) the identification of the behaviors to be measured in reading, spelling, and written expression; (2) the development of technically adequate measurement procedures for measuring those behaviors; and (3) an exploration of alternative approaches (rule systems) for using the data generated by these measures to make decisions about the effectiveness of instruction. The studies in Stage One were intended to lay a foundation for subsequent engineering of a generic formative evaluation system. Identifying valid simple measures of student performance was critical because later development of the evaluation system rested on whether performance data that were technically adequate could be easily and frequently collected.

Consistent with the intent of the three-stage plan, measurement and evaluation procedures were developed for three academic areas (reading, spelling, and written expression). For purposes of illustration, the process of identifying the reading measures will be described.

The basic strategy used in identifying useful measures involved a process of elimination. Initially a pool of five easily measured reading behaviors was generated through a review of the available literature. The behaviors measured in reading included (1) reading isolated word lists, (2) reading isolated words in context, (3) reading aloud from text, (4) identifying deleted words in text, and (5) giving word meanings (Deno, Mirkin, & Chiang, 1982). The next step was to develop simple standardized measurement procedures. Specific directions, which could be used routinely to conduct assessment, were devised. These specifics included how to choose a sample and provide directions to the student.

The third step was to determine the criterion validity of the measurement procedures by correlating the scores obtained from them with scores on commercially available standardized measures, with program placement, and with grade level. The measures that were not reliable or valid, or those that were deemed less acceptable with respect to any other desired characteristics, were eliminated from the pool.

The results of the criterion validity research led to the conclusion that reading aloud from a basal text is an optimal behavior to measure in reading. The rationale for this selection includes the fact that reading aloud provides a broader range of scores than isolated words, and relates somewhat more closely to comprehension. In addition, reading aloud requires little teacher preparation because a teacher can simply randomly select a passage and direct a child to read aloud. The procedures for measuring reading aloud have been detailed in a manual available through DBA and are briefly described in the procedures section of this article.

Once the procedures have been developed for measuring reading, the next step in stage one of the research program was to investigate two procedures for writing objectives. Short-term objectives (STOs) are based on the long-range goals, which are developed using a formula and the student's scores from the reading-aloud measure. STOs can be written so that measurement is on a standard task (e.g., reading aloud at a specific level of a reading series), or measurement can be based on a standard criterion applied to sequential tasks (e.g., mastery of units in a basal reader). Both procedures for writing objectives were adequate (Fuchs, Wesson, Tindal, Mirkin, & Deno, 1982).

At the same time, several studies were conducted to examine various procedures for using the data generated from the administration of the generic measures. Analyses of student performance data indicated that students showed greater academic growth when a data utilization strategy was in effect than when teachers did not use the data systematically (Martin, 1980; Mirkin, Deno, Tindal, & Kuehnle, 1980). Questionnaires designed to evaluate teacher satisfaction with two alternative data-utilization strategies revealed that teachers preferred to use a combination of the two strategies over using either strategy alone (Fuchs, Wesson, Tindal, Mirkin, & Deno, 1982). This finding contributed to the design of the data-utilization strategy employed in stage three studies. This strategy is described in the procedures section.

Stage Two

Stage Two consisted of improving the logistical feasibility (Lovitt, 1977) of the formative evaluation system, as measured by teacher efficiency and satisfaction. No system of formative evaluation would be useful if teachers found it to be too time-consuming or if they were dissatisfied with other aspects of the system. Without efficiency and teacher acceptance, the formative evaluation system probably would not be used regardless of its value in monitoring student progress.

A series of field tests was conducted with a cooperating school district. The results indicated that with practice and systematic attempts to reduce measurement time, teachers were able to increase their efficiency by 15 times. At the end of the study teachers required, on the average, only two minutes to prepare for measurement, conduct a one-minute assessment, and score and graph the results (Fuchs, Wesson, Tindal, Mirkin, & Deno, 1981). These teachers were also highly satisfied with the evaluation procedures.

When questioned by independent evaluators, the teachers stated that (1) the system eliminated much of the jargon, ambiguity, and vague descriptions once found in IEPs; (2) the system met the real intent of the law; (3) their own testing was now relevant to the instruction being provided in the classroom; (4) they were confident in the reliability of their test, making decisions easier and meetings shorter; (5) their testing was more meaningful because students are compared with peers from their own school and grade level; (6) the students were more aware of their own progress because of the frequent charting required by the data-based system; (7) their ability to measure the effectiveness of their teaching strategies with any particular student was improved; and (8) the system made writing IEPs much easier (Wesson, Deno, & Mirkin, 1982). These results clearly suggest that this monitoring system not only is logistically feasible but in fact has practical advantages.

Stage Three

Stage Three of this research and development plan brings the focus of research back to the primary goal: to determine the effects of teachers' use of formative evaluation on student achievement. Preliminary findings on this topic are encouraging. Results of a study involving teachers from 39 large-city schools indicated that implementation of the frequent, direct measurement and evaluation procedures affected positively both student achievement and student awareness of their own achievement. Students of experimental teachers performed better than students of comparison teachers on virtually all achievement measures; rate and accuracy in reading aloud from text materials, and the Structural Analysis and Reading Comprehension subtests of the Stanford Diagnostic Reading Test. It is worth noting that although the former measure (reading aloud from text) was used throughout the study, the ~~latter~~ two were not directly measured by the teachers as part of the evaluation system.

The findings suggest that when teachers repeatedly employ the simple one-minute test of reading aloud from text passages to index student progress, they can interpret student gains as representing general reading achievement. That is, the data apparently validly reflect fluency, decoding, and comprehension. The only measure on which experimental and control group performance was undifferentiated was error scores on the third-grade oral reading passages. This may be explained by the poor reliability of such error scores (Deno, Mirkin, Chiang, & Lowry, 1980; Fuchs & Deno, 1981; Fuchs, Deno, & Marston, 1982). Consequently, the results of this study suggest that technically adequate, repeated curriculum-based measurement, when used by teachers to evaluate and modify programs, positively affects student achievement.

In addition to achieving better, the students in this study were more knowledgeable about their own learning when their teachers used systematic measurement and evaluation procedures. As compared to pupils whose progress was measured and evaluated via conventional special education practice, students who were measured and evaluated repeatedly and systematically in their curricula (1) more frequently said that they know their goals, (2) more often actually stated their goals, (3) were more accurate in their estimates of whether they would meet their goals, and (4) more typically reported that they relied on data to formulate estimates of whether they would meet their goals. The results revealed that repeated, direct systematic measurement and evaluation enhances not only students' reading achievement, but also their knowledge concerning their own learning. These outcomes are theoretically and socially important. On the one hand they support the hypothesis of many educational psychologists (Bandura, 1982; Crow & Crow, 1963; Farnham-Diggory, 1972; Prentice, 1961) that students' knowledge of their learning may improve academic performance. On the other hand increased participation by students in their own education is often regarded as an important educational goal.

This study generally provides support for increased use of systematic, ongoing measurement and evaluation of student progress by teachers. It provides evidence that individual special education programs can be monitored continuously and improved as required to increase the likelihood of student gains. The findings of this research contradict the conventional argument that teachers do not need to use frequent measurement and evaluation because (1) they are already sufficiently aware of student achievement and (2) such procedures are inefficient. Teachers who used frequent measurement and systematic evaluation were more effective in enhancing student growth and student awareness of their educational programs.

Procedures Used With DBPM

Teachers using DBPM require training to carry out a specific set of procedures, including establishing an appropriate measurement level, writing long-range goals (LRGs) and short-term objectives (STOs), collecting three oral reading scores per week for each student, inserting the data into a disk or plotting the scores on a graph, and using the data in making decisions about the effectiveness of student's instructional programs.

Measurement. Reading measurement consists of one-minute timed samples of reading from the student's curriculum. Correct and incorrect words are scored and charted on equal interval charts. The level of stimulus material for testing, which also represents baseline level, is selected as the level from which the student reads aloud about 50 words per minute.

Writing goals. Teachers are instructed to write long-range goals for the student's IEP using both the entry-level criterion and a desired year-end mastery criterion, usually 90 to 150 words correctly per minute with no more than seven errors. The format used in writing the long-range goal is similar to the following example:

> In 32 weeks, when presented with stories from level G, Ginn 720, John will read aloud at the rate of 110 words per minute with 7 or fewer errors.

Writing objectives. For performance objectives, in order to compute the short-term objective, teachers first subtract the baseline level of performance from the criterion level listed in the LRG. Dividing this difference by the number of weeks necessary until the annual review, they arrive at the number of words per week gain necessary to meet the long-range goal criteria. The measurement task is a random sample of items from a constant set of stimuli, and the goal is to improve the level of performance on that stimulus material. In graphing performance measurement, the horizontal axis represents successive school days and the vertical axis represents the level of performance on a constant measurement task. Each data point represents the level of proficiency on that constant measurement task. The line of best fit through the data points depicts the student's rate of improvement in performance on the set of stimulus material.

Data utilization. In addition to measuring and writing goals and objectives, the teachers are trained in the use of the measurement procedures for evaluation of the instructional program. In order to monitor student growth, the baseline reading level and the long-range goal are connected by an aimline that showed the student's desired progress. This aimline appears on the Apple disk. Every seven data points, the computer monitors student growth by means of statistically evaluating the data. If the student were progressing at a rate equivalent to, or greater than, that indicated by the aimline, the instructional program was continued. If the projected rate of growth were less than that indicated by the aimline, teachers were directed to make a major change in the student's instructional program.

Technical information on DBPM. DBPM is Apple compatible. It requires the use of an Apple II plus microcomputer with 48K memory. Compatibility with other systems is in progress with information available upon request. Each 5 1/4-inch diskette is available in three formats:

1. Program A is designed to measure and evaluate the performance of 20 students in reading, spelling, written expression, and math over a one-year period.
2. Program B assists the teacher in analyzing the reading and math performance of 40 students over a one-year period.
3. Program C allows the progress of 40 students to be monitored over one year in written expression and spelling.

ADDITIONAL SERVICES OFFERED BY DBA

Data Based Associates provides training via in-service workshops designed to illustrate basic data collection and goal setting techniques. A typical training program focuses on:

- the measurement procedures for each academic area;
- procedures for setting goals and objectives;
- the use of the data for program evaluation;
- the use of unique DBA designed microcomputer software; and
- the application of the computer-generated data for program evaluation.

Data Based Associates also offers consultation to school districts regarding the implementation of these progress-monitoring procedures. Consultation services are uniquely designed to meet the needs of each district.

For more information, contact Data Based Associates, 973 Laurel, St. Paul, Minnesota 55104, (612) 221-0046.

ED#234534

REFERENCES

Bandura, A. Self-efficacy mechanism in human agency. American Psychologist, 1982, 37(2), 122-147.

Crow, L. D., & Crow, A. Readings in human learning. New York: David McKay, 1963.

Deno, S., & Mirkin, P. Data-based IEP development: An approach to substantive compliance. Teaching Exceptional Children, 1980, 12, 92-99.

Deno, S. L., Mirkin, P. K., & Chiang, B. Identifying valid measures of reading. Exceptional Children, 1982, 49, 36-45.

Deno, S. L., Mirkin, P. K., Chiang, B., & Lowry, L. Relationships among simple measures of reading and performance on standardized achievement tests (Research Report No. 20). Minneapolis: University of Minnesota, Institute for Research on Learning Diabilities, 1980. (ERIC Document Reproduction Service No. ED 197507)

Farnham-Diggory, S. Cognitive processes in education: A psychological preparation for teaching and curriculum development. New York: Harper & Row, 1972.

Fuchs, L. S., & Deno, S. L. The relationship between curriculum-based mastery measures and standardized achievement tests in reading (Research Report No. 57). Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities, 1981. (ERIC Document Reproduction Service No. ED 212 662)

Fuchs, L. S., Deno, S. L., & Marston, D. Use of aggregation to improve reliability of simple direct measures of academic performance (Research Report No. 94). Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities, 1982.

Fuchs, L.S., Wesson, C., Tindal, G., Mirkin, P., & Deno, S.L., Instructional changes, student performance, and teacher preferences: The effects of specific measurements and evaluation procedures (Research Report No. 64). Minneapolis: University of Minnesota, Institute for Learning Disabilities, 1982

Fuchs, L.S., Wesson, C., Tindal, G., Mirkin, P., & Deno, S.L. Teacher efficiency in continuous evaluation of IEP goals (Research Report No. 53). Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities, 1981.

Lovitt, T. In spite of my resistance, I've learned from children. Columbus: Charles E. Merrill, 1977.

Martin, M. A. A comparison of variations in data utilization procedures on the reading performance of mildly handicapped students. Unpublished doctoral dissertation, University of Washington, 1980.

Mirkin, P., Deno, S., Tindal, G., & Kuehnle, K. Frequency of measurement and data utilization strategies as factors in standardized assessment of academic skill. Journal of Behavioral Assessment, in press.

Prentice, W. C. H. Some cognitive aspects of motivation. American Psychologist, 1961, 16, 503-511.

Wesson, C., Deno, S., & Mirkin, P. Research on developing and monitoring progress on IEP goals: Current findings and implications for practice (Monograph No. 18). Minneapolis: University of Minnesota, Institute for Research on Learning Disabilities, 1982.

SPECIALNET: AN APPLICATION OF COMPUTER-ASSISTED TELECOMMUNICATIONS IN SPECIAL EDUCATION INFORMATION AND RESOURCE MANAGEMENT

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This session provided hands-on experience with SpecialNet. SpecialNet is a national special education computer-assisted telecommunications network developed by The National Association of State Directors of Special Education (NASDSE). The network described in this session provides rapid computer-assisted communication among nearly 1500 individuals and agency users in 50 states, including 48 state education offices. In addition, the presentors provided an overview of the twenty-five information bases, which include programmatic areas (e.g., multihandicapped, early childhood), technology (e.g., computer application, television, and video), and special education management (e.g., federal and legislative, litigation, CSPD) providing up-to-the-minute resources from experts in those areas as well as from other network users.

The participants in this session did not need to have any formal experience with computers. However, computer literate participants may have been introduced to a new application for their hardware.

The session's major goal was to lead participants from a general understanding of telecommunication technology to the specific applications of computer-assisted telecommunications in special education. Four major objectives were included to meet this goal.

1. An introduction to the concept of computer-assisted telecommunications network. Objective one provides an introduction and definition of the basic forms of telecommunication. The primary benefits and risks involved in the application of this technology were presented, including hardware requirements and the adaptability of hardware for use by handicapped individuals. Finally, the concept of network was defined and the SpecialNet computer-assisted telecommunications system's potential as a national and statewide network linking special educators at the national, regional, state, district, and institutional level, was examined.

2. An overview of the communication and information applications of the computer-assisted special education network, SpecialNet. Objective two examines the information and resource applications of SpecialNet. The various services offered to network subscribers are outlined, including an explanation of the network's electronic bulletin boards which provide an informal information base in twenty-one content areas related to the handicapped. Examples of the type of information provided, the format for entering information, and how to access the information were presented.

3. Carefully programmed instruction leading to actual ability of each participant to use the network. Objective three is designed to lead the participant through the actual operation of the system. The participants learn to compose messages and use the various send options, read and scan file options and access information from various bulletin boards. In addition, the more complex operations involving editing and filing are outlined.

4. Hands on access and use of SpecialNet by participants using portable electronic data terminals. Objective four provides each participant with (as time permits) an actual opportunity to apply the knowledge acquired through objective three. A minimum of four portable electronic data terminals were provided by the presentors for this purpose. Participants access the network, send and receive a message, and retrieve information from one of the bulletin boards.

Participants have adequate knowledge and skill to use SpecialNet after the session. Additionally, each participant has the opportunity to ask questions regarding the potential for the system's use in the agency and explore how other special educators are making use of the system.

RESOURCE LIST

Campbell, R. The SpecialNet communication and information network: An application of computer-assisted telecommunications in special education. Directions Gallaudet College: Issues in postsecondary education, 1982, 3, (2), 70-75.

Campbell, B., Snodgrass G., & Gibbs, L. Telecommunications: Information systems for special education's future. Journal of Special Education Technology, 1982, 5, (1), 1-11.

Snodgrass, G., & Campbell, R. The application of electronic communication in special education. In J. Dominguez and A. Waldstein (Eds.), Educational Applications of Electronic Technology. Monmouth OR: WESTAR, 1982.

DATA BASE MANAGEMENT SYSTEMS

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There are two types of data base management systems. The first type is a simple, or general, electronic filing system. It can be used as a substitute for all those applications that involve maintaining records and files and generating reports from those files.

It does not matter whether the records relate to students, personnel, inventory items, or purchase orders. You will designate the file when you enter your choice of data, i.e., inventory.

The number of potential applications is mind boggling. For example, a typical elementary school can establish a student demographic data base on diskette and have instant access to any portion of the file; i.e., a bus breaks down and the kindergarten students are stranded at school: list/print all kindergarten students on bus run 15: priority 1. home phone; 2. emergency phone; 3. parents name, etc.

You set up a phone system and call home. Unless you had a filing system to accommodate a problem of this type, it would have been an impossible task.

ELECTRONIC SPREAD SHEETS

Business executives have discovered that the time (and power) saving advantages of this one type of program alone justifies the cost of purchasing a microcomputer.

These programs handle jobs that involve two-dimensional (rows and columns) tables filled with numbers that need extensive processing and repetitious calculations. The value of the program is that you can change a single variable, and all the related values will automatically change with it. The power of the program rests with its potential for forecasting, mapping, and negotiations. The program basis is the what--if and if--then tasks that it can perform.

Numerous central office tasks can be accomplished with the electronic spread sheet. This is truly a time saver.

WORD PROCESSING

A word-processing program is not simply a sophisticated typewriter. It is more aptly defined as a tool that can turn a laborious, time-consuming writing task into one that is almost enjoyable.

If you write like I do, it takes a minimum of three drafts before a final copy is produced. This means that the typist must retype the copy a number of times while trying to decipher my hieroglyphics, scratch-outs, write-overs, and arrows. This is where a word-processing program shines.

Words, sentences, or paragraphs can be changed, deleted, substituted, or rearranged in a matter of seconds, electronically.

Word processing is most useful for writing tasks such as reports, curriculum guides, departmental procedures, or policies, which frequently require extensive changes during the creation of the original draft or after the draft has been produced. In addition, word processing is also useful for customizing standard documents such as contracts and letters to parents, where a small portion of the overall text needs changing.

Some word-processing programs can be linked to data bases or mailing programs that make some insertion, such as name and address, automatically. Certain word-processing programs are accompanied by dictionary files that automatically check for spelling errors.

ADMINISTRATIVE DATA BASE AND MANAGEMENT SYSTEMS

These systems include functions such as the following:

Attendance
Student--record files
Calendar of events
Cost accounting
Inventory
Library and media center
Maintenance
Scheduling
Bus and transportation
Club and social activities
Grade reporting
Ledger
Mailing Lists
Payroll
Sports accounting
Word processing
Staff data base
IEP generator
Curriculum and course objectives

Some of these applications stand alone; some are integrated data bases.

A FEW PROBLEMS INHERENT IN APPLICATIONS

For most applications you will need a separate data base, i.e., personnel and student, DBMS. You need to enter the same data into each separate DBMS, i.e., student demographic file and student attendance file. This also creates a problem of maintaining or updating multiple files.

Here are a few solutions to the problem:

1. Keep a detailed DBMS catalog and what is kept on each system. A menu is more complex but is more efficient.
2. Construct a set of instructions for personnel maintenance systems.

If you are handy at constructing small programs, design a program, incorporating solutions 1 and 2 to be permanently on the DBMS disk.

Some hints for using general DBMS follow:

1. Computerize only those portions of your paper work chores that are most routinely used or cause the most problem.

2. Work by exception: Computerize only those portions of the data that are causing the most problems. Contrarily, do not enter every conceivable exception if it will not be regularly used. Use the following as a guide: 25 percent of the students use 75 percent of your time. Use only 25 percent of the data that you want to store because it will be used 75 percent of the time.
3. Know your limits: Scale down your data base. You have only so much room for storage. Two disks can hold 800 to 1,600 records. Beyond two disks you cannot tell "Who is on third." If you cannot hold it down, then you will require an expensive system.

Certain applications require a number of DBMS, linked together, to provide a larger integrated data-based management system. They are difficult and not as economical to produce. They are specific to a particular need.

Let us look at a few problems in this area. You have purchased a general DBMS package and another for negotiations (VisiCalc). Each works well alone, but what problems come up as you move information from one to the other. Each costs approximately $400, for a total of $800.

Wouldn't it be wonderful if someone would construct an integrated program that included payroll, personnel, VisiCalc, and budget? There would be a common data base: each of the components talking to one another; each doing a particular function; and your ability to do whatever you wished from this program. The time and energy savings would be immense. But what about the cost?

Is a $40,000 price tag worth the effort? It is--over time. Will it save time? Yes. Will it save staff? Yes. Will it be more accurate? Yes.

Now let us look at the area of special education. You can purchase general DBMS that will do isolated functions. However, our needs are integrated and our audience is limited. This affects cost of the program, but can be captured in personnel cost (time).

Normally an integrated data-based management system (IDBMS) is constructed of modules that are linked together within the program.

The computerized special education management system should be a menu-oriented, data-based system. The system should be designed for use by nontechnical staff. The program should consist of three segments: the main segment being an all-purpose data base; the second segment stores all the pertinent evaluation data for each child; the third segment is an extensive goals and objective file.

Be sure to provide yourself and staff with information that can be quickly retrieved in a variety of forms, thus requiring less staff to maintain a more comprehensive data system. It eliminates going to file cabinets for single pieces of information.

The writing of IEPs, which take a substantial amount of time, becomes simply the selection of appropriate goals and objectives, and the computer does the writing. This allows teachers more time to teach and plan. The system may be used by a clerk for processing routine or personalized letters for a student's next PPT (three copies), etc. Planning and placement team (PPT) meetings and annual reviews go more quickly and smoothly.

Those routine matters that take time from you are automatically done. It provides a list of students needing a three-year evaluation and provides needed data at budget time. Most of all, you know that the tasks are being completed, in your office by your computer.

1. Demographics module: Should store the following types of information for each student: name, birthdate, school, race, sex, living address, parents or guardians, key telephone numbers, grade, student identification, handicapping condition, etc.
2. Procedural safeguards module: Should list local administrative procedures, and action dates, which are implemented in the processing of a child into special education, through ongoing evaluation and IEP update, and exit from the program. A record should also be kept of all accesses to each individual student file by name, date, and reason. Access should be at two levels minimum to protect certain information. Confidentiality should be maintained through the use of passwords and knowledge of entry procedure.
3. Test Data module: Accepts user input of the history of an individual child's testing including (a) area evaluated, (b) tests administered, (c) date of testing, and (d) the test administrator. Summary of testing assessments may also be included in each child's file. Actual categories are determined with local staff.
4. Observations and assessment module: Provides an opportunity to maintain narrative material in a child's file. Such information could include (a) summary of findings of the test data, (b) indication of the verified handicapping conditions, (c) educational and therapy needs, (d) anecdotal comments on behavior and performance, (e) results of psychological testing, (f) committee decisions and actions, and other information. Specific categories are finalized with local staff.
5. IEP management module: Provides file space for main IEP components such as, but not limited to, (a) overall educational needs and (b) long-term education goals. In addition, this file would allow for printing an individual child's IEP format containing the following types of information: (a) summary demographics, (b) instructional activities, evaluation methods, mastery criteria, and date mastery achieved. The actual printing format may be designed to meet local requirements for inclusion in the IEP forms package for an individual child. Actual content of the printed form may be determined with local staff.
6. Data sort module: Sorts through all child files on a single disk or on several disks for specific user selected characteristics. Files can be searched for identification of particular students for single or multiple characteristics. For example, a user could search all records for students of a certain age, a certain grade, certain handicapping condition that were receiving a particular type of educational service. The data sort module would identify the individual students who met all the requirements and printed out their names and educational service.
7. Report writer module: Allows the administrative user to prepare summary reports on the special education program. The state education agency may require periodic summary reporting of program information such as participant groupings by age, grade, and handicapping condition; services being provided; number of instructional hours; and much more. The federal report for the same information may be organized differently, require a different format, and make the report developer recompute child data differently. This part of the program should allow you to access and print any information across files.
8. Word-processing module: Should allow the administrative user to store and recall standard letters and documents that can be individualized for mailing. Label production should be integrated into this module.
9. Calculation module: Should perform all calculations of distributed data to produce summaries, etc.

Other features may include a statistical package and an automatic test scoring packages (which is an add-on); your computer can be networked with appropriate equipment.

An example of a report generated from an IDMS, is illustrated in Exhibit 1.

EXHIBIT 1

First page of a sample student (automatic portion)

NAME	TOM DOE	C O N F I D E N T I A L
PRESENT AGE	17 years, 3 months	
SCHOOL	SHELTON HIGH SCHOOL	PSYCHOEDUCATIONAL FILES
GRADE	12	
DATE OF BIRTH	05/27/65	
DATE OF REPORT	08/30/82	
SEX	Male	

REASON FOR REFERRAL

This is a new evaluation requested on 8/4/82. The primary concern was stated as behavioral. Communication difficulty may be a secondary factor.

REFERRAL PROCEDURE RECORD

*** ACTIONS: ***	Dates	By	Remarks
Referral Initiated	8/4/82	4	N
Parent permission to evaluate requested	8/5/82	4	
Received permission to evaluate	8/7/82	8	G
Vision screening complete	8/10/82	8	
Hearing screening complete	8/10/82	8	
All screening complete	8/12/82	8	
Evaluation Completed	8/15/82	8	
Determination committee meeting	8/17/82	8	G
Parents informed of decision	8/17/82	8	
Parents response to decision	8/17/82	8	A
IEP Consensus-approval	8/22/82	8	
Program Implementation	9/4/82	4	
Case now assigned to		8	

OBSERVATIONS

TEST DATA

Wechsler Intelligence Scale for Children-Revised, Given 8/15/82 by * 8

Information	5	Picture completion	16
Similarities	8	Picture arrangement	14
Arithmetic	18	Block design	18
Vocabulary	15	Object Assembly	14
Comprehension	4	Coding	6
Digit Span	10	Mazes	0

Verbal IQ= 100, Performance IQ= 126, Full Scale IQ = 112

BACKGROUND/HISTORY

Overall learning rate on the WISC-R was in the high average range. There was a significant difference between verbal & performance scores.

RECOMMENDATIONS

Based on how Tom did on specific items, the following instructional objectives are next in this specific developmental sequence:

In the language development area, work toward being able to . . .

In independent functioning, the child should be able to . . .

WHAT YOU NEED TO KNOW

Each computer application has its own particular needs. A general data base is designed to fit a multitude of needs and is inexpensive because of its wide distribution. However, specific needs are sacrificed. Specific software applications are more expensive because of their complexity and limited audience.

The first thing that you need to do is to list your particular needs. Then list what the general data base will do. Compare. If you are seeking a data base for demographic information, then a general data base will suffice. If you are looking for more complex usage, you may have to purchase several software packages, i.e., general data base, Calstar, Wordstar. Each performs a specific function. Also inherent in this direction are an overlap and isolation of information.

Program Considerations

- o Does the design and format of information produced by the program meet district, state, and federal requirements so that the data will not have to be entered onto other forms by hand?
- o Consider security. If the software is to be used at multiple sites, will the company sell multiple copies at a discount?
- o It is imperative that modules be interactive.
- o Consider compatible computer systems. If you have a computer, will it run on yours without modifications?
- o Does the system have a compatible operating system with yours? DOS, SOS, CPM?
- o Does the program back up data automatically?
- o How big is your system? Implications? Can you use a microcomputer? Floppy disks? Hard disks?

Ease in Use and Flexibility

- o Is there an easy menu to use? Some programs require you to master a complex set of programming procedures.
- o How much of the system is menu-driven? To what extent can the user define the environment without which the system operates?
- o What are the editing capabilities?
- o Does it enable user to update records across file boundaries?
- o Can the files be modified easily or extended to accept new data elements?

- Can you customize to meet your particular need without "coding"?
- Are there categories that can be defined by the user?
- Is there ease of data entry?
- Is there easy data entry and review of that data?
- Are input fields well-defined and self-prompting?
- Are input errors diagnosed and described in an understandable way?
- Is there error-trapping?
- When the software is running, does it give the user feedback about what part of the processing is taking place?
- Are the reports that the software produces formatted in an easy-to-read manner, using appropriate abbreviations, spacing, and print size?
- Can you access the screen at various levels without always returning to a main menu?
- Are the screen formats easy to read?
- Can you generate the reports that you want? Labels? Letters?
- What is average response time?
- <u>Documentation</u>
- Consider documentation and support.
- Is there documentation supplied, users training guide, i.e., examples of data files?
- Do you receive operating instruction?
- Do you receive nontechnical manuals on how to use the system?
- Do they provide a system reference manual?
- Do they provide a copy of the operating system?
- Do they provide technical descriptions of the program and an explanation of how to add new reports, transactions, etc.?
- Do you receive a descriptor of how to set report outputs?
- Do they tell you how to deal with "error" messages--and how to take corrective action?

<u>Evaluation</u>

- What are the hardware requirements?
- When asking about customizing program, i.e., reports, don't accept "it can be customized." <u>Have them show you.</u>
- See the program run.
- See evidence of field testing.

- Talk with other users.
- Read reviews.
- Do not evaluate a program in terms of its price.

Support Maintenance and Agreement

- What is the cost of the maintenance?
- Consider the warranty? Consider a license?
- How long is the initial warranty period?
- Do they promise money back guarantee?
- How often are new releases announced?
- What enhancements are planned?
- Is the documentation updated with new releases?
- What is the company's back up policy?
- Will you receive the source code?

Training

- What training is available?
- What is the cost?
- How long are the training sessions?
- Is follow-up training available?
- Are there written materials as well as verbal and visual presentations?
- Whom do you call if you have questions, i.e., program ends prematurely?

HARDWARE REQUIREMENTS

Minimum hardware requirements for a small district (300 students, 10 percent special education) include one megabyte of storage; 32K RAM; two disk drives; full editing capability; one line printer (dot matrix); Z-80 card to utilize a CPM operating system; one high-speed port; and one video display. It is important that any system be expandable.

Practical hardware requirements for a medium district (10,000 students, 10 percent special education) are two megabytes of storage; 48K RAM; three disk drives; full editing capability; one line printer (dot matrix); Z-80 micro processor and capable of accepting a Z-80 card to utilize CPM operating system; high-speed ports; and video display.

SUMMARY

You're considering entering the computer era. Be knowledgable; be cautious.

1. A tremendous amount of time is needed to establish the information for the original data base. Are you willing to make the effort?
2. Initially it will force a tremendous amount of planning, organization and coordination, i.e., development of data sheets to gather information.
3. It is essential that you update (upkeep) your files. Do you have the resources?
4. It will force decisions. Is the information worth the space it takes?

ED#229907

EDUCATION TURNKEY SYSTEMS/MEAN:
INVOLVEMENT IN SPECIAL EDUCATION TECHNOLOGY USE BROADENS

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Education TURNKEY Systems, Inc., through its MEAN division, has broadened its services and related activities in technology use in special education. Eighteen months were spent interviewing several hundred developers, publishers, and directors of special education, to gain insight into the potential of technology applications in special education and the barriers or preconditions for effective use. In the summer of 1983, scenarios on how microcomputer, videodisk, communication aids, and telecommunication technologies are applied in special education were published and are available through ERIC. TURNKEY projected that the number of microcomputers in special education will increase from approximately 25,000 in 1982 to approximately 150,000 in 1985-1986. Instructional applications were to surpass administrative applications in 1983.

In addition, TURNKEY is conducting Project Tech Mark, which is designed to assess the feasibility of alternative procedures and strategies to facilitate the commercial distribution of special education software developed by independents or by federally funded projects. An alternative that TURNKEY is studying is the use of bulletin boards (TECHMARK and COMPUTER) on SpecialNet to provide information of use to both developers and to the 30 or 40 commercial publishers that are subscribing to SpecialNet and are participating in TechMark. Developers should contact TURNKEY regarding software products that they are developing or have available and for which they seek commercial distribution. Publishers and distributors should contact TURNKEY regarding profile information and subscriptions to SpecialNet.

During 1982 and 1983, Alfred Morin, director of MEAN, conducted workshops on microcomputer applications in special education for over 5,000 special education administrators across the country. These workshops were custom-designed for each of the state or local education agencies sponsoring the workshops, and ranged from one to three days in duration. For further information about TURNKEY workshops, contact Alfred Morin.

TURNKEY's Modularized Student Management System (MSMS) is operational in districts in virtually all regions of the country. In Louisiana, a custom version of MSMS is being used statewide by Special School district 1, which has 13 residential facilities. Each facility develops and enters data into the MSMS program. Data are transmitted to SSD 1 at the state level for compilation and review and then transmitted to a mainframe computer for additional state use and archiving. TURNKEY also assisted the West Virginia Department of Education in developing a microcomputer-based management information reporting system for all 55 school divisions within the state. That network will rely on SpecialNet and state-leased lines for on-line networking.

MICROCOMPUTER NETWORKS FOR SPECIAL EDUCATION ADMINISTRATION AND INSTRUCTION

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Special education programs across the country are beginning to use computers for a variety of applications, including the following:

- o Instruction (e.g., LOGO, Pilot, Super-Pilot, Blocks)
- o Curriculum development (e.g., Curriculum Management System, objectives data bases)
- o Administration (e.g., child counts, due process tracking, IEPs, word processing, budget planning)
- o Telecommunications (e.g., electronic mail, computer to computer communications, data base access)

This session addressed issues related to integrating a wide variety of applications on one or more microcomputer networks. As programs attempt to introduce and integrate more applications on increasingly powerful microcomputers (e.g., 64K Apple II with Pascal, DEC Professional 350, IBM PC), there is a rapidly increasing need for greater program and file storage capacity. In addition to storage needs, there are practical problems of integrating software into a "friendly" system providing for various kinds of data interchange between programs and files. These various needs and problems are effectively addressed by the rapidly expanding technologies of computer networking (e.g., Corvus Omninet, Nestar and DECNet) and distributed processing.

The participants received a list of questions that should be asked at each of the major decision points in implementing a microcomputer network: When should a network be introduced? How can a network be cost-justified over stand-alone microcomputer operation? What are the performance advantages of accessing data and programs on a hard disk as opposed to floppy disks? How can the administrative configuration of student information files be enhanced on a network? How can MIT-LOGO be implemented on a network? How can a network improve student achievement monitoring? What are options for remote access to networks?

ADMINISTRATORS REVIEW THE SUPERPLANNER MANAGEMENT SYSTEM

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This workshop consisted of a brief overview presentation of the SuperPlanner special education management system, and practical reviews of the different ways that SuperPlanner has been implemented by four special education adminstrators:

District Program. James Damatt, special education director, Sioux Falls Public Schools, Sioux Falls, South Dakota, discussed management issues regarding monitoring service delivery and cost-effectiveness justification of a computerized management information system.

Special School Program. Michael Deninger, Dean, Kendall Demonstration Elementary School, Gallaudet College, discussed the flexible application of SuperPlanner on a microcomputer network within a model demonstration elementary school for hearing impaired children.

Vocational Education Program. Don Mack, trainer, Training Based Education Program, Laramie Senior High School, Laramie, Wyoming, discussed vocational training curriculum development and generation of IEPs and lesson plans from this specialized data base.

Rural Special Education Program. Sam Bushon, special education coordinator, North Slope Borough School District, Barrow, Alaska, discussed the problems of information management and communication in Alaska's largest and northernmost school district. Mr. Bushon detailed the development of an elaborate record-keeping system capable of storing over 1,000 items of information on each student including comprehensive medical and educational diagnostics.

SuperPlanner is a general-purpose user-definable system with three specialized components for use by special education teachers and administrators. The Curriculum Management System (CMS) organizes, centralizes, maintains, and prints a broad range of instructional information in any subject area. The Teacher Planning System (TPS) creates, accesses, edits, and prints individual student information. The Administrative Planning System (APS) is automatically updated from more elaborate TPS student files and provides interactive access to a large student data base and user-defined administrative reports. SuperPlanner features simple-to-use single key English commands, user-definability to a variety of applications and needs, and portability to a large number of advanced microcomputers using the UCSD-Pascal operating system.

All of these presentations were accompanied with graphic presentations showing computer printouts and administrative procedures adopted as part of the software implementation. Curriculum files, student information files, and other practical aspects of computer operation were available for viewing during this session and the remainder of the conference.

SECTION 3

TEACHER TRAINING

INTRODUCTION

The training of teachers in the use of microcomputers in special education, as opposed to the training of children, is the topic of the third section of the proceedings. The two articles and four input and output briefs cover topics including university-level curriculum sequences, the use of authoring languages, and techniques of designing instructional software for exceptional individuals.

Cartwright and Schloss begin by discussing a computer-based training module for teaching and testing generic special education concepts via microcomputers. In response to state requirements that school personnel be prepared to educate handicapped individuals, they describe a microcomputer-based program to meet ten generic competencies identified by the state department of personnel. They detail how students were provided three credit hours of microcomputer instruction and how their competence was evaluated via computer.

McDonald reports on a 1982 summer institute for gifted and talented middle-school students in mathematics and science. The institute has two components: instructing children and training teachers. The article details the design for the summer institute, the selection and preparation of teachers of gifted and talented students, the selection and production of materials, the process and criteria for selecting children to participate in the institute, and the actual institute itself. Results of data collected on students and teacher training are provided.

There are four briefs in the input and output section. The first discusses eight steps to be followed in designing a computer-assisted instructional lesson. The second outlines six factors in designing educational microcomputer programs for exceptional children. The third illustrates the uses of the programming language PILOT for programmed inquiry, learning or teaching. The final brief describes the use of a simulation program in vocational assessment for training teachers of handicapped children.

TEACHING AND TESTING GENERIC SPECIAL EDUCATION CONCEPTS BY MICROCOMPUTER

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In April 1980, the secretary of education of the Commonwealth of Pennsylvania, Robert G. Schanlon, ordered each Pennsylvania program leading to the certification of school personnel to prepare all personnel to educate handicapped individuals in the least restrictive environment. Ten generic competencies were identified by the state Department of Education as crucial to all professional school personnel. They were published as follows (Pennsylvania Department of Education, 1980 a):

Each educator completing an approved preservice program or approved inservice course should be prepared to demonstrate an acceptable level of achievement in the following ten generic competencies. The Educator:

1. Understands the legal basis for educating students with handicaps in the least restrictive environment.
2. Understands the implications which handicapped conditions have for the learning process.
3. Recognizes students who may be in need of special services.
4. Makes use of appropriate resource and support services.
5. Confers with and reports to parents on educational programs for students with handicaps.
6. Facilitates the social acceptance of persons with handicaps by encouraging positive, interpersonal relationships.
7. Uses individual, group, and classroom management techniques for effective accommodation of students with handicaps.
8. Assesses the educational needs of students with handicaps.
9. Modifies instructional strategies to provide for the individual needs of students with handicaps.
10. Evaluates classroom progress of students with handicaps.

In the context of the guidelines, educator includes classroom teachers, counselors, administrators, and other school support personnel.

Pennsylvania State University is a multicampus institution with 20 commonwealth or branch campuses in addition to the main campus. Most students attend a branch campus for two years, then transfer to the main campus for the last two years of their baccalaureate programs. Each of the certification programs at the University Park campus was reviewed and suggestions made to modify the program so that its graduates are capable of mastering the competencies. In many cases teacher preparation programs were able to use courses or experience already available within the university. In other cases modification of courses or experiences were made with technical advice of the Division of Special Education and Communication Disorders. In reviewing the 20 commonwealth and branch campuses, no special education faculty were found to be employed. The competency mandate there has been immediate need to begin instruction on educating the exceptional student before the junior year at the University Park campus.

In response to the needs of Pennsylvania State University and Pennsylvania residents, a series of microcomputer modules was developed to assist university students and inservice teachers attain the generic competencies and obtain basic information about the handicapped. An innovative microcomputer-based procedure was developed to evaluate the extent to which students and inservice teachers have achieved the competencies, and prescribe remedial strategies if necessary. The quizzes and modules were tested, are in use at the university, and are available for use by other institutions.

Students at each of the campuses can take a three-credit course in special education at any time. The course is administered by microcomputer and is a stand-alone course. All instruction is via microcomputer through a series of computer-assisted instruction modules. The modules are easily transportable to other institutions and use the Apple Plus II or Apple IIe computer with minimal configuration (48K or 64K, one-disk drive, B&W monitor).

The course, a selected set of modules prescribed for the individual student, prepares students for the special education generic competency examination required university wide. All candidates from the university's 60 certificate programs must pass the examination, including each of the mandate competencies. From a total pool of 700 items, subpools that correspond to individual competencies have been identified. A microcomputer has been programmed to present randomly generated items to candidates in blocks of ten questions with a mix of items weighted according to the size and importance of the subpools. Once a student has responded to a minimum number of items, a decision chart is used to determine whether the candidate has either passed or failed, or whether more items should be presented before a decision is reached. Based on performance, each candidate is provided suggested remedial activities (if needed) through the microcomputer. When [illegible] show deficiencies in specific competencies, the microcomputer prints out a list of suggested readings from several textbooks, a list of computerized learning modules that correspond to the candidate's deficiencies.

Preparations are underway to disseminate the modules throughout Pennsylvania and across the United States to institutions of higher education. Modules are being revised to use with other popular microcomputers and to interface with video devices.

This chapter, plus a sample student manual, are stored in the ERIC data base ED#233515. The microfiche may be viewed wherever there is an ERIC collection, or may be ordered from EDRS, Box 190, Arlington VA 22210.

Course Description, SPLED 105 Via Microcomputer

SPLED 105, "Orientation to Exceptional Children," (three credits) can be offered at Behrend College and at commonwealth campuses on a self-instructional basis by means of the Apple II Plus microcomputer system.

The components of the course are (1) a set of 50 floppy disks; (2) a printed manual that provides brief summaries of each of the lessons on the disks, chapter overviews, references, and related information; and (3) a program on the use of the computer are borrowed by the student. The required textbook for the course is Educating Special Learners by Cartwright, Cartwright, and Ward.

Students are expected to read a chapter in the textbook first, then study the same chapter on the APPLE. The material is self-instructional and does not assume prior knowledge of computers. Use of the computer is taught on the first disk. Students are on their own to pursue the materials and may do so at their own pace. However, students should plan to schedule three to five hours of computer time per week.

Subsequent material is completely self-instructional and self-paced. For each chapter in the textbook a corresponding chapter has been programmed onto one to three disks. Each disk takes 30 to 60 minutes to complete, so that the estimated instruction time spent on the computer equals roughly 37 1/2 clock hours, the same amount of time as is required for a conventional three-credit course. Because the program is self-paced, some students may complete the lessons quickly while others may work at a slower pace and repeat the lessons as often as they wish.

Three quizzes and a final examination are the basis on which grades are awarded. The exams are objective and are monitered by a local faculty member. Similarily a local faculty member will be available periodically to answer questions students may have.

For additional information, please feel free to contact G. Phillip Cartwright, Head, Division of Special Education and Communication Disorders, 109 Moore Building, University Park (814-865-6072).

ED#233515

MICROCOMPUTERS, PROBLEM SOLVING, AND GIFTED KIDS: AN EXCITING COMBINATION

A REPORT OF THE 1982 STATE UNIVERSITY OF NEW YORK AT ALBANY MICROCOMPUTER SUMMER INSTITUTE FOR TALENTED AND GIFTED MIDDLE-SCHOOL STUDENTS IN MATHEMATICS AND SCIENCE

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OVERALL DESIGN AND PURPOSE

In the fall of 1981 a decision was made at the State University of New York at Albany (SUNYA) to design and implement a plan for a two-week intensive summer microcomputer institute for talented and gifted middle-school students. The institute was to be a combined effort of the School of Education, the Department of Teacher Education, the College of Continuing Studies, and the Institute for School Development. The College of Continuing Studies had been involved for several semesters in a continuing series of programs aimed at this population. The remaining three groups had coordinated two previous intensive summer microcomputer institutes, but for a population of teachers.

There were several purposes and perceived directions of the program beyond a desire to provide a two-week microcomputer "experience" for students. The purposes included those of teacher training, the development of instructional materials, and the collection of data for research in the areas of talented and gifted, problem solving and microcomputers.

Previous institutes at SUNYA with teachers had served to identify an intense interest among teachers of mathematics and science in learning more about all aspects of teaching with and about a sequence of three graduate courses (9 semester hours) in which prospective institute teachers would design curricula and prepare materials for the summer program. In this way, the teachers involved with the program would gain further experience in curriculum and program development, the development of computer-based instructional materials, a familiarity with the literature, and teaching of the talented and gifted as well as further experiences teaching with microcomputers. Because there is an extremely limited amount of high-quality software available for use with talented students, an additional purpose of the program was the creation of a package of instructional materials that could be made available to other teachers for use with their own students.

A survey of similar programs for gifted students at other schools and universities showed that most programs tended to emphasize instruction in the BASIC programming language. Although some instruction in programming would be a component of the institute, a decision was made to emphasize problem solving in mathematics and science, rather than programming alone. This decision was made so that the institute might serve to show students the great capacity of the microcomputer as a problem-solving, timesaving tool. Although it was assumed that students would learn more about programming as a result of the institute, the instruction was designed to deemphasize instruction in the syntax of the BASIC language and to emphasize the unique capabilities of computers to solve problems.

A final purpose of the institute was to provide a vehicle for the collection of data related to talented students, their problem-solving abilities and the interaction with microcomputer-based instruction. Because few data have been collected in this area, several data collection techniques and efforts were incorporated into the design. Students were videotaped while solving problems at the computer; teachers collected time-on-task data and also kept anecdotal records on each student. Students also participated in group and individual testing on standardized aptitude tests as well as cognitive development tasks.

DESIGN MODEL FOR THE MICROCOMPUTER INSTITUTE

The basic design of the program includes: (1) initial planning, fall 1981; (2) university course for teachers, spring 1982; (3) two-week instruction, summer 1982; (4) university course for teachers, fall 1982; and (5) evaluation and reporting, spring 1983.

Phase 1--initial planning--included the following tasks: develop overall plan and project goals; design university course structure; advertise program and select prospective teachers; and hire institute director for summer phase.

SELECTION AND PREPARATION OF TEACHERS

The process for the selection of prospective teachers for the summer institute began with an interest meeting in December 1982. Fifteen teachers attended the initial meeting; nine teachers were eventually selected and enrolled in the three-course sequence. Of these nine, six completed the sequence: five mathematics teachers and one science teacher. Each of these teachers had extensive experience with the classroom use of microcomputers as well as having completed one or more university courses on the instructional use of microcomputers. Each teacher had also had a minimum of five years teaching experience.

Phase 2--university course for teachers--included the following components: prepare teachers for work with talented and gifted by reading and studying appropriate literature selections; teachers develop instructional modules; university instructors critique modules and teachers resubmit draft revisions; teachers and university instructors develop process and criteria for student selection and select students and teachers, university instructors, and summer director coordinate overall instructional plan for the two-week institute.

The fall course, "Mathematics/Science via Micros for High Achievers," was designed and taught by Margaret A. Farrell, mathematics educ[illegible] chair of the Department of Teacher Education, and Jan McDonald, mathematics and computer educator within the department. The course was structured with two major purposes in mind: to familiarize the teachers with the literature and research on talented and gifted students and to create instructional materials that would form the core of the instructional sequence for the summer institute. The course included selected readings and discussion in the areas of talented and gifted, problem solving, mathematics education, cognitive development, data collection techniques, and microcomputer instructional design and implementation. As course assignments, the teachers read and abstracted articles on gifted children, mathematics instruction, and microcomputers. The teachers also designed and wrote initial and revised drafts of individual software modules, which they planned to use during the summer instruction of the students.

SELECTION AND PRODUCTION OF INSTRUCTIONAL MATERIALS

The teachers were given several parameters for determinig their individual instructional topic for the summer. First, the topics were to be enrichment rather than acceleration activities. In other words the topics covered were not to be drawn from the normal mathematics and science curricula. This decision was made in an effort to avoid interference with the individual schools' programs for the students and with the intention of broadening the students' mathematical and scientific experiences. Teachers were required to choose topics that involved problem solving in either mathematics or science; involved patterns; hypothesis formation, and testing; and demonstrated the microcomputer's unique strengths and abilities, such as iteration, speed, and flexibility. Teachers were also encouraged to design instructional modules that would distinguish between algorithmic and heuristic programming in problem solutions.

The teachers were asked to incorporate into their plans those problems and experiences that could be used to examine students' abilities to generalize, recognize patterns, form conjectures, curtail (find shortcuts), establish reverse associations, and design flexible and unique applications and approaches. They were also asked to include project "extensions" that could be recommended to students interested in further work on the same general topic. The resulting modules involve software developed by the teachers for demonstration and student use, as well as problems that students would solve by developing programs of their own.

The instructional modules that were developed by the teachers are described briefly:

"Environmental Impact," by Candice Bosworth, a middle-school science teacher with the Bethlehem School District, Delmar, New York. This module introduces the student to the information necessary to make sound decisions regarding environmental land management. Students learn terms such as water table, land slope, soil ph, and wildlife, and the impact of those variables on land development. Through the use of an interactive computer simulation, students make land development decisions. Their choices are evaluated by the software. The concept of permutations is presented as a component of the module.

"Curious Number Patterns," by Donna Blake, a high school mathematics teacher with the Saratoga Springs City School District, Saratoga Springs, New York. Within this module students investigate patterns found in special numbers such as palindromes; perfect, abundant, and deficient numbers; happy numbers; and friendly numbers. The computer is used to generate or test numbers to see if they fit the patterns. The algorithms to generate the numbers are presented as well as information related to the historical significance of each.

"The Game of Life," by Sheila Dolgowich, a high school mathematics and computer teacher and the talented and gifted coordinator with the Berne-Knox-Westerlo School District, Berne, New York. This module presents a game devised by John Conway in the early 1970s. Students are introduced to the rules of the game and are given examples to plot on grid paper. The results of simple configurations, which vanish, become stable, or repeat, are presented. Students investigate multiple configurations and make predictions and identify patterns that emerge using a computer simulation.

"Artificial Intelligence", by Mary Ann Foster, a high school mathematics and computer mathematics teacher with the Greater Johnstown School District, Johnstown, New York. Within this module the student is introduced to machine intelligence, robotics, and heuristic programming. Instructional topics include reading and discussion of artificial intelligence, and experience with the game Animals and the game Hexapawn. Students are provided with software capable of playing these games and are involved in activities through which they are shown how the computer is capable of simulating learning experiences.

"Spirolaterals", by Phyllis Yudikaitis, a junior high mathematics teacher and computer coordinator with the Shenendehowa Central Schools, Clifton Park, New York. This module employs the computer as a tool to generate graphic spirolaterals (cycling paths). The student examines spirolaterals looking for various patterns and is asked to generalize findings and test hypotheses by using two graphics programs.

"Number Expansions and Remainders", by David Van Schaick, a junior high mathematics teacher and computer coordinator with the Shenendehowa Central Schools, Clifton Park, New York. The student is provided with a series of problems dealing with an analysis of the division process and the recovery of remainders. Students design programs to convert to different number bases and analyze rational numbers for repetition and termination. These techniques are then applied to convergent series and approximations of pi.

Specific details of the instruction modules will not be made here but are available in a monograph entitled "Enrichment Activities with Microcomputers in Mathematics and Science for Academically Talented Middle School Students." This document includes detailed daily plans for each of the modules and a disk for the Apple II microcomputer containing instructional software and sample student programs. These materials are available on a cost-of-production basis from the Institute for School Development, State University of New York at Albany, Husted 211, Dr. Nelson Armlin, 135 Western Avenue, Albany, New York 12222. Each module contains a list of prerequisite skills of students, instructional objectives, implementation plans, student work sheets, references, and other support materials.

PROCESS AND CRITERIA FOR SELECTION OF STUDENTS

Student selection was based on several criteria. Students were required to demonstrate high achievement in mathematics and science, strong task commitment, high motivation, and minimum competence in BASIC programming. Because of limited facilities at the university, students were required to bring a microcomputer system for their own use throughout the institute. In most cases the system was provided by the student's school district. In some cases the students brought their own personal microcomputer from home. To assure that students would have the prerequisite skills for the instructional modules, it was additionally required that students had completed seventh-grade mathematics (but not necessarily seventh grade). Several instruments were utilized to determine the preceding criteria.

Schools were requested to provide school grades in mathematics, English, social studies, and science as well as test scores on any standardized achievement or aptitude tests. In addition, the mathematics and science teachers of each student were asked to complete two student rating scales.* The first rating scale (Scale A) dealt with the student's motivation and task commitment. The second scale (Scale B) emphasized the student's general problem-solving abilities and academic potential. These scales were adaptations of Renzulli (1979) scales. Student applicants were then administered a pre-test on BASIC programming skills. This test was designed to measure the student's proficiency with LET, PRINT, INPUT, GOTO, IF...THEN, FOR...NEXT, and READ...DATA statements, memory storage, looping procedures, and program writing. Students who wished to participate and who met all other criteria, but were unable to demonstrate minimum competency on the computer examination, were allowed to demonstrate competency by the completion of one of several area instructional programs before the August institute.

Thirty students were selected on the basis of their combined scores on each of the criteria. The number of students was determined on the basis of the room size available for the institute and with the desire of maintaining a reasonably high teacher-to-student ratio. The students who participated represented a variety of school districts from within the Capital District area. Although the original design included an attempt to have a 50-50 split of males and females, a much higher proportion of males indicated an interest and met the qualifications. The participants included 6 females and 24 males from grades 5 through 8. Two fifth-graders who were originally selected participated in Julian Stanley's summer program instead. They were replaced by the top two students on the waiting list of 37 additional students. The range of ages of the participants was 11 years, 0 months to 14 years, 6 months.

Phase 3--two-week intensive institute--included the following components: implement instructional modules and plan; revise plans based on daily feedback and progress; and collect data on student progress and characteristics.

MICROCOMPUTER INSTITUTE

The summer phase of the model was directed by Joseph R. Kelly, Center for Instructional Development, Old Dominion University, Norfolk, Virginia. Dr. Kelly, a science and mathematics educator with considerable microcomputer experience, was in charge of the day-to-day instructional activities and general coordination of the program and teachers. Margaret Farrell, Walter Farmer, Arnulfo Ramirez, and Janet McDonald coordinated and participated in the student data collection and research component of the summer phase. The following description of the summer phase is abstracted from Dr. Kelly's report of the Problem-Solving Institute.

In the week preceding the two-week institute the six teachers met with Dr. Kelly in daily meetings of 3 to 4 hours' duration. During that week, the instructional [illegible] outlined the specific details of the instructional plan; set up the [illegible]cal organization for student computer stations; presented trial[illegible] of the instructional modules to the other instructors to check pac[illegible]uipment needs, etc.; to get feedback from other instructors, adopted policies and procedures for daily operation; and studied student folders to anticipate individual student needs and behaviors. The teachers also planned and conducted an introductory session and picnic on the Sunday before the institute. This day also included equipment set-up and general information for both students and parents.

The instructional model was based on the Renzulli Enrichment Triad Model (1977). Daily activities included presentations of initial problems by the instructors followed by discussion and independent and group work involving the solution of posed problems. Students were alternately involved in group training activities, general exploratory activities, and individual and small group investigations. Spin-off problems were also posed to students for further exploration. The microcomputer systems that were used by the students included Apples, TRS-80s, PETs, VIC-20s and ATARIS, with the majority of the machines being Apples. To facilitate instructor assistance, the three instructors who were most familiar with Apples spent the majority of their time in the front of the room, where the Apples were located, while the remaining four instructors worked with the students near the back of the room with the other machine types.

At the end of each day, institute staff met for approximately one hour to summarize progress and problems of the day, alter the next day's instruction based on progress and feedback, and express concerns regarding individual participants and suggest appropriate actions. Specific problems that were noted and addressed included weak programming ability of some students, knowledge gaps for several students in programming and mathematical skills, task commitment of some students, persistent game playing and software piracy by some students (despite a general ban on such activities), difficulty of teachers in managing observations as well as helping individual students, resistance of some students to working in pairs or small groups when requested, resistance of most students to planning work on paper before working with the computer, inability of several student to cope with a lack of structured time and long time periods, and a wide range of programming and problem-solving abilities.

COLLECTION OF STUDENT DATA

Several ethnographic data collection procedures were utilized throughout the institute. These included video-taping, student self-reports, and teacher observations. Using data collection materials specifically designed for each instructional module, data were collected on students' abilities to find and generalize patterns, generate and test hypotheses, as well as their flexibility in problem solving strategies with the microcomputer. Teachers also noted the roles that individual students assumed in structured and unstructured group work. A folder of collected data was generated for each participant.

During daily draw-off sessions from the lunch hour, student participants were also administered several other instruments. Students were given the Henman-Nelson Test of Mental Ability (1973) (Grade 9-12 version to avoid a ceiling effect); a ratio and proportion task; "Mr. Tall--Mr. Short" (Karplus et al., 1977); the Test of Logical Thinking (TOLT) (Tobin & Capie, 1981); the Longeot Test (Longeot, 1964); and the Projection of Shadows Task (Inhelder & Piaget, 1958). Each of these instruments is designed to measure the student's formal operational reasoning ability. Students were also administered a self-perception scale related to their microcomputer use, an exit programming examination, which paralleled the entry exam, and an institute interest and evaluation form.

UNIVERSITY COURSE FOLLOW-UP

In the fall of 1982, teachers were enrolled in the final course of the three course sequence, with Jan McDonald as the instructor.

Phase 4--university course; follow-up--included the following components: revise instructional modules; develope teacher activity guide and computer disk; analyze student data collected during summer institute; evaluate institute procedures and effectiveness; and develop case studies of individual student results and characteristics.

The teachers were instructed in the use of a common microcomputer word-processing package, and each teacher entered their instructional module onto a disk. Subsequent revisions throughout the semester were made with the editing features of the software. The resulting product, listed previously, was produced and made available to interested teachers. The data analysis that was performed, as well as the individual case studies, are reported in the research papers, which are noted later.

Teachers and university personnel completed the analysis of the student data. The mean intelligence quotient on the Henman-Nelson was 136.5. This included one low score of 104. With the elimination of that particular score, the mean score of the remaining 29 students was 137.7. The results of the ratio puzzle indicated 87 percent of the students to be formal operational at that task. Results of the TOLT, Longeot, and Shadows Task were 80 percent, 100 percent, and 27 percent in formal operational, respectively. Each of these results indicated capabilities well beyond most high school students. Additional descriptions and discussion of these results can be found in Cognitive Development of Gifted Middle School Students, a paper presented by Walter A. Farmer at the annual meeting of the Association for the Education of Teachers in Science, Fairleigh Dickenson University, May 1983.

At the end of the institute, each teacher involved in the program rank ordered the participants with respect to their problem-solving abilities. These rank orderings were combined to produce a composite rank-ordered list. These rank orders and results on various other tasks were compared to student data, including the results of the student self-perception scale. The results of these data can be found in Student and Teacher Perceptions of Problem Solving Abilities with Microcomputers, a paper presented by Jan McDonald at the annual meeting of the Association for the Education of Teachers in Science, Fairleigh Dickenson University, May 1983. Other papers involving related data, presented at the same meeting, include Metacognitive Analyses of Language Strategies Used in Problem Solving, by Arnulfo G. Ramirez, and Cognitive Processes in Mathematics and Science: Task, Subject and Instruction Variables, by Margaret A. Farrell.

INFORMATION DISSEMINATION

Phase 5--Information dissemination--included the following tasks: produce and dispense teacher activity guide and software; produce report of institute; teachers and university faculty present developed materials at professional conferences; and produce and present papers related to research results at professional meetings.

This document, as well as those previously referenced, represents the final phase of the instructional model. It is the hope of all who were involved in the institute that the model provides a useful structure for others who wish to implement similar instructional programs. The author wishes to thank the many individuals who made the institute a success, including Nels Armlin, Walt Farmer, Marge Farrell, Ca[illegible]son, [illegible] Kelly, Arnulfo Ramirez, the individual school districts, teachers, and students. In particular, the author would like to acknowledge the superior effort, products, and teaching of each of the teachers involved in the project: Donna Blake, Candy Bosworth, Sheila Dolgowich, Mary Ann Foster, Dave VanSchaick, and Phyllis Yudikaitis.

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REFERENCES

Inhelder, B., & Piaget, J. The growth of logical thinking from childhood to adolescence. New York: Basic Books, 1958.

Karplus, R., et al. Science teaching and the development of reasoning. Berkeley: The University of California, 1977.

Lamke, T., Nelson, M. The Henmon-Nelson Tests of Mental Ability. Boston: Houghton Mifflin, 1973.

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Longeot, F. Analyse statistique de trois tests genetiques collectifs. BINOP #4, 1964. (Statistical analysis of three collective genetic tests, translated by K. Kelly.)

Renzulli, J. S. The enrichment triad model. Mansfield CT: Creative Learning Press, 1977.

Renzulli, J. S. A guidebook for developing individualized educational programs for gifted and talented students. Mansfield, CT: Creative Learning Press, 1979.

Tobin, K. G., & Capie, W. The development and validation of a group test of logical thinking. Educational and Psychological Measurement. 1981, 41, 413-423.

ANATOMY OF A COMPUTER-ASSISTED INSTRUCTION LESSON

ABSTRACT

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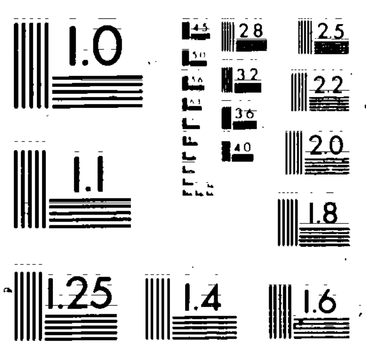
Eight steps that one could follow in designing a computer assisted instruction lesson were described in this session: (1) define objectives; (2) develop the general content outline; (2) assign labels; (4) design the presentation treatment; (5) develop instructional outline; (6) design screen displays; (7) design special effects; and (8) develop support materials. Guidelines for completing each of these steps were provided, with examples of how one might proceed.

Features of the Apple PILOT authoring language were also described; examples of the four editors that accompany this computer program were provided: (1) text editor; (2) graphics editor; (3) sound effects editor; and (4) character set editor. Illustrations were included to show how the computer code for lessons could be written.

The presenter has written an extensive manual containing detailed information related to the content presented during this session. It is available from MICRO-TIPS, Inc., 291 Malabu Drive, Lexington, Kentucky 40502. The manual, which includes a computer disk of demonstration programs, is titled Guideline for Using "Apple PILOT".



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS
STANDARD REFERENCE MATERIAL 1010a
(ANSI and ISO TEST CHART No 2)

HOW TO DESIGN EDUCATIONAL MICROCOMPUTER PROGRAMS FOR THE EXCEPTIONAL STUDENT

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"To devour an elephant
one must first cut it up
into very small pieces."

"If you don't have time
to do it right
the first time,
where will you find time
to fix the mistakes you made!!"

Too often the first thing that we do in attacking an elephantine programming problem is to sit down at a terminal and start typing code. But fuzzy goals yield fuzzy results and waste much time by forcing many revisions of our plans as we go along. This leads to frustration, logic that cannot be followed, and unreadable code.

In a 90-minute demonstration, "How to Design Educational Microcomputer Programs for the Exceptional Student," techniques that have proven successful in other audiovisual fields such as TV and film are presented.

The six steps discussed in detail are: statement of a problem; writing objectives; creating a storyboard; writing pseudocode; manual walkthrough; and coding and documentation.

Of special interest to teachers of exceptional children who are designing or evaluating microcomputer programs are the computer's talents not available with any other teacher or teaching tool: its ability to adjust difficulty of materials to each student based on student accuracy, its ability to give immediate feedback of correctness, and its ability to keep a score and to keep a running timer.

A model spelling program using the six steps were developed with the participants. Objectives were selected (at this stage without considering whether the chosen objectives can be coded to plan) to use the ability of the computer to flash words with flash-time based on word length and on accuracy of student; to break a word into syllables on the second try and flash the syllables; to leave a word on the screen on the third try so that the student cannot fail to spell the word correctly before going on; to repeat at a later time words missed, while not wasting student time repeating words successfully spelled; to keep a score based on time and accuracy; to report number of words correct as well as score; to display a list of misspelled words at the end of the game for the learner to write down, thus requiring the use of the additional tactile sense of writing to reinforce correct spelling of words missed while using the visual senses. Additional objectives require the program to allow teacher selection of words for today's lesson and teacher selection of number of words to be presented in a game, thus adjusting for a class of gifted or a class of slow learners.

Emphasis in this presentation was on the ability of the computer to individualize, to maximize motivation and to maximize efficient use of each student's learning style.

PILOT: PROGRAMMED INQUIRY, LEARNING, OR TEACHING

Dr. Janice M. Schnorr
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PILOT is the name for a special programming language that is easy for beginners to learn. The name PILOT stands for programmed inquiry, learning, or teaching. The language contains only 22 different commands; this is substantially fewer than most other languages. In addition, the command codes feature common vernacular that is readily identifiable and easily learned.

PILOT is available for several brands of microcomputers including Apple, Radio Shack, and Atari. This presentation focused on the PILOT program produced by Apple.

Apple PILOT requires at least 48K bytes of memory and two disk drives. The author disk, containing all the special language control features, is inserted into drive 1 and the lesson disk is placed into drive 2. Lessons that are created for student use are stored on the lesson disk. Lesson disks can be run on single-drive systems, but two drives are required for creating lesson disks.

The author disk contains four different editors: the lesson text editor, the character set editor, the graphics editor, and the sound effects editor. The lesson.text editor stores text including words, numbers, etc., and all the commands that control the lesson. The character set editor stores any set of characters that you design; this could include Japanese or Chinese character sets. The graphics editor stores pictures, maps, diagrams, etc., that can be used when the lesson is run. The sound effects editor stores music and other sound effects that can be used. This presentation focused on two of these editors: the text editor and the graphics editor.

For more information refer to ED#224905 or contact Janice M. Schnorr, 711 W. Whiting Road, Flagstaff, Arizona 86001.

MICROCOMPUTORS IN VOCATIONAL ASSESSMENT

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The use of microcomputers in education has increased significantly in the past few years. This increase has been reflected in the great diversity of hardware and software available in the marketplace. This presentation demonstrated the utility of microcomputers in teacher training programs. This presentation on a simulation program was developed to enable students to practice decision making skills related to vocational assessment of special education learners.

The development of the simulation was based on the following assumptions: (1) assessment simulation activities can provide the student with practice in making diagnostic judgements and (2) microcomputers lend themselves well to the development of assessment simulations. These assumptions led the authors to the development of the Vocational Assessment Microcomputer Simulation. The authors, after careful analysis of what can be done realistically in the public school setting, selected several instruments that are commonly used in vocational assessment and developed a model of vocational assessment for training secondary level special education teachers.

The Vocational Assessment Microcomputer Simulation is designed to take a student from an intake interview all the way through a recommendation as to the type of vocational programming from which the special education learner will be most likely to profit. The simulation allows the student to practice making decisions about diagnostic information, provides the student with practice in writing reports, and also provides the student with the opportunity of exploring alternative instruments in assessing the secondary-level special education learner. The simulation is designed so that the teacher trainer can monitor the progress of the student and provide feedback on a frequent basis.

The simulation is a multitrack competency-based activity that allows a great deal of flexibility in terms of how, when, and where it is used. It was developed for use with a microcomputer having a 32-K memory capability. Because the simulation requires only a 32-K memory, it would appear to be quite affordable and cost effective for teacher-training programs to become involved in these activities.

SECTION 4

INTRODUCTION

Instructional Applications with computers, Section 4, includes eight articles and three input and output briefs, which focus on the instructional applications for handicapped children. The topics include teaching computer literacy skills to exceptional children and methods of applying techniques of computer-assisted instruction.

In the first article Zabinski provides an overview and description of a national computer camp to teach literacy skills to children, its objectives, the methods used, and special events and activities provided in the camp environment. Neuman's article discusses a highly structured instructional package that is designed to provide individualized career exploration and career planning experiences for mildly handicapped students at the middle-school age. The paper gives an overview of the system, discusses ways that the interest areas of children are identified and sorted, describes the instructional materials, and provides a method to develop plans for further examination of and preparation for occupations of interest. A management system that simplifies the teacher's task of monitoring and facilitating student progress through the career planning system is also presented.

The third and fourth articles are directed primarily toward the gifted population. Swartz suggests methods for using computers to solve learning problems, and Edwards addresses the teaching of higher-level thinking skills through computer courseware. Edwards includes discussions on computer literacy, a rationale for teaching students to program computers, a brief description of different types of courseware, and evaluation of their usefulness in instructing gifted students.

The fifth paper in this section is directed toward using computer graphics for problem solving and creative thinking skills with deaf and language-disordered students. In this three-part paper Rose, Waldron, Kolomyjec, and Barber discuss a method for developing and initially testing problem-solving software for deaf and language-disordered students. They highlight the advantages of the graphics software package for their teachers and provide information about the development of this program, including descriptions of frequently used subroutines and hardware specifications. Looking at a different population of exceptional children, Wilson and Fox discuss the need to have talking programs for young, severely handicapped, and nonreading handicapped individuals, and are proponents of the use of audible microcomputer software in special education. Three such programs are described, including the hardware required for their operation.

The seventh and eighth papers in this section relate to the more severely handicapped population. Bourland, Jablonski, Allen, and White provide an overview of learning characteristics of severely and profoundly handicapped individuals, a discussion of a systematic approach to using microcomputers to develop and maintain responses to stimuli that are presented by the microcomputer, and examples of individual student's reactions to the microcomputer intervention. Blissymbol drill programs for use by severely physically handicapped, nonverbal individuals is the subject of the paper by Wertz. The general concept and development of Blissymbols are discussed, and a software program for teaching and drilling students on the use of Blissymbols is presented.

Section 4 concludes with three input and output briefs. The first is a discussion of methods for enabling blind students to use the computers. The second is a review of a research project that uses the computer to provide handwriting exercises with a digitizer pen to track the shaping of letters. The final brief is a discussion of the use of Apple LOGO as an instructional tool for teaching handicapped children.

COMPUTER CAMPS--THE CURRENT CRAZE

NATIONAL COMPUTER CAMP

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INTRODUCTION

One of the great American institutions, the summer camp for children, has joined the computer age. With many schools, television sets, and the cover of Time adapting to the influence of the machines, what is believed to be the country's first computer camp was held in July 1978 in Orange, Connecticut. The camp was like traditional summer camp for children; however, instead of primarily engaging in such activities as baseball, drama, or music, the teenagers spent their time working with computers.

Computer Camp is the brain child of Michael Zabinski. In the mid-1970s he was awarded several federal grants to train teachers on how to integrate computers into the classroom. Wishing to reach the youngsters personally, Dr. Zabinski originated the National Computer Camps of Orange, Connecticut, in 1977.

Why is there such a camp? That computers have affected the lives of nearly all of us is indisputable. Their impact has been experienced in areas as widely separated as space research and primary instruction. Computers are an important educational consideration as students need to be prepared to live in a computerized society. Both parents and students are aware of the computer revolution and are interested in computer literacy. The purpose of the camp is to provide youngsters with ample opportunities to use the computer for instructional as well as recreational applications. In the process they come to understand the potential as well as limitations in using computers.

CAMP OBJECTIVES

The impact of computers on our society requires that a computer camp provide general knowledge about computers, computing, social implications of computers, and opportunities for careers. The goals of the National Computer Camps are to offer a general introduction to computers and computer programming, while at the same time presenting youngsters with a proper balance of recreational time both on and off the computer. The following objectives served as guidelines in conducting the camp:

1. To introduce computer concepts and techniques and thus provide a general appreciation of the power and limitations of computers, i.e., to remove the mystique about computers.
2. To provide a technical social and moral perspective of present and future roles of computers in our society.

3. To acquire competence in computer operations and programming in BASIC and machine language.
4. To use the computer as a motivational instrument to stimulate interest in science and mathematics. Techniques gained through the use of the computer may be applied to life situations due to step-by-step approach.
5. To discover that working with a computer can be recreational and entertaining.

ORGANIZATION

Enrollment

Coed campers aged 9 to 18 enjoy a continuous program in successive weeks without repetition. Campers may attend 1-, 2-, 3-, 4-, or 5-week programs. Small group instruction is provided, with campers grouped by background and age; no computer experience is necessary.

Computer Staff

National Computer Camp is well known for its skilled staff. The instructors are trained teachers in the field of education who love to work with kids. They specialize in teaching computers year-round in elementary and secondary schools and have been with NCC for several summers. The philosophy of the staff is to motivate campers by presenting material in exciting ways with examples they can relate to and identify with.

Computer Instruction

Each group of 12 campers is instructed by one teacher and one assistant. Up to 5 hours per day of computer instruction is available. Campers may learn beginner, intermediate, and advanced TRS-80 and Apple Basic; also disk-operating systems, files, and machine language for both the TRS-80 and Apple. Pascal for beginners is also available.

Recreation

Swimming, volleyball, tennis, soccer, kickball, basketball, and softball are supervised by experienced recreation instructors. All recreational activities are optional. The computer room is open during recreation periods.

Computer Hardware

Radio Shack TRS-80, Apple, Pet, and Wang computers with screens, cassettes, disk drives, and printers are available. Every two to three campers have their "own" computer.

Locations

The camps are conducted in private schools with all facilities available to the camp. The three locations are Simsbury, Connecticut; Atlanta, Georgia; and St. Louis, Missouri.

Special Evening Events

Every evening is filled with excitement and surprises. Campers select from a variety of activities and can even win the popular "I WON IT" T-shirts. The following are examples of such events.

Study groups. How to solve adventures; computer languages--Fortran, APL, Cobol; hardware and software topics; ordinary computer maintenance; advanced applications; social implications of computers; open forum and discussion.
Open computer room. With lab sessions, organized games, tournaments, and Olympics.
Adventure challenge. Crack a new adventure especially written for the National Computer Camps.
Recreational time. Enjoy an evening swim, a popular movie, a talent show, or dormitory intramurals.

Daily Activities

Daily activities include computer instruction, computer workshops, computer game tournaments, movies, guest speakers, and recreational activities. Campers may enjoy up to 10 hours of computer time per day. Camp has a sufficient number of computers to make recreational activities optional.

National Computer Camps provide an opportunity for campers from all parts of the United States and abroad to interact creatively with each other. This harmonious integration of young minds is the foremost quality of the National Computer Camps. The primary ingredient for making a success is the enthusiasm of the staff and their campers. The next most important component for such a camp is organization and adequate facilities.

CAREER PLANNING MEETS THE MICROCOMPUTER:

A DEMONSTRATION

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THE CAREER PLANNING SYSTEM

The Career Planning System (CPS), Microcomputer Version, is a comprehensive, highly structured instructional package designed to provide individualized career-exploration and career-planning experiences for mildly handicapped students of approximately middle-school age. Developed specifically to take advantage of the motivational, managerial, and interactive capabilities of the Atari 800 microcomputer system (console, monitor, and two disk drives) with 48K of memory, the CPS is intended to serve students with mild mental retardation, learning disabilities, and severe behavior handicaps who are capable of reading at the 3.5 grade level. Field-tested with such students at five school districts within or adjacent to major population centers in Colorado, Missouri, New York, Ohio, and Texas, the CPS has been found to engender a significant increase (at the .05 level) in the students' overall knowledge about careers, about themselves with respect to careers and career planning, and about career planning in general.

A combined staff of instructional designers and computer programmers at the National Center for Research in Vocational Education, Ohio State University, worked under an eighteen-month grant from the U.S. Department of Education to develop, test, and revise the CPS materials and to initiate a plan for their dissemination. The final instructional package prepared through this effort consists of three components:

- thirty floppy disks--the core of the CPS--that provide (1) an interactive instructional component that is the main vehicle for student progress through the forty occupations represented in the CPS and (2) a comprehensive managment system with a variety of instructor options for monitoring student progress throughout the instructional materials;
- a student guide for each student that provides reinforcement for student learning, a permanent record of the student's experiences with the CPS, and a means for expansion and discussion of those experiences; and
- an instructor guide that provides the theoretical, technical, and instructional information a teacher or counselor needs to implement the CPS.

Each of the components of the CPS was developed in accordance with a set of detailed specifications compiled by project staff early in the conduct of the work effort. These specifications--which cover both the computerized and the printed CPS materials as well as their interrelationships--were developed to ensure that the final materials truly meet the needs of the target population and their teachers. Thus the specifications detail not only the content of all the pieces but the particular format of each; for example, the layout of each type of computerized display to ensure that it presents information in a direct, consistent, and visually appealing manner that will enhance the possibilities for student learning. A particularly significant segment of the specifications deals with instructional and technical considerations related to the needs of mildly handicapped learners. This segment addresses such issues as the presentation of objectives, the appropriate development of concepts, various aspects of reading level and language style, the use of sensitive and effectively presented feedback, the provision of aids to the transfer of learning and generalization of knowledge, appropriate student-computer interaction, selected types of individualization, the use of sound and graphics, and the encouragement of learner independence.

THE INSTRUCTIONAL MATERIALS

Through the CPS, students become acquainted with a variety of occupations that are representative of basic worker functions. The key to the system is the student' own interests--not in occupations themselves but in activities that the students enjoy either in school or during leisure. The final intended outcome is the students' insightful participation in planning their studies and activities for the future. This goal must, of course, be an outgrowth of development in other areas--in self-understanding; in problem-solving, decision-making, and planning skills; and in increasing knowledge of occupations, their interrelationships, and their relationship to the individual. Therefore, the CPS materials are designed to help students achieve four major career-development outcomes:

- o to learn about personal interests;
- o to examine occupations to learn how they may relate to personal interests;
- o to identify activities and areas of study in which personal interests may be nurtured and in which related skills may be developed; and
- o to relate educational preparation to potential occupational choices.

The organization of the CPS reflects the system's emphasis on these goals. As noted in Figure 1, the student begins to proceed through the instructional materials at the level of personal interests and progresses through a wide variety of experiences before being asked to consider various factors in relation to educational and career planning.

After reading in the student guide, a brief welcome, and an illustrated list of the six steps involved in loading a disk into a disk drive, the student signs on to the computer by typing the first name and personal CPS code number. The student is then routed automatically through each of the system's four major components in turn--introduction, interest, sort, interest areas, and education plan. The instructor guide provides a detailed description of each of these components and of the procedures that the teacher and students should follow in relation to them.

Introduction

The introduction includes an explanation of the general content and structure of the CPS and of the objectives that students should achieve through using it; a variety of vocabulary-building activities--for example, work-search and crossword puzzles--related to terms essential to the CPS; and general instruc- tions on how to use the CPS. Student understanding of this information is reinforced through a series of exercises in the student guide designed to complement the computer-based

FIGURE 1

CAREER PLANNING SYSTEM OVERVIEW

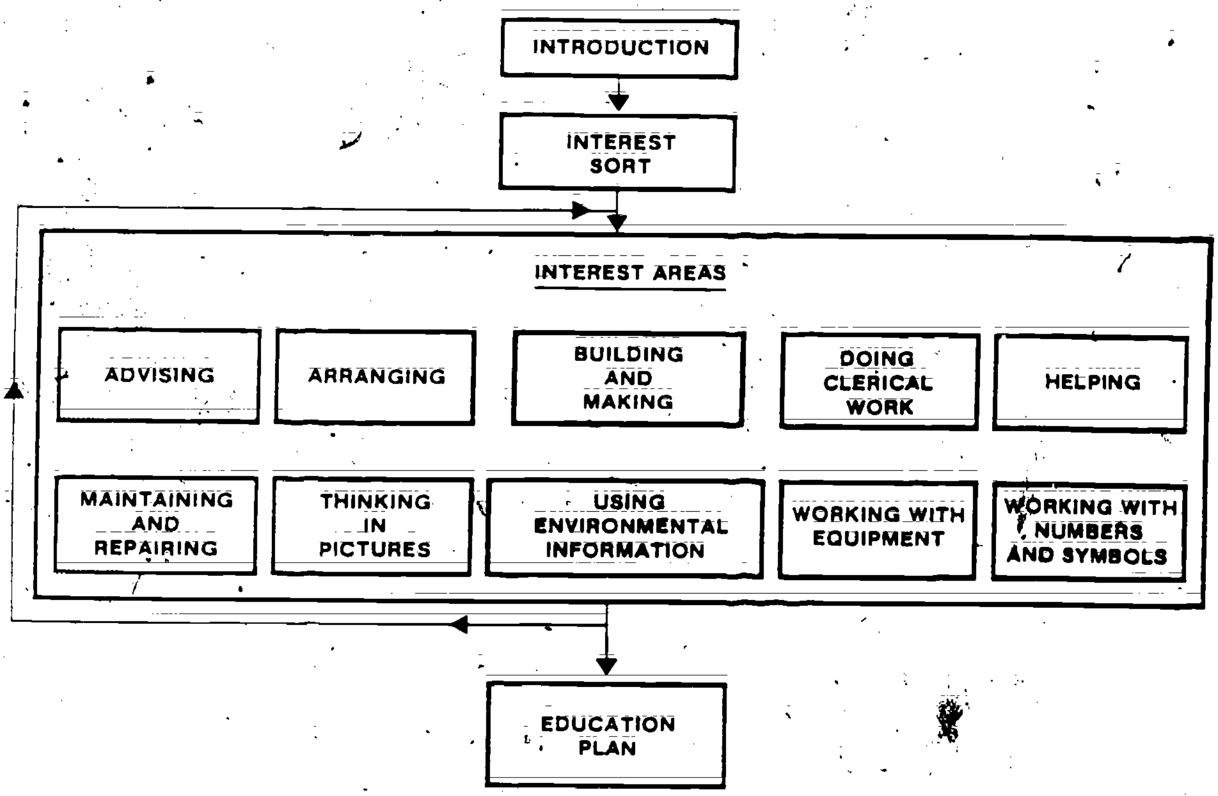


FIGURE 2

CPS INTEREST AREAS AND OCCUPATIONS

1. Advising

Child care attendant
Employment counselor
Lawyer
Travel agent

2. Arranging

Architect
Florist
Hair stylist
Interior designer

3. Building and Making

Carpenter
Drafter
Painter
Roofer

4. Doing Clerical Work

Cashier
File clerk
Secretary
Stock clerk

5. Helping

Licensed practical nurse
Police officer
Properties manager
Waiter

6. Maintaining and Repairing

Appliance repairer
Mechanic
Plumber
Sanitation worker

7. Thinking in Pictures

Cartoonist
Commercial artist
Display artist
Photographer

8. Using Environmental Information

Farmer
Fish and game warden
Landscape gardener
Meteorologist

9. Working with Equipment

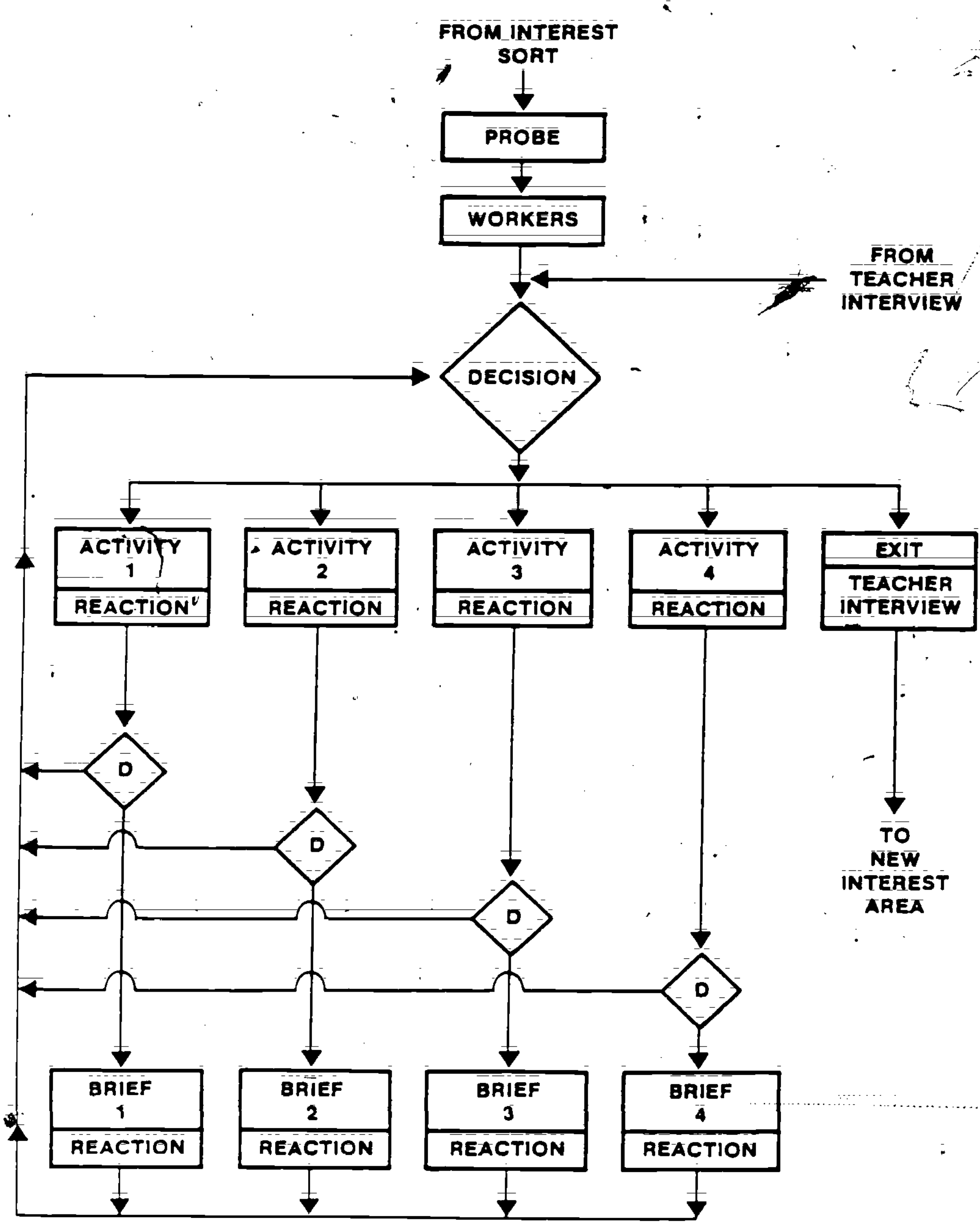
Computer service technician
Cook
Machinist
Telephone operator

10. Working with Numbers and Symbols

Library assistant
Market research coder
Medical laboratory assistant
Teller

FIGURE 3

INTEREST AREA FLOWCHART



access to important terms that they may not know without overloading the computerized introduction with vocabulary that will not be used for a long time.

Interest sort

This key component of the system is comprised of 50 general questions related to the 10 CPS interest areas. Designed to help students identify interests in a variety of work-related environments and activities--for example, working outdoors, helping people with their problems, etc.--the interest sort provides the basis for each student's individualized movement through the rest of the CPS package. After the student responds A, B, or C, to each statement according to the degree of interest in it (A a lot, B a little, or C none at all) the CPS's computerized management system automatically sorts and compiles the answers into an ordered listing of the student's interest areas. When the student's list appears on the display, the student is instructed to copy the list into the student guide for reference. From this point on, each time the student signs on to the computer to use the CPS, the student will be taken through the system automatically on the basis of this list.

Interest Areas

The 10 CPS interest areas are the heart of the Career Planning System. Developed around general areas that middle-school students might have or wish to explore rather than selected from traditional occupations clustering systems, the interest areas are designed to help students deal with immediate self-knowledge rather than with abstract speculation about the future. Each interest area is built around four occupations chosen to cover an educational continuum from high school diploma to graduate degree; a range of skills from entry level to professional; and an array of visual, verbal, and computational abilities. Figure 2 displays the titles of the 10 interest areas and the names of the four occupations covered in each.

Figure 3 indicates the way in which a student moves through each interest area that is explored. First, the student reads a probe, which provides a brief description of the interest area and presents 10 statements related to the area's activities. The student responds yes or no to these statements, which are designed to help consider whether personal interests, abilities, and skills match those that are typically found among workers in the interest area.

Next the student meets four imaginary workers representative of the occupations included in the interest area. These workers--for example, Jimmy Wolinski (painter), Cynthia Sakuma (architect), Clark Hampson (file clerk), Barbara MacIntosh (auto mechanic)--explain a little about their job tasks as simulated in the CPS activities in order to enable the student to choose one or more of these activities to explore.

The student next decides which of four activities to complete as the first step in exploring a particular career. Across the CPS, the activities cover a wide range of tasks: the visual problem identification of the landscape gardener, the computation of the waiter, the form completion of the employment counselor, and so on. Designed to give students a "feel" for the occupations that they represent, the activities are highly interactive and make sustained and persistent use of a variety of strategies

Each activity takes approximately 20 to 30 minutes to complete, offers a list of additional activities (external to the CPS) that a student might try in order to expand exploration of the occupation, and concludes with a reaction form designed to provide an opportunity for the student to record personal perceptions of the activity. The computer stores the student's responses to the two questions on this form--"How much did you like this activity?"--and later uses these, as well as other student responses, to compile an individualized list of up to 10 CPS jobs that are of greatest interest to the student. The student is also instructed to fill out a complementary reaction form in the student guide that encourages expansion on the computerized responses and the reasons for them.

At this point the student encounters another decision: whether to read an occupational brief about the job just explored in the activity, to explore another activity in the interest area, or to leave the interest area to go to another one or, if appropriate, to proceed to the education plan component of the CPS.

The CPS includes 40 menu-driven occupational briefs, one for each activity. The briefs follow a consistent format to provide sketches of the kinds of information that the student should consider when making career choices--additional job tasks, the work environment, educational preparation, salary range, and so on.

To complete a brief, the student "interviews" the worker whose comments earlier in the interest area first sent that student to the occupational activity. The student meets the worker again, reads a few displays in which the worker gives some basic information about the occupation, and then selects any four (or more) of six questions to "ask" the worker. The student may ask those questions in any order and is returned to the menu of questions after each answer for this next selection. A computerized counting routine keeps track of the questions that the student asks in order to ensure that questions are not repeated and to allow the student the option of skipping either one or two questions and continuing with the next section of the brief.

The answers to five of the six questions are given in conversational, first-person narratives by the worker whom the student is interviewing. The answer to the sixth question--"How can I become a (occupational title)"--is a list of high-school courses to take, in- and out-of-school activities to pursue now, and things to do after high school to enter the occupation. The student is instructed to copy this information into the career plan section of the student guide for use in the culminating component of the CPS, the development of the education plan. Finally the student completes a two-part reaction form: (1) a computerized part that stores answers to two questions--"Would you like to do the kind or work you learned about in the brief?" and "Could you learn to do good work in this job?"--to use in compiling the list of student-preferred jobs described earlier and (2) a complementary student guide part designed to help the student expand on the reasons for the computerized responses.

A student can explore as much or as little of each interest area as desired. As Figure 3 shows, a student can leave an area after reading the probe and meeting the workers, after completing any activity, or after completing any brief. Thus, a student can leave an interest area if none of the jobs seems appealing or can remain in it to complete one or more activities and, if desired, their accompanying briefs. Each time a student decides to leave an interest area, that person is directed to participate in an exit interview designed to assist the teacher in facilitating the over the experience, the interview should be supportive rather than directive. If appropriate, the discussion might be based on the reaction forms completed by the student during work in the interest area.

Although the CPS is essentially an individualized, self-paced instructional package that focuses on growth in self-awareness rather than on interpersonal concerns, students should come to recognize that growth comes through interaction with others as well as through solitary reflection. To encourage this recognition, the instructor guide includes a number of suggestions for discussions, games, and other activities that the teacher and pairs, or other small groups of students, can use to enhance personal growth. These supplementary activities are related to career planning and decision-making in general and to topics related specifically to particular CPS interest areas. They are not mandatory, but are to be used at the discretion of the teacher--for example, with students who have finished several interest areas and might profit from discussing their experiences with one another. The instructor guide also lists sources and references that teachers and counselors can use to provide additional occupational information to students who request it.

Education Plan

Developing plans for further examination of and preparation for occupations of interest is the culmination of the student's work with the Career Planning System. Once the student has completed all the CPS activities and briefs of interest, the student, in conference with the teacher or counselor, designs a plan for further exploration that incorporates the self-knowledge gained from the CPS experience. The student begins this effort with a computerized component that presents some brief introductory information and then compiles the student's responses on all computerized reaction forms into a ranked list of as many as 10 CPS jobs in which the student indicated the greatest amount of interest. The student copies this list into the student guide, then takes the guide to the teacher or counselor to serve as the basis for a joint planning session in which the student and the adult together develop a plan for the student to follow to learn more about each occupation of interest.

The two-person planning team follows a standard procedure to develop plans related to as many of the student's preferred occupations as seems appropriate. Starting with the job at the top of the list, the team reviews the relevant reaction forms and career plan pages contained in the student guide. This material, supplemented by the teacher's or counselor's knowledge, enables the team to answer the eight questions on the education plan pages in the guide. These questions, which address such issues as the skills and training required for the occupation, and the traditional and nontraditional ways for acquiring these, are designed to focus the student's planning efforts and to provide initial suggestions for implementing early career-planning decisions.

Although the completion of the education plan component of the Career Planning System constitutes the completion of the CPS itself, the student's career exploration and planning efforts should obviously not terminate at this point. Once a student has completed one or more plans, the student should select one (if necessary) and--with the teacher's or counselor's assistance as necessary and practical--begin to implement it. In addition, the student can repeat the work with the CPS one or more times, gaining something more from each experience as self- and career-knowledge and sophistication in career-planning increase.

agement component is a thorough and sophisticated mechanism that does all the student record keeping required by the CPS instructional component and offers a number of additional options as well. As displayed in Figure 4, the management system offers two menus of functions to be used in concert with the CPS.

To begin working with the system, the teacher chooses function H in the main menu to get to the extended instructor options menu, a list of functions that the teacher uses only once to initiate work on the CPS and can then ignore for the remainder of the experience. Essentially, these functions enable the teacher to prepare disks to accept and store the data that both determine each student's progress through the CPS and allow the teacher to track that progress. By following carefully detailed instructions that appear in the instructor guide and on individual computer displays, the teacher uses these options (1) to create the computer files that will store the student's individualized records and (2) to format and copy backup disk as insurance in case the original record disks are lost or destroyed.

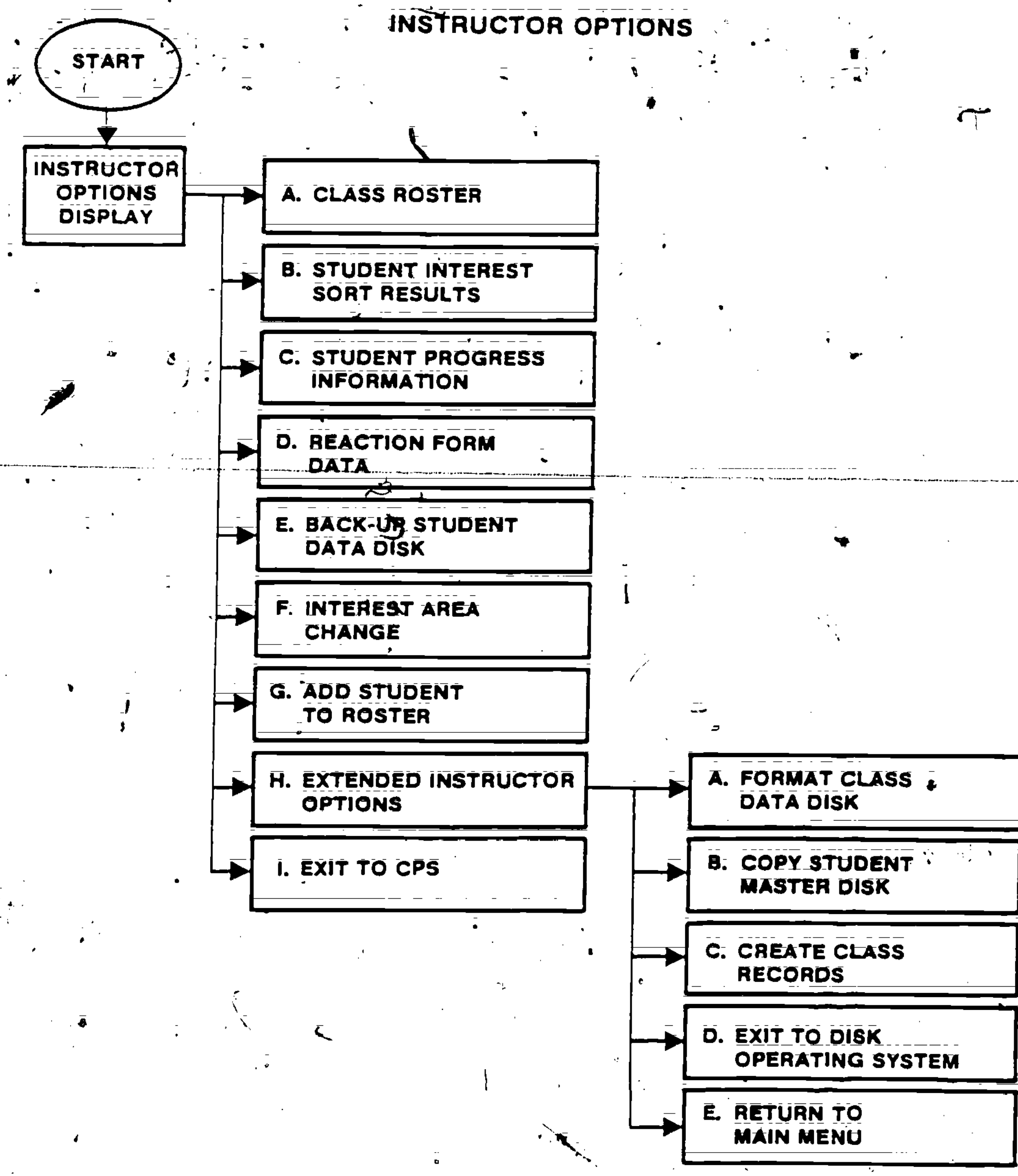
Each record disk can hold complete files for up to 12 students, and the teacher established these files simply by typing each student's first and last names and a three digit number between 100 and 998. This number becomes the students CPS code number--the number that the computer uses to store the student's records and route the student automatically through the CPS, and that the teacher uses to gain access to the student's stored records.

The seven instructor options on the main menu (i.e., all but the two included to provide access to the extended options menu and to the instructional component itself) comprise the set of functions that the teacher will use throughout the students' CPS experience. The first of these--i.e., the class roster, results from the creation of the class records and provides a list of the first and last names and (as a reference for the teacher) of the CPS code numbers of all the students working on the CPS. The second option, student interest sort results, enables the teacher to see, on a student-by-student basis, the student's name, the interest area in which the student is currently working, and the list of all identified interest areas in order of preference as computed during the interest sort. The third option, student progress information, shows the linear progress of any student through the CPS by listing, in order as completed, all the probes, activities, and briefs that the student has finished. The fourth option, reaction form data, provides a summary of any student's answers to the questions on the computerized reaction forms for all the activities and briefs explored.

The final three options on this menu are concerned more with instructional management than with tracking student progress. Backup student data, for example, should be used at the end of each day's work in order to keep a current backup record of students' progress in case the original record becomes unavailable. Interest area change--a function that allows the teacher to interrupt the normal flow of the CPS when it is determined that such an interruption is in the best interests of a student--enables the student either to explore an interest area that was not indicated by the original interest sort or to return to an interest area previously completed. Add student to roster allows the teacher to create computer files on an existing record disk for any students who begin their work on the CPS after the roster for the rest of the class has been created.

FIGURE 4

INSTRUCTOR OPTIONS



Planning System, Microcomputer Version, provide a comprehensive, well-integrated, thoroughly documented, and thoroughly tested instructional package for learning disabled, mildly mentally retarded, and severely behaviorally handicapped middle-school students. Designed to capitalize on the motivational and managerial capabilities of one of the most exciting and powerful innovations in the history of instructional technology, this courseware package holds special potential for helping exceptional student make sound, well-informed career decisions that will ease their transition from school to jobs and ultimately enable them to achieve their right to full participation in the American workforce.

For further information, please contact Program Information Office, The National Center for Research in Vocational Education, 1960 Kenny Road, Columbus, Ohio 43210.

ED#229906

USING COMPUTERS TO SOLVE LEARNING PROBLEMS

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We find ourselves at an extraordinary point in the history of education. We are at a place where two movements are merging to produce a surge of energy that is likely to significantly enhance the quality of education that we can deliver now and, increasingly, in the future. The current movement is bringing advanced computer technology into homes and schools everywhere. The other movement, whose origin can be traced to the master teachers of antiquity, is bringing into the awareness of more and more teachers the progressive insight that persons, handicapped or not, are remarkable learning systems with mental resources that generally have gone untapped in formalized educational settings. Thus, increasing numbers of educators are finding themselves at a crossroad where the presence of both an advanced technology of learning and an advanced technology of machines greatly increases their capacities to involve their students in learning activities that tap powerful mental resources.

Many workers are already devoting themselves to the exploration and discovery of how the day-to-day implementation of the merged technologies can best meet the needs of many different students. Their efforts have produced some software products that draw learners into spontaneous uses of their mental powers to produce learnings that approach, in profundity and apparent effortlessness, such accomplishments as mastery of one's mother tongue or complex motor skills. Most noteworthy of such products are the results of projects led by pioneers like Gattegno or Papert, which have produced "microworlds."

Caleb Gattegno has written extensively of an approach to education that he has labeled the subordination of teaching to learning. A detailed listing of his publications and information about his software project, entitled Visible and Tangible Mathematics" (funded in part by the National Science Foundation) can be obtained by writing to him at Educational Solutions, Inc., 80 Fifth Avenue, New York, New York 10011. Seymour Papert's leading role in the development of LOGO (also supported by the National Science Foundation) is well known. In addition to Papert's own writings on LOGO and on his overall philosophy of education (see especially Mindstorms 198), many articles and some books on the uses of LOGO have been authored by a variety of educators at all levels.

These worlds increase the possibilities for students everywhere to explore how their intelligence opens one door after another in their quest to master increasingly complex challenges. In a true microworld, memorizing takes a back seat to the more exhilarating and reliable mental powers of imagery, stressing and ignoring, perception, analysis, synthesis, intuition, retaining, recognition, and so on. There is an engagement of learners in activities that lead them to produce their own knowledge by perceiving and acting on material on the computer screen.

and channel them so that they solve their learning problems. Two conditions would have to be met: those working with the students need to recognize that behind the observed accomplishments there are mechanisms (i.e., mental powers) at work that make the behaviors possible; and specific exercises need to be implemented to lead them to tap the same mental powers within a context that will produce the learnings which have proven problematic.

It is hoped that Exhibit 1 can provide some help to educators in the field who wish to pursue this way of working. They are the ones who will lead us from our present crossroad to the place where all learners are recognized as exceptionally capable of learning systems, who can tackle in stride one challenge after another, so long as they know that it is their mental strengths they need to apply.

EXHIBIT 1

SAMPLE WORK SHEET FOR USING COMPUTERS TO SOLVE LEARNING PROBLEMS

1. Select a computer program that involves the learners in actively exploring possibilities in a restricted "world" (often referred to as a microworld).

2. Scrutinize the selected program to determine which specific mental powers are elicited in a learner who explores possibilities in the microworld (e.g., generating imagery, suspending judgement, analyzing, synthesizing, focusing, ignoring, retaining, etc.). List those mental powers.

3. Match the specified mental powers that are tapped with areas of learning that have proven to pose problems for any particular student. For example:

Mental Powers Elicited	Problem Areas
Generated imagery, focusing, retaining	Letter formation, spelling

4. Have the learners engage in the activities on the computer, freely exploring the possibilities offered. Give suggestions, provide guidance, but act more as a facilitator than a trainer. (Well-designed microworlds will allow, even encourage that role.)

5. Design "bridges" to take the learners from the computer activities to actual performance in a targeted skill area that has been a problem. For example, if LOGO is the selected microworld and letter formation is the problem area, a learner could be asked:

   a. to make the turtle draw any or all of the letters, upper or lower case,
   b. to decide which movements of the turtle are common to the drawing of the various letters,
   c. to develop procedures that will produce those movements shared by the drawing of two or more letters,
   d. to draw the letters using only the procedures developed, and
   e. to use a pencil point on a piece of paper in place of the turtle on the screen and to reproduce the drawings achieved in LOGO, using reference to learner-defined procedures when and if necessary.

TEACHING HIGHER-LEVEL THINKING SKILLS THROUGH COMPUTER COURSEWARE

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While this presentation focuses on using computer courseware in gifted programs, a brief overview of the many possibilities for using computers with gifted students will serve as a framework for the examination of courseware for teaching higher-level thinking skills.

COMPUTERS IN GIFTED EDUCATION

Computer Literacy

Vital for all students in preparing for tomorrow's technological society, computer literacy is especially important for gifted students, many of whom will be involved in making far-reaching decisions regarding technology and society. Gifted students need to explore what computers can and cannot do, how widely and deeply they affect our society, and what ethical questions surround their use.

Programming

Programming is an excellent activity for increasing cognitive and creative skills and, as such, is an appropriate component of many gifted programs. It is widely recognized that programming can promote logical, deductive thinking. It is, however, less commonly understood that programming also strengthens creative thinking skills and problem-solving abilities. Programming can in fact enable students to think about thinking. In order to design and code a program to perform a specific task, students must thoroughly understand the thought processes required to solve the problem.

There are a number of reasons for teaching programming, and these objectives influence the particular programming language taught. Programming as career preparation might focus on Pascal, which is prevalent in computer science departments. Programming as a problem-solving tool for use in scientific courses should involve the widely available BASIC and Pascal. Programming as training and experience in logical, analytical processes might feature LOGO and Pascal but could also use BASIC. Finally programming as an outlet for creativity could begin with LOGO, then use either Pascal or BASIC.

However, requiring all gifted students to learn to program computers makes less sense than making them all learn to play the piano. Programming is a specialized activity that may not be appropriate for all students or even all gifted students. The need to program computers in order to use them is quickly diminishing as computers are increasingly designed to be more user-friendly. This is not to downplay the value of teaching "gifted program" with a class in computer programming.

Utility Software

The effective use of utility software packages goes beyond the realm of computer literacy. Such software is beginning to have a significant impact on curricula in our schools. For example, word-processing packages are changing the way writing is taught. Word processors allow students to achieve success in the area of composition where they previously had difficulty because of slow or poor handwriting ability or their own demand for perfection in their work. Gifted students should be encouraged to use word-processing systems to record their creative ideas, evaluations, and conclusions. Other utility programs include graphics routines to draw and color on the screen, and music generation packages for composing and recording original music. Both provide vehicles for the creative talents of gifted students. Also valuable are the electronic spreadsheets, which encourage students to explore "what if . . ." in a variety of realistic economics and business situations, and to see immediately the results of their experiments.

Courseware

Courseware or educational software involves students in an interactive learning environment. Courseware exists in a variety of forms and levels of quality. Obviously not all courseware is appropriate for gifted students any more than all printed text material is suitable for the gifted. We here explore courseware that contributes to the strengthening of higher level thinking skills, such as analysis, synthesis, evaluation, creative thinking, critical thinking, and problem solving.

Generally speaking, courseware can be divided into categories, although overlapping among categories is inevitable, and the distinctions seem to be fading as courseware becomes more sophisticated. Nevertheless categories can be useful in illustrating the variety of courseware activities:

Drill and practice provides practice, usually with feedback, on skills or information that the student has previously encountered.

Tutorial provides instruction in new concepts or skills; includes examples and often involves practice; best when highly interactive.

Simulation models a real-life situation (or an imaginary one), allowing students to make decisions and observe the results; may have game features.

Problem solving tool facilitates the solving of a student-defined problem by retrieving, analyzing, or calculating with data appropriate to the problem.

Educational game requires the creation of strategies to choose moves that will lead to a successful completion of the game; may involve memory, analysis, evaluation, logical thinking, and flexible thinking.

Each of these categories of courseware can be used in several modes, that is by individual students or large or small groups. Simulations, problem-solving tools, and games in particular are most valuable in a group setting. The myth that computers in instruction require that students work independently, concentrating on their own monitor screens, denies the powerful effect of computer courseware in encouraging group interaction. Gifted students who are given opportunities to work together on projects involving computers can improve their interaction skills and strengthen vital peer relationships.

Lower Level Thinking Skills

Drill-and-practice programs emphasize recall and comprehension, which are considered lower-level thinking skills. Although most gifted students do not require extensive practice to learn concepts, computer drills can be useful in allowing a gifted student to master the material at an appropriately fast pace because the drills can be individualized. They might also be used in a content area in which a gifted student does not excell by providing unemotional, objective feedback for incorrect answers. The computer does not expect a gifted student to be gifted in all areas and will patiently correct student errors.

Tutorials are designed to teach comprehension but can include analysis and evaluation as well. Some tutorials can be appropriate for gifted students because they adapt to individual students' abilities. These are highly interactive programs in which students control the pace of the instruction and which include extensive branching based on student responses to numerous questions. However, many tutorials are still of the page-turner variety, simply a textbook on a screen. These should be avoided.

Higher-Level Thinking Skills

It is in the other three courseware categories--simulations, problem-solving tools, and educational games--that higher-level thinking skills are emphasized.

Simulations are probably the most exciting form of instructional computer programs available and may become the dominant form of courseware. Simulating or modeling real-world events is a process that computers perform expertly and that no other media can accomplish. By simplifying complex situations and permitting specified parameters to be altered, simulations enable students to experience processes and events. Students analyze data, evaluate possibilities, make decisions, observe the results of the decisions, and reevaluate the situation on the basis of the results. Simulations condense time, allowing the examination of events lasting too long for classroom study. They also permit students to experiment safely without the possibility of disastrous results.

Three well-known MECC simulations involve this process and illustrate the variety of events that can be simulated. Odell Lake simulates the food chain among fish and other animals around a lake. Oregon simulates a trip by covered wagon along the Oregon Trail. Lemonade simulates the business of managing a lemonade stand.

Problem-solving tools enable students to use the information retrieval and calculating power of the computer without writing their own programs. This courseware allows students to focus on setting up the problem, on the steps of a solution, and on interpreting and evaluating the results. The computer performs the necessary but tedious intermediate calculations. These tools can be valuable in teaching problem-solving heuristics in realistic problems.

Examples of this courseware include graphing programs in mathematics, food intake analysis and calorie expenditure analysis programs in nutrition, and numerical analysis and statistical programs in mathematics, the sciences, and the social sciences.

Educational strategy games require the development of successful strategies. Students learn to analyze the game situation and predict or imagine the results of possible "moves." They evaluate the possible out-games before choosing their moves, then reevaluate the situation after their moves and their opponents' moves. Creating strategies requires a great deal of "what if. . ." thinking.

Examples of educational strategy games include Words, a language arts memory game; BAGELS, a logical thinking-guessing game; and Gertrude's Puzzles, games involving attributes and sets. Educational games can be designed to encourage fluent thinking, such as the word game Friendly Fred, where players compete in generating words that meet stated rules.

EVALUATING COURSEWARE FOR GIFTED STUDENTS

Identifying courseware appropriate for gifted students can be a formidable task. Such courseware should meet three sets of criteria. It should be judged as instructional material, as material appropriate for gifted students, and as computer software.

Instructional Soundness

First, courseware should be evaluated using the general criteria against which any educational material is measured. It must be instructionally sound, include identified learning objectives, have an appealing format, and be free of unacceptable social biases.

Appropriateness for Gifted Students

Then the courseware should be evaluated according to criteria used in selecting materials appropriate for gifted programs. These criteria include encouraging or requiring divergent thinking, problem finding and problem solving, and risk taking. Such materials should be adaptable to various learning styles and easily individualized. Extensive guides to evaluating curriculum materials for gifted programs, recently published in books and journals, can provide further guidelines.

Appropriate Computer Utilization

Finally, the courseware should be evaluated according to criteria specific to computer-based materials. A highly recognized evaluation form for courseware is the one developed by MicroSIFT at the Northwest Regional Educational Laboratory in Oregon. In addition to the content of the courseware, these 21 criteria relate to the instructional quality and the technical quality of the software. Examples of specific criteria include appropriate use of graphics, color, and sound; effective feedback; learner control of rate and sequence of presentation; ease of operation of the programs by students; and appropriate use of computer capabilities.

CONCLUSION

Computers are an important factor in the education of gifted students and will grow in importance. Their versatility and their ability to open new areas for study and exploration are of great benefit to gifted students. Computer courseware, one of many ways to make use of computers in gifted programs, can be effective in strengthening higher-level thinking skills. Some courseware appropriate for gifted students exists, and more will soon become available as the sophistication of courseware increases and as its potential for use with gifted students becomes more widely recognized.

COMPUTER GRAPHICS AND CREATIVITY AND PROBLEM-SOLVING SKILLS WITH DEAF AND SEVERELY LANGUAGE-DISORDERED STUDENTS

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PART I - PROBLEM SOLVING AND CREATIVE THINKING WITH DEAF STUDENTS

When confronted with a problem, we often invest time in thinking about it rather than actually solving it. Many times the solution just happens. At other times one needs to systematize the solution, referring to prior knowledge and experience. Some problems require creative solutions; others are more mundane and routine. Whatever the situation, the problem solver needs to develop a schemata that helps attack a problem in the generic sense. Good problem solvers are characterized by their generality and independence of subject matter while using the basic problem-solving tools like inference, classification, subgoals, and contradictions (Wickelgren, 1974).

Shouksmith (1970) reported that intelligence and cognitive style as well as the ability to solve problems are involved in the creative thinking process. Persons valued as creative are those who are able to solve problems requiring the manipulation of information.

Deaf and language-disordered students are frequently identified as lacking problem-solving and creative thinking skills. It was hypothesized by the authors that this lack of problem-solving and creativity skills was perhaps an inaccessibility to the problem or the situation due to the barriers imposed by the English language. An example of this situation is the student who is capable with mathematical computations, such as 6 - 2 = 3; however, when given a problem, "with six cookies for two students, how many will each student get?" The student is unable to respond to the problem due to the language structure surrounding the components of the problem. Thus, in order to provide hearing impaired and language-disordered students with problem-solving experiences, a medium that was not bound by the English language needed to be developed.

Because hearing-impaired persons' nonimpaired information access system is primarily visual, it was concluded that graphic representation can play an important role in acquisition of these skills (Waldron & Rose, 1983). Computer graphics, due to highly visual and manipulative characteristics, was selected as the medium to ascertain the problem-solving abilities and creativity skills of hearing-impaired learners.

Basic Materials and Methods

A drawing tablet and supporting software allowed students to utilize the basic elements of any artwork: points, lines, rectangles, polygons, rotation of rectangles, filling in closed figures, and fitting a curve through a set of points. The students could erase the last step on the screen or save the image. All this was done via special keys on the keyboard. The users became familiar with various key functions through an illustrated manual. Each key with its function was introduced in a single-step progression without adult intervention and without the use of the English language. When the students complete the elements presented in the manual, they were free to create their own images.

Problem-Solving Software

In a separate set of tasks, problem-solving software was developed by the authors in the areas of pattern recognition, coding, tanagrams, and numerical matrices. Each of the tasks used a graphic format with a multiple-choice response mode. Students selected the solution or correct answer through a cursor control. The original software was created on a PDP 11/44 minicomputer and has been adapted for use on the Apple II and on Apple IIE microcomputer.

The software design concentrated on providing the language-impaired student with a creative medium, that of the computer, and a few key controls. Students were in control of the elements or tools for creating or problem solving and used them. Because no specific directions were provided, each student had to utilize inference and deductive reasoning skills to discover the rules and select an answer. The uniqueness of the design was that no English words were used in the entire process. The system was demonstrated to a group of randomly selected students who attended a local hearing-impaired program. They were essentially allowed to be on their own. The only intervention occurred if the student had a question or the system crashed. In these instances, monitors reset the program for the students.

Project Results

The information acquired through this project is particularly valuable to teachers of language-hearing-impaired students, researchers, and micro-computer users alike. Hearing-impaired students were able to solve problems given a medium that was accessible, that is, visual, and a set of rules that were consistent. The students acquired the rules through experimentation and deduction. Problem-solving and creative computer drawing tasks were highly motivating and challenging. This was particularly evident in the successful performance of eight- and nine-year-old deaf children who were identified as behavior problems, hyperactive, and multiply handicapped. These children attended to the computer graphics' tasks for 90 minutes without a break, excitedly sharing their creations and solutions with their neighbors.

Perhaps the most significant result was the fact that the students were able to find solutions to problems utilizing their personal schemata of deduction and inferences unencumbered by the English language system. In addition, students with a tradition of failure experienced success and a feeling of self-worth.

DISCUSSION

Technology in the special education classroom is neither new nor startling. What is all the excitement about? Why is there a national conference, and why special publications? The answer appears embedded in the fact that never before has a technology been so powerful and so accessible to so many. The potential of the microcomputer as a significant teaching and learning tool can be realized only through a masterful teacher. The microcomputer cannot teach. Software cannot make students learn. It is the careful coupling of individual student's learning skills, needs, and strengths with software, programs, and experiences that will utilize and maximize the potential of the technology of the microcomputer. The teacher holds the key to a world of learning in the computer age. This project has opened only one of the many avenues available to the hearing- and language-impaired learner through computer graphics in education.

PART II - DEVELOPING CREATIVITY AND PROBLEM-SOLVING SOFTWARE FOR TEACHING

"Man need not bend to linguistic circumstance but may easily bend language to his needs." Joshua Whatmough

Software like LOGO allows students to write their own programs interactively to express visually difficult concepts (Pappert, 1980). However, teachers find these programs hard to use in developing thinking and problem solving skills, specifically if the teaching methods involve testing specific skills and measuring progress. The software presented here recognizes this need of the classroom teacher and is designed so that, in addition to drawing pictures simply with a cursor and key control, the teachers can design tasks in specific categories.

The two distinct advantages of our design are that (1) the software is user-oriented; the user does not need to know any system software in order to generate their own graphic symbols; and (2) the entire design of the software is modular in nature, hence the user can develop any task wanted in using their own symbol library. The task-building program accesses the procedures that it needs. Hence, each developed task designed by the teacher can be stored on a separate diskette, independent of the master program used to generate the symbols.

USER-ORIENTED SOFTWARE

It was recognized that the software design would require sophisticated programming. However, with some forethought and procedural planning one could write software that was user-transparent. With this approach the teacher and students would not need to know the microcomputer programming language; rather they need to know their own tasks, which they can "write" into the computer. PASCAL language was chosen for its wide availability on microcomputers, ease in writing large programs in simple procedures, and good file-handling capabilities. PASCAL allows the programs to be written with structure and hence has all the advantages of structural and procedural programming language. The other great advantage is the use of turtle graphics, which is easy to use in the programs to generate graphics and use these in many procedures (Luehrmann & Peckham, 1981). In this section the program design is presented along with a sample program for one of the problem solving tasks; other programs that are similar in design are mentioned. All programs are well documented and complete.

System Specifications

The problem-solving and drawing software require a 64K-RAM Apple II+ microcomputer, joystick, and PASCAL language system diskette. The software described allows the teacher to design problems and tasks for students in the area of pattern recognition, numerical matrix, graphical coding, and verbal tasks without knowing PASCAL, the system programming language. Built in utilities and softwares are transparent to the user who communicates only in English and draws, using the cursor via the control of the joystick and some selected keys on the keyboard. The system can be booted up and then the programs run; however, for ease of use, the relevant files were put on the diskette so one could run the program by simply turning the power on (refer to APPLEPASCAL system language manual).

Generating Graphics

All graphical symbols were generated through the use of a program called MAKESYMBOL. Figure 1 shows the menu used in designing the graphic symbols to be used in tasks. These symbols could be shown in the square grid in any "color." The symbols could be "saved" and "recalled" by their name (see Figure 2). Their position could be moved in the x-y direction. They could be rotated, scaled, or erased in case an error was made. Thus, a library of graphical symbols can be created by the teacher and then used in any of the tasks to be designed. In the following four tasks, the screen is divided into two parts; left for questions and right for answers.

Pattern recognition. A graphical pattern consisting of up to six symbols is presented on the left; four possible answers are provided on the right. The student selects one of the four possible answers. If the answer is correct, they are rewarded by a symbol. If incorrect, nothing happens (see Figure 3).

Numeric matrix. Here a matrix with user-defined numbers is presented on the left. One of the boxes in the matrix is left blank. Based on the given numbers, the student guesses the underlying operation of the matrix and chooses the answer from four possible answers, which fit in the blank box. If the answer is correct, a reward symbol appears; otherwise nothing happens.

Coding and decoding tasks. In this program two sets of nine shapes appear on the top of the screen; with each shape is associated a symbol. Four shapes appear on the left. The student must choose the associated symbol patterns from four possible choices on the right-hand side of the screen. If one choice is correct, a reward symbol appears.

Verbal tasks. A verbal task presents a question written on the left side of the screen. The student selects one of the four possible answers, and if the answer is correct, a reward symbol appears.

Building and Running Tasks

In all the tasks described, the teacher has full control of what graphic, number, or letters to put in the question space or the answer space. The process of building and running the task is done by two major sets of programs. To build the tasks, the DATA/BUILDTASK diskette is put in Drive 1, which contains the symbols and the programs. The BUILDTASK diskette goes in Drive 2, where the designed tasks are stored. After the tasks are built and control RUN file is written on the task diskette, the task can be run by putting the task diskette in Drive 1 and rebooting the system.

1. Building tasks. Involves a three-step procedure. Turn power off. Put the DATA/BUILDTASK diskette in Drive 1. Put the task diskette in Drive 2 and turn the power on. The program will then run. A build task menu appears to allow you to select the appropriate task that you want to build. Up to 10 tasks may be put on a diskette.
2. Running tasks. This also requires three steps. Turn power off. Put the task diskette in Drive 1. Put any diskette with Question.DATA, Answer.DATA and Yes.DATA and any other Symbol.DATA file on it in Drive 2 and turn the power on. The program will then ask for the student information. Then the program will run all the prepared tasks. After the last question has been answered, subject information prompt will come back. The student information is stored in a results file to show the teacher how each of the students performed.

A sample build-and-run program for pattern recognition is given in Appendix 1. The program is well documented, explaining all the variables and procedures used. It also contains the explanation of use so the reader can select the relevant portion of the program for inspection.

DISCUSSION

The user-friendly software was designed so that teachers could create graphic symbols and use them in problem-solving and thinking tasks of different sorts. The software design allows teachers to generate symbols, store them, and use them in the tasks where most suited. The program Makesymbol allows the student and teacher alike to draw any designs and store them for future use, thus providing a creative flexible medium to the hearing impaired student and the teacher. The main use envisaged for this software is to allow teachers to generate low-verbal, highly graphic tasks to encourage visual, deductive, and inductive thinking and problem-solving skills of these students. It is hoped that the ease of use of software to design complex visual problems will encourage teachers to use microcomputer graphics in a more constructive manner than simple drill and practice. The teacher prepares material no different than on paper; however, the students work both interactively and independently and have an opportunity to explore their own thinking and creative skills with immediate feedback.

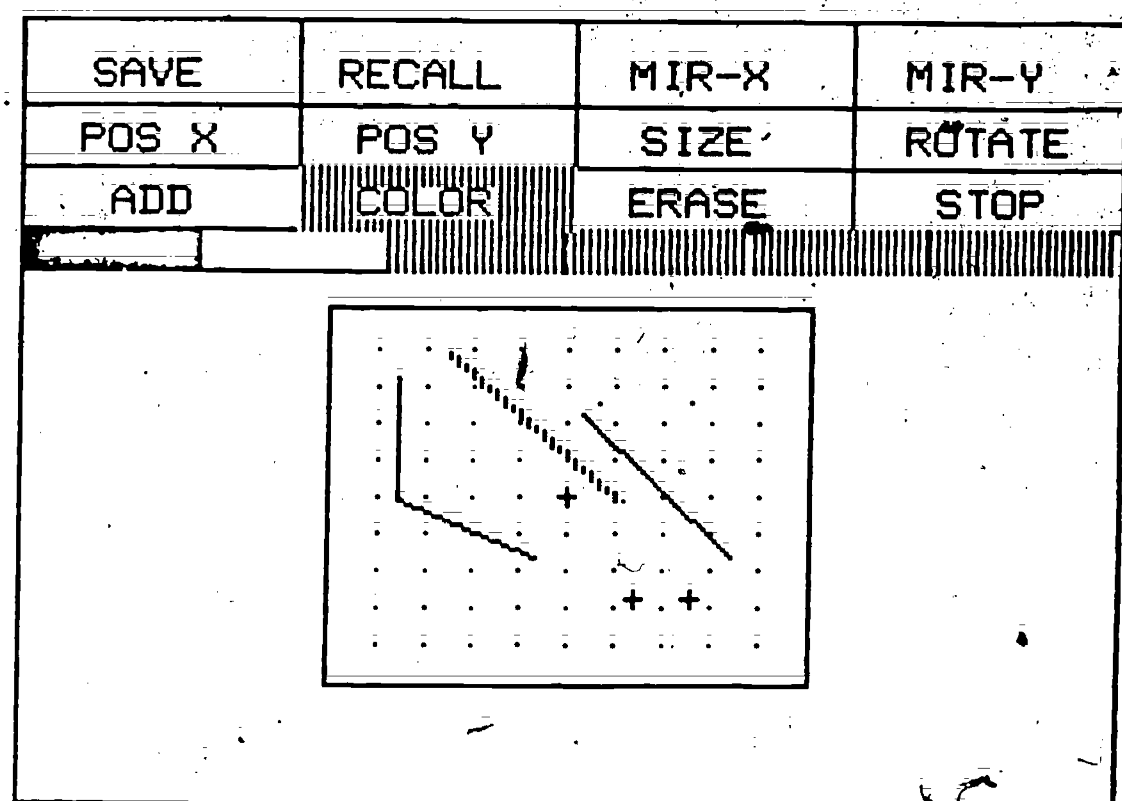

Figure 1: Make symbol menu

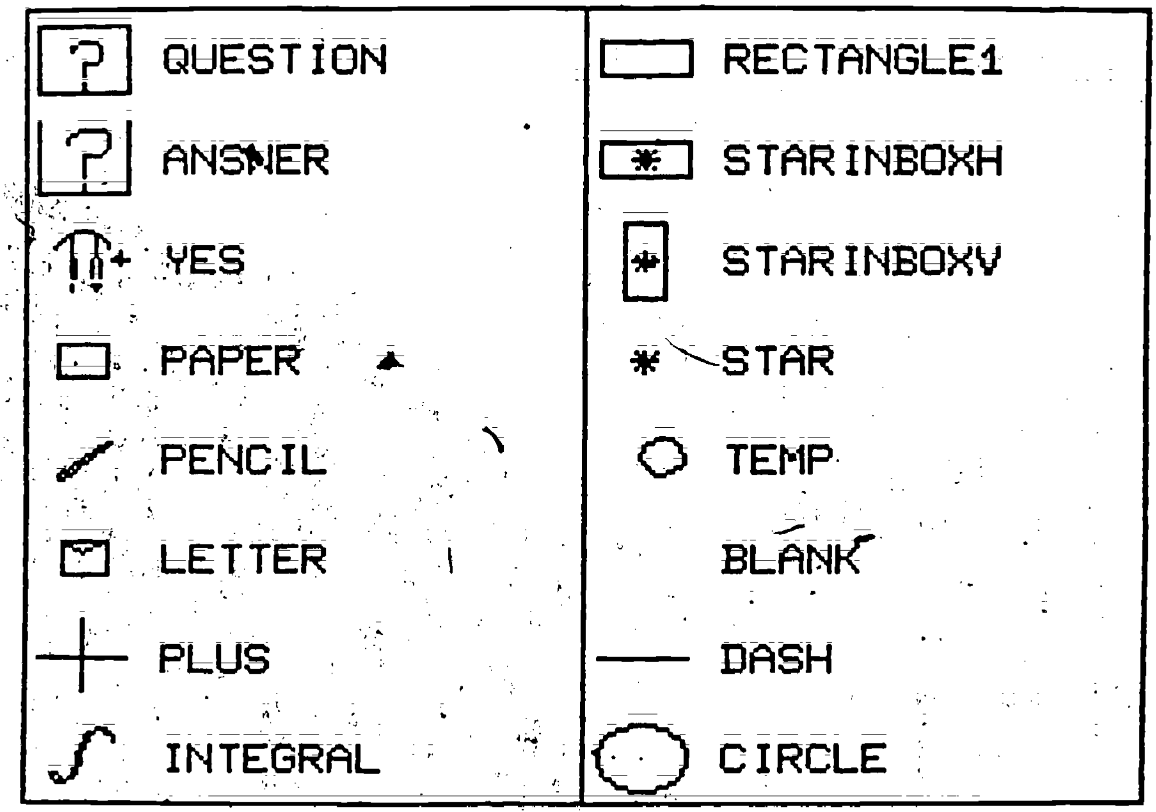

Figure 2: Symbols stored

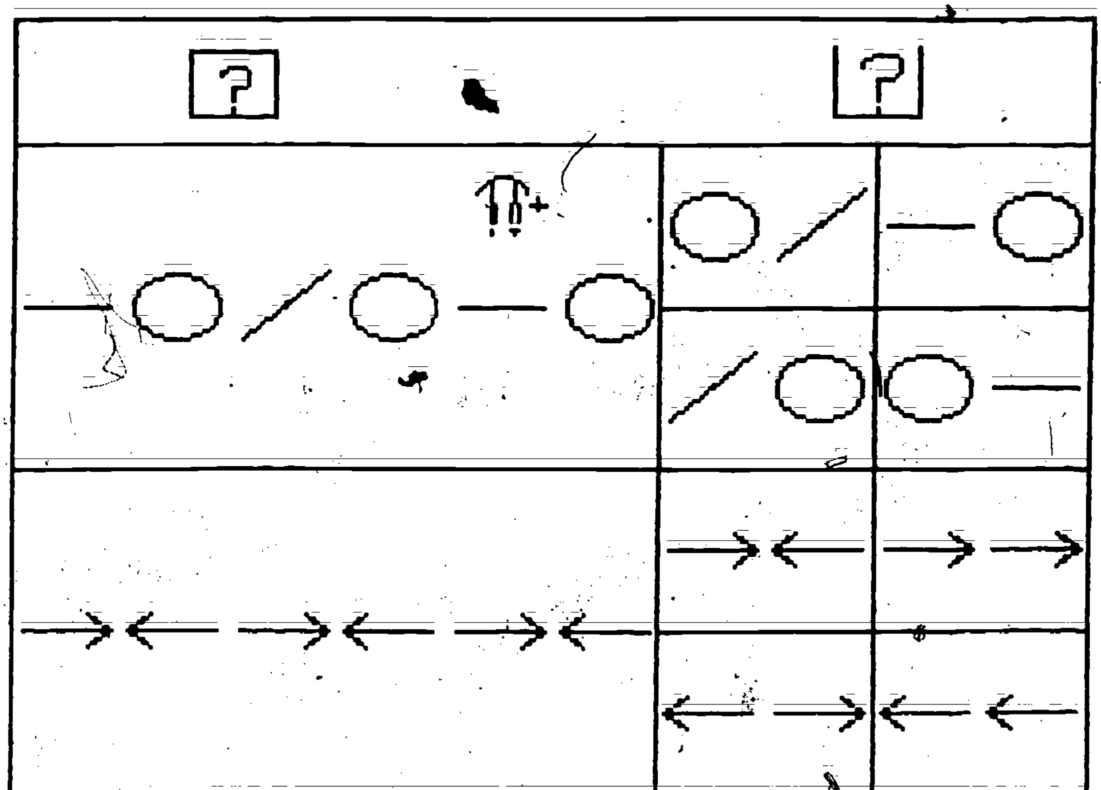

Figure 3: Pattern recognition task

PART III - USING THE MICROCOMPUTER AS A CREATIVE TOOL

This is the final part in a series of three articles having to do with exploring creativity through computer graphics with hearing-impaired children. The body of this article consists of a discussion of an Applesoft (TM) BASIC program that will allow an individual using an Apple (TM) microcomputer to create visual imagery. The software presented illustrates how computer graphics might become a medium allowing individual expression. It is based on a research instrument originally designed for use with hearing impaired subjects. Children aged 8 to 15 produced imagery with similar software, which in turn provided a means to study visual creativity.

In the original research project the software was written in FORTRAN on a DED PDP 11/44 minicomputer. (Kolomyjec, Rose, & Waldron, 1982). (See Part 1.) Time-sharing was used to support the graphics terminal, and there were many advantages for conducting the experiment in this manner, including high information exchange rate, simultaneous availability of a large number of terminals, mass storage, and hard-copy. Moreover, experimental conditions could be easily maintained. However, there are also disadvantages to a large-system approach; namely, access to the hardware is usually restricted, subjects have to be transported to the facility, and the software is not transportable, i.e., it cannot be used on other systems. Because the experience was positive for both the subjects and the researchers, the next logical step seemed to adapt the software to the microcomputer. On small, user-oriented machines more individuals can use this instrument for both research and nonresearch activities. The software has enormous recreational value as well as the potential to allow individual expression. A brief discussion of the program follows.

HARDWARE REQUIREMENTS

A standard Apple II Plus (TM) with 48K RAM or Apple IIe is required. The program generates monochromatic images and therefore does not require a color monitor. A joystick with two buttons or both game paddles is necessary.

OPERATION

Upon running the program, a text menu is displayed. The following function options are provided:

0 = ERASE SCREEN
1 = LINE (END POINTS)
2 = LINE (CONTINUOUS)
3 = RECTANGLES (OPPOSITE CORNERS)
4 = CIRCLE (CENTER RADIUS)
5 = ARC (THRU THREE POINTS)
6 = SPLINE (UP TO 15 POINTS)
7 = EXIT

Directions for use. The user selects an option via the keyboard. Only option 0 erases the screen. Entering a drawing mode, numbers 1 to 6, will not clear the screen. Option 7 will exit the program.

In each drawing mode (options 1 to 6), depressing the paddle button 0 will perform the function; depressing paddle button 1 will return to the menu. Spline is an exception. In the spline mode (option 6) pushing button 0 will define the curve; pushing button 1 will draw it. This mode is not exited until button 1 is pushed again, after the curve is complete. That's all there is to it!

PROGRAM DESCRIPTION

Main program. The main program, lines 100 to 999, typifies good graphics style. Line 120 keeps the program above the graphics portion of memory (Poole et. al., 1981). In line 125 a statement function is defined; it effectively adjusts the screen origin and corrects the aspect ratio. Line 130 transfers control to a subroutine that performs initialization of the program variables, as well as the clipping and joystick routines. Line 140 causes the text menu to be displayed.

After the user selects a function, line 150, it is checked for correctness. At line 170 control is transfered via a multiple-branch statement to the selected function's subroutine. Branching to each function entails (1) switching into the graphics mode without erasure; (2) executing the proper code to perform the function; and (3) on return, redisplaying the menu. The program again awaits user input. The exceptions to this process are erase and exit.

Subroutines

PLOTSUBC, lines 1000 to 1210. This contains the code for a plotting subroutine with clipping. This subroutine is used by the circle, arc, and spline functions because they have the potential to lie in part outside the screen boundaries. The clipping algorithm significantly reduces the plotting speed of the microcomputer due to the extensive number calculations that it is required to perform.

DON'T ERASE, lines 1250 to 1260. A series of "soft switches" are POKE'd to reenter the graphics mode without clearing the present contents of screen memory (Poole et. al., 1981).

ARC SUB, lines 1700 to 1860. This is a general arc drawing subroutine that requires six parameters: The X and Y coordinates of the center and a radius account for three parameters. A beginning and final angle (in degrees) and a flag to indicate drawing direction clockwise or counterclockwise constitute the remaining parameters. The smoothness of the arc, i.e., the sampling rate, varies with the size of its radius.

LINE1, lines 3000 to 3080. This is the first function option subroutine. The cursor is displayed (line 3010). Locating the cursor and depressing button 0 will continuously define line segment end points. After the first end point is entered, that pixel (discrete screen coordinate) is illuminated. After the other endpoint is selected, the line segment is drawn. This process will continue until button 1 is depressed, returning to the menu.

LINE2, lines 3500 to 3590. This function works in a manner similar to LINE1 with the exception that every time a location is selected with button 0 after the second location, a line segment is connected to the previous endpoint. Thus, a continuous line is produced. Again button 1 exits the routine.

CURSOR RECTANGELS, lines 4000 to 4120. The opposite corners of a rectangle are defined by positioning the cursor and depressing button 0. These locations are momentarily displayed. The computer checks the coordinate data of these locations and calculates the width and height of the desired rectangle, then draws it. This process will continue until button 1 is depressed.

CIRCLE, lines 4500 to 4620. This function mode uses the ARC SUB. To use the arc subroutine, six variables must be defined. Because a complete circle is required, the beginning and final angle and direction are constant. The remaining variables for center and radius can be determined by entering two points using the cursor routine. The first point is the center and the second point is a point on the circle's circumference. If part of the selected circle exceeds any screen boundary, then PLOTSUBC will clip off the overlapping portion.

ARC THRU THREE POINTS, lines 5000 to 5220. Three points are entered using the cursor. The computer will fit an arc through the points in the order in which they were entered. Try not to place the three points along a straight line because this does not make much sense and it might confuse the algorithm. This routine requires the support of two other subroutines: COMPUTE CENTER AND RADIUS AND THETA.

SPLINE, lines 5500 to 5670, and CURVE COORD; FINDER, lines 6500 to 6560. These two subroutines work together to produce a spline curve through a series of points. When this function is selected, the user may locate and enter, using button 0, up to 15 points on the screen. Each point or pixel will be illuminated as selected. Depressing button 1 will tell the computer to fit the spline through these points. Unfortunately the process is slow due to the calculations involved. After the spline curve is drawn, and unless button 1 is depressed, the process is repeated.

IMPROVED CURSORSUB2, lines 7000 to 7090. This subroutine lies at the heart of the interactive capabilities of this program. The cursor, which is a high-resolution "shape," is controlled on the screen by the analog inputs (joystick or paddle controls). The location of the center of the cursor at any time it appears on the screen is contained by the integer variables XY, X%. When either paddle button is depressed this screen location is noted, and also which button was depressed. Thus this information can be used by the various routines. This cursor routine is "improved" because it will not allow data to be read in until the button is released and depressed again. See the Applesoft (TM) reference manual (Apple, 1981) or the Apple II User's Guide (Poole et. al., 1981) to learn more about XDRAW.

INITCURSORSUB, lines 7500 to 7560. This routine is used only once. It is called by the initialization subroutine when the program is first executed. It POKE's the shape (the cross-shaped cursor) into an obsure part of memory ($300-$30F). This shape can then be used by the XDRAW predefined function in the cursor subroutine.

COMPUTE CENTER AND RADIUS, lines 8500 to 8570. This subroutine computes the center and radius of a circle given three points in two dimensional space. It is obviously used by the ARC THRU THREE POINTS subroutine.

THETA, lines 8750 to 8850. This simulates a function that returns the angle (in radians) formed between a point in a plane and the +X axis of the coordinate system.

TEXT MENU, lines 9000 to 9110. The main menu is produced by this subroutine. When it is executed, it clears the text screen and prints the option menu. In other versions of this program, this routine is replaced by a cursor-driven menu where the cursor's position is used to select a function option. This version will not be given.

CLIPPING INITIALIZATION, lines 10000 to 10120. Like INITCURSORSUB, this routine is called only once. An array is filled with the appropriate value that defines the entire display screen to be a "viewport" for the clipping algorithm.

Here is final word about the listing that follows. In order to speed program execution and fit it into a 48K machine, the program had to be compressed. The majority of the REM statements (comments) were removed

```
100  REM  <<<<< MICROCOMPUTER DRAWING >>>>>
101  REM
102  REM  COPYRIGHT 1983 W.J.KOLOMYJEC
103  REM
104  REM  <<<<< TEXT MENU VERSION >>>>>
105  REM
120  LOMEM: 24576
125  DEF  FN Y(Y) = 192 - (Y * 0.881 + 0.5)
130  GOSUB 8000
140  GOSUB 9000
150  PRINT : PRINT "ENTER OPTION : ": GET O$: PRINT O$
155 O% =  VAL (O$)
160  IF O% < 0 OR O% > 7 THEN 140
170  ON O% + 1 GOTO 180,190,200,210,220,230,240,250
180  HGR2 : GOTO 140: REM  ERASE
190  GOSUB 1250: GOSUB 3000: GOTO 140
200  GOSUB 1250: GOSUB 3500: GOTO 140
210  GOSUB 1250: GOSUB 4000: GOTO 140
220  GOSUB 1250: GOSUB 4500: GOTO 140
230  GOSUB 1250: GOSUB 5000: GOTO 140
240  GOSUB 1250: GOSUB 5500: GOTO 140
250  TEXT : HOME : VTAB 10: PRINT "END COMPUTER DRAWING..."
999  END
1000  REM  <<<<< PLOTSUBC >>>>>
1010  IF P = 2 THEN X1 = X:Y1 = Y: RETURN
1020  IF P = 1 THEN 1040
1030  PRINT : PRINT "PEN ERROR, P NOT 1 OR 2": STOP
1040 X2 = X:Y2 = Y
1050  FOR I = 0 TO NW - 2
1060 V1 = (W(I + 1,1) - W(I,1)) * X1 + (W(I,0) - W(I + 1,0)) * Y1 + W(I + 1,0) *
 W(I,1) - W(I,0) * W(I + 1,1)
1070 V2 = (W(I + 1,1) - W(I,1)) * X2 + (W(I,0) - W(I + 1,0)) * Y2 + W(I + 1,0) *
 W(I,1) - W(I,0) * W(I + 1,1)
1075  REM  ADD 0.0001 TO THE DIVISOR TO PREVENT DIVIDE BY ZERO ERRORS
1080 PT = V1 / ((V1 - V2) + 0.0001)
1090  IF V1 > 0 THEN 1140
1100  IF V2 < 0 THEN 1200
1110 X1 = X1 + PT * (X2 - X1)
1120 Y1 = Y1 + PT * (Y2 - Y1)
1130  GOTO 1170
1140  IF V2 > 0 THEN 1170
1150 X2 = X1 + PT * (X2 - X1)
1160 Y2 = Y1 + PT * (Y2 - Y1)
1170  NEXT I
1180 Y1 = 192 - (Y1 * AR + 0.5):Y2 = 192 - (Y2 * AR + 0.5)
1190  HPLOT X1,Y1 TO X2,Y2
1200 X1 = X:Y1 = Y
1210  RETURN
1250  REM  <<<<< DON'T ERASE >>>>>
1260  POKE 49232,0: POKE 49239,0: POKE 49237,0: RETURN
1700  REM  <<<<< ARC SUB >>>>>
1710  IF R <  = 8 THEN NS = 10: GOTO 1760
1720  IF R >  = 9 AND R < 16 THEN NS = 20: GOTO 1760
1730  IF R >  = 17 AND R < 32 THEN NS = 30: GOTO 1760
1740  IF R >  = 33 AND R < 64 THEN NS = 45: GOTO 1760
1750  IF R >  = 65 THEN NS = 90
1760 AL =  ABS (LANG - FANG):N =  INT ((AL / 360) * NS + 0.5)
1770 F = FANG / 57.295779:L = LANG / 57.295779
1780  FOR J = 1 TO N
1790 PCT = (J - 1) / (N - 1 + 0.00001)
1800  IF IDIR% < 0 THEN PCT = 1.0 - PCT
1810 AN = (L - F) * PCT + F
```

```
1820 X = INT (R * COS (AN) + XCT + 0.5):Y = INT (R * SIN (AN) + YCT + 0.5)
1830 IF J < > 1 THEN 1850
1840 P = 2: GOSUB 1000: GOTO 1860
1850 P = 1: GOSUB 1000
1860 NEXT J: RETURN
3000 REM <<<<< LINE1 >>>>>
3010 GOSUB 7000: REM CURSOR
3020 IF F1% = 1 THEN 3080
3030 X1 = X%:Y1 = Y%: HPLOT X1,Y1
3040 GOSUB 7000
3050 IF F1% = 1 THEN 3080
3060 X2 = X%:Y2 = Y%: HPLOT X1,Y1 TO X2,Y2
3070 GOTO 3010
3080 RETURN
3500 REM <<<<< LINE2 >>>>>
3510 GOSUB 7000
3520 IF F1% = 1 THEN 3590
3530 X1 = X%:Y1 = Y%: HPLOT X1,Y1
3550 GOSUB 7000
3560 IF F1% = 1 THEN 3590
3570 X2 = X%:Y2 = Y%: HPLOT X1,Y1 TO X2,Y2
3580 X1 = X2:Y1 = Y2: GOTO 3550
3590 RETURN
4000 REM <<<<< CURSOR RECTANGLES >>>>>
4010 GOSUB 7000
4020 IF F1% = 1 THEN 4120
4030 XR = X%:YR = Y%: HPLOT XR,YR
4040 GOSUB 7000
4050 IF F1% = 1 THEN 4120
4060 XS = X%:YS = Y%: HPLOT XS,YS
4070 IF XS < XR THEN T = XR:XR = XS:XS = T
4080 IF YS < YR THEN T = YR:YR = YS:YS = T
4090 H = ABS (YS - YR):W = ABS (XS - XR)
4100 HPLOT XR,YR TO XR + W,YR TO XR + W,YR + H TO XR,YR + H TO XR,YR
4110 GOTO 4010
4120 RETURN
4500 REM <<<<< CIRCLE >>>>>
4510 FANG = 0:LANG = 360:IDIR% = 1
4520 GOSUB 7000
4530 IF F1% = 1 THEN 4620
4540 X1 = X%:Y1 = YS%: HPLOT X1, FN Y(Y1)
4550 GOSUB 7000
4560 IF F1% = 1 THEN 4620
4570 X2 = X%:Y2 = YS%: HPLOT X2, FN Y(Y2)
4590 HCOLOR= 4: HPLOT X1, FN Y(Y1): HCOLOR= 3
4600 XD = ABS (X2 - X1):YD = ABS (Y2 - Y1):R = SQR (XD * XD + YD * YD)
4610 XCT = X1:YCT = Y1: GOSUB 1700: GOTO 4520
4620 RETURN
5000 REM <<<<< ARC THRU THREE POINTS >>>>>
5010 GOSUB 7000
5020 IF F1% = 1 THEN 5220
5030 X1 = X%:Y1 = YS%: HPLOT X1, FN Y(Y1)
5040 GOSUB 7000
5050 IF F1% = 1 THEN 5220
5060 X2 = X%:Y2 = YS%: HPLOT X2, FN Y(Y2)
5070 GOSUB 7000
5080 IF F1% = 1 THEN 5220
5090 X3 = X%:Y3 = YS%: HPLOT X3, FN Y(Y3)
5100 GOSUB 8500: REM CALC XO,YO,R
5110 XCT = XO:YCT = YO:XX = X1 - XCT:YY = Y1 - YCT: GOSUB 8750:FANG = THETA * 57
.295779
5120 XX = X2 - XCT:YY = Y2 - YCT: GOSUB 8750:MANG = THETA * 57.295779
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5130 XX = X3 - XCT:YY = Y3 - YCT: GOSUB 8750:LANG = THETA * 57.295779
5140  IF FANG < MANG AND MANG < LANG THEN IDIR% = 1: GOTO 5200
5150  IF FANG < LANG AND LANG < MANG THEN IDIR% =  - 1:TEMP = LANG:LANG = FANG +
 360:FANG = TEMP: GOTO 5200
5160  IF MANG < FANG AND FANG < LANG THEN IDIR% =  - 1:TEMP = LANG:LANG = FANG +
 360:MANG = MANG + 360:FANG = TEMP: GOTO 5200
5170  IF MANG < LANG AND LANG < FANG THEN IDIR% = 1:MANG = MANG + 360:LANG = LAN
G + 360: GOTO 5200
5180  IF LANG < FANG AND FANG < MANG THEN IDIR% = 1:LANG = LANG + 360: GOTO 5200
5190 IDIR% =  - 1:TEMP = LANG:LANG = FANG:FANG = TEMP
5200  GOSUB 1700
5210  GOTO 5010
5220  RETURN
5500  REM  <<<<< SPLINE >>>>>
5510 K = 1
5520  GOSUB 7000
5530  IF F1% = 1 THEN 5590
5540  HPLOT X%, FN Y(YS%)
5550 C(K,1) = X%:C(K,2) = YS%
5560 K = K + 1
5570  IF K > NP% THEN K = NP%: REM  LIMIT CHECK
5580  GOTO 5520
5590 KNT = K - 1:NS = IRS * KNT:P = 2
5600  FOR J = 1 TO NS
5610 T = (J - 1) / (NS - 1) * (KNT - 1) + 1
5620  GOSUB 6500
5630  IF J <  > 1 THEN P = 1
5640  GOSUB 1000
5650  NEXT J
5660  GOSUB 7000: IF F1% = 1 THEN  RETURN
5670 K = 1: GOTO 5540
6500  REM  <<<<< CURVE COORD FINDER >>>>>
6510 X = 0:Y = 0:D = 0:S =  - 1
6520  FOR I = 1 TO KNT
6530 F =  EXP (T - I + 0.001):F = 2 / (F - 1 / F)
6540 X = X + S * C(I,1) * F:Y = Y + S * C(I,2) * F
6550 D = D + S * F:S =  - S
6560  NEXT I:X = X / D:Y = Y / D: RETURN
7000  REM  <<<<< IMPROVED CURSOR2SUB >>>>>
7005  IF  PEEK (P0) < 127 AND  PEEK (P1) < 127 THEN FF% = 0: GOTO 7010
7006 FF% = 1
7010 XP =  PDL (0) / 255:YP =  PDL (1) / 255:X% = 279 * XP:Y% = 191 * YP: XDRAW
 1 AT X%,Y%
7020 PX% = X%:PY% = Y%
7030 XP =  PDL (0) / 255:YP =  PDL (1) / 255:X% = 279 * XP:Y% = 191 * YP
7040  XDRAW 1 AT PX%,PY%: XDRAW 1 AT X%,Y%
7050  IF  PEEK (P0) > 127 THEN F1% = 0: GOTO 7070
7060  IF  PEEK (P1) > 127 THEN F1% = 1: GOTO 7070
7065 FF% = 0: GOTO 7020
7070  IF FF% = 1 THEN 7020
7075 FF% = 1
7080  XDRAW 1 AT X%,Y%
7090 YS% = 217 * (1 - YP): RETURN
7500  REM  <<<<< INITCURSORSUB >>>>>
7510  ROT= 0: SCALE= 2:LOOP = 6
7520  DATA  1,0,4,0,36,76,145,58
7530  DATA  63,63,23,82,9,36,4,0
7540  FOR J = 768 TO 783: READ D: POKE J,D: NEXT J
7550  POKE 232,0: POKE 233,3
7560  RETURN
8000  REM  <<<<< INIT PROGRAM VARIABLES >>>>>
```

```
8010  HGR : HGR2 : HCOLOR= 3
8020 DL = 50:P0 = 49249:P1 = 49250:F1% = 0
8030  GOSUB 7500: REM  INIT CURSOR
8040  GOSUB 10000: REM  CLIPPING INIT
8050 IRS = 5:NP% = 15: DIM C(NP%,2)
8060  RETURN
8500  REM  <<<<< COMPUTE CENTER & RADIUS >>>>>
8510 T1 = (Y2 - Y1) / (X2 - X1 + 0.00001):T2 = (Y3 - Y1) / (X3 - X1 + 0.00001)
8520 T3 = ((X2 - X1) * (X2 + X1)) + ((Y2 - Y1) * (Y2 + Y1))
8530 T4 = T3 / (2 * (X2 - X1) + 0.00001)
8540 T5 = ((X3 - X1) * (X3 + X1)) + ((Y3 - Y1) * (Y3 + Y1))
8550 T6 = T5 / (2 * (X3 - X1) + 0.00001)
8560 YO = (T6 - T4) / (T2 - T1):XO = T6 - (T2 * YO)
8570 R =  SQR ((X3 - XO) ^ 2 + (Y3 - YO) ^ 2): RETURN
8750  REM  <<<<< THETA FUNCTION >>>>>
8760 PI = 4 *  ATN (1.):UNDF = 0
8770  IF XX < 0 THEN THETA = PI +  ATN (YY / XX): RETURN
8780  IF XX = 0 THEN 8800
8790  GOTO 8830
8800  IF YY < 0 THEN THETA = PI * 1.5: RETURN
8810  IF YY = 0 THEN THETA = UNDF: RETURN
8820 THETA = PI / 2: RETURN
8830  IF YY < 0 THEN THETA = 2 * PI +  ATN (YY / XX)
8840  IF YY = 0 THEN THETA = 0: RETURN
8850 THETA =  ATN (YY / XX): RETURN
9000  REM  <<<<< TEXT MENU >>>>>
9010  HOME : TEXT : VTAB 5
9020  PRINT "FUNCTION OPTIONS:"
9030  PRINT : PRINT "   0=ERASE SCREEN"
9040  PRINT "   1=LINE (END POINTS)
9050  PRINT "   2=LINE (CONTINUOUS)"
9060  PRINT "   3=RECTANGLE (OPPOSITE CORNERS)"
9070  PRINT "   4=CIRCLE (CENTER & RADIUS)"
9080  PRINT "   5=ARC (THRU THREE POINTS)"
9090  PRINT "   6=SPLINE (UP TO 15 POINTS)"
9100  PRINT "   7=EXIT"
9110  RETURN
10000  REM  <<<<< CLIPPING INITIALIZATION >>>>>
10010 AR = 0.881: REM  ASPECT RATIO
10020 NW = 5: REM  NUMBER OF CONNECTED POINTS IN WINDOW
10030  DIM W(NW - 1,1)
10040  REM  RECTANGULAR WINDOW
10050 XL = 0:XR = 279
10060 YB = 0:YT = 212
10065  REM  EFFICIENT ARRAY USAGE
10070 W(0,0) = XL:W(0,1) = YB
10080 W(1,0) = XL:W(1,1) = YT
10090 W(2,0) = XR:W(2,1) = YT
10100 W(3,0) = XR:W(3,1) = YB
10110 W(4,0) = XL:W(4,1) = YB
10120  RETURN
22222  REM  <<<<< END OF MICROCOMPUTER DRAWING >>>>>

]
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and the technique of using the delimiter (:) such that multiple statements could be placed on one line was employed (Apple, 1981). Although these techniques expedite execution and save space, they also make the listing hard to read. For this, please accept an apology. Lastly, execution time can be significantly improved by compiling this program using any of several commercially available compilers. However, these are often expensive to purchase and not easy to use.

CONCLUSION

Software is what gives intelligence to a computer, enabling it to function as an instrument or tool. The program discussed will transform the Apple (TM) into an image-generating tool, which can be used in a variety of educational applications. It is particularly useful for handicapped individuals in that it requires (in this version) only touching a number key, moving a joystick, and depressing paddle buttons. As suggested, keyboard input can be eliminated by replacing the text menu with a graphics menu. Thus only a joystick and two buttons would be required. In our research we have demonstrated the utility of this instrument. By publishing this software, we make this tool available to any interested person willing to take the time to enter it into their own Apple (TM).

ED#233517

REFERENCES

Kolomyjec, W. J. Rose, S., and Waldron, M. B. Creativity through computer graphics with hearing impaired children. Final Report for Spencer Foundation Young Scholars Grant, Department of Educational Research. Columbus: The Ohio State University, 1982.

Poole, L., et. al. Apple II user's guide. Berkeley: Osborne/McGraw Hill, 1981; p. 204.

Apple Computer Company. Applesoft: Basic programming reference manual. (Product No. A210006). Cupertino, California 1981; p. 98.

Apple Computer Company. Applesoft: Basic programming reference manual. (Product No. A210006). Cupertino, California: 1981, p. 118-120.

Luehrman, A., & Peckham, H. Apple Pascal: A hands on approach. New York: McGraw-Hill, 1981.

Pappert, S. Mindstorms New York: Basic Books, Inc., 1980.

Shouksmith, G. Intelligence, creativity and cognitive style. New York: John Wiley & Sons, 1970.

Waldron, M., & Rose, S. Visual thinking for severe language handicapped children through the use of computer graphics. Journal of computer-based instruction, May 1983, (special issue), p. 206-210.

Wickelgren, W. How to solve problems. San Francisco: W.H. Freeman Co., 1974.

USING AUDIBLE MICROCOMPUTER SOFTWARE IN SPECIAL EDUCATION

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INTRODUCTION

Audible programs offer special advantages to handicapped learners. In the past, most computer programs required that a user be able to read, or at the least match, symbols. Talking programs, which incorporate colorful graphics and animations, in contrast, can be used with handicapped infants for cognitive, language, and motor development. An infant able to activate a switch can interact with computer software designed to train cause and effect.

Since 1980 we have been working on courseware for language development. These programs are intended for nonreaders and do not use text. They use speech, graphics, and animation to teach vocabulary and syntax. By combining text with speech and graphics, early reading programs can be developed. Disabled readers benefit from having a reading aloud component added to text programs.

Another application for audible software is with augmentative communication systems. Although microcomputer-based systems lack the portability of dedicated devices, they are more flexible. With a speech utility program that we developed, some of our nonvocal users are building the content of their communication systems. The lexicon and phrases developed this way can be included in a software program that is designed to improve access time.

AUDIBLE MICROCOMPUTER SOFTWARE

FIRST WORDS is a tutorial program that trains receptive vocabulary. Normally developing children begin understanding words at about nine months of age. The fifty nouns included in FIRST WORDS are among the earliest to be understood. By the time most children are two-years-old, they will comprehend all of them. Thus we designed this audible courseware for use by young and handicapped children.

Although FIRST WORDS provides an initial step in vocabulary instruction, it is not just a vocabulary training program. Two exemplars for each noun aid in generalizing noun groups. Instructional levels with cuing can be used to encourage eye tracking. The game can be used to train the causality relationship between a button press and a consequent event. FIRST WORDS can be used to train these behaviors even before a child has reached the cognitive level for vocabulary comprehension. Contextually appropriate speech is included on all six instructional levels.

For the child whose language and cognitive level is above two years, FIRST WORDS can be used as an instructional tool to help in learning categories. If the child already knows all the exemplars but has yet to learn the category names, you can have the child go through level 6, which is the test. Following completion of the set, you can ask into what category the words fall. This can be presented as either a multiple choice or a free recall task.

Educational programs should come with detailed documentation that not only describes how to use the program but also why. Courseware documentation should contain a rationale for the program's use in educational settings. An extensive reference list is included in the FIRST WORDS manual. We also give careful attention to such important, yet frequently neglected, elements such as picture sequence and position randomization. Parameters such as criterion and length of time the program waits before moving on to the next stimulus picture can be set by the user.

A wide variety of children can benefit from using FIRST WORDS. It can be used in individualized educational programs for mentally retarded children ranging from mildly to severely and profoundly retarded. Young language impaired and cerebral palsied children will enjoy interactive learning of items. FIRST WORDS provides a unique way to address the severe linguistic deficits of the autistic child. You can also use it with young nonnative speakers of English as an English as a second language program.

SPEAK UP is a program that allows you to build your own audible dictionaries and phrases. In addition to being used as a utility for facilitating the production of audible augmentative communication systems and courseware, it can be used alone as an instructional tool. By building words themselves using the word processor, users learn the relationship between grapheme and phoneme representation. Children can use the phrase processor with an already existing word file to build sentences that they can then print out. These are just two examples of how SPEAK UP can be used. There are two sample programs on the diskette. One is a simple functional phrase augmentative communication system, and the other is an instructional program.

The sample instructional program on the SPEAK UP diskette is an audible categories tutorial program that uses text. There are two versions. In one the child indicates the category in which the stimulus noun belongs. In the second version the child finds the noun that belongs in the category presented. The sample augmentative communication program provided has forty phrases that can be accessed with a single switch. All phrases are both spoken and presented in text form on the screen. The user chooses a phrase from a list of words on the screen. Instructions are provided for developing your own audible courseware and augmentative communication systems. The sample program can be easily individualized with forty new phrases represented by forty new words on the screen.

FIRST CATEGORIES is an enhanced and expanded version of the sample instructional program on the SPEAK UP diskette. Including categories is frequently difficult for the language-learning disabled person. FIRST CATEGORIES uses speech, graphics, and text to train the following noun categories: animials, body parts, clothing, food, utensils, and vehicles. The price for this program is $120.

We are in the process of completing a microcomputer language assessment and development system called Micro-LADS. It will be a six-diskette package covering the following constructions:

1. Noun plurals and noun-verb agreement
2. Verb forms
3. Prepositions
4. Pronouns
5. Negatives
6. Wh-Questions, passive, and deictic expressions

This program uses speech, graphics, and animation.

We also offer the ECHO II speech synthesizer for $100 with the purchase of software. This peripheral lists at $149.95. The ECHO II comes with a text-to-speech software program that enables you to use it creatively in educational settings as well as for straight text screen reading. SPEAK UP, the ECHO II speech synthesizer, and its accompanying software provide an excellent package for implementing a wide variety of speech output applications.

ON MICROCOMPUTERS, INSTRUCTION, AND THE SEVERELY DEVELOPMENTALLY DISABLED

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INTRODUCTION

In this presentation we will be sharing some perceived needs, a bit of fantasy, and a challenge, same data and some problems. We are employed at a state residential facility for mentally retarded persons in West Virginia. As is the case in many such facilities, the population has been declining over the past few years and the proportion of clients who are classified as severly or profoundly retarded has grown. At our facility of 410 residents, slightly more than 96 percent are classified in these categories. The majority of the clients also have other significant handicaps including major motor impairments, hearing impairments, and seizures. According to P.L. 94-142, all school-aged individuals, regardless of their handicaps, are required to receive individualized educational services. Additionally, in a facility such as ours, there are requirements of provision of active treatment by ICF-MR certification standards, departmental policies, and various professional ethical standards regarding provision of educational and other services. Translating statutory requirements and theoretical statements about provision of services to severely, multihandicapped persons into actual, effective services is no small or simple task. As persons charged with the responsibility of converting rhetoric to reality, we are continually on the alert for new means of instruction.

Several years ago we conceived the possibility of using microcomputers as adjuncts to our existing, more traditional instructional procedures. The speed, programmable versatility, and small size of the machines suggested several possibilities. Clearly a microcomputer could be used for administrative purposes such as tracking student progress, generating individual education plans (IEPs) and reports, monitoring compliance with all the P.L. 94-142 requirements, and scheduling services. While development of software for these purposes is clearly valuable and has been done to varying degrees, our interests lay more in applying microcomputer technology in the instructional and stimulation processes. Although considerable work has been done in this area, our analysis reveals that the instructional activities reported generally require cognitive skills that are far more advanced than those to be taught our population of students. This also seems true for the available commercially produced instructional software.

CHARACTERISTICS OF NONAMBULATORY, PROFOUNDLY MENTALLY RETARDED

Who are these students who have such special needs? They are the most severely mentally retarded students, many with multiple handicaps. The portion of our resident population most in need of extra attention were those described by Landesman-Dwyer and Sackett (1978) as nonambulatory, profoudly mentally retarded (NPMR) persons. Table 1 is adapted from their paper and provides criteria for identifying NPMR persons. Students classified as NPMR have virtually no self-help skills or language, are minimally socially responsive, and learn exceedingly simple skills very slowly. A series of studies by Rice and colleagues during the 1960s, e.g., Rice and McDaniel (1966), revealed that students such as these learned even such simple behaviors as arm or head movements or a ring pull in an operant conditioning procedure with great difficulty. Determining reinforcers was extremely difficult and once a behavior increased in frequency, it often unaccountably and precipitously dropped in rate, a phenomenon that they called spontaneous extinction. Often the most evident overt behaviors of NPMR students are stereotyped movements such as headrolling, rocking, and repetitive hand, arm, and leg waving.

TABLE 1

Characteristics of Nonambulatory Profoundly Mentally Retarded Persons

Physical size. Very small head and body; typically weight, length, and head circumference below third percetile for chronological age.

Medical status. Frequently ill with complications requiring extensive medical and nursing attention. Records from the first three years of life indicate little hope for subsequent development or extended survival.

Head control. Little to no voluntary control.

Sitting ability. Virtually unable to achieve or stay in a seated position.

Mobility. Even with prothestic devices and extensive training, little movement other than by twisting or turning movements of the body.

General responsiveness. Clear responses to external stimulation being extremely limited at best. Totally dependent on others.

Intellectual functioning. Untestable or profoundly mentally retarded on standardized assessments.

Adapted from Landesman-Dwyer and Sackett, 1978.

IMPACT ON LEARNING

It would be well to review briefly the impact that these handicaps may present to learning situations. It is likely that the handicaps effect both frequency and complexity of behavior. It is also generally agreed that the handicaps may effect the environmental response to behaviors produced by these students. The less overt behavior a person emits, the fewer enviromental feedbacks and interaction received. This situation results in a gradual extinction of whatever skills may have existed. This analysis is consistent with the work of Bijou (1966) and Lindsley (1965). Motor handicaps may make emission of some behaviors a strenuous undertaking, resulting in low emission rates. In like manner, inappropriate behaviors with a high rate may encourage a strong environmental response that inadvertently serves to maintain those behaviors, (e.g., well-intended attention to stereotypical behaviors like head banging or crying may actually maintain those behaviors). Inappropriate behaviors such as these may be physically incompatible with more adaptive behaviors, such as manipulating leisure objects and assisting in self-care routines. Students with sensory handicaps, such as blindness, have no way of observing and modeling appropriate behavior in others. Finally, a handicap may prevent a behavior from occuring altogether; e.g., spastic quadriplegia may prevent several motor actions integral to ambulation, self-feeding, and dressing. Inability to perform certain reflexive behaviors will clearly affect the performance of more complex behaviors.

According to Piaget the inability of a person to behave in certain ways may seriously limit sensory-motor learning activities. It is generally believed by developmentalists that behaviors learned at each sensory-motor stage are necessary for the development of later stages.

TARGETING BEHAVIORS FOR INSTRUCTION

Given the severely limited skills and motor abilities of NPMR students, behaviors targeted for instruction are kept simple. To be more concrete, what would one select to teach a teenaged student with a mental age of six months or less, no expressive language skills, minimal responsiveness to conversations, limited range of motion of all extremities, no mobility skills, no self-help skills, poor head and trunk control, and whose most frequent overt motor behavior was head rolling? Probably we would begin with visual tracking, responding to being spoken to, and object manipulation. Tracking and social responsiveness skills are requisites to many basic social skills and potentiate enhanced quality and frequency of interaction with others. Development of even simple object manipulation behaviors promote fine and gross motor development, teaches the student to control the environment (as in Piaget's circular reactions stage), prevents loss of muscle function and responsiveness due to inactivity, and, as suggested by Zuromski (1978), prevents development of learned helplessness. Clearly, commercially available educational software for microcomputers and most of the educational applications of microcomputers, even in special education settings, to date provide little help for dealing with non-ambulatory, profoundly mentally retarded students.

MICROCOMPUTER APPLICATIONS IN NPMR INSTRUCTION

Being impressed with the potential of microcomputer technology for education, and having a substantial number of NPMR students in residence at our facility, we found the possibility of adapting microcomputer technology to the needs and characteristics of nonambulatory, profoundly mentally retarded persons a great challenge. What did we hope to accomplish in the process? At one level our intentions were simple. Primarily we wanted to increase the rate of occurrence of simple motor behaviors of severely handicapped students. Also we wanted to assist staff with these students and increase the precision of instruction.

Typically, work with these students involves an intensive program of one-to-one teacher-student ratio for instruction. For this instruction to be effective, the teacher must be patient (because responses often occur at quite low rates), be exceedingly consistent, and reinforce target responses instantaneously. Even minute delay greatly diminishes reinforcement effectiveness and, hence, rate of response acquisition. Obviously, performing in the indicated manner can be a demanding, taxing, and repetitive task. Our notion was that a microcomputer should readily provide precise contingency control, record response data, and deliver immediate reinforcement simultaneously for multiple students for some types of behaviors. If such repetitive yet relatively simple tasks could be handled, perhaps even with increased precision, by the computer, the teacher would be freed to work with other students on skills best taught through direct social interaction.

System Specifications

At this point let us consider the system that we have used in an attempt to address these tasks. In most situations we used an Apple II Plus computer (Dos 3.3) with 48K of RAM, two drives for 5 1/4-inch minifloppy disks, a video monitor, and a Centronics 779 dot matrix printer. Purchase of this equipment was made possible by a Title IV-C grant from the West Virginia Department of Education. The programs used in the work discussed here were written in BASIC. In deciding to purchase an Apple system, the availability of an extensive amount of well-documented software and a substantial number of service outlets were important to us. Probably all we have done with the Apple could be done with other seemingly less expensive systems, but note should be made that much of the ostensive cost savings would be substantially offset by the need to purchase expansion interfaces in order to handle necessary peripherals such as dual disk drives, printers, etc. which would also have to be acquired.

Modifications for NPMR Students

Because the students were unable to respond via the typical keyboard arrangement due to their motoric limitations, it was necessary to devise alternative response modes. At the same time it was necessary to devise feedback from the computer that would be perceived and would be positively reinforcing. On the equipment that we are using, all external switch outputs are connected through the game port of the computer. Inasmuch as the same response and hence manipulandum or responsive transducer would not be useable for all students, allowance had to be made for easily and safely changing the manipulanda which were connected into the system. After a few false starts we have settled on an arrangement involving plug connectors for the input from the switches of each student-operated manipulandum. This then goes to an interface that debounces the switch input (preventing a single response from being mistakenly read by the computer as multiple responses) and serves as an input buffer (storing the response input until the computer acknowledges it).[1]

Feedback to students. Another part of the system that required some development effort was the output of the computer to the students. Clearly, textual feedback on a video monitor was meaningless. Color graphics and audio output seemed promising for some students; however, previous experience suggested that a greater variety of stimuli would be required. We decided to have the computer control a variety of devices including a cassette recorder, a hair dryer, a light display, and a pom-pom affixed to a flexible rod that could be "flipped" by a solenoid (causing the pom-pom to shake). After a number of preliminary attempts, we developed an output interface in which a computer output pulse operated a relay by which a direct connection of the computer and stimulation device was prevented by opto-isolation (removing the possibility of inordinately large voltages feeding back into the computer). The various devices were connected to this interface by standard plug connectors. [In some cases, e.g., an air blower or a battery-operated toy, some relativly minor alterations in the standard control circuits had to be made to allow remote operations; see Higgins (1982) for a simple description of ways to do this adaption.]

System portability. The final product of the efforts to deal with the complications has been a portable system. In order to facilitate use of the equipment in different instructional spaces, the system has come to rest on a rolling lockable storage unit of the sort typically used for audiovisual equipment. Painted masonite panels have been attached to the sides of the unit by metal brackets. On these panels are sockets for the necessary connectors and accommodations, e.g., brackets, clamps, for affixing the devices used to present stimuli to the students. On the back of these panels are the interfaces and other circuitry as mentioned.

DESCRIPTION OF COMPUTER-BASED INTERVENTION

Description of Students--Sample Selection

Some summary information on students who participated in the project is presented in Table 2. The table shows two groups of students. Group 1 consists of seven persons and Group 2 consists of four persons. The two groups differ by slightly more than 3 years in chronological age. Column 6 shows that the mental age of the two groups differ quite dramatically with mean mental age for Group 1 being 4 months as opposed to 15 months for Group 2. However, with this population of students mental age is a may not be particularly useful predictor of motor activity production or rate of response acquisition. Instead, mental age needs to be considered in light of the total handicapping conditions, e.g., in Group 1 the highest mental age person may be the most physically disabled.

Before any formal development of manipulanda was undertaken, students who could participate were screened. From this population the 11 students were selected. Observations indicated that each student could move at least one arm. In most cases both arms could be voluntarily moved, though with a substantially limited range of motion. Only two students could voluntarily move their legs, and such motions were extremely limited as they lacked sufficient trunk control to produce compensatory movements. All clients except one could move their heads in all directions. All observations were corroborated by consultations with a registered physical therapist. From this population then, the following response pool was available: Group 1--reaching, pulling, grasping, head rotation, biting, scratching or rubbing and nodding; in a few cases, leaning was also available; and Group 2--reaching, pulling, pushing, grasping, head rotation, head nodding, biting, scratching or rubbing, leaning, and squeezing.

Originally, it was anticipated that by dealing with the most severely mentally retarded students (Group 1), the limits and ultimate capabilities of microcomputers in instruction of NPMR could be readily and clearly determined. Indeed, this test appears not to have provided us with sufficient information to make a conclusive statement. The characteristics of the groups that are shown in Table 2 do not tell the entire story. With the exception of three persons, most members of Group 1 regularly produced behaviors that we felt could be increased in terms of frequency and complexity. Group 2 was selected as an alternative demonstration. Members of this group differed from Group 1 in mental age, but they had many similar physical handicaps. Actual initiation of activities was not begun simultaneously with all students. In our eagerness to commence, we began exploratory efforts with these students, while capabilities to handle multiple students simultaneously, to vary response inputs, and to change stimulus outputs were being developed. Gradually, all Group 1 students were added and served in the afternoon. This, in turn, was followed by initiation of computer-managed activities to Group 2 during mornings.

TABLE 2

Table of Client Characteristics

Client	Age	Sex	Sensory Handicap	Motor Handicap	Seizure	Mental Age	Functional Level
Macel	15 yrs.	F		Spastic quadriplegia contractures of wrist		3 mos.	Profound
Alice	15 yrs.	F	Blind	Limited leg use		5 mos.	Profound
Sue	14 yrs.	F		Spastic quadriplegia hemiparesis	Grand mal	3 mos.	Profound
Ron	13 yrs.	M		Spastic diplegia		5 mos.	Profound
Faye	17 yrs.	F		Spastic paraplegia	Petite mal	4 mos.	Profound
Al	22 yrs.	M	Hearing Deficit	Spastic quadriplegia		5 mos.	Profound
Lyn	24 yrs.	F		Spastic quadriplegia		4 mos.	Profound
Fred	22 yrs.	M		Spastic quadriplegia		17 mos.	Profound
Ray	21 yrs.	M	Strabismus	Hip dislocation		23 mos.	Profound
Herb	19 yrs.	M		Spastic paraplegia, hip dislocation	General motor	17 mos.	Profound
Eloise	21 yrs.	F		Paraplegia		4 mos.	Profound

Selecting Student Responses

The selection of responses for utilization was finally limited to those behaviors that we felt were possible given the student's handicaps, were within current sensory-motor development level, were not reflexive in nature; and had eventual functional utility. In several cases, especially among members of Group 1, students seemed physically capable of reaching for, grasping, and retrieving objects, e.g., toys, but they did not. Indeed, they failed to do so even when such objects were placed in close proximity. With the goals of improving sensory-motor operations, encouraging exploration behaviors, and possibily developing some rudimentory forms of play, it was decided that the target behaviors should encourage reaching, grasping, manipulating and perhaps retrieving. For Group 1, such a combination initially seemed best produced in the form of a pulling response.

Members of Group 2, however, showed a fair capacity for retrieval of toys as well as exploration behaviors but not, as a rule, prolonged involvement with objects. Thus, while most members of this group reached out and retrieved play objects and at least minimally manipulated objects, play itself was a low-rate response. In fact, all group members revealed only limited exploration, retrieval, and play. Thus, for members of Group 2 it was decided that a simple pull response, already available at considerable rates in some of their repertoires, might not be an optimal choice. Rather, it was determined that behaviors of this group should demonstrate more complexity. Arm movements should be accompanied by hand movements, e.g., reaching, grasping, holding, and moving needed to be part of the behavioral complex up to the limits of each group member's ability.

Manipulanda. For members of Group 1 the manipulandum initially consisted of a light weight pull string. More specifically, a piece of fishing line was attached to the microswitch at one end and to a plastic cuff at the other. The student completed a pull response by simply flexing an arm or could grab the string with either hand and pull on it. This manipulandum was used initially for all members of Group 1. For members of Group 2, three different manipulanda were used: rotating cylinder, an omnidirectional joystick, and a joystick connected to an adjustable goose neck stand. The rotating cylinder (actually a modified rolling pin) was used to encourage hand as well as arm movements, although, as designed, the rolling pin could be moved by simply dragging one's hand across the barrel. The rolling pin was anchored to a stand, and screws were placed in one end of it in such a manner as to depress a microswitch when the pin was turned. To prevent direct manipulation of the microswitch by the student, plastic covers were placed over the end of the cylinder and the microswitch. This manipulandum was then clamped to a tray that could be placed within arms' reach of the students. Eventually this manipulandum was used with three of the Group 1 students who had low rates of the string-pull response.

The joystick and gooseneck mounted joystick mounted on a gooseneck were purchased from the Prentke-Romich Company of Shreve, Ohio. Like most omnidirectional joysticks, microswitches could be activated by pushing, pulling, or otherwise moving the stick out of the center position. Each stick was spring-action controlled to return to the center of the manipulandum when released. Additionally the flexible shaft of the joystick mounted on the gooseneck could be twisted and angled to conform to the particular capability of a student. Each manipulandum was capable of accommodating high response rates and forces, as well as a variety of manipulation forms. Each of these devices were then anchored to trays that could be placed within the reach of each student. We also have a number of other manipulanda that could be used, e.g., wobble switch, air cushion, pneumatic (pillow) switch, and pneumatic switch requiring either sucking or blowing into a tube.

Identifying Training Objectives

Figure 1 shows some samples of generalized IEP objectives that we have found adequate to apply to training with these responses. The particular response criteria, whether a percentage or frequency measure; type of prompts--e.g., verbal, gestural, physical guidance; and type of any other reinforcers--e.g., social, edible; would have to be specified. Obviously, goals such as these would comprise only a portion of a student's objectives. They would have to be integrated into the total plan of educational and related services.

EXAMPLE GOAL STATEMENTS*

Reaching toward object ___% of time with ___ prompts and ___ reinforcers during a 2-week period.

Grasps object producing auditory and visual stimulation ___% of time with ___ prompts during a 2-week period.

Grasps object producing auditory stimulation ___ times per session with ___ prompts during a 2-week period.

Grasps object producing visual stimulation ___% of time with ___ prompts during a 2-week period.

Moves toy or manipulandum ___ times per minute with ___ prompts and ___ reinforcers during a 2-week period.

Uncovers toys or manipulanda ___ times in 5 minutes with ___ prompts and ___ reinforcers during a 2-week period.

* Criteria, type of prompts (e.g., verbal, gestural, manual), and of reinforcers (e.g., social, edible, sensory) are to be provided in the blanks.

FIGURE 1

Selection of Response Consequences

One topic of enormous import to be considered before we began the actual training with the computer was selection of response consequences. Although it may be true that some persons of this population may perform fairly well for food and drink, we decided to take a different approach. Our decision to use other consequences was based on three factors: (1) logistically speaking, our current training location and equipment do not lend themselves to use of edible consequences very well; (2) consumables are indeed consumed, requiring a constant supply; and (3) there often is a significant delay between occurrence of target response and the actual consumption of the reinforcer. For these reasons we elected instead to concentrate on the production of visual, auditory, and other stimulus events as consequences. Initially, we felt that we should capitalize on hearing and visual skills in the response consequences that we provided. Thus, we used shaking a pom-pom and having a series of lights sequence through or "chase themselves around" a circular configuration. For others, we provided music and spoken stories via cassette tapes. Later, we provided activation of the lights and sounds from a space gun (originally battery-operated and softly blowing air from a hair dryer without the heating element) as consequences.

To date, we have found the blowing air and spoken stories the most effective of our consequences. This is not to say that other visual, auditory, or vibratory events will not be effective, but rather, with the persons we have tried to date, they have not been as effective as we had hoped. We will, of course, continue to keep these various consequences in our armamentarium while we explore the effectiveness of others. We have not tried every combination of consequence with all students, nor have we systematically explored varying durations or onset and offset parameters.

Selecting Individual Student Response Consequences. After obtaining our base rate of behaviors, the student is provided with a variety of stimuli. We observed closely for obvious signs of distress--e.g., frowning, crying, withdrawing; for orienting response--e.g., eye opening, cessation of movement, head or eye movement in the direction of the stimulus if spatially localizable; and overt positive affective responses--e.g., smiling and laughing. The event eliciting the least signs of distress and the most orienting and positive affective response is tried first as an ostensive reinforcer. We are attempting to formalize and evaluate this procedure empirically.

To ensure that at least some initial contact is made with the consequences, we have used a priming technique. In this technique, before a training session begins, the instructor operates the apparatus that will present the stimuli used during training as response consequences; e.g., the cassette player is operated, presenting a brief sample of the music or story being used. This priming technique is used daily when student response rates may be low. For some students, priming had to be used only once or twice.

The Instructional Session

During instructional sessions the instructor turns on the system, loads the relevant program disk, then goes through a start-up dialogue (shown at the top of Figure 2). During this dialogue each student involved in the upcoming indicated session is identified; the type of data being collected is indicated as baseline or intervention; the type of reinforcement schedule to be used is noted; and maximum session duration is shown. After this review, the instructor connects and positions the appropriate stimulus-devices. The students are then checked for appropriate positioning in their wheelchairs (as indicated by a physical therapist), and then the manipulanda are placed in front on the students, either clamped to a lap tray or affixed to a modified hospital tray. Once all is in order, the instructor starts the session and remains nearby to monitor the students. We have been providing three 5-minute sessions per day with each student (barring illness or system malfunction). Brief sessions are used to ensure that the instructor continues to interact frequently with the student--i.e., we do not want to "park" a student in front of a machine and then "forget" that student--and to provide opportunity for repositioning any student who may move into an inappropriate position in the wheelchair during a session. At the end of a student's third daily session, data are stored on disk and then output on the monitor as shown in the lower portion of Figure 2.

RESULTS

Some sample student data illustrate some of our progress. One of the first students to be involved in this project was Macel. The response utilized was the pull-response, which was used exclusively in the beginning (in part due to a lack of better alternatives.) The response consequence used was 4 seconds of music. Data for each 5-minute session are presented in Figure 3. After a period of baseline conditions (no programmed response

Start-Up Dialogue

```
PER#01
2
3
4
5
6
7
8
9   NULL
10  TESTDAT
11  ABORT

SCHEDULE FOR KEY 1
ENTER FILE NO.  CLIENT ID NULL FILE
CONDITION NO. 1
CONDITION TOTALS
SESSIONS 0 TRIALS 0

SESSION DATA
NO. OF TRIALS 3
TYPE OF SCHEDULE FR100
DURATION OF REINFORCEMENT 1
WHAT IS THE MAXIMUM SESSION LENGTH (IN MINUTES) CLIENT ID TEST FILE
CONDITION NO. 1
CONDITION TOTALS
SESSIONS 0  TRIALS 0

SESSION DATA
NO. OF TRIALS 300
TYPE OF SCHEDULE FR1
DURATION OF REINFORCEMENT 3
WHAT IS THE MAXIMUM SESSION LENGTH (IN MINUTES)
 GOTO 620
PRESS RETURN TO START
```

End of Session Output

```
THIS DATA IS FOR THE SCHEDULE WAS AN FR1
TOTAL TRIALS = 0  TOTAL RESPONSES = 3
TOTAL TINE = 1 MIN AND 0 SEC
RESPONSES PER MIN = 3

THIS DATA IS FOR THE SCHEDULE WAS AN FR1
TOTAL TRIALS= 1 TOTAL RESPONSES= 1
TOTAL TINE= 1 MIN. AND 0 SEC.
RESPONSES PER MIN. = 1 .

DO YOU WANT TO RUN MORE SUBJECTS (Y,N) N

PROJECT ORION DISC
```

FIGURE 2

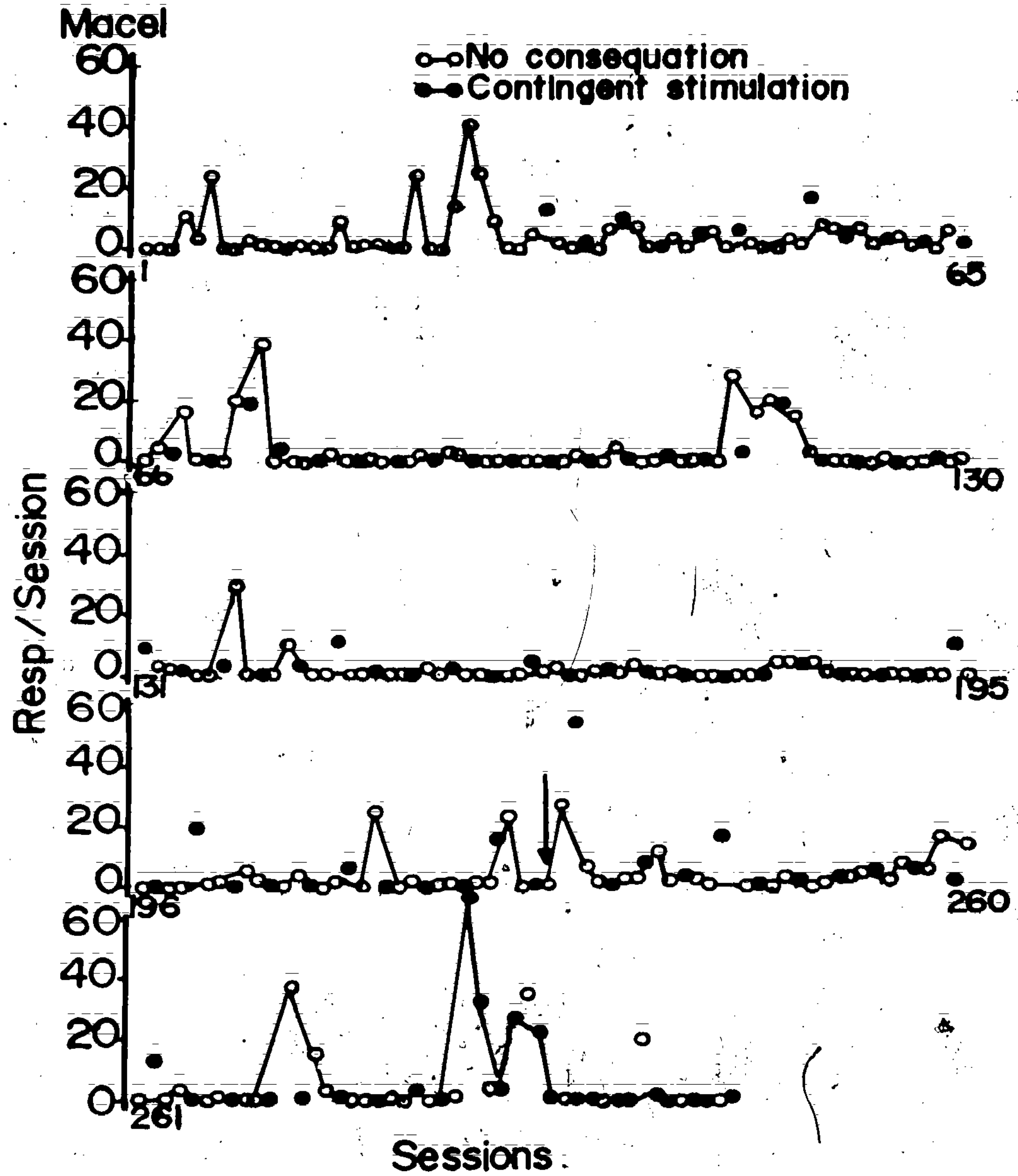

Macel
No consequation
Contingent stimulation
Resp / Session
Sessions
0
20
40
60
1
65
66
130
131
195
196
260
261

Figure 3

consequences) with considerable session-to-session variability in response rate, response-contingent presentation of stimulation had no clear, systematic effect. The most remarkable effect was the large range in response rates. Beginning at session 287, there was a fairly short-lived increase in response rate during sessions with contingent-stimulation. However, it is unclear whether the eventual decrement in rate was an instance of spontaneous extinction or merely a return to low rates following brief high-rate sessions. We are exploring use of alternative manipulanda and response-contingent stimuli. In retrospect, perhaps we should have taken this tactic earlier. However, this tactic was not taken during the earlier period of work with Macel because we were just developing some of the other devices and capability; later when rate increased for a session or two, we were hoping an overall trend in the direction of increased rate would evolve. Perhaps it is worth noting that transient rate increases during contingent stimulation sessions occurred at session 229, when the priming procedure was introduced, and following the change to two rather than one contingent stimulation sessions daily beginning at session 285.

As with Macel, response rate varied considerably between sessions during the initial phase when baseline conditions were used exclusively with Ray (see Figure 4). The frequency of response--in this case, use of the rotating cylinder switch--increased over that in baseline conditions when each resulted in presentation of a recorded story for four seconds. Rate clearly decreased when baseline conditions were reinstated in session 55, then rose again when contingent stimulation was reinstituted in session 60. Response rate clearly dropped during session 46 (indicated by a triangle in Figure 4), when the cassette player malfunctioned part way through the session.

Rate of use of the joystick switch by Eloise is shown in Figure 5. No change in response rate is evident subsequent to response-contingent stimulation--i.e., four seconds of music--becoming available. Inasmuch as virtually no responses occurred during this latter phase, the instructor began attempting to shape the response by activating the cassette player on occurrence of hand or arm movements in the direction of the joystick (these would not be shown as reponses on the graph, however). This strategy has not been effective. Consequently we are reevaluating what responses and what type of contingent stimuli to use with Eloise.

Herb's rate of using the rotating cylinder manipulandum is shown in Figure 6. Response rate was low during baseline conditions, then increased when switch activation produced four seconds of activation of the space gun. The increase in rate was transient, unfortunately. Consequently other types of response consequences are being tried because the response per se does not seem to be problematic. The reason for the precipitous drop in rate is unclear, but it does seem to be an instance of the phenomenon previously termed spontaneous extinction.

A final set of data is shown in Figure 7. Only a few sessions were required for a clear demonstration of the effectiveness of the procedures. Rate of utilization of the rotating cylinder manipulandum increased when it produced four seconds of operation of the air blower, than rapidly decreased when contingent stimulation was discontinued. With contingent stimulation reinstituted, the response rate again increased. We anticipate soon moving to some simple discrimination tasks with Fred.

DISCUSSION

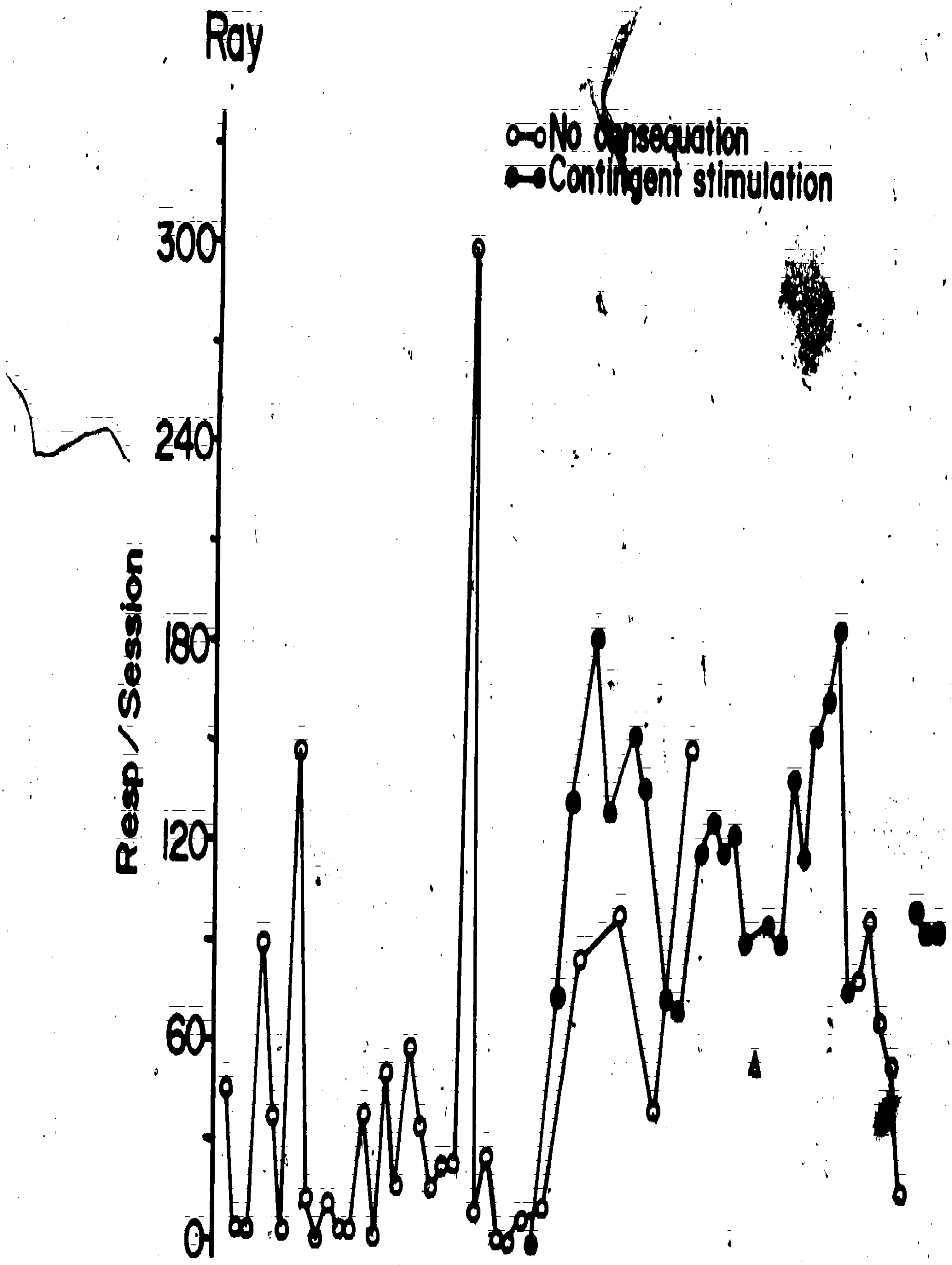
Due to time and space constraints, data for all participating students have not been discussed. The described data do, however, illustrate the effects (or lack thereof) we have observed. In some instances, e.g., Macel and Eloise, we have been frustrated in attempts to generate consistent increases in the rate of productive behaviors. In other instances, e.g., Herb's, response rate increases were transient. How to predict or circumvent such occurrences is as yet unknown to us. Finally, we have seen some unequivocal increases in rate, e.g., Ray and Fred. We are convinced that a system involving a microcomputer can be effectively utilized in precisely and consistently conducting training of simple behaviors that can enhance motor and, potentially, cognitive skills, providing the students something constructive to do, and at least partially relieving an instructor of a tedious, repetitive task. We attribute the lack of progress by some students to inadequacies, not of the computer system, but in the state of our knowledge about effective instruction with NPMR students.

Difficulties Encountered

Funding. One of the first difficulties that we encountered--and in these times of economic austerity we suspect others will also encounter--was locating funding for, and permisssion to purchase, the equipment. Some administrators are predisposed to view microcomputers as a faddish gimmick, the latest audiovisual "toy," which will quickly be stuck on a shelf and not used. Why spend the money on something that may be of little use in instruction (perhaps due to lack of staff who know what to do with it) and will be a dust collector? One suggestion is to attempt to obtain funding from private contributions or special fundraisers. At one of our children's schools, contributions from businesses and collection of Campbell's soup labels have helped provide a microcomputer. Another source is small grants such as the Title IV-C grant, which funded the equipment for this project. Either of these strategies avoids encroachment on local revenues. On the other hand, persons proposing purchase of a microcomputer should be prepared to provide a realistic projection of potential applications and trained staff. Additionally, overselling should be avoided and latent difficulties acknowledged. A dose of humility probably will be helpful in convincing skeptical administrators who are concerned about conserving funds.

Turf. Another difficulty that we encountered was organizational turf-defensiveness. We discovered that the staff responsible for operation of the large computer systems that handled personnel information, payroll, inventory, etc., had some negative opinions about facilities such as ours purchasing microcomputers. Some of these concerns included: What possible use could we have for a computer? Who did we have that knew anything about computers? Why should money be spent on buying a number of cheap little, and from their perspective, dinky, light-duty machines that wouldn't hold up well? Finally, and seemingly most substantially, why didn't we just let them handle whatever it was we wanted to do with their large, powerful machines?

Because the opinion and recommendation of these computer specialists were important to the administrators who approved purchase, we began attempting to inform them of the capacities of microcomputers, of the specific applications of interest, of the necessity of immediate access to and output from a computer used for instruction, and of the uselessness, for our purposes, of reports of student activity which arrived even a day after the fact. We gave numerous assurances, both oral and written, that we would not develop an information management system that would rival or



Ray
No consequation
Contingent stimulation
Resp / Session
300
240
180
120
60
0

Figure 4

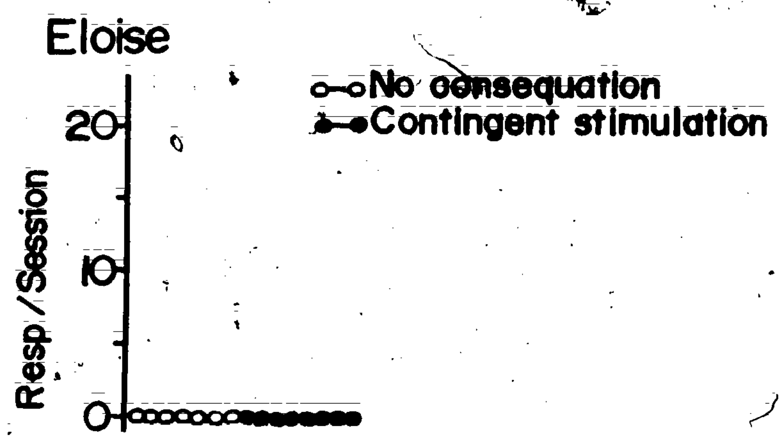


Figure 5

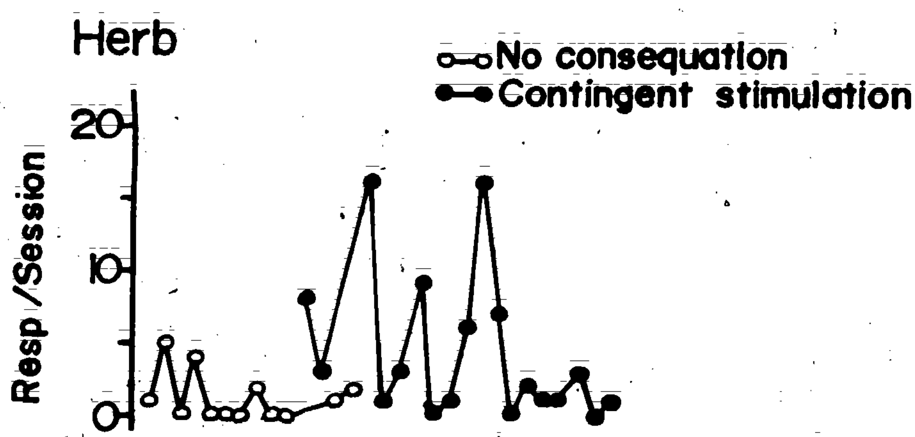


Figure 6

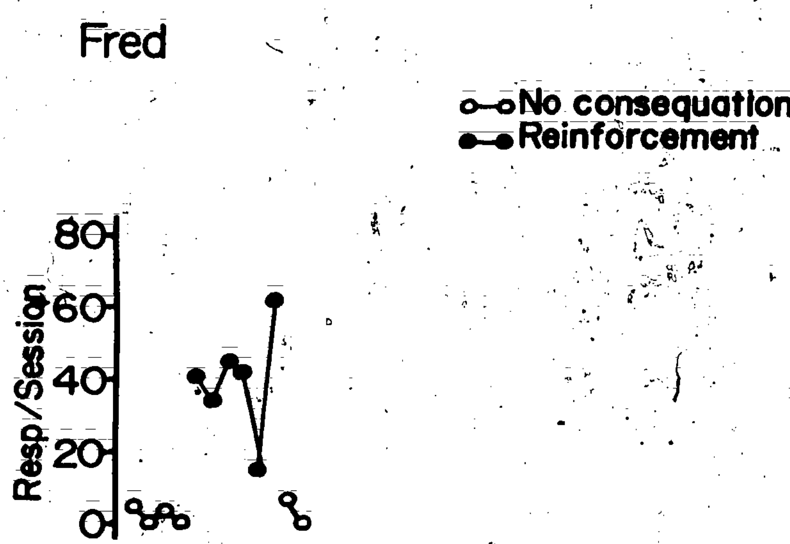

Fred
No consequation
Reinforcement
Resp/Session
80
60
40
20
0

Figure 7

duplicate any of their activities. In retrospect, perhaps we were a bit naive in not having spent more time with the people dealing with the large systems before we began developing our proposal.

System development. A third set of difficulties that we encountered pertained to system development. Along this line we have encountered difficulties with systems operating as we had expected and had been assured they would. We discovered that it is possible that some microcomputer salesmen, with apparent backing by their "technical people," sometimes give firm assurances that software will operate with a particular disk-operating system or that specific components or boards are compatible and can be utilized simultaneously when such is not the case. To illustrate, in the development of a separate system, we were assured that speech recognition, synthetic speech, and color graphics packages could be simultaneously available for operation in an instructional manner with another microsystem with the available memory and simple BASIC programs. We found that was clearly not the case, at least without substantial and expensive software development. For what it is worth, we were dealing with a firm specifically recommended by the manufacturer as having expertise in such matters. Probably everyone was operating in good faith, and ultimately all the components probably could be made to function as we wanted, given time and money. However, one should recognize that people may have different perspectives and time frames when addressing the question, "Can component A and component B be used together in a XYZ microsystem?" Most of us in education want to know, "Can we plug them in, turn on the power, and tell them to go?" Dealers and technicians may really be saying, "Sure it will work ultimately, but there may be some considerable adaptations needed first."

Equipment availability. Another circumstance that we have encountered relative to difficulties in system development is that all components are not readily available off a shelf. For the type of instructional applications discussed here, adequate software is not readily commercially available. If you are contemplating an application similar to ours, you need someone fluent in BASIC or whatever programming language you plan to use. The time needed to develop such software can be considerable. The more sophistication wanted from a system, the more time will be required for program writing and testing. If an adequately skilled programmer is not on staff, the propriety of developing a microcomputer system should be viewed skeptically unless a firm commitment can be obtained from a consultant or perhaps someone affiliated with a nearby college or university program. Similarly, as noted, we have found a need for some relatively simple electronic circuits that had to be fabricated. Again, time and some money need to be allowed for this purpose. If an adequately skilled person is not on staff, proceed cautiously. A commitment from an adequately trained person from somewhere is essential.

Maintenance. A fourth class of difficulties that we have encountered pertains to maintenance and repair of the equipment. Inevitably, things quit. Keys on terminals will stick. The heads on disk drives will need to be adjusted. Wires on switches will come off. Pins will break on connectors. Connections may tarnish or corrode. The occurrence of many of these problems is exacerbated by frequent moving of the equipment. Having a skilled technician on staff or readily available to deal with such problems is essential. Having a maintenance contract is highly desirable, but do not let having one lead to smug confidence. Unless the contractor is nearby and makes "housecalls" on short notice, a problem that develops may not be resolved immediately and may necessitate some transportation of the malfunctioning components to the repair shop. Also, for what it is worth, precautions will be needed to minimize the likelihood of damage to the system by students grabbing cables, housekeeping staff bumping components or engaging cables on dustmops or buffers, or deliberate vandalism, if not theft. Secure storage is essential.

Our experience has been such that we all have become believers in Murphy's Law; just about anything that could go wrong with the system, has gone wrong at some point. For a while, this situation caused us to be rather doubtful of our competence. However, after learning that other persons who seemed to have even more computer sophistication than we have voiced some similar concerns (Kieras, 1981; Mayer, 1981; Schneider, 1981), we did not feel so bad.

Student characteristics. A final set of difficulties in developing a microcomputer system for instruction with nonambulatory, profoundly mentally retarded students pertains to student characteristics, rather than the computer system. As noted, selections of an optimal response and optimal reinforcer for each student are difficult. Many of these students have such profound physical handicaps that determination of which motor activities are possible, particularly without inadvertently eliciting counterproductive reflexes, is difficult. A prior specification, when the number of different, clearly voluntary movements and rate of occurrence of each are so low, is difficult. In some cases the range of motion and the flexibility of the limbs are limited. Clearly, consultation with a physical therapist and occupational therapist is essential. However, sometimes the advice of such skilled specialists is to try working with a given movement and see what happens.

Although we have not finalized the process, our practice is to position each of a number of manipulanda, one at a time, in front of a student and observe which is activated at the highest rate. Selecting what to use as an ostensive reinforcer is, if anything, even more problematic. With less severely handicapped persons, determinations of reinforcers is simpler because they often can indicate preferences among activities and stimuli by means of language, gestures, or even actual approach. With the greatly limited language and motor abilities of students such as those involved in this project, such indications are unlikely. Similarly, a clear demonstration of the effectiveness of some stimulus or activity as a reinforcer for some other behavior generally is not readily available. This was one of our concerns when we started this project. Currently are finalizing a formal procedure for assessment of reinforcer effectiveness with these students.

REFERENCES

Bijou, S. W. A functional analysis of retarded development. In N. Ellis (Ed.), International review of research in mental retardation, Vol. 1, 1966.

Huggins, J. Guidelines for adapting battery operated toys for the physically handicapped. Vista CA, Vista Unified School District, 1982.

Kieras, D. E. Effective ways to dispose of unwanted time and money with a laboratory computer. Behavior Research methods and Instrumentation, 1981, 13, 145-148.

Landesman-Dwyer, S., & Sackett, G. Nonambulatory, profoundly mentally retarded individuals. In C. E. Meyers (Ed.), Quality of life in severely and profoundly retarded people: Research foundations for improvement. American Association on Mental Deficiency Monograph No. 3, 1978, 55-144.

Lindsley, O. R. Direct measurement and prosthesis of retarded behavior. Journal of Education, 1964, 147, 62-81.

Mayer, R. E. My many mistakes with microcomputers (or four years of fun trying to get my computer to run.) Behavior Research Methods and Instrumentation, 1981, 13, 141-149.

Microcomputer Director: Applications in educational settings (2nd ed.) Cambridge: Monroe C. Gutman Library, Harvard University Graduate School of Education, 1982.

Rice, H. K., & McDaniel, M. W. Operant behavior in vegative patients. The Psychological Record, 1966, 16, 279-281.
Schneider, W. Basic computer troubleshooting and prevention computer maintenance operation. Behavior Research Methods and Instrumentation, 1981, 13, 153-162.
Zuromski, E. S. Learned helplessness (Technical Newsletter No. 5, Trudeau-Zimbarano active stimulation program). Foster RI: Educational Technology Center, 1978.

FOOTNOTES

Acknowledgements: Much of the financial support for this work was provided by ESEA Title IV-C grand DE[illegible]601-80-0. Support and assistance of the following is greatly acknowledged: W. E. Richards, Kirk Lockwood, Joe Lancaster, Chris Price, Holly Brown, Molly Watson, and Vicki Kyle. Opinions are those of the authors and not necessarily those of the West Virginia Department of Education or Department of Health.

1 Descriptions and diagrams of circuitry as well as copies of program listings are available from the first author.

BLISSYMBOL DRILL PROGRAMS FOR THE APPLE II COMPUTER

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INTRODUCTION TO BLISSYMBOLICS

Blissymbolics (Bliss, 1978; Silverman, McNaughton, & Kates, 1978; Helfman, 1981) is an effective system of communication for many nonverbal individuals with a variety of handicaps. In a recent custody case, a young man's ability to use Blissymbols for statements and answers to questions convinced an Ontario judge to declare him competent to manage his own affairs ("Palsy Victim," 1982.) Because Blissymbolics is not the optimal alternative for all individuals, it is presumed here that appropriate assessment procedures (Mussel with a St. Louis, 1982) will have been carried out by a qualified team.

Traditionally, a Blissymbol user points to a symbol on an accessible rigid board (Blissboard) displaying the symbols with which the user is familiar. Success in communication depends on the user's ability to designate the desired symbols and the interpreter's ability to recognize them. In some instances eye pointing is less ambiguous than hand pointing. The word meaning printed above the symbols makes communication possible with persons having no knowledge of Blissymbols.

The Blissboard usually accompanies the user; duplicates of it may be located at home, school, or place of work. The making of such boards and keeping them current requires substantial amounts of time and considerable dedication. Blissymbol stamps and some Blissymbolics instructional materials are commercially available.

However, the conscientious instructor must expect to draw many symbols to meet specific needs. For the necessary precision, templates should be used for drawing the symbols.

The Apple II computer, in conjunction with existent software, offers attractive possibilities for

1. accuracy in communication with teachers, parents, peers, and others involved with the client;
2. encouragement of communication;
3. unlimited opportunity for repetitive drill programs, with multiplied teacher or therapist effectiveness;
4. rapid access to the full range of Blissymbols in the standard dictionary, Blissymbols for Use (Hehner, 1979) (hereafter referred to as BFU); and
5. greatly reduced tedium of generating Blissymbolics materials.

The standard set of Blissymbols in BFU has become available on diskette in two different computer languages. The first to appear was the excellent self-contained BlissApple (Vanderheiden, Kelso 1982) program, written in FORTH. The BlissApple program is written for the Apple II computer with

48K memory and one disk drive. A "speaking" version is available. The same Blissymbol set has been drawn and stored with BASIC programs as Bliss Library. Bliss Drills and Blissboard are each on one diskette. Bliss Library symbols are on two diskettes; programs are on a third diskette. Diskettes and manuals are available from the Minnesota Educational Computing Consortium (MECC), 2520 Broadway Drive, St. Paul Minnesota 55113. They are also available from the Blissymbolics Communication Institute, 450 Rumsey Road, Toronto M4G 1R8. Both sets of programs permit display or printing of the symbols by entry of their sequential numbers based on their position in BFU. Bliss Library, in conjunction with Blisstable Maker, serves as a source of symbols for drills or for any program written in BASIC.

With the Apple II computer and either the BlissApple or the Bliss Library diskettes, any standard Blissymbol can rapidly be displayed along with letters of the alphabet, numbers or other standard symbols. On a typical black-and-white classroom-size video monitor screen, the Blissymbols are large enough to read from a distance of 10 feet. This is highly advantageous in numerous teaching and demonstration situations, such as those for parents, visitors, or peers.

REFERENCES

Bliss, C. K., Semantography (Blissymbolics) Semantography Blissymbolics Publications, (34d ed.) Coogee, Sydney: 1978.

Hehner, B. Blissymbols for use. Toronto: Blissymbolics Communications Institute, 1979.

Musselwhite, C. R., and St. Louis, K. W. Communication programs for the severely handicapped: Vocal and nonvocal strategies. San Diego: College-Hill Press, 1982.

Silverman, H., McNaughton, S., & Kates, B., Toronto: Blissymbolics Communication Institute: 1978 Teaching and using Blissymbolics. Toronto: Blissymbolics Communication Institute, 1980; Helfman, E.S., Blissymbolics:

Speaking without speech. New York: Elsevier/Nelson, 1981.

Palsy victim moves courtoom to tears, Toronto Star, November 20, 1982.

Vanderheiden, G., and Kelso, D., Blissapple manual. Madison University of Wisconsin, Trace Center.

BLISSYMBOL DRILL PROGRAMS

Description of Programs

We shall describe several programs that (1) store selected groups of symbols for intensive drill, (2) use these Blissymbols for drills in two formats, or (3) display them for teaching or communications.

Drill Maker, which is on the diskette Bliss Drills (MECC, 198), allows the assembly of groups of symbols on Bliss Library into one drill. (The symbols may also be taken from Blissboard (MECC, 198), to be described later.) The number of symbols stored in one drill may be as many as 10, depending on the complexity of the symbols. All symbols plus their word meanings and their Blissymbol numbers are displayed during the process of drill assembly; this aids in avoiding omissions. The program will not accept duplication of symbols in the same drill. It also allows the instructor to reject any symbol asked for in error. The names of all drills are displayed on a single menu (Figure 1).

Single Symbol Drill is useful for introducing individual symbols. The symbol to be taught is identified as the stimulus (Figure 2). Three other symbols from the same drill are chosen as "distractors." Some of these may be chosen for their similarity in form to the stimulus; for beginners one may start with distractors that are dissimilar. The stimulus symbol is displayed continuously on the top line of the screen until the symbols and the operating procedure are presumably understood.

On striking the ESC key, the stimulus symbol or one of the distractors appears briefly in random sequence on the second line, immediately below the stimulus symbol. If the displayed symbol is identical to the stimulus, the striking of any key during the display causes a smiling face to appear on the third line of the screen (Figure 3). If the two symbols are different, striking a key will cause a sad face to appear at the bottom of the screen (Figure 4). Six correct matches--with none incorrect--will cause the computer bell to sound. On resuming with ESC, the stimulus symbol disappears from the top line, but the random-order display continues. The student is operating from a recollection of the stimulus symbol. Six correct matches without error are required before the display stops.

The computer keeps tallies of correct and incorrect scores, as well as the number of symbols displayed. The display times of each of the symbols may be adjusted from about 1 second to approximately 7 seconds. Long display times may be needed for some users, especially for those who use a head pointer.

When a student shows evidence of ability to recognize words that correspond to the Blissymbols already known, the Word-Symbol Drill (also on the Bliss Drills diskette) may appropriately be used. Three symbols are selected and displayed on the top line of the screen, with their associated words (Figure 5.) After the procedure is understood and ESC is struck, the symbols will disappear from the top line, but their word meanings remain.

The available drills are:

school people	medical
body parts	clothing
numbers	greetings
eating	to think
prepositions	room
transportation	time
feelings	family

Which drill do you want?

Figure 1. Each of the drills listed on the menu is a collection of up to 10 Blissymbols chosen for learning the symbols of a given category. Any of these is available for either Single Symbol Drill or Word-Symbol Drill.

1 school
2 child
3 teacher
4 therapist
5 nurse
6 friend
7 aide

Which number should be the stimulus?

Figure 2. The words for the Blissymbols in the drill "school people" are enumerated after the drills menu has been displayed and a named drill has been selected.

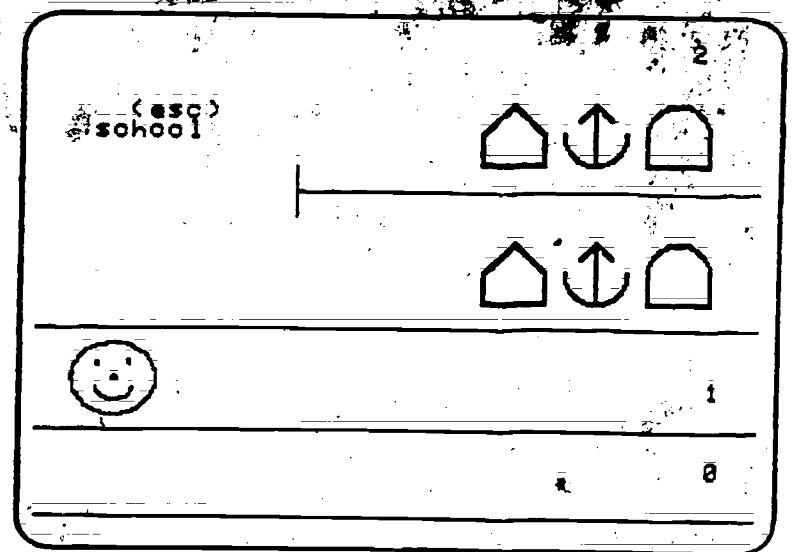

Figure 3. Single Symbol Drill. The stimulus symbol school remains in its position on the top line during the first half of the drill. When, as one of four symbols, it appeared briefly on the second line, a key was struck. Because the match was correct, a smiling face appears on the third line and is tallied.

These symbols will be displayed in random sequence on the second line, one at a time. If a key is struck while a symbol and its correct word are vertically aligned, a happy face appears, just as for Single Symbol Drill. Scoring and tallying are also similar (Figure 6).

A drill may be eliminated (with Drill Eraser, on the Bliss Drills diskette) if it were poorly designed or if it no longer serves a useful purpose. For example, the student for whom it was assembled may have learned all its symbols fully.

It would be difficult to overemphasize the importance of planning Blissymbol drills before they are stored and run on the two available drills formats. Typically one starts with a category of symbols that are on the user's Blissboard. The drills should be a judicious mixture of symbols already learned and symbols to be taught. A record should be kept of every symbol in each drill, both to avoid duplication and for ready reference. Planning should begin at the level of categories of drill topics. Groupings of Blissymbols may be based on:

1. Similarities of Blissymbol shapes or parts, for example, teacher and school.
2. Categories of symbols used in a particular context, for example, words related to eating, dressing, or the weather.
3. Categories according to grammatical function, for example, pronouns, prepositions, or verbs. The latter are so numerous that one might group verbs that relate to the action of the eye, the ear, the hand, and the mind; to feelings; or to motion. Not surprisingly, in these categories one will see considerable similarities in shapes as well; Blissymbols were intended to suggest concepts by their form and relative placement.

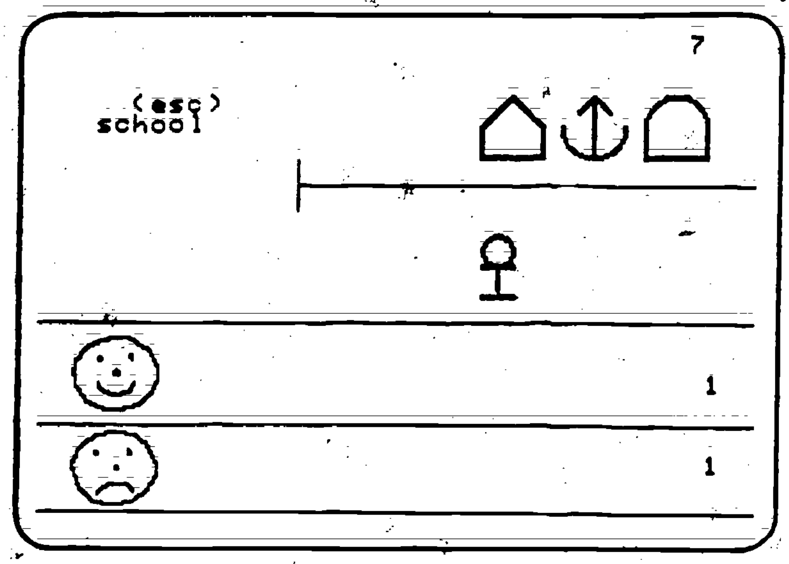

Figure 4. Single Symbol Drill, showing a distractor symbol (child) briefly appearing under the stimulus symbol school. Of the seven symbols presented, one was incorrectly indicated as matching school, causing a frowning face to appear on the fourth line.

When planning a drill for a young child, it is desirable to use only pictographic symbols. These may include symbols for car, boat, house, or table. After the child has made progress with a base set, then an ideographic symbol can be incorporated into the same series. Examples of such symbols are those for happy, sad, or light.

It cannot be stressed enough that complete reocrds be kept of each student's introduction to a Blissymbol and of subsequent indications that it has been learned. It is recommended that a daily log of computer instruction be kept. The form in Exhibit 1 has proved convenient.

A specially selected set of nearly 500 Blissymbols has been in use for a number of years on advanced users' Blissboards at Michael Dowling School, Minneapolis. The particular symbols were chosen after extensive interactions with students, teachers, and parents. The identical symbols, bearing the same number, have been placed on the Blissboard (MECC, 198) diskette. (These symbols were transferred from Bliss Library.) Thus, Blissboard may be regarded as a very basic Blissymbol vocabulary. Nonetheless, many sophisticated concepts may be conveyed by symbol combinations surrounded by the "combine" indicator. Any symbol or sequence of symbols may be displayed on the screen with the program Blissboard Talk.

Blissymbol Transfer and Printout Capabilities

Blisstable Maker, (on the Bliss Library Programs (MECC, 198) diskette,) allows transfer of Blissymbols in groups (shape tables) to a user's diskette for programs of one's own devising. Because these symbols have already been approved by the Blissymbolics Communication Institute (Toronto), it is unnecessary to duplicate the preparation, review, and approval processes.

Especially where there is a classroom of Blissymbolics students, there is a frequent demand for special collections of symbols. They are

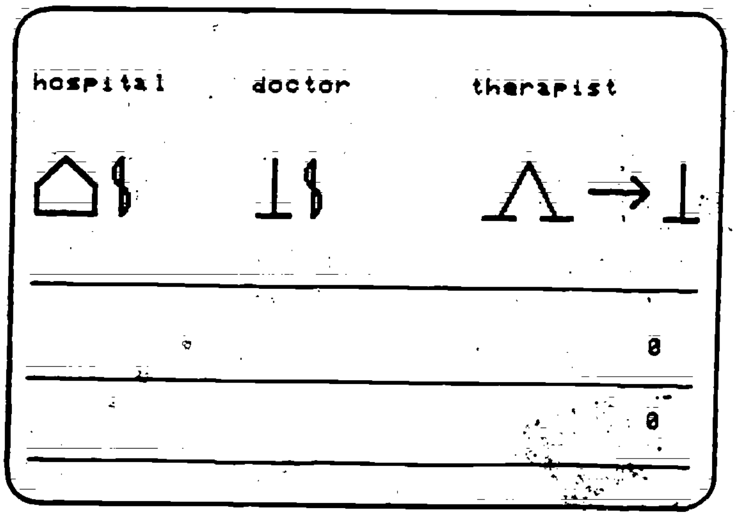

Figure 5. The three symbols of Word-Symbol Drill are shown together before they disappear, to reappear one at a time, in random order and location.

displayed with the Blisstalk program Bliss Library Programs (MECC, 198) diskette. Any desired Blissymbols may be printed from this program with less effort than for hand drawing if a high-resolution printer is available.

Experience and Observations

The programs and approaches described have been applied for more than one year to a total of 11 nonvocal Blissymbol students in Michael Dowling School (Minneapolis.) A Blissymbolics classroom had previously been established and is in its third year. Student ages range from 4 to 12. The class typically has eight students. For the Blissymbol computer sessions, students work singly or take turns in pairs. Larger groups may be desirable for group review, games, or other applications of symbols already learned.

Once students have been introduced to computer-assisted instruction in Blissymbolics, they tend to be disappointed or obviously annoyed if that day's instruction does not involve the computer. Perhaps this reflects a perception that the computer session is a game to be played; it is obviously a mode of instruction that can elicit a high level of motivation. Those nonspeaking, nonreading students who can make keyboard entries either by hand or with a head pointer have acquired an unambiguous mode of communication.

For the selection of Blissymbols, it is necessary that the student be able to recognize and discriminate between numbers. However, even if that ability is lacking, the student may still learn to recognize individual symbols and to discriminate between those that are similar. For young symbol users the instructor may enter Blissymbol numbers into the computer as the child selects symbols from a Blissboard. If a printer is available,

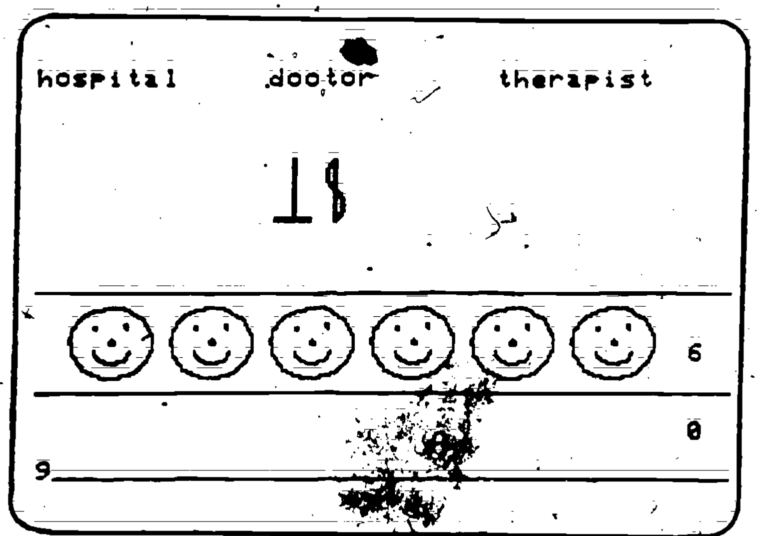

Figure 6. The six smiling faces, with no sad ones, indicate that a key was struck only when a Blissymbol appeared under its own word meaning. Display has stopped because of 6 correct matches without any incorrect. It is rare for 6 correct matches to occur in only nine presentations. More typically, it would take in excess of 21 to provide 6 correct matching opportunities.

the printout recording the efforts may be taken home. Thus a parent may be given lists of newly learned Blissymbols, together with examples of their use in sentences.

Blissymbolics students working in well-selected pairs may stimulate one another's performance on drills. Well-selected implies that their Blissymbol vocabularies are roughly comparable, because a keen competitive spirit is often shown. In running either Single Symbol Drill or Word-Symbol Drill, students may take turns in responding as a symbol is displayed. For this application a convenient input device is a game paddle for each student. Or one may strike the keyboard and the other a numeric pad (see next section). Whereas the student may show various levels of interest in working with a therapist or teacher, there is often a considerable amount of excitement when the computer is tallying team--rather than individual--performance. The importance of peer approval is obvious under these conditions. Though their vocal responses may not be understandable as words, the students understand well if their team mate is cheating. It may be for entering an incorrect match or for missing an opportunity to register a correct match.

Exhibit 1

DAILY LOG ON COMPUTER INSTRUCTION
(a continuum of learning)

Name ____________________ Clinician ____________________

Date ______________ Symbols selected from ______________ drill.

Symbols selected for drill ________ ________ ________ ________

Symbols previously known ________ ________ ________ ________

Date:				
Symbol selected for lesson:				
Tally from computer: number correct with matching stimulus:				
number wrong with matching stimulus:				
total number of symbols shown:				
number correct without matching stimulus:				
number wrong without matching stimulus:				
Transfer of symbol recognition to own board:				
Use of symbol in sentence completion:				
Use of symbol in sentence:				
Use of symbol meaningfully:				
Uses of symbol spontaneously:				

IF CHILD FAILS ABOVE, CONTINUE BELOW

Self recognition with only verbal stimulus given:				
Self recognition with general area specified:				
Needs to be shown position on board:				
Needs to repeat symbol:				
Comments: Date ________				
Date ________				
Date ________				

Instructional plan designed by Florence C. Wertz, C.C.C., Dowling School, Mpls., MN.

A byproduct of the paired drills is the experience of being required to take turns, even if the other is slow to recognize a correct match. Too often the "taking of turns" with handicapped students is a contrived experience. In the drill programs cited here, two students are allocted the same length of time to make similar responses in a common activity.

Computer Adaptation for Handicapped Blissymbols Users

Four of the MECC Blissymbolics programs will accept the striking of any key for responses. These are the two drills, and the cursor modes of Blisstalk and Blissboard talk. For either of these a numerical command will display a line of digits (zero to nine), plus RETURN and -- (the erase arrow). This line appears at the bottom of the screen, where the prompt normally appears and where one sees the numbers that have been struck on the keyboard. A cursor moving to the right pauses on each digit for a length of time that can be preset. Striking any key while the cursor is on the first digit desired will cause it to be registered on the screen. When the complete number has been registered, it is entered into the computer by striking any key while the cursor is on RETURN. Any or all digits may be erased by striking the keyboard while the cursor is on --

Another alternative to direct keyboard entry on the Apple computer is the use of a numeric pad. The movable partial keyboard is a small box at the end of a cable, with keys for the numbers and some control functions. The pad can readily be placed at a convenient angle on the working table of even a small wheelchair. This adaptation is much preferred to other possible arrangments, such as seating the student on the instructor's lap in order to reach the computer keyboard and to see the monitor screen.

Two additional advantages were noted in using the numeric pad at Michael Dowling School, (1) the protection of the computer keyboard from uncontrolled salivation and (2) the ability of two students to cooperate in preparing a story for their classroom by taking turns at the pad.

The Apple II and other computers are presently far less portable than one might desire. One may be confident that in a few years computers adapted for the handicapped will become highly portable. This projection is based on our anticipation of a big market for portable computers for students. One may also predict with assurance the creation of a large number of innovative programs for the handicapped nonvocal client.

As yet, it is premature to attempt quantitative assessment of these Blissymbol programs. We invite comments and will compile the documentation of user's experiences to refine and extend the programs.

The Blissymbols used in these programs were drawn by Florence C. Wertz of the Minneapolis Public Schools and have been approved by the Blissymbolics Communication Institute, Toronto. Blissymbols used herein are derived from the symbols described in the work Semantography, original copyright C.K. Bliss, 1949.

Appendix

Equipment required for operating the MECC Blissymbolics programs:

1. Apple II computer with 48K memory
2. Disk drive
3. MONITOR. A black-and-white unit is much preferred over a color unit for clear resolution of Blissymbols and words.

Optional but highly recommended auxillary equipment:

1. A high resolution graphics printer with its appropriate (serial or parallel) card for insertion into the appropriate Apple II computer slot.
2. A numeric pad.
3. A keyguard. This device is merely a thick plate with holes that match those of the keyboard. Thus a direct downward thrust is required to make a keyboard entry, without penalty for uncontrolled lateral motion. It can greatly diminish the frustration of users who have difficulty in controlling hand movement. It is equally valuable to those using a head pointer.
4. A second disk drive is convenient, especially for Bliss Library. This allows for automatic selection of the correct disk without shifting between the two library diskettes.

ED#231096

ENABLING BLIND STUDENTS TO USE MICROCOMPUTERS

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The thesis of this presentation was that with the aid of various kinds of access technology, blind students are gaining increased access to microcomputers. S. C. Ashcroft's paper enumerated the five objectives of his federally funded research grant entitled "Research on Multimedia Access to Microcomputers for Visually Impaired Youth." Dr. Ashcroft also proposed criteria for the evaluation of software for use by visually impaired students.

Sandra Ruconich demonstrated some of the pieces of access technology highlighted in Dr. Ashcroft's paper, including the Optacon, the VersaBraille, and the Cranmer Modified Perkins brailler. She discussed her dissertation research, in which 12 students from the Kentucky School for the Blind were taught to use the Cranmer Modified Perkins as a computer terminal. All 12 students successfully completed the project, thus providing empirical support for the utility of the Cranmer Modified Perkins in this application.

T. V. Cranmer, developer of the Cranmer Modified Perkins brailler, demonstrated its capabilities as a graphics printer by using the device to produce an outline map of Kentucky, a bar graph, and a graph depicting various wave forms. He discussed how teachers could use equipment to photograph drawings that they made, which could then be reproduced on the Cranmer Modified Perkins. He suggested that this capability might be particularly useful when teaching handwriting to blind students.

THE LOOK AND FEEL OF HANDWRTING: COMPUTER-BASED INSTRUCTION

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The Department of Engineering Physics at the Australian National University is studying computer-aided skill development, with the aim of exploiting the unique characteristics of computers to implement new and more effective educational strategies (Lally & Macleod, 1982). The team involved in this research includes engineers, educators, psychologists, and computer specialists. Emphasis is put on the benefits that are obtained by focusing on educational objectives and devising methods for student-machine interaction that are both appropriate to the learning task and simple and natural for the student.

In computer-based handwriting exercises, students use a digitizer pen to track various letter shapes displayed on a graphic screen. In the initial implementation (Macleod & Procter, 1979), the computer gave the impression of writing by drawing a thin lighted track under the tip of the pen as it was pressed down and moved around over the display screen. Students tracked series of line segments, which could range in complexity from individual strokes to complete works, and the display gave moment to moment feedback on their attempts.

In the most recent implementation, the digitizer pen and writing surface are positioned below and in front of the display screen. This deliberate displacement of the visual feedback is easily adapted to, and emphasizes the role of kinesthetic feedback in writing (i.e., students are encouraged to attend to the "feel" of their writing as well as its "look"). A second advantage is that the displaced visual feedback can be magnified in size relative to the pen movements, such that students see large letters on the screen (aiding perception of small details) as they execute the fine motor movements used in writing of conventional size (Lally & Macleod, 1983). The overall effect of the computer-mediated feedback is to facilitate transfer of control of letter formation from the visual guidance used by beginning writers to the muscular processes characteristic of fluent writers.

The question of transferring the benefits of research findings to the classroom arises. Educators need to be able to use inexpensive and readily available computer technology which preserve the educational validity of techniques developed during the original research. Successful introduction and management of computer-based exercises in the classroom requires both computer-based and conventional exercises to accommodate students' learning characteristics and educational needs.

We have implemented handwriting exercises appropriate for a wide range of abilities on an Apple microcomputer and graphics tablet. An accompanying suite of programs facilitates preparation of curriculum materials by teachers. These exercises can thus readily be used as a supplement to classroom activity. Their advantages (Macleod & Lally, 1981) include ability to exercise fine control over the learning process; emphasize the integrated sequence of steps used in handwriting, as well as the appearance of the end product; enhance student motivation; accommodate a variety of curriculum materials; enable students to work independently; direct students' attention to critical aspects of the learning task; and make relationships between visual and kinesthetic feedback more distinct.

The new exercises are effective with intellectually handicapped students (Lally, 1982) and are showing promise with mainstream students who have handwriting difficulties.

REFERENCES

Lally, M. R. Computer-assisted handwriting instruction and visual-kinesthetic feedback processes. Applied Research in Mental Retardation, 1982, 3 (4), 397-405.

Lally, M. R. & Macleod, I. D. G. Development of skills through computers: Achieving an effective, enjoyable learning environment. Impact of Science on Society, 1982, 32 (4), 449-460.

Lally, M. R. & Macleod, I. D. G. The promise of microcomputers in developing basic skills. In World Yearbook of Education 1982/83. J. Megarry et al. (Eds.), London: Kogan Page, 1983, pp.194-205.

Macleod, I. D. G., & Lally, M. R. The effectiveness of computer controlled feedback in handwriting instruction. Computers in Education. R. Lewis and E. D. Tagg, (Eds.), Amsterdam: North-Holland, 1981.

Macleod, I. D. G., & Procter, P. S. A dynamic approach to teaching handwriting skills. Visible Language., 1979, 13 (1), 29-42.

APPLE LOGO

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INTRODUCTION

The computer language know as LOGO is really a multi-level learning environment in which users draw geometric designs and colorful pictures in the process of mastering problem-solving skills. LOGO is actually composed of two different computer languages. The one most frequently referred to is turtle graphics, which takes its name from its precursor, which has a mechanical turtle that could be maneuvered on a large piece of drawing paper. Developed by Seymour Papert at MIT, turtle graphics has graduated to a TV screen and its movements are controlled from a computer keyboard. The other half of LOGO is a version of the computer language Lisp, whose main utility is the manipulation of string data (words). The combination of these two capabilities makes LOGO a powerful language suitable for young children, adults, and everyone in-between. LOGO is available in one form or another on Texas Instruments, Apple, Atari, and Radio Shack computers.

LOGO is often described as an interactive or user-driven language that, unlike other computer languages, is not limited to a specific set of commands. LOGO users combine primitives (commands) to write procedures (programs), and these procedures can then be used as if they themselves were primitives to create a limitless number of procedures, each of which functions as a new computer command.

A LOGO DEMONSTRATION

Let's begin the demo with a look at some of the simplest graphics primitives. First, I would like to introduce you to the turtle. To meet the turtle, you simply type ST, which stands for showturtle. In LOGO the turtle is represented by a triangle in the center of the screen. The turtle has a heading and a direction. To move the turtle, you simply give the command forward (FD) or backward (BK) and specify the number of steps you would like the turtle to move. Typing FD 90 moves the turtle forward 90 steps. To turn the turtle, give the command left turn (LT) or right turn (RT) and specify the number of degrees that you would like the turtle to turn. RT 90 commands the turtle to turn 90 degrees to the right.

Using these simple commands, children can make any number of designs and shapes. For example, to draw a square, give the command FD 60 followed by RT 90 four times. The primitive REPEAT, which can be used whenever you want to repeat a procedure, simplifies many procedures. For example, to draw a square using the REPEAT procedure, simply type REPEAT 4 [FD 60 RT 90].

Although the REPEAT procedure simplifies the process of drawing a square, giving that procedure a name (in this case "S") simplifies the process still. For example, type in the procedure listed next called S, to draw a square:

```
TO S
REPEAT 4 [FD 60 RT 90]
END
```

The screen will respond with "S defined," and the turtle now knows how to S. Each time you type S, the turtle will draw a square, and you can combine muliple S procedures to create geometric designs. For example, typing REPEAT 12 [S RT 30] gives us a design with 12 squares each one rotated 30 degrees to the right of the last one. To simplify the creation of this geometric shape, simply create a procedure called MS for many squares.

```
TO MS
REPEAT 12 [S RT 30]
END
```

LOGO procedures can be executed in black and white or in any of six colors simply by telling the turtle to change the background color and the pencolor. For example, to create the "many squares" procedure in blue (color 5) on a white (color 1) background, type:

```
SETPC 5
SETBG 1
MS
```

One of the special features of LOGO is its ability to combine many short procedures into longer procedures. For example, a procedure that I have written, called Garden, uses a procedure called flower, which consists of two procedures called bloom and stem. Another procedure that I have written, called PIC (for picture), is made from a series of shorter procedures called sun, lawn, house, and tree.

Often young children learn LOGO more quickly if I provide them with single-key procedures that enable them to move the turtle by typing single keys. I have taught the turtle a procedure called draw, which allows the typist to direct the turtle by typing F to go forward 50 steps; B to go backward 50 steps; R to turn 90 degrees to the right; L to turn 90 degrees to the left; C to clearscreen; and E to end the procedure.

LOGO can be used as a tutorial or as computer-assisted instruction by using the Lisp capabilities, which are a bit more complicated than turtle graphics but very powerful. These Lisp capabilities, when combined with turtle graphics, make LOGO an extremely powerful and useful computer language.

SECTION 5

COMPUTERS AS TOOLS

INTRODUCTION

"Computers as Tools" highlights the use of computers to enhance the handicapped individual's interaction with the environment and methods of tracking these skills. The first article is a justification for the use of computers with the physically handicapped. Burns delineates how computers can be used to provide tools for handicapped children to enhance their ability to learn and interact with their environment. A discussion of alternative interface devices for the physically handicapped is provided, reviewing a variety of homemade and commercially available interfaces.

Behramann and Lahm discuss a pilot research project teaching multiple-handicapped babies to use the computer for communication, environmental control, and environmental manipulation during their critical learning period. Young children are taught to make choices that will result in an environmental interaction. Preliminary research results are discussed.

Speech recognition by microcomputers and its instructional applications for handicapped learners are discussed by Horn and Scott. They illustrate how speech recognition technology can be used cost effectively in a number of different applications including environmental control. They discuss the research and development activities surrounding the voice-based learning system as well as the accompanying software.

Key factors in versatile communication programs for microcomputers that utilize speech output are presented by Rushakoff. These include the need for different methods for interacting with the computer, the need for a versatile and easy to change vocabulary, and efficiency in message construction and output. A number of examples are provided and a bibliography is included.

A JUSTIFICATION FOR THE USE OF
COMPUTER-ASSISTED INSTRUCTION
WITH THE PHYSICALLY HANDICAPPED

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INTRODUCTION

With the passage of Public Law 92-142 in 1975, public school systems were required to provide each child in the United States with an education appropriate to individual needs. Specifically, this law demanded a unique curriculum, an individual educational plan (IEP) specifically written for each handicapped child, while at the same time requiring that the child be placed in the "least restrictive environment," an educational setting where, as much as possible, the physically handicapped student would be allowed to interact with non-handicapped peers. To encourage this, Section 604 of the law provided for the use of technical aids and devices.

The financial implications of this law have been considerable for larger school systems, and almost insurmountable for smaller systems; both have had to hire special educators, adapt curricula, and initiate extensive record-keeping activities. Education of the physically handicapped is extremely time-consuming on the part of both the teacher and the student. Teachers find themselves constantly waiting for feedback from nonoral students. This interaction, whether handwritten or displayed in some other fashion (e.g., typewriting, alphabet lap board, Bliss symbol board) can extend communication time, and as a result learning time, to the point of frustration for both teachers and students. Goeffrion and Bergeron (1977) described the problem as follows:

> Perhaps the most universal characteristic shared by handicapped individuals is the inability to communicate effectively through conventional symbol systems. Various handicaps differ as to the locus of the communication breakdown, but once broken, the results of a lack of communication are very similar across handicaps.

The authors continued by indicating that the greatest visible effect was a failure on the part of the handicapped individual to learn the system used by "normal" people. This has frequently been accompanied by loss of interest in any activity that involves communication and interaction.

Gearheart and Weisman (1976) felt that adapted educational materials should be provided so that cerebral palsied students have every opportunity to survive in a regular classroom. They cautioned teachers by saying, "It may take him considerably longer than the other (normal) students to complete an assignment because of the motor involvement, but he must be allowed to complete it independently," (pp.83, 85).

Meyen stated that "because of the varied educational needs of the physically disabled, curricula must integrate adaptive techniques with a variety of educational materials," (1982, p. 395). The author continued by saying that emphasis should be on the creation of new, and on the

adaptation of existing materials to meet individual needs. It must be remembered that, while on one hand the damage that has produced the physical abnormality may also produce a mental deficiency, it is also quite possible that physical disabilities are not accompanied by mental deficiency (Schwartz, 1975, p. 41).

To summarize, since the passage of PL 94-142 in June 1975, many educators have been confronted with an almost monumental task--that of educating a child with special needs, typically in a classroom designed for "normal" students. Although these special needs are not impossible to deal with, they generally require a disproportionately large amount of time on the part of both the teacher and the student. Generally the handicapped student takes longer to communicate, takes longer to learn, and requires specially designed instructional materials. All of this represents teacher time, which to administrators means money. As indicated, however, this law also encouraged the use of technical aids and devices. Technical aid in the form of computer assisted instruction may be a viable solution to the problems inherent in educating the physically handicapped.

COMPUTER-ASSISTED INSTRUCTION

Computer-assisted instruction (CAI) came into existence in the early 1960s, probably due to the increasing general availability of mainframe computers; to the programmed instruction movement, which saw CAI as the perfect medium in which to manifest Pressey's teaching machine; and to Skinner's reinforcement learning principles (Gleason, 1981; Dence 1980; Burns & Bozeman, 1981; Grinstein & Yarmish, 1981; Steinberg, 1977). With the birth of CAI came CAI research, with a majority of projects being carried out by the universities and business interests, which could afford the abundant mainframe computer resources necessary for CAI at that time. By the early 1970s, however, larger public school systems had become computerized, resulting in increased CAI studies at the primary and secondary levels (Jamison, Suppes, & Wells, 1974). With the commercial availability of the first microcomputers in 1976 came an alternative to the expensive and frequently tempermental, mainframe computers, which added impetus to the CAI movement. Extremely cost-effective microcomputer-based educational systems can be afforded by almost any facility (Caldwell, 1980; McIsaac & Baker, 1981; Watts, 1981; Stevens, 1981; Daneliuk & Wright, 1981; Cavin Cavin, & Lagowski, 1980; Holmes, 1982; Mills & Stonier, 1982; Skyrme, 1982).

Computer-Assisted versus Traditional Instruction

Although a variety of seemingly beneficial instructional features are inherent in CAI (CAI is self-paced and provides immediate feedback; it is adaptive, and highly interactive) are undebated, five facets of the effectiveness of CAI over that of traditional instruction (TI) have consistently been considered in the literature: (1) student achievement; (2) student attitudes toward CAI and subject matter; (3) student retention; (4) cost; and (5) learning time. Each of these variables has been studied repeatedly, often with confusing and contradictory results. Burns and Bozeman (1981) described the resulting situation:

> Various researchers have attempted to narratively review the research litrature in an attempt to formulate conclusions and/or to establish a more broadly based case for CAI. These endeavors . . . have resulted in conflicting and inconclusive findings.

When used as the sole instructional medium, the effectiveness of CAI in terms of student achievement has not always been shown to be significantly better than TI (Dence, 1980; Edwards, Norton, Taylor, Weiss, &

VanDusseldorp, 1975; Vinsonhaler & Bass, 1972; Jamison et al., 1974). However, Holmes (1982), while admitting to the debatability of the CAI effectiveness question, indicated that a medium with the versatility of CAI, seen only as effective as TI, might still be advantageous in other areas:

> At the very least it must be admitted that a machine which can, when required, replace traditional instruction without deleterious effects on learning must surely be seen as an advantage for learners who have limited access to traditional modes of instruction, and perhaps those who do not respond well to those modes.

Herbert (1982) expressed similar sentiments. Reporting on a study that produced no significant differences between achievement levels of students in CAI and TI situations, they pointed out other observed benefits such as student-paced instruction, reduction of paper work for instructors, and improved student attitudes. When used to supplement, rather than replace, TI, evidence strongly supported the effectiveness of CAI (Vinsonhaler & Bass, 1972; Edwards et al., 1975; Chambers & Sprecher, 1980; and Burns & Bozeman, 1981).

As pointed out by Clement (1981), student attitudes toward CAI have been found to be almost consistently positive at all educational levels. Clement indicated that this was probably due to five attributes of CAI:

> (a) self-paced; (b) lack of embarassment when mistakes are made; (c) immediate feedback; (d) a general feeling that they learn better through the computer system; and (e) lack of subjective evaluations; the computer bases its evaluations strictly on student performance, not on personal characteristics of a student.

Chambers and Sprecher (1980) in a literature review cited six references indicating improved student attitude toward the use of computers in learning. Dence (1980) in a review of 17 studies found evidence that students having experienced CAI had more positive attitudes toward it than those students without any CAI experience. Magidson (1977), Herbert (1982), Cavin et al. (1980), and Holmes (1982) also mentioned positive student attitudes toward CAI and subject matter. Kulik, Kulik, and Cohen (1980) in considering the 11 relevant studies in their meta-analysis of 59 studies found a "small" difference in favor of CAI in "course quality" as compared to TI. In the seven studies reviewing student attitudes toward subject matter, an even smaller difference was reported, again in favor of CAI.

In terms of student retention, Gleason (1981) stat[illegible] students taught via CAI had retention rates equivalent to, if n[illegible] than, those students taught by TI. Dence (1980) agreed with [illegible]eason[illegible] Edwards et al. (1975), in a review of literature, mentioned that in the three relevant studies the reverse situation was evident: students taught [illegible]I had higher retention rates than students taught with CAI.

Cost of CAI

The topic of cost has generally been considered in terms of the cost of microcomputer-supported vs mini- or mainframe computer-supported CAI. Cavin et al. (1980), Caldwell (1980), and McIsaac and Baker (1981) pointed out that microcomputers were much more desirable for CAI than mainframe computers and gave cost as a major factor. Chambers and Sprecher (1980) felt that the microcomputer had all of the capabilities of the minicomputer, plus color, graphics, and the potential for audio in and output, but at a much lower cost. The smaller memory capacity of microcomputers was mentioned as a major disadvantage, however. The authors continued by mentioning that with mass production and improved technology the cost of microcomputers was expected to drop quickly to the point of cost-effective uses of CAI.

Reduction of Learning Time

It is in terms of reduced student learning time that CAI has its one seemingly indisputable benefit. An abundance of authors (Kulik et al., 1980; Kearsley, Hunter, & Seidel, 1983; Chambers & Sprecher, 1980; Dence, 1980; Lewellen, 1971; Magidson, 1977; Edwards et al., 1975; Gleason, 1981; Jamison et al., 1974; Burns & Bozeman, 1981) reported savings in students' time estimated from 30 to 50 percent over that of TI.

CAI AND HANDICAPPED LEARNERS

Apparently, the effectiveness of CAI with nonhandicapped students has been, at least to some extent, delineated. Its benefits, when used as a supplemental form of instruction are well documented, as is its ability to reduce student learning time. The following authors have expressed their interest in using CAI specifically with the physically handicapped.

Thorkildsen and Williams (1981), who described special education as an extremely "labor intensive educational process," demanding a considerable amount of one-on-one, and small group interaction, felt that CAI may prove to be an economically feasible solution to the heavy work load created by P.L. 94-142. The fact that every child must receive an appropriate education in the least restrictive environment means that teaching resources are stretched to the limit.

CAI provides a satisfactory means of individualization and self-paced instruction to handicapped students. A number of authors (Jamison, Suppes, & Wells, 1974; Clement, 1981; Carman & Kosberg, 1982; Magidson, 1977; Lewellen, 1971) have stated that CAI provides the most highly individualized interaction between curriculum and student of any available instructional method. Frustration, resulting from slow progress and frequent mistakes, commonly experienced by physically handicapped students, can be greatly reduced.

Computers and the Physically Handicapped

Hill (1976) believes that the computer may provide a solution to many of the needs of the physically handicapped. Many of these students use typewriters rather than paper and pencil because it is physically impossible to write by hand. Doing a math problem on a typewriter, however, has its frustrations, e.g., most mathematical computations are done from right to left, and most typewriters move from left to right. Mistakes are also a problem. Computers, on the other hand, can be programmed to move from right to left, and computer erasures are made by pressing a key. If the student can type efficiently enough to make the mistake in the first place, the student can erase with a similar effort.

Papert, in testimony to the House Subcommittee on Science and Technology (1977), stated that even the most physically involved person usually has some control over some muscle. Once that control has been identified, and in conjunction with appropriate electronic interface devices, it is generally a simple matter to program a microcomputer to respond to the movement, resulting in the formation of a channel of communications from human to computer. This linking of a handicapped individual to a computer more efficiently than simply having the person use a head-stick on a keyboard may enable a handicapped person to interact efficiently enough to become financially self-supporting. When a computer is used in this manner, Papert refers to it as an informational prosthesis.

Goldenberg (1979) described the potential for computer aids to the physically handicapped as follows:

> The computer provides flexible technology that can so thoroughly enrich the experiences and communication of certain handicapped persons that activities and learning that were previously thought impossible for them become routine and easy. (p. 5)

Goldenberg described the handicapped child as being at a decided disadvantage when the child "must mediate interaction with the world through coordinated motor activity." The author pointed out, however, that with the adaptable technology of the computer the same student can learn to communicate quite adequately. In addition, handicapped students who are exposed to the immediate feedback and experimentation permitted with computers and appropriate software experience a "striking change" in their autonomy (Goldenberg, 1979, pp. 12; 24). To summarize, Goldenberg (1979) states:

> In my view, it is the child's abnormal experiences of the world (e.g., his lack of easy, fluent communication and casual play) more than his abnormal behavior (e.g., his inability to speak, write or walk) that handicaps the child. (pp. 30-31)

The computer can provide a more normal interface between the abnormal student and his environment.

Vanderheiden (1981) felt that microcomputers were essential to the proper education of the handicapped. He stated that the "manipulation and exploration important to development may be impossible" without them. Using microcomputers with specially devised and individualized electronic interface devices might provide a means of manipulating objects on a TV screen or in real space. In addition, Vanderheiden pointed out a more direct educational need that can be met by use of CAI. Almost by definition, the handicapped experience a slow rate of coordinated meaningful physical activity. This necessitates extended time for most educational tasks. For example, in a typical classroom discussion, the handicapped student may know the correct answer, but conveying the answer to the teacher may often prove to be too time-consuming for all involved. In addition, such common educational activities as diagramming sentences, working a set of practice math problems, or writing a paragraph would be such monumental tasks that even the most dedicated handicapped student becomes frustrated. As Vanderheiden stated:

> Since the need to see, read and write, take notes, and do independent work are necessary capabilities for receiving an education within our current system, the severely physically handicapped individual who lacks them is at an exreme disadvantage.

Appropriate courseware, coupled with the general tendency of CAI to reduce learning time, has the combined potential to solve many problems experienced by physically handicapped students and their teachers.

It is apparent that, although many "benefits" of CAI are still being debated, this educational medium has much to offer the teacher who is attempting to educate a special needs child. CAI can be relatively inexpensive when compared to its human counterpart, and it appears to be extremely effective in terms of student achievement. CAI is adaptable enough to meet the needs of even the most severely physically involved student, and it is infinitely patient. The major strength of CAI, however, that of reducing learning time meshes precisely with the major weakness of the handicapped student: extended learning time.

ED#229909

REFERENCES

Burns, P. K., & Bozeman, W. C. Computer-assisted instruction and mathematics achievement: Is there a relationship? Educational Technology, 1981, 21(10), 32--39.

Caldwell, R. M. Guidelines for developing basic skills instructional materials for use with microcomputer technology. Educational Technology, 1980, 20(10), 7--12.

Cavin, S., Cavin, E. D., & Lagowski, J. J. The use of microcomputers in college teaching. Educational Technology, 1980, 20(5), [illegible]43.

Chambers, J. A., & Sprecher, J. W. Computer assisted instruction: current trends and critical issues. Communications of the ACM, 1980, 23(6), 332--342.

Clement, F. J. Affective considerations in computer-based education. Educational Technology, 1981, 21(5), 28--32.

Daneliuk, C., & Wright, A. Instructional uses of microcomputers. Education Canada, Fall 1981, pp. 4--11.

Denee, M. Toward defining the role of CAI: A review. Educational Technology, 1980, 20(11), 50--54.

[illegible] Norton, S., Taylor, S., Weiss, M., & VanDusseldorp, R. How [illegible] is CAI? A review of the research. Educational Leadership, [illegible]33, 147--153.

Geoffrion, L. D., & Bergeron, P. D. Initial reading through computer animation. Paper presented at the Annual Meeting of the American Educational Research Association, 1977, New York. (ERIC Document Reproduction Service No. 138 929)

Gleason, G. T. Microcomputers in education: The state of the art. Educational Technology, 1981, 21(3), 7--17.

Goldenberg, E. P. Special technology for special children. Baltimore: University Park Press, 1979

Grinstein, L. S., & Yarmish, R. J. The computer in education: Myth and reality. Educational Horizons, summer 1981, pp. 158--164.

Herbert, M. Microcomputer-assisted instruction: Equal may be better. Business Education Forum, February 1982, pp. 31--33.

Hill, [illegible] A. Computer assisted learning with the physically handicapped. Unpublished master's thesis, University of Manitoba, 1976.

Holmes, G. Computer-assisted instruction: A discussion of some of the issues for would-be implementors. Educational Technology, 1982, 22(9), 7--13.

Jamison, D., Suppes, P., & Wells, S. The effectiveness of alternative instructional media: A survey. Review of Educational Research, 1974, 44, 1--61.

Kulik, J. A., Kulik, C. C., & Cohen, P. A. Effectiveness of computer-based college teaching: A meta-analysis of findings. Review of Educational Research, winter 1981, pp. 525--544.

Lewellen, L. Computers in the classroom. Journal of Educational Data Processes, 1971, 8, 3[illegible]8.

Magidson, E. M. One more time: CAI is not dehumanizing. Audiovisual Instruction, October 1977, pp. 20--21.

McIsaac, D. N., & Baker, F. B. Computer-managed instruction system implementation on a microcomputer. Educational Tehcnology, 1981, 21(10), 40--46.

Meyen, E. L. Exceptional children and youth: An introduction. Denver: Love Publishing Co., 1982, p. [illegible].

M[illegible], G. [illegible], & Stonier, T. T. Trends and prospects for microcomputer-based education. International Journal of Man-Machine Studies, 1982, 17, 143--148.

Papert, S. Testimony to the House Committee on Science and Technology; Special Sessions on Utilization of Computers in Aiding the Education of the Handicapped 95th Cong., 1st sess., 1977., Washington DC: U.S. Government Printing Office, 1977.

Schwartz, L. L. The exceptional child: A primer. Belmont CA: Wadsworth Publishing Co., 1975; pp. 41--46.
Skyrme, D. J. The evolution of graphics in CAL. Computers & Education, 1982, 6, 13--24.
Steinberg, E. R. Review of student control in computer-assisted instruction. Journal of Computer Based Instruction, 1977, 3, 84--90.
Stevens, D. J. Computers, curriculum and careful planning. Educational Technology, 1981, 21(11), 21--24.
Thorkildsen, R., & Williams, J. Handicapped and special education. In Topics Computer Education for Elementary and Secondary Schools. New York: The Association for Computing Machinery, 1981.
Vanderheiden, G. C. Practical applications of microcomputers to aid the handicapped. Computer, January 1981, pp. 54--61.
Vinsonhaler, J., & Bass, R. A summary of ten major studies of CAI drill & and practice, Educational Technology, 1972, 12(7), 29--32.
Watts, N. A dozen uses for the computer in education, Educational Technology, 1981, 21(10), 18--22.

ALTERNATE INTERFACE DEVICES FOR THE PHYSICALLY HANDICAPPED

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In order to meet the needs of students having a broad range of physical limitations, a variety of interface devices and techniques have been acquired and developed by the staff at the Shrine School in Memphis. Several of these, along with a brief description and perceived advantages and disadvantages of each, follow.

INTERFACE DEVICES

Time Delay Keyboard

This is a software routing that provides the user with the option of typing a single character and then having the computer wait a preselected amount of time before that character is actually accepted as input. One feature of the Apple II computer is a keyboard strobe that goes high when any key is pressed. Once a key is pressed, the appropriate character is displayed, and control is shifted to a timing loop. This loop also polls the keyboard strobe so that, if another key is pressed before time is up, the displayed character can be replaced by the new character. The timing loop is then reinitialized and subsequently reentered. If the timing loop is not interrupted, a tone sounds, and the outer loop prepares to receive the next character.

Advantages. This technique reduces frustration experienced by students who know the correct answer but who frequently press the wrong key due to some physical problem.

Disadvantages. If not needed, the extended time required for input using this technique can be frustrating.

Keyguard

This device allows the user to rest a hand on the keyboard and type with one finger. To activate keys, the user must poke a finger (or some type of pointer) through the appropriate hole and depress a key. Provision is also made for using the shift and control keys. (Prentke-Romich Co, 8769 Twp Rd 513, Shreve, Ohio, 44676. Price: $110.) Also available soon from COPH-2, 2030 West Irving Park, Chicago, Illinois, 60618. Price: approximately $25.)

Advantages. (Advantages and disadvantages listed are for the P-R version only.) This device appears to work as advertised.

Disadvantages. The cost seems somewhat high. In addition, when mounted on the keyboard, the device may tend to block the view of the user so that symbols on the keys can not be seen. Some difficulty is encountered while installing or removing the device; although this is not a major barrier, it could pose a problem for the exact population for whom it was designed.

The Magic Keyboard

This device is a small circuit board (with four chips) that plugs into the socket on the Apple motherboard, which normally takes the cable from the keyboard. The keyboard cable in turn plugs into the Magic Keyboard circuit board. With this device the user has the option of using the Apple keyboard with keys in their normal pattern of arrangement or of using one of several alternate arrangements. Included among the alternate formats available are two formats designed for people having the use of only one hand. These two formats (one for right hand and one for left hand) are specifically designed to allow easy access to the most commonly used keys. Several numeric keypad formats are provided, as are stickers for the user to place on the keys indicating their alternate functions. Provisions are also made for acquiring custom-designed formats for specific needs. (Southern California Research Group, Box 2231, Goleta, California, 93118. Cost: $90.)

Advantages. This device is appropriate for those students with limited arm and hand movement. Any modified keyboard can be changed back to the standard Apple with a single switch.

Disadvantages. This device requires slight modification to the existing Apple motherboard, which may discourage some users.

Presfax-100 Touch Key-Pad

This device consists of a 10 by 10 matrix of 1 1/4-inch-square switches mounted on a thin board. Interface to the computer is achieved by a ribbon cable that connects to the Apple's game input and output socket. In addition, a disk of software useful in demonstrating and calibrating the keyboard is included. The board's driver is a machine language routine that, when a key is pressed, produces a tone and returns the number of the key, as well as its x and y coordinates. In operation, the board is normally covered with a paper overlay that assigns values to the keys. Software must be specific to the overlays. For example, if key number 1 is pressed, this information is passed to the main program by the machine language driver routine. It is up to the main program to decide whether the key pressed represented a number, letter, or picture on the overlay and to make the appropriate response. (Computer Data Services, Box 696, Route 122, Amherst, New Hampshire, 03031. Cost: $95.)

Advantages. The large keys encourage easy access and are activated by light pressure. This device is extremely adaptable in terms of presentation format and subject level. It is relatively inexpensive and probably more adaptable than expanded keyboards.

Disadvantages. The Presfax-100 must be "recalibrated" periodically, and software must be designed specifically for this device, even for specific overlays.

Switches

The Apple Computer supports three switches through its game input and output socket. There are a variety of ways to make use of the switches. The "ping-pong" switches demonstrated are momentary (normally open) switches constructed by the University of Tennessee Rehabilitation Engineering Center. The Brow Wrinkle Switch (from Trace Research and Development Center for the Severely Communicatively Handicapped, University of Wisconsin, Madison, 314 Waisman Center, 1500 Highland Avenue, Madison, Wisconsin, 53706, price about $40) is essentially a reed switch that closes when moved into the field of small magnet by a wrinkled brow. Switches are usually used in either a single- or multiple-switch format.

Single switch. Typically, when a single switch is used, a line of words, letters, or numbers by which a pointer passes is displayed. When the pointer indicates the appropriate letter or word, the switch is depressed by the user. The software "knows" which word or letter was being indicated and acts accordingly. In a more complex situation a matrix of words, letters, or numbers is presented in the initial display. The pointer is programmed first to move down, pointing at each successive row until a switch is pressed. At this point the pointer moves across the selected row until the desired column is reached, at which time the switch is again depressed. This method of input provides for a larger choice of items, with but a slight increase in input time.

Multiple switches. Usually with this input mode some form of multiple-choice problem is presented, and the student hits the left switch, for example, to indicate the left-most choice or the right switch to indicate the right-most choice.

Advantages. Switches are easy to build and use, and are usually quite adaptable to a student's physical limitations. They are relatively inexpensive, and easy to support with software.

Disadvantages. The Apple computer is designed to support three switches, and this may not prove enough in some applications.

Optical Strip Printer

The optical strip printer (OSP) was designed as a communication device for individuals with little physical control other than in the head and neck regions. A sensor attaches to the user's head and is pointed to the OSP in order to "type" a message on a paper strip. The OSP also features an interface port through which it can be attached to the Apple computer through a serial interface card. When so configured, the Apple interprets characters typed on the OSP as originating on its own keyboard. (Prentke--Romich)

Advantages. This device provides an efficient interface method for users who are extremely physically involved but who are mentally capable of using the input potential that a full keyboard offers.

Disadvantages. Software must support the device. Because most commercially available software packages are read-protected, alterations could pose problems. Some commands (GET in Applesoft, for example) are not permitted, as is the simultaneous use of two keys (e.g., control C).

CONCLUSION

It is the hope of the staff at the Shrine School that material discussed, while by no means exhaustive of the topic, will at least serve as a springboard for further exploration and creativity in the area of relatively inexpensive alternate interface devices for the physically handicapped.

CRITICAL LEARNING:

MULTIPLY HANDICAPPED BABIES GET ON-LINE

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INTRODUCTION: EARLY LEARNING AND COMPUTERS

Severely physically handicapped infants and toddlers are usually motorically limited in the amount of interaction that they can have with their environment. This may limit their learning, causing secondary handicaps and thus creating an even more handicapped individual. This cycle can possibly be broken by using a microcomputer to restore some opportunities for environmental interaction.

The early years are vitally important for conceptual and language development. Kephart states that all knowledge is built on the infant's motor experimentation on the world around him (Goldenberg, 1979). Without that motor information the child is unable to attach meaning to his world. Similarly Piaget states that "knowledge is derived from action . . ." (Goldenberg, 1979, p. 41). These individuals are joined by many others in reciting the importance of early motor actions and environmental manipulations to develop knowledge bases. Ruder, Bricker, and Ruder (1975) show that Bruner, Piaget, and Inhelder reach the same conclusion in reference to language development. Language is a symbol system and the child must know how to manipulate symbols before language is possible. To achieve symbolization, manipulation of the objects that these symbols represent is necessary.

The question is raised by Goldenberg as to the level of motor interaction necessary to obtain the sensorimotor experiences needed (1979). He points out that some severely motorically handicapped individuals reach high levels of cognitive development, and suggests that active control over the environment may not be necessary but that these individuals are receiving feedback from their surroundings in some other form. He proposes the possibility of "remote control" manipulation as an adequate experimentation method for conceptual development.

The inability to act on the environment creates a second handicap for a child because it does not allow the normal experiences needed for acquiring information (Goldenberg, 1979). If these secondary handicaps can be prevented, intervention should begin at an early age to take advantage of critical learning periods. The prevention of lags in conceptual development will facilitate language development, providing a good base on which to build. The microcomputer and the related technology can be utilized in this prevention process. It can provide a reliable means for an infant to control and manipulate the world and explore as nonhandicapped children do (Vanderheiden, 1981).

Technology For Learning

The ability to interact with one's environment is probably essential to the learning process. Although the process of vicarious learning has been published in the research literature (Bandura, 1963), to assess learning, it is necessary for an interactive behavior to occur on the part of the child.

Microcomputer-based technology is providing the means to maximize children's ability to interact with their environment (i.e., respond to or initiate an observable action) as well as provide a means to evaluate systematically the consistency and accuracy of those interactions, even though they may be insignificant to the observer. There are three areas in which technology can significatly affect learning by enhancing environmental interactions of the child: communication, environmental control, and environmental manipulation. These three "domains" must be woven together in order to equip teachers and parents with the means to "teach" these children to function at their fullest potential.

Communication. Communication can be considered one of the most basic forms of environmental interaction. Typically it begins within the first year of life for handicapped and nonhandicapped individuals. Defining communication as the transmitting of a message with two necessary components: the intention of the sender to transmit and a receiver who intends to receive and understand that message (Bryen, 1982), the nonhandicapped child soon has an advantage in the ability to learn verbal language, the most efficient mode of communication. Many handicapped children are delayed in their ability to learn verbal language and some never learn it at all. Additionally, ability to interact nonverbally may be severely limited. The inability to communicate efficiently and rapidly creates setbacks in learning, inhibiting experimentation with the environment. The technology is available to give individuals efficient modes of communication that do not rely on verbal abilities. Thus, a nonverbal child can communicate (and thus interact with the environment) through auditory means (including voice synthesis), physical movements, and symbols (pictures or words).

Environmental control. The category of environmental interaction includes the physical manipulation of the environment, such as the turning on and off of electrical toys and appliances. Children with limited motor abilities miss out on these life experiences and often must depend on others to perform the tasks for them. Again, the technology is available to return to them that lost independence. Inexpensive home controllers are readily available for adult consumers. Remote control or program control devices can electrically regulate such things as heat, burglar alarms, phone-answer machine, and house lighting. These same devices, combined with thoughtful programming, can allow the young handicapped child to be in control of such developmentally appropriate tasks as turning on the TV or radio, and operating electrical and battery-operated toys.

Environmental manipulating. The category in which devices or mechanisms are available for environmental manipulation is robotics. Robots can fulfill single or multiple functions including communication and environmental control. However, physical manipulation of the environment is probably the most important aspect of the robot. A robot can become an extension of the individual by extending the child's accessible environmental space with a mobile, multidirectional arm that will allow the child to manipulate objects within the environment. As technology improves, the capabilities for providing meaningful, appropriate, and controlled experiences for young handicapped children through robotics will increase too.

Developing Parameters for Using the Computer

Campbell, Bricker, and Esposito voice a number of concerns in using technology with severely handicapped individuals (1980). First are the concerns about using technology as an end rather than a means to higher-level development. The use of the computer to provide environmental control for the purpose of building a conceptual information base surely minimizes that concern, as long as efforts to direct that learning are systematic and individually monitored. A second concern involves finding meaningful, motivating, and relevant consequences that will take control of the behavior. Many young and severely handicapped individuals have learned to be helpless, and finding consequences strong enough to overcome that behavior, while still avoiding satiation and extinction, is a real challenge. This challenge is shared by all educators of the severely handicapped whether using microcomputers or not. The flexibility of the computer can help meet that challenge. A third problem is the lack of ability to generalize skills that have been taught in fixed or contrived situations. Again a systematic plan for bringing the technology into the classroom and home is necessary.

An additional concern (Campbell et al., 1980) is that children, functioning in the primary circular reaction stage of cognitive development, will be unable to generalize; repetition of new experiences is for the sole purpose of reproducing the same experience. During this stage, however, variations in schemes are developed to new stimuli. Schemes become coordinated as functional relationships are realized, and perceptual recognition is achieved through the repetition of actions (Philips, 1975). These stage characteristics do not rule out the use of computers, but suggest a valid research area of looking at specific cognitive levels and their affect on computer interactions. Brinker and Lewis (1982) have used microcomputers to demonstrate that handicapped infants (CA 3 to 5 months and MA 2 to 5 mos.) can learn cause-effect relationships.

PILOT RESEARCH

Description of the Population

Two phases of a pilot research project have been conducted using students from a county health infant stimulation program. The program is governed by a nonexclusion [illegible] thus these students range in abilities from "at risk" or mildly hand[illegible] severely multiply handicapped. Ages range from birth through 30 [illegible] which time they enter the public school system. The initial re[illegible]ked [illegible] five students; three were 11 to 14 months and nonhandicapped, [illegible] two older multihandicapped children were 25 to 27 months (Behrmann & Lahm, 1982).

The second phase, not yet completed, is looking at older handicapped children. The subjects were selected because they will soon move into the public schools and thus will not be candidates for further research. These second-phase subjects can be divided into two groups: mildly and multiply handicapped.

Description of Equipment

Equipment includes an Apple II+ microcomputer, Votrax Type 'N Talk voice synthesizer, a color TV monitor, and various custom-made switches as input devices. Efforts are being made to use only readily available commercial hardware to allow for replication of the program at other facilities. Inexpensive, easy to make switches can be custom-made, or commercially available switches can be substituted.

The second phase of the pilot research project examines the parameters (motor, language, and cognitive developmental levels) for using the microcomputer to establish cause-effect relationships. The entire project looks at eight levels of use, ranging from the establishment of a cause-effect relationship to the use of a menu-driven program for initiating environmental interactions. Software is developed to fit individual needs. Objectives, response cues, screen diagram, and measured variables for each level are shown in Table 1.

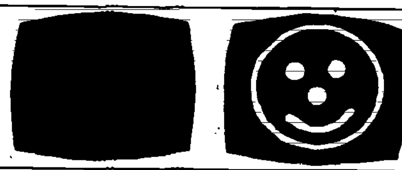
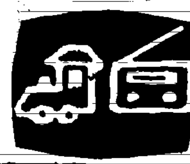
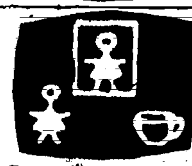
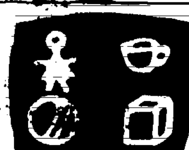
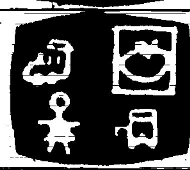
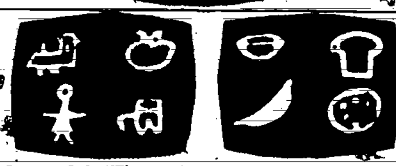
At level 1, the objectives are to assess the needs of the individual child regarding what type of switch to try, based on the child's available response repetoire, and what program adaptations are required for visual or hearing impairments. Objectives at level 2 are aimed at teaching the child to activate the switch that allows the making of choices among items displayed on a computer screen. It is important that the child understand the cause-effect relationship between switch and choice. In levels 3 through 6, the child is required to use the switch to actually choose a toy or a kind of food from several displayed on the screen. The picture on the screen is gradually made more ambiguous which allows for increased flexibility and encourages vocabulary development. There is also an increase in the number of pictures or options presented as the child proceeds from level three through level 6. The end result provides a system of categorizing choices that facilitates communication of specific responses or choices (levels 7 and 8). Table 1 relates the response cue or the command given to the child at each level. The format of the computer screen is also shown to illustrate the amount of information given to the child at each level. The column labeled variables simply lists the kind of information the program is collecting for further analysis.

Two kinds of feedback are given to the child when the switch is activated. Level 2 replies to the child's response by immediately displaying a fun, rewarding picture with an auditory response. Levels 4 to 6 use that same response reward when the child chooses the correct picture. These rewards are randomly generated to avoid satiation. In levels 3, 7, and 8 the computer rewards the child with a direct action; i.e., it turns on or activates the object of the choice for a short period. These three levels utilize the concept of the child directly controlling environment.

PRELIMINARY RESULTS

The first three levels of the project (assessment, cause-effect, and concept of choice) have been implemented to date with 10 infants and toddlers.

TABLE 1

	OBJECTIVE	RESPONSE CUE	SCREEN DIAGRAM	VARIABLES
1	assess needs	N/A	N/A	position switch program needs
2	establish cause/effect relationship	voice "press the switch"		response time average time
3	teach concept of making choices	teacher asks "which do you want to play with?"		monitor response times frequency of choices
4	select between 2 options of abstract pictures	voice/teacher "find picture" plus visual cue		response time no. correct
5	select between 2 options of abstract pictures	voice/teacher "find picture"		response time no. correct
6	select between 4 options of abstract pictures	voice/teacher "find Picture"		response time no. correct
7	select between 4 options of environmental controls	Teacher asks "what do you want to do?"		response time frequency of responses
8	select between 4 main categories to find new 'pages' of choices	teacher asks "what do you want to do?"		monitor response times frequency of responses

Level 2 results are shown in Table 2 and 3. The 10 subjects evaluated on this level can clearly be divided into two groups. Table 2 represents a group of children whose Early Learning Accomplishment Profile (ELAP) scores indicate functioning levels from 55 percent to 77 percent of their chronological age. These children in general are more mildly handicapped and able to perform the level 2 task without assistance (i.e., minimal positioning and adaptive equipment). Table 3 represents a lower functioning group. Their ELAP scores are significantly lower, showing functioning levels from 6 percent to 15 percent of their chronological age. In general, the children in Figure 2 were multihandicapped, including severely motorically handicapped and sensory impaired. They required a great deal of teaching and assistance (positioning and adaptive equipment, prompting) to perform the task at this level.

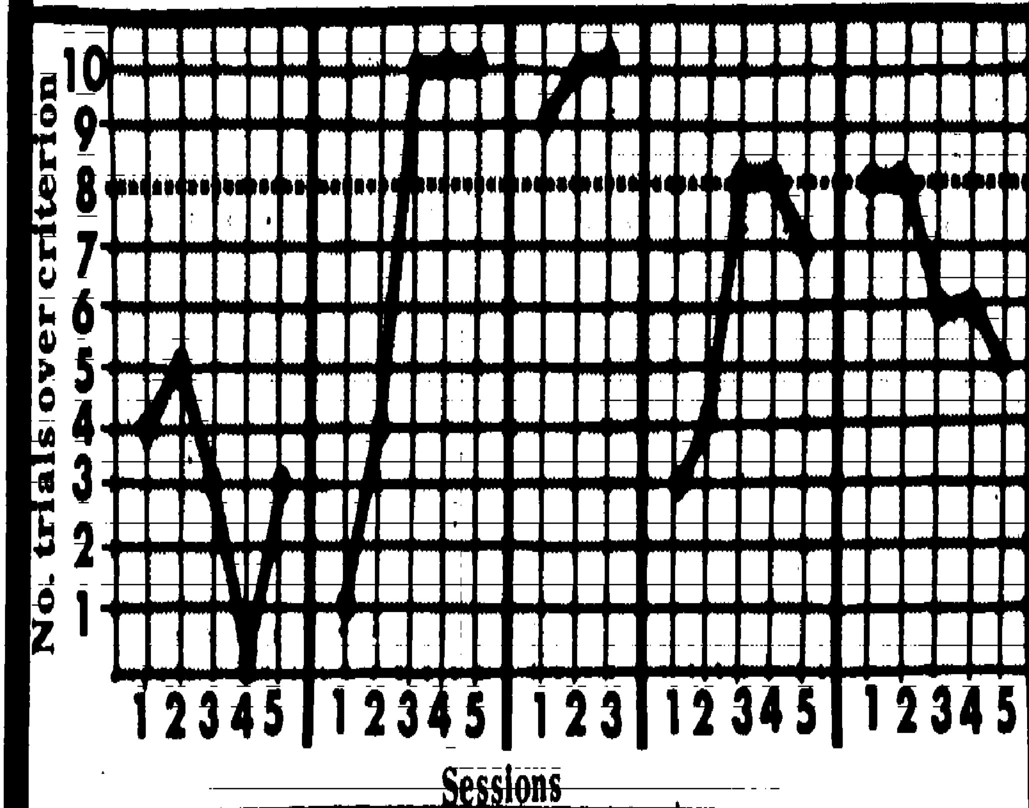
Of the five mildly handicapped children represented in Table 2, two of them met a criterion of responding in 5 seconds or less; 80 percent of the time, over three or four sessions. Two other children are close to that criterion but are showing a deterioration of response time. The fifth child, although never close to criterion, shows this same deterioration of response. In all cases the researchers immediately noted that the five children in Figure 1 apparently understood the task, but with the last three children interest was lost and other aspects of the testing environment became more attractive (e.g., knobs on the TV, other people present). It was concluded that if the program were more highly motivating, they too would reach criterion rapidly.

The five multihandicapped children represented on Table 3 depict clearly different results. The two that reached criterion were the first two subjects and took part in the initial pilot work. Their scores are comparable to the others because the computer program and testing situations were essentially the same. However, no ELAP scores were collected for them. Their level 2 results are similar to those of the more mildly handicapped children in Table 2. However, each of these two subjects were severely limited due to their multiple handicaps. The other three children have not yet come close to criterion. Subjectively, the researchers have noted that on most trials the subjects appear to make an effort and show an understanding of the task, but are unable to perform to criterion. This raises questions about expected levels of performance and response times that are realistic for severely multihandicapped children. It also brings into question how well level 1 assessment addresses optimal positioning, switch selection, and program adaptation.

Table 4 compares the ELAP scores of the two subjects who met criterion and two who come close to meeting it. This comparison is the first attempt to look at the motor, language, and cognitive levels of successful children and to identify parameters for success. Four subjects are clearly not enough to make statements about predictors of success but it is a beginning. Approximately 80 subjects will be evaluated during the next stage of research.

Only one subject tested on level 2 advanced to level 3 of the program (teaching the concept of making a choice). Table 5 shows this subject's performance on level 2, and Table 6, on level 3. A clear trend toward a faster, more consistent level of responding in choosing between two toys is seen. Observations of the child's behavior indicate an understanding of the connection between the scanning indicator and making the choice using the switch. Because it is not possible to measure the correctness of choices when given a free choice, the child's accuracy of choosing is not reported. It is interesting to note that, even though the child reached a more stringent criterion for response time in level 2, the response time in level 3 is slower. No criterion was set at this level even though it was monitored. Free-choice decisions did not have a time restraint attached and therefore were not measured. The increased response

TABLE 2



No. trials over criterion
10
9
8
7
6
5
4
3
2
1
1 2 3 4 5
1 2 3 4 5
1 2 3
1 2 3 4 5
1 2 3 4 5
Sessions

TABLE 3

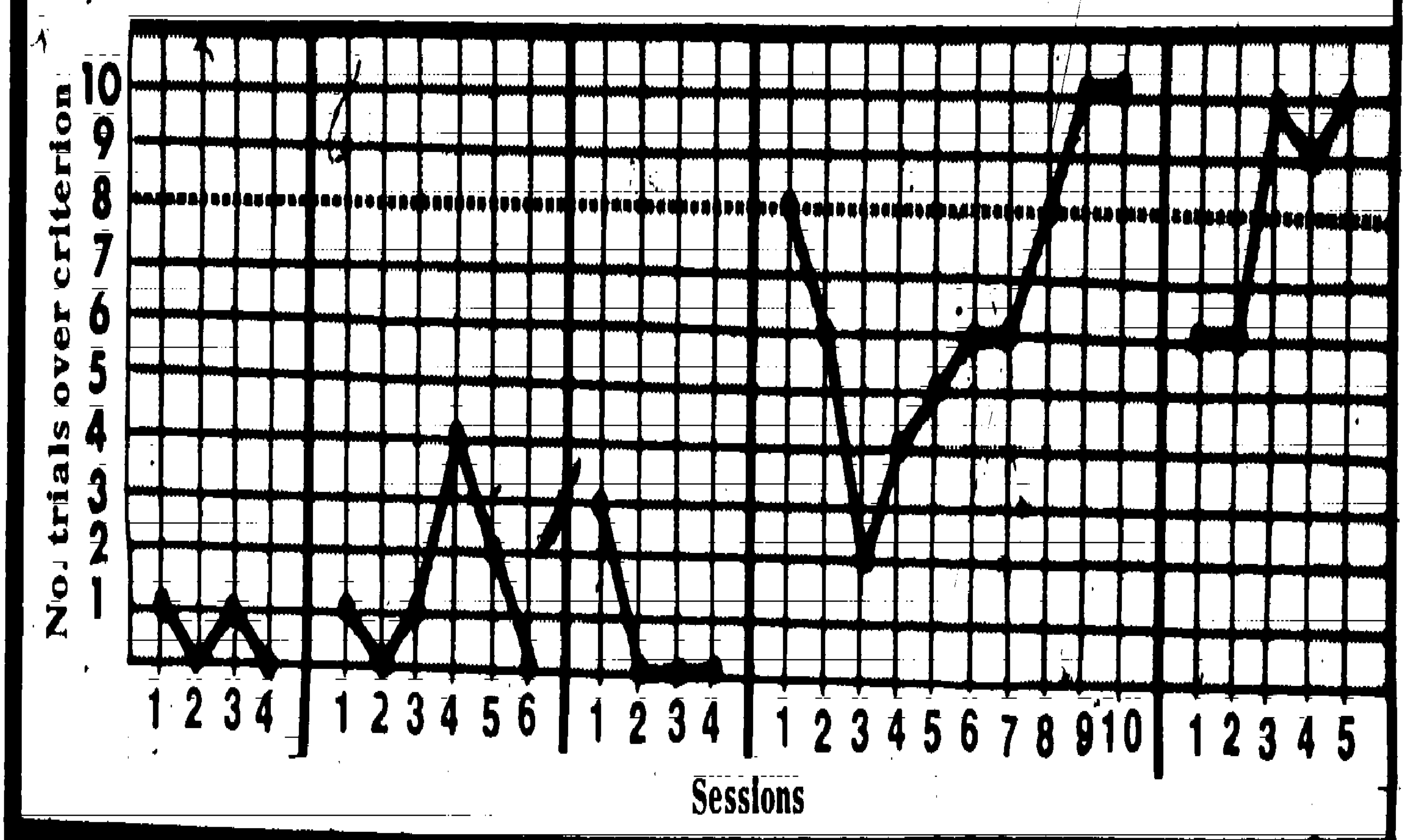
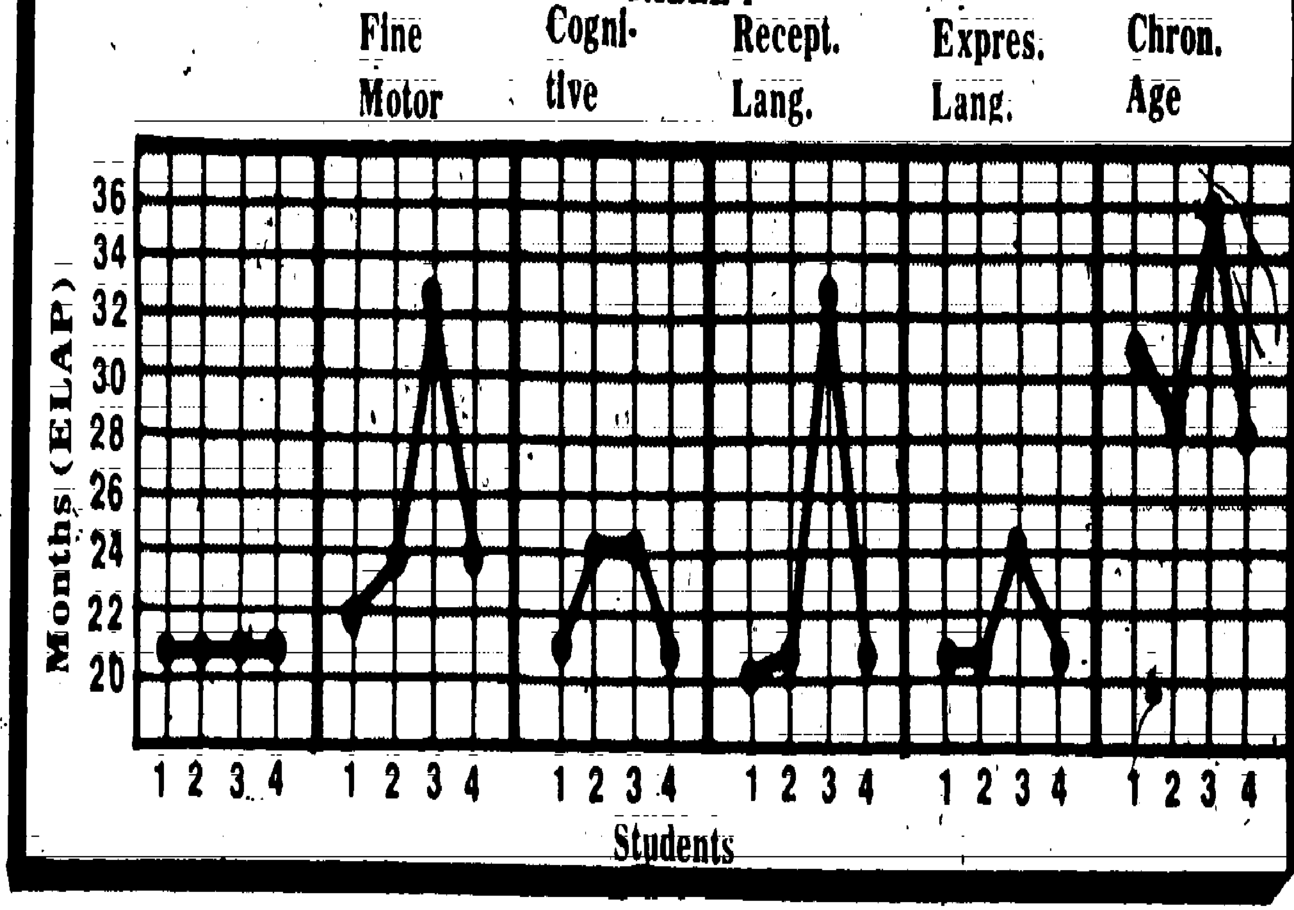

No. trials over criterion
10
9
8
7
6
5
4
3
2
1
1 2 3 4
1 2 3 4 5 6
1 2 3 4
1 2 3 4 5 6 7 8 9 10
1 2 3 4 5
Sessions

TABLE 4


Fine Motor
Cognitive
Recept. Lang.
Expres. Lang.
Chron. Age
Months (ELAP)
36
34
32
30
28
26
24
22
20
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
1 2 3 4
Students

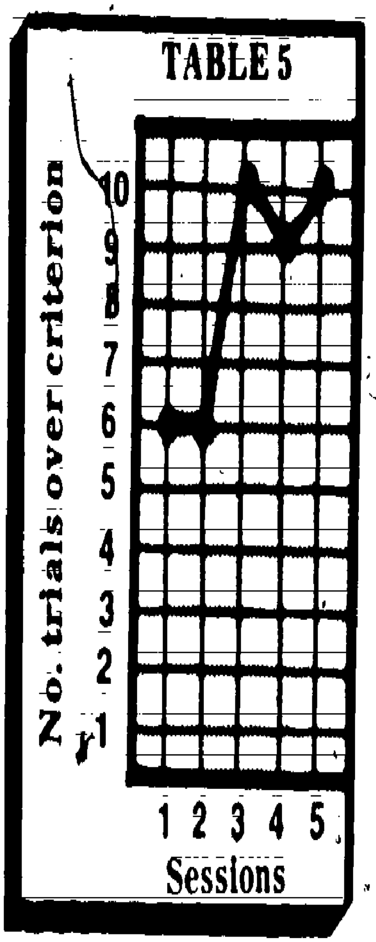


TABLE 5
No. trials over criterion
10
9
8
7
6
5
4
3
2
1
1 2 3 4 5
Sessions

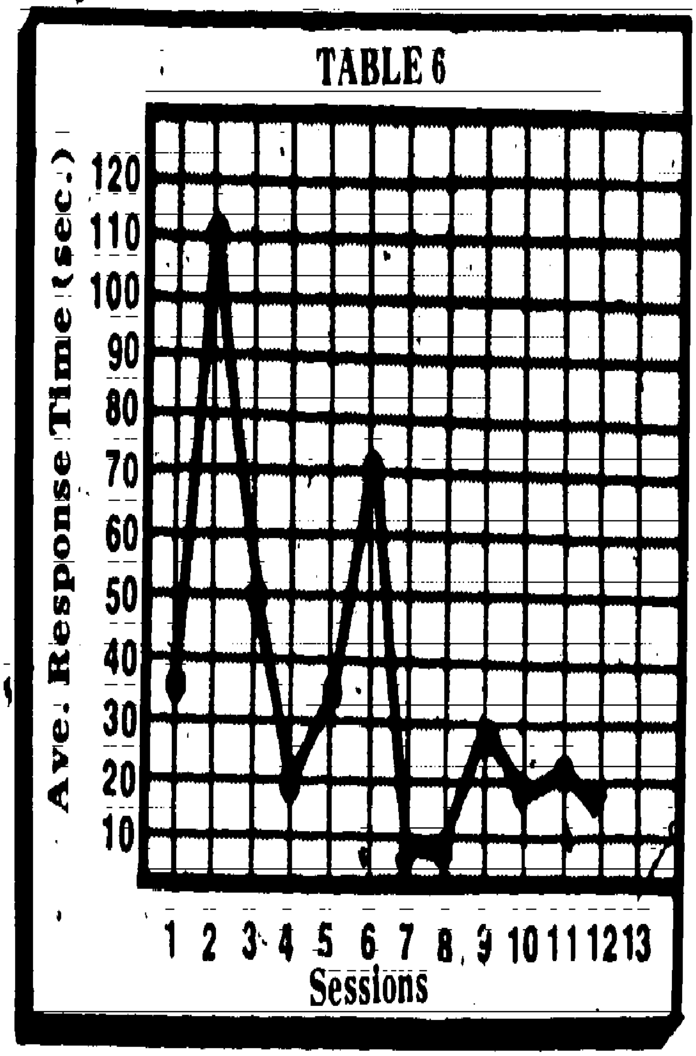


TABLE 6
Ave. Response Time (sec.)
120
110
100
90
80
70
60
50
40
30
20
10
1 2 3 4 5 6 7 8 9 10 11 12 13
Sessions

time is attributed to the mental process of decision-making and the amount of time involved for the indicator to scan the two choices. The objective at level 3 was not to decrease response time, but rather to improve understanding of the concept and functional use of making choices.

Discussion

The research conducted thus far has begun to answer some basic questions about the ability of infants and toddlers to interact with microcomputers. It appears that they understand the cause-effect relationship between the computer screen and their control switch. It also appears that their response time can become adequate and consistent.

After looking at the two distinct groups of handicapped children used in this study, the question of what is an appropriate response time needs reevaluation. Subjectively, it has been noted that the lower functioning group appears to understand the cause-effect relationship, which is the prerequisite for using a computer system to control the environment functionally. However, the data also indicates that these children may never reach preset criterion of five-second response times. The appropriateness of the criterion must be evaluated before deciding whether the lower functioning group can benefit from the computer system.

The major question that remains in regard to level 2, is the identification of success indicators or parameters using developmental levels or scores from the ELAP. This question will be analyzed more completely when more subject data are available. Once identified, appropriate parameters will be chosen for selecting individuals who will continue through level 8 of the program.

IMPLICATIONS FOR FURTHER RESEARCH

The research design and results discussed in the previous sections represent only the beginning state of the technology applications research planned. Level 1 and 2 data, when evaluated for approximately 80 children, should provide indicators as to which multihandicapped children will benefit most from this type of training.

Levels 3 to 8 of the project will provide a systematic training approach to teach developmentally disabled young children to utilize microcomputer technology effectively to interact with their environment. The technology involved includes use of an Apple II+ computer, voice synthesizer, environmental control mechanism (BSR X-10 controller), and robotics (Heath Hero-1). These combined technologies will be programmed so that the child will be able to select options from a menu. The selection of an option will then be translated into an interaction with the child's environment in a preprogrammed format using one or more of these technologies.

On reaching level 8, a child will be able to select from a variety of categories: robot, communications, environmental control. From these categories additional choices will be available (i.e., robot to get X toy or robot get teacher).

The general purpose of the project is to apply commercially available technology that is relatively inexpensive to the learning needs of developmentally disabled young handicapped children. Technology is growing at an almost incredible pace, but the technology and need are present, and the wait for something better may never end. The robot which is being used in the project was not available 6 months ago. It may well make some of the hardware obsolete almost before the project starts. This robot can "see," "hear," move about, manipulate objects, and turn switches off and on. Thus, it may have already removed the necessity of an environmental controller and voice synthesis communication. What has NOT changed, though, is the need to systematically train handicapped individuals to use technology that can benefit them.

Systematic training can be done in such a manner that the technology, and application can change while the "format and interaction mechanism" between the handicapped individual and the technology remains the same. One of the major problems is training severely and profoundly handicapped persons to generalize from one situation to another. The potential is there however, for developing a format that enables individuals to make choices.

It is hoped that the capabilities of microcomputer systems to extend environmental interactions to infants of limited motor abilities will provide them with the consistent control of their environment necessary for normal concept development. This, in turn, should affect the language development, self-concept development, ability to communicate, and social interactions. By developing these skills at normal developmental ages, it is hoped that secondary handicaps will be prevented. As skills advance, the technology can advance with them, always giving them appropriate opportunities for interaction and communication. Ultimately, these children will have the capacity to reach outside their immediate environment by using telecommunicaton networks. This will enable them to transmit information or communicate with others through telephone and television lines.

The findings of this research should have an impact on other populations of handicapped individuals in addition to those who are physically handicapped. It can have direct application to all individuals who have a mental age in the range of 0 through 30 months, as studied in this project. Mentally handicapped individuals who have additional physical handicaps should also be able to utilize a similar approach regardless of their age.

ED#232330

REFERENCES

Blaszczyk, H. J. Computing and the handicapped: The challenge in education. Computer, January 1981, pp. 15-17.

Brinker, R. P., & Lewis, M. Making the world work with microcomputers: A learning prosthesis for handicapped infants. Exceptional Children, 1982, 49 (2), 163-170.

Bryon, D. N. Inquiries into child languages. Boston: Allyn & Bacon, 1982.

Campbell, P. H., Bricker, W. A., & Esposito, L. Technology in the education of the severely handicapped. In B. Wilcox & B. York (Eds.), Quality Education for the Severely Handicapped, Washington DC: U.S. Dept. of Education, 1982, pp. 223-246.

Goldenberg, E. P. Special technology for special children. Baltimore: University Park Press, 1979.

Jones, R. L. Special education and the future: Some questions to be answered and answers to be questioned. In M. C. Reynolds (Ed.), Futures of education for exceptional students: Emerging structures. Reston VA: The Council for Exceptional Children, 1978, pp. 65-87.

Kornbluth, M. Application of technology to handicapped individuals: Process and issues. In The proceedings of the IEEE Computer Society Workshop of the Application of Personal Computing to Aid the Handicapped. Long Beach CA: IEEE Computer Society 1980, pp. 5-10.

Phillips, J. L. The origins of intellect: Piaget's theory. San Francisco: W. H. Freeman & Co., 1975.

Proceedings of the Johns Hopkins First National Search for Application of Personal Computing to Aid the Handicapped. New York: IEEE Computer Society Press, 1981.

Rahimi, M. A. Intelligent prosthetic devices. _Computer_, January 1981, pp. 19-23.

Ruder, K., Bricker, W. A., & Ruder, C. Language acquisition. In J.J. Gallagher (Ed.), _The application of child development research to exceptional children._ Reston VA: The Council for Exceptional Children, 1975.

Vanderheiden, G. C. Practical application of microcomputers to aid the handicapped. _Computer_, January 1981, pp. 54-61.

MICRO-BASED SPEECH RECOGNITION: A INSTRUCTIONAL INNOVATION FOR HANDICAPPED LEARNERS

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> There is an apparent need to develop and implement policy to guide the application of information and communications technologies to all levels of education. Full advantages of the socially desirable educational opportunities offered by a broad range of technologies must be pursued to increase intellectual productivity and enhance the quality of life.
>
> Hon. George E. Brown, Jr. (1979)

VOICE INPUT AND THE HANDICAPPED LEARNER

With over 20 million handicapped persons in the United States, there is no one user-profile describing the special needs learner. The most common characteristic shared by disabled persons, however, is the difficulty and often inability to communicate with other people in a meaningful way. The need for basic communication skills, which are highly personal and individualized, becomes intensified when the range of physical functions decreases. Until recently, physically handicapped individuals have needed a range of motion to access a computer's keyboard (or an extended keyboard) using a finger, a mouthstick, headstick, toe, etc. Effective computing, whether for communication enhancement, environmental control, or instructional purposes, was dependent on the speed and accuracy of user motor skills. All expressive thoughts were translated into keyboard manipulations of some description.

The VBLS™ voice-based learning system, which was designed for able-bodied and physically disabled student-users, may be run with no user keyboard entry whatsoever. The VBLS system reviewed in this article is a low-cost, speech-controlled authoring system. The system takes drill and repetition learning beyond relative linguistic competence. The VBLS word verification algorithm for speech recognition encourages communicative competency within a specific context, regardless of reading level or speech disorder.

SPEECH RECOGNITION

Speech recognition (voice recognition) is the computerized process of identifying a spoken word or phrase by matching an unknown utterance to a number of known utterances and selecting the closest match within prescribed tolerances. The basic logic of a speech recognition system involves processing an acoustic waveform with a filter bank, a linear predictive coding (LPC) analysis, or zero-crossing analysis to extract spectral data. Templates of the resulting digital data are then stored and become the active vocabulary or language model for the spoken words or phrases.

Recognition itself occurs when a search and match is made between newly input speech and existing vocabulary templates. The matching or mapping process varies with the recognition algorithm being used. Figure 1 illustrates the schematic logic of a speech recognition system.

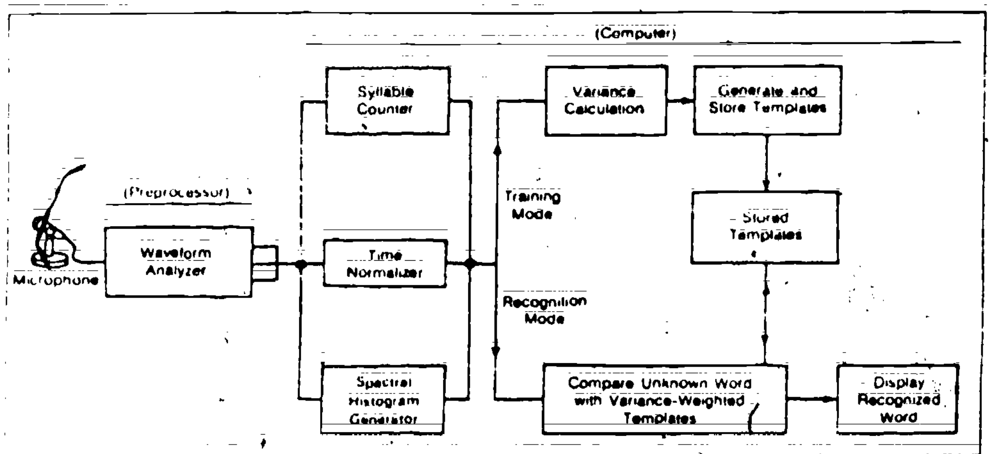


Figure 1

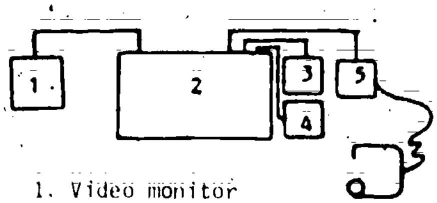
Speech recognition technology can be cost-effectively used in numerous applications, including data entry, hands-and-eyes busy tasks, distant or mobile inputs, data verification, or when data perishability is a problem. Voice-entry terminals enable severely physically handicapped individuals to operate a computer by speaking to it in any language. Applications specific to disabled persons are most frequently expressive communication aids or environmental control systems, wherein the handicapped user directs several microcomputer-based electronic devices by voice commands (see Figure 2). Aside from facilitating environmental control, speech recognition technology is providing innovative educational opportunities for the physically handicapped. Voice makes many electronic instructional aids, previously inaccessible to the physically disabled, available for special education. Such voice-controlled devices actively involve handicapped learners in their own educational and vocational progress.

Research and Development Activities

Task. The task of the VBLS project is to develop voice-based learning system for noncomputer-oriented users, with voice input and system acceptance essentially instantaneous.

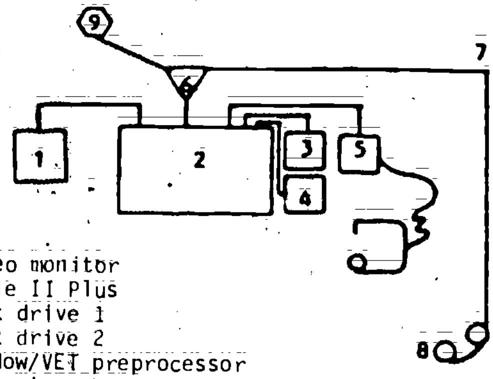
Objective. The objective is to research, develop, design, and market a low-cost, speech-controlled authoring system to meet educational needs of

CONFIGURATION 1



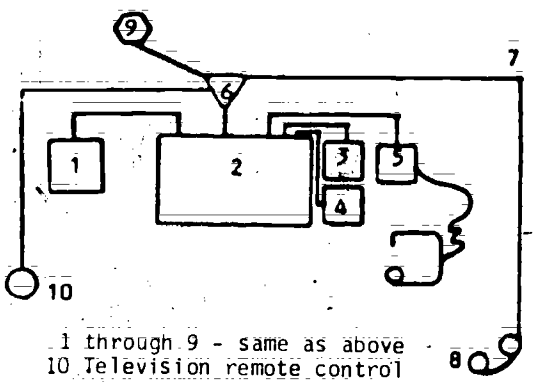
1. Video monitor
2. Apple II
3. Disk drive 1
4. Disk drive 2
5. Shadow/VLT preprocessor with microphone

CONFIGURATION 2



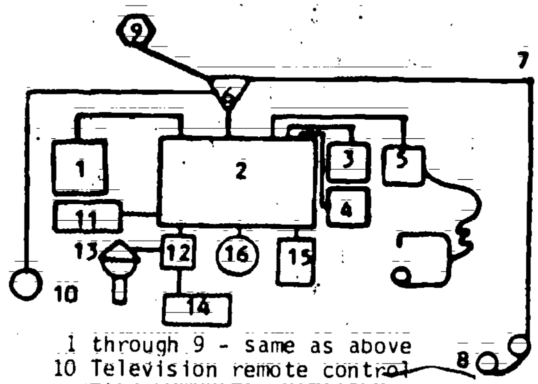
1. Video monitor
2. Apple II Plus
3. Disk drive 1
4. Disk drive 2
5. Shadow/VET preprocessor with microphone
6. Novation AppleCAT expansion module
7. Phone line
8. Telephone headset
9. Novation A/C control

CONFIGURATION 3



1 through 9 - same as above
10 Television remote control with computer interface

THE C2E2 SYSTEM



1 through 9 - same as above
10 Television remote control with computer interface
11 Speaker
12 Power control
13 Lamp
14 Radio
15 Printer
16 Switches for push-button control

Figure 2. THE VBLS VOICE-BASED LEARNING SYSTEM

physically handicapped and able-bodied learners that will reinforce learning through pronunciation of correct responses. The resulting courseware would enable nonbiased, nondiscriminatory tutoring, reviewing, and testing of handicapped and non-handicapped student populations.

Rationale, Pronunciation, and Meaningfulness. The instructional technology of the VBLS system is a systematic method for designing educational materials that incorporate an innovative communication medium: speech recognition. The relationship between pronunciation and meaningful learning is significant because pronunciation serves to decode the written word into its oral form, which can then elicit a meaningful response, if in fact the word is in the oral vocabulary of the learner (Ghatala, Levin, & Wilder, 1975). In this sense, speech becomes the bridge between conscious awareness and largely unconscious cognitive operations, such as identification, classification, and storage (McNeill, 1975). The ability to read is basically dependent on the skill relationships between visually displayed words and the spoken language that the learner already possesses (Clark, 1976).

In an extensive examination of meaningfulness, Underwood and Schultz found that pronounciability was frequently an excellent predictor of learning. In one study, using paired-associate procedures (Experiment 11) for 36 items obtained from three separately learned lists, the correlation between frequency and mean number of correct responses over 15 trials was .09. On the other hand the correlation for pronounciability and mean number correct was .57. In another experiment (Experiment 12) the correlation between proconnciability and correct responses was .76 (Halt, 1975). DiVesta and Ingersoll also found that paired-associate learning was related to ease of pronounciability (1969).

In summary, learning is reinforced through the pronunciation of contextually meaningful utterances.

Impact. The intention is that any nonprogramming educator and trainer could author highly individualized, speech-controlled educational materials within a structure flexible enough to support instructional designs in any discipline and within any reading level. The resulting courseware would evolve into a library of voice-based instructional materials.

Instructional Design Team. The design team is composed of William D. Wagers, systems development and systems analyst; Carin E. Horn, instructional systems and educator; Warren C. Jones, systems development and programmer; and Janice D. Drake, instructional systems and communications liaison.

Product Development. The VBLS voice-based learning system prototype was completed in June 1982. It was presented at the National Educational Computing Conference in Kansas City, Missouri. The VBLS system is comprised of an Apple-compatible voice-entry terminal by Scott Instruments, with a Shure SM-10B or equivalent noise-cancelling microphone, a reference manual, and VBLS software on a 5 1/4-inch floppy disc. The voice entry terminal measures approximately 1 1/4 inches high by 6 inches wide by 9 inches deep and weighs 3 pounds. Power consumption is between 1 and 10 w. Suggested retail price is $895 F.O.B., Denton, Texas.

The prototype was field tested in a "typical" first-grade public school classroom (spring 1982) and has been subsequently critiqued by numerous professionals in various disciplines, including special education. The critiques have resulted in modifications to the original design and are incorporated into the most current version of the VBLS system. Further peripheral options and adaptations are anticipated to highly customize the VBLS voice-based learning system for special needs learners.

isolated words and phrases, including those resulting from speech impediments. Input sound waves are converted to digital data, and several samples (usually five) of the same word and phrase are averaged to construct a master template in the computer's memory, which is then stored on discs. (The Shadow/VET™, another Scott voice entry terminal, has 16K onboard memory and does not use the host computer's memory to store templates.) The speech analysis technique involves amplitude envelope and zero-crossing detection within the frequency regions of 250 to 1,000 Hz and 1,000 to 5,000 Hz. Templates are derived through linear time compression, syllable counting, spectral histograms, and variance measurements of the data. Specification of active vocabulary, the effective vocabulary, and the total vocabulary size are determined by software control. The VBLS terminal is not intended for speaker-independent use, and training is required.

The VBLS systems software is written in assembler code and BASIC. There are approximately 2,600 lines of BASIC and 3,200 lines of assembly language source in the VBLS authoring system.

User's Perspective. The process of training (enrolling) the preprocessor to recognize a specific word or phrase is essentially invisible to the VBLS end-user. The technique of word verification coupled with the VBLS tutorial structure camouflages speaker-adaptive procedures. Word verification is an algorithm that employs the concept of the one-word and one-phrase vocabulary. Regardless of the total vocabulary size, only one word or phrase is acceptable at any point in time. The recognition task is to verify the active word, not to select the correct word from among several candidates. As a result, more data can be kept on each word and more processing time can be devoted to the single word and phrase. The vocabulary becomes completely disc-based and is limited in size only by the mass storage capabilities of the system being used. An Apple floppy disc can store a 1,600-word vocabulary (see Figure 3.) Voice is an integral component of the teaching and learning system, and training becomes part of that process, for example.

During the lesson authoring, the system randomly prompts a training sequence for tokens of words, continuing to do so until N passes of a word and phrase have been made. Training is a preset sequence wherein the author types the alphanumeric word and phrase identity into the keyboard terminal, then also speaks it when prompted.

During the study session, the student-user is prompted to say a lesson vocabulary word or phrase, to read the related question, and to vocalize the question into the system's microphone by saying the prompted correct response. Master templates are hereby adapted to each user's unique speech patterns as part of the instructional design logic. Once completed, the student does not retrain author-made vocabulary for that lesson but accesses the adapted templates on disc to be recognized by the VBLS system in the review. Adaptive procedures exist to update templates, if necessary.

Typical use. The VBLS system is an authoring structure and instructional delivery system. The relative value of the resulting courseware is dependent on the quality of instruction that the system delivers. Materials may be presented in small, easily understood segments or as a series of comprehensive questions and answers that also include supplemental information. The VBLS system is flexible enough to adapt to varying skill levels: physical, cognitive, and communicative. Lesson practicality and originality are the author's responsibility.

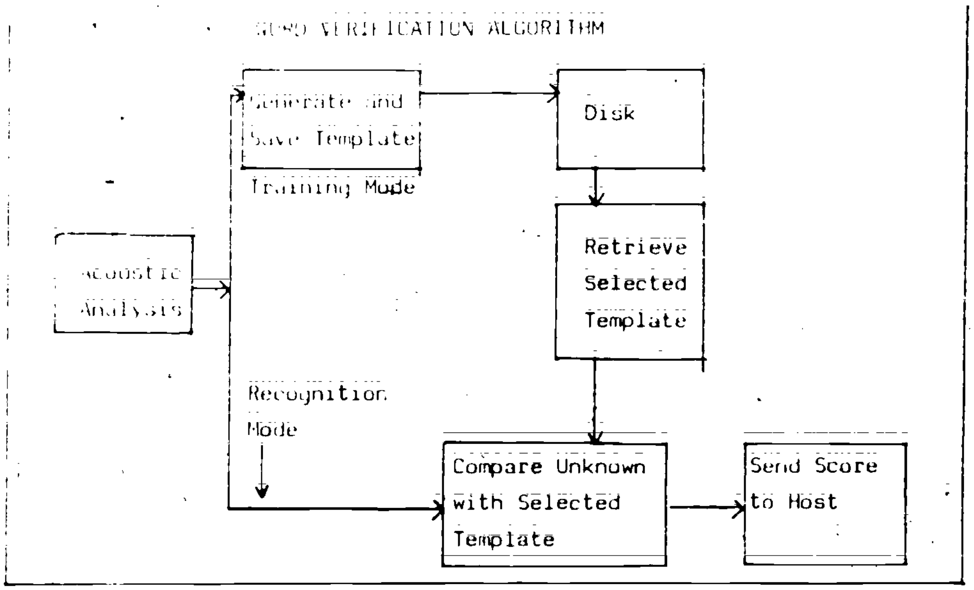


Figure 3

The VBLS special needs learner should have some visual acuity, minimal reading skills (K-1), and the ability to help assign meaningful alpha-numeric identifiers to spoken language components. For example, if a student refers to water as wa and consistently uses this utterance in a water-related way, the VBLS system can be trained to recognize wa to mean water. Once oral language vocabulary components have been identified, lessons may be authored to cultivate communication competency using that individual student's uniquely spoken language.

VBLS lessons may be authored for instruction in the home as well as in the classroom. A unit may be designed for a specific population or an individual student. The menu-driven authoring format enables the teacher and parent to input whatever materials are student-appropriate. The VBLS system will support unlimited types of curriculum. System conventions require that all spoken responses be said within three seconds. The VBLS system "assumes" that the author has no technical training, save in one's own area of expertise. No programming skills are needed to study VBLS lessons. This authoring system option eliminates the need for keyboard-related motor movements. A typical study session would include voice-based tutoring, drill and repetition, review, and testing (optional).

Word Drill, which is another author-designated study session option, provides the student with real-time pronunciation feedback. Lesson vocabularies may be practiced at the word, phrase, or short sentence level within the 3-second convention. This option is particularly useful when nunciation score. Scores with range from 0 to 1,000, with 1,000 representing a perfect match. This technique allows the learner to refine pronunciation progressively. Vocabulary words and phrases may be repeated as many times as the student chooses. Progressing to the next word requires two keyboard strokes (Space Bar and RETURN).

The VBLS system allows for built-in overlearning and diversified teaching and learning styles. More than 40 options are available so that any one lesson can easily be adapted to focus on each student-user's ability and learning sequence preferences. One student, for example, can review the lesson vocabulary, take a pretest, be tutored, reviewed, and tested on a lesson. Another might be instructor-directed to use Word Drill before running the tutorial and its review. A third student might complete the tutorial and its review. A fourth student might complete the tutorial and then run its review three times. Each student study disc may be a highly customized version of the same exact tutorial information. The VBLS system provides the opportunity to develop voice-controlled learning materials for handicapped and nonhandicapped student populations. VBLS lessons are adapted to recognize each individual student's system or oral communication.

COMMENTS

The human voice is interfacing instructional innovation and the physically handicapped learner. The absence of quality education for handicapped children necessitated P.L. 94-142, the Education for All Handicapped Children Act. Microcomputer-based speech recognition is helping to implement the law, and the VBLS system is providing the structure to author nonbiased, nondiscriminatory instructional courseware for handicapped and able-bodied learners.

ED#231146

REFERENCES

Brown, Hon. George E., Jr. Hearing before U.S. House of Representatives Committee on Science and Technology. Information and Communications Technologies Appropriate in Education (including H.R. 4326), 96th Cong., 1st sess., 1979. Washington DC: U.S. Government Printing Office, 1979.

Clark, M. M. Language and reading: Research trends. In Alan David (Ed.), Problems of Language and Learning. London: Heinemann, 1975.

DiVesta and Ingersoll, cited in John Hall (Ed.), Verbal Learning and Retention. Philadelphia: J.B. Lippincott, 1971.

Ghatala, E. S., Levin, J. R., and Wilder, L. Pronunciation and the Frequency of Meaningfulness Effect in Children's Frequency Discrimination (Technical Report No. 344). Madison: Wisconsin Research and Development Center for Cognitive Learning, May 1975.

Hall, John F. Verbal Learning and Retention. Philadelphia: J.B. Lippincott, 1971, pp.

McNeill. The two-fold way for speech. (Paper). Cited in J.S. Bruner, Language as an Instrument of Thought in Alan David (Ed.), Problems of Language and Learning. London: Heinemann, 1975.

THE MICROCOMPUTER AS AN EFFICIENT AND VERSATILE SPEECH-OUTPUT COMMUNICATION AID

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Director, Clinical Microcomputer Laboratory
Department of Speech
New Mexico State University
Las Cruces, New Mexico 88003

The microcomputer has been found to be a versatile electronic aid for many physically handicapped children and adults (Rushakoff & Lombardino, in press). One application has been as a stationary speech output communication aid. Many of the programs created for this purpose are listed in the International Software/Hardware Registry (Vanderheiden & Walstead, 1982).

The purpose of this article is to describe several key features in versatile communication programs for microcomputers. It is not meant to be a complete list, but to give the clinician, educator, user, and families a model with which to look at communication software.

KEY FEATURES FOR MICROCOMPUTER COMMUNICATION PROGRAMS

Encoding

Some communication programs are specifically designed for use by single-switch users. Others are designed for keyboard users but can be used by single-switch users with a single-switch hardware or firmware interface (Tetra Scan II, Express III, Omni, Adaptive Firmware Card, etc.) Programs designed for use from the keyboard may increase the speed of message production. Any letter, word, phrase, or sentence may be assigned a keyboard letter (Figures 1 and 2). A program designed only for single-switch users may be slower in message production speed for individuals able to use the keyboard. (Individuals who have some difficulty using the standard Apple II keyboard may be able to utilize it with a keyguard or with an expanded keyboard.)

Easy-to-Change Vocabulary

Any communication program should make it easy to change the vocabulary at any time. Almost all programs allow this through the use of an editor. It is not considered easy to change vocabulary if it is necessary to change part of the computer program listing.

Can Speak and Print

The communication program should have the capability of speaking the message through synthesized speech and also printing out the message.

Correctable

As with any communication system there should be a way for the user to delete an incorrect entry before the message is produced.

A]	K]	V]
B]	L]	W]
C]	M]	X]
D]	N]	Y]
E]	O]	Z]
F]	P]	;]
G]	Q]	,]
H]	R]	.]
I]	S]	/]
J]	U]	:]

Figure 2: Talk II word page after some vocabulary had been entered.

PG. 2

A	I	K	AND	V	
B	ME	L		W	
C	YOU	M	KAREN	X	
D	WE	N	STEVE	Y	
E	THEY	O	LINDA	Z	
F		P		;	MR. HENRY
G	MOM	Q		,	MRS. PLITT
H	DAD	R		.	MISS BASKIN
I		S		/	
J		U		:	

MOM AND DAD TOOK ME TO THE STORE LAST NIGHT. WE ENDED UP BUYING SOME FURNITURE FOR THE LIVING ROOM.

minutes to create a message about the movie. Without a message-save feature it would take the same amount of time each time to relate the story. With a message-save feature the user can save the completed message and speak it again with much fewer keystrokes.

Message Efficiency

Message efficiency relates to the number of key (or switch) presses needed to produce (speak) a message. Using the following example:

How are you doing today speak command

if the program allowed the message only to be created from letters, it would require 24 key presses to produce (speak) the message (count each letter, space, and the speak command.)

If the program allowed many common words to be accessed from one letter (encoding, Figure 2), it would require 6 key presses to produce that message. If the program allowed the encoding of many common sentences (Figure 3), it could require only 1 or 2 key presses to speak that message.

Figure 3: A sentence page from Talk II. Pressing the letter next to the sentence speaks that message. Each sentence or paragraph can be up to 100 words long.

Page 1

B I'm doing fine thanks for asking.
C My name is David.
D Stick it in your ear dog breath.
E
F
G Would you like to hear a joke?
H What do you get when you put four ducks....
I A box of quackers.
J
K
L Hang on. It will take me a minute to respond...
M
N Could you tell me the time please?
O

Grabbers

Part of the problem that speechless individuals have in using communication aids is that they are often unable to respond quickly to many of the individuals who pass by during the day. Beyond the clinician, educator, and family, few people will take the time to get involved in a conversation with a speechless person. They are just not always able to provide the quick response that is needed to "grab" the person who might not otherwise think to take a moment to converse.

Grabbers are a special feature that allows the user to speak a response with one key press. This feature was incorporated in TALK II (Rushakoff, Condon & Lee, 1982). With one key press the individual can speak any predetermined message up to 100 words long. Some that we have recommended in the past are:

SINGLE-SWITCH USE OF THE APPLE II

It is possible for single-switch and other nonkeyboard users to operate all keyboard software for the Apple II. This can be accomplished in four ways: (1) software, (2) firmware, (3) hardware, and (4) keyboard modifications.

Software

Some programs allow for the conversion of keyboard software so that it can be used by single switch users (Schwejda, 1982; Rushakoff & Steinberg, 1982.)

Firmware

A peripheral card than when plugged into the Apple will allow single-switch access to keyboard programs.[1]

Hardware

When devices such as the Tetra Scan II,[2] Zygo 100,[2] Express III,[3] and Omni[4] are attached to the Apple II, they allow single-switch access to all keyboard programs.

Keyboard Modifications

A couple of devices can be used for individuals who have some difficulty using the standard Apple II keyboard. Prentke-Romich[2] and TASH[5] manufacture a keyguard for the Apple II. TASH[5] and Cacti Computer Services[6] produce a large, expanded keyboard for the Apple. TASH[5] also manufactures a mouth-operated keyboard.

ED#229908

REFERENCES

Apple Computer, Inc. Personal Computers for the Physically Disabled: A Resource Guide. Cupertino CA: Apple Computer, Inc., undated.

Bennett, R. E. Applications of Microcomputer Technology to Special Education, Exceptional Children, October 1982.

Budoff, M., and Hutten, L. R. Microcomputers in special education: Promises and pitfalls, Exceptional Children, October 1982, pp. 6.

Foulds, R. Applications of microcomputers in the education of the physically disabled child, Exceptional Children, October 1982, pp. 8.

Goldenberg, E. P. Special Technology for Special Children, Baltimore: University Park Press, 1979.

Hannafprd, A. E., and Tabber, F. Microcomputer software for the handicapped: Development and evaluation, Exceptional Children, October 1982, pp. 6.

Hazan, P. (Ed.). Proceedings of the Johns Hopkins First National Search for Applications of Personal Computing to Aid the Handicapped. Piscataway NJ: Institute of Electrical and Electronic Engineering, 1982.

Luttner, S. Computers for the Handicapped, Apple Magazine, 1981, 2(1).

Rushakoff, G. E., Condon, J., and Lee, R. Talk II, Communication Outlook, April 1982.

Rushakoff, G. E., and Steinberg, D. Florida Scanner, In G. Vanderheiden and L. Walstead (Eds.), International Software/Hardware Registry. Madison WI: Trace Center, 1982.

physically handicapped children and adults. In Proceedings of the Second International Non-Speech Communication Conference. Toronto: Blissymbolics Communication Institute, November 1982.
Rushakoff, G. E., and Lombardino, L. J. Comprehensive microcomputer applications for severely physically handicapped children, In Teaching Exceptional Children, in press.
Schwejda, P. Special Inputs Disk. In G. Vonderheiden and L. Walstead (Eds.), International Software/Hardware Registry. Madison WI: Trace Center, 1982.
Schejda, P., and Vanderheiden G., Adaptive firmware car' for the Apple II. Byte, September 1982.
Seyfried, D. J., and Lowe, D. Microcomputers in teaching handicapped students. Monitor, November 1980.
Stallard, C. K. Computer education for Exceptional Children: Emerging applications, Exceptional Children, October 1982, pp. 3.
Sterling Swift, Educational Software Directory: Apple II ed. Austin: Sterling Swift, 1981.
Vanderheiden, G. Practical applications of microcomputers to aid the handicapped, Computer, 1981, 14(1).
Vanderheiden, G., and Walstead, L. International Software/Hardware Registry, Madison WI: Trace Center, 1982.
Vanloves Educators Handbook and Software Directory, Kansas City: Vital Information, Inc., 1981.

Notes

[1]Adaptive Peripherals
4529 Bagley Avenue North
Seattle, Washington
90103

[2]ZYGO Industries
P. O. Box 1008
Portland, Oregon
97207

[3]Prentke-Romich Company
8769 Township Road 513
Shreve, Ohio
44676

[4]Communications Research Corporation
1720-130th Avenue, Northeast
Bellvue, Washington
98005

[5]Technical Aids and Systems for the Handicapped
2075 Bayview Avenue
Toronto, Ontario
M4N 3M5, Canada

[6]Cacti Computer Services
130 9th Street, Southwest
Portage la Prairie, Manitoba
R1N 2N4, Canada

SECTION 6

INTRODUCTION TO COMMERCIAL RESOURCES

Theory, curriculum, and methods research and development are necessary components of any emerging educational field but, the practitioner cannot always apply the results of those efforts immediately and purposefully. Individuals or facilities interested in utilizing the technology in special education need to know more. They need to know what practical applications are available today. The Exhibits at the conference provided evidence that there are numerous practical applications that have been developed for exceptional users. Information about specific products can be the key to incorporating the technology into individual programs, meeting individual needs and meeting system needs. A single information source does not exist, making the process of gathering information on hardware and software time consuming and difficult.

This section of the Proceedings begins to provide an information source of practical applications. Each of the exhibitors were invited to submit short descriptions of their products that are appropriate for the special education population. They were also asked to provide contact names and addresses. Due to space limitations and an effort not to turn the Proceedings into a commercial catalog, each entry is very limited. Readers are invited to contact these people for more detailed information about the specific products of interest.

To facilitate the search process, the entries are organized into four sections by area of application: (1) general, (2) managment, (3) instructional, and (4) tools. Within each section, the vendors are listed alphabetically. When available, hardware requirements and costs have been provided.

Follett Library Book Company
4065 Northwest Highway
Crystal Lake, Illinois 60014
Contact People:
Andrew Larson, Director, Micro Division, 800/435-6170
Selected Products of Interest to Special Educators:
Distributors of quality educational software. Unique demand-printed catalog has the capability of providing the most up-to-date software and prices. Catalog contains a special education section. The company also has two software showrooms where anyone may preview software prior to purchasing. The showrooms are located in Crystal Lake, Illinois, and Valley Forge, Pennsylvania.

Gamco Industries
Box 1911
Big Spring, Texas 79721
Contact People:
Carol Hunter, Marketing Director, 915/267-6327
Selected Products of Interest to Special Educators:
Gamco Industries sells microcomputer software through our comprehensive 68-page catalog. We carry computer programs and books in various subject areas for the Apple, Pet, TRS-80, Atari, VIC and Commodore 64 machines. We offer a 30-day, money-back guarantee. Gamco carries other products, chiefly filmstrips and cassettes, books, games, and transparencies through our other catalogs.

J. L. Hammett Company
Hammett Place
Braintree, Massachusetts 02184
Contact People:
Rick Holden, Manager, 617/848-1000
Bonnie Turrentine, Assistant Manager
Pat Quimby, Administrative Assistant
Ruth Ann Alexander, New England Software Specialist
Selected Products of Interest to Special Educators:
Distributes over 600 software titles for the Apple, TRS-80, IBM PC, Atari, and Commodore computers. The product line includes software products for administration, language arts, math, and computer literacy.

New England School Supply
P.O. Box 1581
Springfield, Massachusetts 01101
Contact People:
Michael J. Greiner, Manager, 413/525-6411
Leonard C. Campagna, Sales Manager, 413/525-6411
Warren Luthgren, Purchasing Agent, 413/525-6411
Selected Products of Interest to Special Educators:
Stocks over 14,000 different educational products in the Springfield, Massachusetts, warehouse. These products include learning aids, art materials, papers, school and office supplies, school and office furniture, library supplies, microcomputer software, and furniture. New England School Supply selects products manufactured by the world's most respected manufacturers including Milliken, Binney & Smith, Atari, and Apple.

Radio Shack
1400 One Tandy Center
Fort Worth, Texas 76102

Ron Moore, Eastern Educational Marketing Manager, 817/390-3527
Scott Bowers, Western Educational Marketing Manager, 817/390-3910
Selected Products of Interest to Special Educators:
TRS-80 microcomputer--16K to 512K memory, black and white, color, sound--computer-assisted and computer-managed instruction--$100 to $4,000. All grade levels.

Reston Publishing Company
11480 Sunset Hills Road
Reston, Virginia 22090
Contact People:
Carol King, Editor, Computers in Education, 703/437-8900
Selected Products of Interest to Special Educators:
Microcomputer Handbook for Special Education, Dolores Hagen, 1984, book written for parents and teachers. Also distributed by The Council for Exceptional Children, January 1984, $15.95.
Apple LOGO Primer, Gary Bitter and Nancy Watson, June 1983, $14.95.
My Students Use Computers, Bev Hunter, June 1983, $16.95.
NOTE: Free educational catalog available.

MANAGEMENT COMMERCIAL

American Guidance Service
Publishers' Building
Circle Pines, Minnesota 55014
800/328-2560, 612/786-4343
Contact People:
Mary Louise Bergee, Vice President-Conferences
Gary J. Robertson, Director of Test Development
Dorothy B. Chapman, Director of Program Development
Selected Products of Interest to Special Educators:
Woodcock Reading Mastery Tests (WRMT)--A comprehensive battery of individually administered reading tests for kindergarten through grade 12, in two forms. These multipurpose tests are used to help detect reading problems, to group students for instruction, and to evaluate school reading programs. WRMT, Form A: $37.50, WRMT, Form B: $37.50.
ASSIST for WRMT--A microcomputer program for instantaneous score conversions, record storage, and retrieval of the Woodcock scores on the Apple II Plus computer with 48K memory. $29.50.
Kaufmann Assessment Battery for Children (K-ABC)--An individually administered measure of intelligence and achievement for children ages 2 1/2 through 12 1/2 years. The K-ABC assesses the ability to solve problems using simultaneous and sequential mental processes. A separate Achievement Scale measures children's acquired knowledge, including skills in reading and arithmetic. K-ABC Kit (regular edition): $135.00. K-ABC Kit (special edition): $168.00.
ASSIST for K-ABC--Enables use of the Apple II Plus or Radio Shack TRS-80 to compute K-ABC derived scores and generate student profiles highlighting significant strengths and weaknesses.

Curriculum Associates, Inc.

5 Esquire Road
North Billerica, Massachusetts 01862
Contact People:
Patricia McLaughlin, Computer Service Specialist
Barbara Russell, National Sales Manager
Frank Ferguson, President
Selected Products of Interest to Special Educators:
Computer-Managed Special Education Programs
BRIGANCE Diagnostic Comprehensive Inventory of Basic Skills-Criterion Referenced Assessment, $99.

Assessment, $99.95.
BRIGANCE Diagnostic Inventory of Basic Skills-Criterion Referenced Assessment, $59.95.
BRIGANCE Diagnostic Inventory of Early Development-Criterion Referenced Assessment, $57.95.
ENRIGHT Diagnostic Inventory of Basic Arithmetic Skills-Criterion Referenced Assessment, $79.95.

Ek-Ed Computer Systems, Inc.
71-11 112th Street
Forest Hills, New York 11375
Contact People:
M. A. Stiskin, President, 212/268-0020
Tom R. Williams, Director of Development, 212/268-0020
Selected Products of Interest to Special Educators:
Student Information Record--sophisticated data base management software for special education administrators--CP/M based for microcomputers, also operating on minicomputers and mainframes: $2,495.
Behavior Objective Plan--produces each student's IEP from data base of 7,500 annual goals and short-term objectives in elementary and secondary curriculum areas: $1,249

K-12 Micromedia, Inc.
172 Broadway
Woodcliff Lake, New Jersey 07675
Contact People:
Alan Zoldan, Publisher, 201/391-7555
Leslie Nassau, Editor
Pam Weber, Marketing Manager
Anthony Schweiker, President
Selected Products of Interest to Special Educators:
The IEP Kit--IEP customized report generator
The COMPOSE Curriculum--preprogrammed IEP data base
Many reading and number readiness programs, PIAT, Error Analysis Report, ECHO II Speech Synthesizer, early childhood learning games--all offered to schools on free, 30-day approval.

Learning Systems
3 Peter Circle
P.O. Box 15
Marblehead, Massachusetts 01945
Contact People:
Christine A. Dhionis, Vice President/Marketing, 639-0114
Kristine E. Rhoades, Staff Associate, 639-0114
Selected Products of Interest to Special Educators:
Special Education Data Management System--Saves and sorts data necessary for mandated reports.
Individual Student Management--Computer-facilitated individual educational plans and progress reports.
Hand-Tailored Software Programs
Objective Manuals Individual Learning Objectives--Volumes 1 and 2 contain approximately 9,000 behavioral objectives in areas addressed by IEPs.
Consultant Administrative Services--Learning Systems consults to many school systems on the cost-effective management of special services.

Learning Tools
686 Massachusetts Avenue
Cambridge, Massachusetts 02139
617/864-8086

Joan Thormann, Educational Consultant
Kirk Wilson, President

Selected Products of Interest to Special Educators:

Administrative Planning System--Interactive access to a large student or client database. Print user-defined reports and answers administrative inquiries. Useful for student or client counts, program planning, local, state, federal reporting and other requirements. Automatically updates administrative files from information maintained with the individualized planning system (IPS). Price: $1,195.

Individualized Planning System--Maintain, locate, and print student or client information. Create individualized plans and other user-defined individualized reports. Confidentiality maintained through passwords and authorization levels. Items of information may be adapted for current use and future needs by non-technical professionals. Use with the Curriculum Management System (CMS) for individualized goal planning. Price: $495.

Curriculum Management System--Centralize and coordinate instructional and services resources including goals and objectives, text books, learning activities, library materials, films, and others. Create, access, edit, and print curricula in any subject area. Use with the Individualized Planning System (IPS) to create individualized plans. Price: $295.

Audience: Administrators, supervisors, curriculum developers, teachers, counselors, clinicians, and others involved with planning individualized services.

Microcomputer Education Applications Network (MEAN)
256 N. Washington Street
Falls Church, Virginia 22046
703/536-2310

Contact People:
Alfred J. Morin, Director

Selected Products of Interest to Special Educators:

Workshops on microcomputer applications in special education instruction and administration; all administrative levels including SEA, LEA, and special interest groups. Price: $485 and up, plus travel and per diem.

Software (Modularized Student Management Systems) allows special education administrators to develop a pupil data base, prepare IEPs for parent signature, prepare teacher guides, maintain a bank of objectives, and prepare summary reports. Price: operating system, $500; 10 modules, $485-$650 (sold individually).

Demonstrations of adaptive devices and new technologies with special education applications.

Newsletter--Mean Brief--a quarterly newsletter that helps microcomputer users keep up to date on applications in special education. Price: $10 per year.

OUTREACH
Pre College Programs
MSSD Box 114P
Gallaudet College
Washington, D.C. 20002
202/651-5048

Contact People:
Michael L. D[illegible]inger, Dean, Kendall Demonstration Elementary School, 202/651-5286

Selected Products of Interest to Special Educators:

Comprehensive elementary-level curriculum guides in language arts, hearing-impaired students. Also curriculum management software for computers.

Precision People, Inc.
3452 North Ride Circle South
Jacksonville, Florida 32217
Contact People:
Diane T. Trifiletti, President, 904/262-1096
Barbara J. Tracy, Executive Administrator, 904/262-1096
Selected Products of Interest to Special Educators:
SPARK-80--Kindergarten through 8th-grade math series containing programs providing instruction, drill, game, and assessment. The complete courseware includes 103 diskettes. Price: $2,995.
WISCR-80--Translates WISC-R results into meaningful clinical interpretations and educational recommendations. Computer report for psychologists and educators. Price: $298.
PIAT-80--Translates results of the Peabody Individual Achievement Test (PIAT) into meaningful educational strategies. Price: $149.
WAISR-80--A diagnostic program for the Wechsler Adult Intelligence Scale for Psychologist. Price: $299.
LURIA-NEBRASKA AUTOMATED SCORING SYSTEM--Tabulates all of the standard profile scales. Price: $199.

Skillcorp Software, Inc.
1711 McGaw Avenue
Irvine, California 92714
800/854-8688, 714/549-3246
Contact People:
George Campbell, Executive Vice President
Robert Jewett, General Manager
Selected Products of Interest to Special Educators:
Computer Management Systems (CMS) in Reading and Math--This system reads and scores criterion-referenced tests and transfers data to a microcomputer. It uses CMS programs to generate statistics, reports and prescriptions. Price: $30 (diskette/backup).
A.I.D.S.--An Authoring System--This package is an authoring system designed to create CAI without needing to know how to use a programming language.

Southern Micro Systems for Educators
716 East Davis Street
Burlington, North Carolina 27215
Contact People:
Richard H. Swank, President, 800/334-5521, 919/226-7610
Selected Products of Interest to Special Educators:
UNISTAR I Pre-IEP for Learning Disabilities--Elementary through junior high. Price: $650.
P.E.A.R.--PIAT Error Analysis Report. Price: $395.
WISC-R Computer Report. Price: $495.
WAIS-R Computer Report. Price: $495.
ACCUMULATOR II data base designed for educators. Price: $175.
The audience should include all special education supervisors.

UNICOM
297 Elmwood Avenue
Providence, Rhode Island 02907
Contact People:
Richard Casabonne, Marketing Director, 401/467-5600
Jean Muccini, Sales Manager/Connecticut-New York, 203/838-3617
Joseph Curreri, Sales Manager/Massachusetts-Rhode Island, 617/329-3950
Selected Products of Interest to Special Educators:
UNICOM Educational Management Series--The Grade Reporting Module is

designed to maintain data on students, courses, instructors, and enrollment. From this data you can print report cards, calculate grade point averages, and also produce student and instructor schedules. The School Inventory Module allows the management of various media and patron data. Specific functions include circulation control, generation of inventory status reports, past due notices, and utilization statistics. AppleII+ or IIe: Dual-disc version: $250/module, Corvus version: $450.

NMT--The Network Manager's Toolkit--The Network Manager's Toolkit has been designed specifically for the Corvus network (both Omninet and Multiplexer). The Network Manager's Toolkit is composed of two distinct parts: UNICORE and UNIMENU. UNICOR is a network management language. It extends Applesoft BASIC, adding 20+ new commands (keywords), which may be invoked either from within an application program or directly from the keyboard. UNIMENU simplifies the task of developing menus. It provides an additional level of user-application security and a common interface to network applications. The cost of the Network Manager's Toolkit is $300, including one UNIROM card.

LOGO for Your Apple Computer Network--UNICOM has created a version of Terrapin LOGO designed to be used on Corvus networks. Any size Corvus disc may be used and any number of Apple computers may be used (up to the limit supported by the network). The cost is $300, which includes a Terrapin manual, one UNIROM card, complete network version documentation, and installation diskette. A UNIROM card is required for each Apple computer on the network (there is a licensing fee of $50 per card).

Valpar International Corporation
3801 East 34th Street, Suite 105
Tucson, Arizona 85713
602/790-7141
Contact People:
Thomas L. Brandon, Executive Vice President
Michael Lesnik, Director of Training
Pamela S. Corey, Sales Director
Selected Products of Interest to Special Educators:
MESA (Microcomputer Evaluation and Screening Assessment)--Consists of hands-on group testing, individual computerized assessment, with data entry and access profile resulting in a printed report and D.O.T. Profile. Program without computer materials for 4 evaluees: $4,975. No consumables.

INSTRUCTION COMMERCIAL

Computer Skill Builders
Box 42050
Tucson, Arizona 85733
602/323-7500
Contact People:
William G. Crider, Managing Editor
Steven Weintraub, Sales Manager
Selected Products of Interest to Special Educators:
Math Skill Builders--Diagnosis, tutorial, assignment, and practice in mathematics. This program adjusts itself to the skill level of the user. Requirements: 3rd-grade reading skills, TRS-80 with 2 disc drives. Price: $75 each or $250 for a set of 4.

Create Your Own Greeting Cards--Students learn communication and art skills on an Apple II+ or IIe with 1 disc drive. Grade 2-Adult. Price: $39.95.

Creative Publications
P.O. Box 10328
Palo Alto, California 94303
415/968-1101
Contact People:
Maggie Holler, Vice President/Sales and Services
George Bratton, Math Product Manager
Linda Holden, Computer Product Manager
Selected Products of Interest to Special Educators:
BASIC Discoveries: A Problem-Solving Approach to Beginning Programming--An introduction to beginning programming. Contains additional classroom activities, reproducible activity sheets, and answer key. Grade 4-Adult. Price: $8.95 each.
Problems for BASIC Discoveries--Contains motivating problems and activities to provide practice in BASIC. Includes a set of assessment activities for BASIC commands, discovery activities that encourage students to predict program outcomes, debugging activities, flow-charting activities, and 20 problems for computer solutions. Grade 4-Adult. Price: $7.95 each.
Pascal Discoveries--Breaks up the task of learning Pascal into a series of easy, step-by-step activities. Includes activity pages suitable for reproduction. Use as a teacher's resource or student text. Grade 6-Adult. Price: $7.95 each.
The Great Computer GameWorks--Students can create their own computer games. No programming required. Students answer questions and move their playing pieces around the track. For Apple II, 48K, single-disk drive. Grades 2-8. Price: $59.95.
FasTrack Quizzer: Action game to quiz students on facts that they need to memorize. By answering questions, they can race their cars around the track. For Apple II, 48K single disk drive. Grades 2-8. Price: $39.95.

Cuisenaire Company of America
12 Church Street, Box D
New Rochelle, New York 10805
914/235-0900
Contact People:
Jeffrey B. Sellon, Vice President
Selected Products of Interest to Special Educators:
Math Ideas with Base 10 Blocks--Extends the use of base 10 blocks to the pictorial level through vivid displays of the place value materials. The diskette reinforces counting, comparing, addition, subtraction, multiplication, and division with particular attention to the transition to paper and pencil work. Grades 1-8. Price: $49.95.
Building Estimation Skills--uses a hidden picture format tied to correct answers for questions involving rounding numbers, percentage, addition, subtraction, multiplication, and division. Volume 1 provides practice rounding 2- to 7-digit whole numbers and estimating a percentage of a number. Volume 2 provides practice with estimating the sums, differences, products, and quotients of 2- to 7-digit whole numbers. Grades 3-8. Price: $65 (2 diskettes).
Geoboard Geometry and Measurement--Extends the use of geoboards to the pictorial level through vivid displays of a 25-pin geoboard. The diskette reinforces ruler reading, measuring of line segments, constructing parallel and perpendicular lines and the area and perimeter of rectangles, triangles, and other polygons. Grades 3-8. Price: $49.95.

Floppy Enterprises
716 East Fillmore
Eau Claire, Wisconsin 54701
715/835-0310

Contact People:
Janice M. Keil, Partner
Priscilla D. Kesting, Partner
Selected Products of Interest to Special Educators:
The Floppy Teaches--Series has been designed for young children, nonreaders, and students with special needs. The following programs are available for the Apple on DOS 3.3 diskettes (What is Missing? and Same and Different are also available for TI99/4A.)
How to Print Letters and Numerals--designed to help children master the printing of alphabet letters and the numerals. In addition to the capital letters, small letters, and numerals 0 to 9, the following options are available: various strokes, groups of letters having similar characteristics, and the choice of any capital letters, small letters, or numerals. Appropriate for small-group as well as individual instruction. Price: $34.95.
What Is Missing?--An exciting educational game that teaches children to identify parts missing from whole objects. When identified, the missing part floats to where it belongs. Price: $29.95.
Same and Different--A visual perceptual game that requires children to distinguish between two objects (rabbits, ships, etc.) or two letters that may be the same or differ in some way. Price: $29.95.
Letter and Numeral Recognition--A visual perceptual game that helps the children identify individual letters (capital and small) and the numerals 0 to 9. Price: $29.95.

Hartley Courseware, Inc.
Dimondale, Michigan 48821
Contact People:
Rosie Bogo, President, 616/942-8987, 517/646-6458
Selected Products of Interest to Special Educators:
Educational Software for the Apple II, IIe, and Franklin ACE 1000.
Special Features: Record keeping--Content may be modified to meet the needs of the child and reading level. Some programs have the capability of synchronizing voice for directions and feedback.

Laureate Learning Systems, Inc.
1 Mill Street
Burlington, Vermont 05401
Contact People:
Dr. Mary Sweig Wilson, President, 862-7355
Bernard J. Fox, Vice President
Steven Goodman, Marketing Consultant
Selected Products of Interest to Special Educators:
First Words--This program uses animation and speech to teach the meaning of 50 essential nouns. For learners in the language development ages of 9 to 24 months. Price: $185.
First Categories--Uses graphics, speech, and text to train six noun categories. For learners at the beginning reading stage and learning disabled youngsters having trouble with categorization. Price: $120.
Micro-LADS--Uses animation and speech to teach 26 language concepts. For learners between the language development ages of 2 and 5. Price: $1,000 for complete 6-diskette package.
Speak Up--Is a versatile utility program that works with an Echo II Speech Synthesizer to add speech to conventional programs. It contains a dictionary of more than 300 words and 40 functional phrases that can be used as an augmentative communication system. Price: $95.
All programs require an Apple II+ and an Echo II speech synthesizer.

Learning Tree Software, Inc.
P.O. Box 246
Kings Park, New York 11754
516/462-6316

Contact People:
Phyllis Becker, President
Rita Kaplan-Spina, Vice President
Robert Nathanson, Secretary-Treasurer
Selected Products of Interest to Special Educators:
A complete line of natural voiced software (audio-graphic system) for the nonreader or beginning reader (preschool, kindergarten, special education).

MCE Inc.
157 South Kalamazoo Mall, Suite 250
Kalamazoo, Michigan 49007
800/421-4157, 616/345-8681
Contact People:
Allen Kemmerer, Director of Marketing/Sales
Florence M. Taber, Director of Media Development
George L. Spengler, Director of Programming
Selected Products of Interest to Special Educators:
ALL programs have at least one branch or a complete program within a program designed for secondary special education students and adults with learning problems (reading and conceptual). Programs include Managing Your Time ($44.95); Financing a Car ($44.95); Analyzing an Ad ($44.95); Study Skills: Improvement Series ($165.00; 4 individual diskettes, $44.95 each), Problem Solving in Everyday Math Series ($165.00; 4 individual diskettes, $44.95 each); Buying Skills: Learning Improvement Series ($165.00; 4 individual diskettes, $44.95 each); Job Survival Series ($119.95; 3 individual diskettes, $44.95 each); Personal Finance Library ($749.95 for 14 diskettes); Money Management Assessment Series ($965.00 for 4 diskettes); Home Safe Home Series ($965.00 for 4 diskettes); Poison Proof Your Home Series ($210.00 for 5 diskettes); Job Readiness--Assessment and Development Series ($965.00; individual diskettes, $44.95 each).
ALL programs are designed for learners with reading and conceptual levels from 2nd through 6th grade through the use of branching to individualize to the specific learner's level of functioning.

Milliken Publishing Company
1100 Research Boulevard
St. Louis, Missouri 63132
Contact People:
Michael Moore, Regional Sales Manager, 314/991-4220
Selected Products of Interest to Special Educators:
Math Sequences--1-8 Math package. Price: $450.
Comprehension Power--4-12 Reading Program. Price: $1,700.
Sentence Combining--4-8 Writing Skills Program. Price: $95.
EduFun! Learning Games--1-8 Math games. Price: $240.

Milton Bradley Company
443 Shaker Road
East Longmeadow, Massachusetts 01028
413/525-6411
Contact People:
Ronald O. Weingartner, Director, Sales and Development, Education Division
Leslie Lawrence, Product Manager, Education Division
Steve Cox, Regional Manager, Education Division
Selected Products of Interest to Special Educators:
Microcomputer programs with activity sheets for Apple II+ and IIe for grades 5 and up. Math Skills: Division Skills, Mixed Numbers, Decimal Skills, Ratios and Proportions, Percents. Language: Reading Comprehension I, Punctuation Skills (Commas), Punctuation Skills (End Marks, Semicolon, Colon), Vocabulary Skills (Context Clues), Vocabulary Skills (Prefixes, Suffixes, Root Words), Building Better

Sentences (Combining Sentence Parts), Building Better Sentences (Complex and Compound). Also computer literacy items. Price: $49.95 each.

The Motor Skills Corporation
P.O. Box 835
Rockville, Maryland 20853
Contact People:
Sam Patsy, President, 301/946-0969
Dr. Julian Stein, Consultant, 703/323-2398
Selected Products of Interest to Special Educators:
MOTORVATOR--A microcomputer-controlled variable-speed moving target for teaching motor skills. Audience: special education, adaptive physical education, early childhood development, rehabilitation therapy, research, athletics, recreation. Price: $3,265 plus shipping.

Sunburst Communications, Inc.
39 Washington Avenue
Pleasantville, New York 10570
914/769-5030
Contact People:
Marge Kosel, Microcomputer Manager
Warren Schloat, President
Selected Products of Interest to Special Educators:
Spelling for the Physically Impaired--Twenty spelling drills enable students with motor impairment or poor coordination to do independent work. There is a special feature that allows teachers to add, subtract, or change words to tailor word lists for student's specific needs. Grades 3-9, special education. Price: $30. For Apple.
Drills and Games for the Physically Handicapped--Produced by MECC. Five programs enable motor-impaired students to use the computer as a learning tool. The student may use a paddle or any key to respond. The five drills are Arithmetic Practice, Change, Odell Woods and Odell Lake (ecology simulations), and Wrong Note (musical concepts). Grades 2-6, special education. Price: $35. For Apple.
Memory: The First Step in Problem Solving--Includes 10 activities that strengthen students memory skills. Each program uses graphics and sound to stimulate the child's imagination. The programs provide practice in remembering: sequencing, order of events, self-testing, contents of groups in objects, matching, parts of a whole, regrouping, and following directions. Memory is broken into three parts: (1) Package A--Grades 1-2, $150; (2) Package B--Grades 3-4, $190; (3) Package C--Complete Curriculum, Grades 1-6, $250. For Apple.
Survival Math: Simulations--Four simulations require students to use their math skills as the basis for making sound judgments. Grade 6-Adult. For Apple. Price: $50.

TOOLS COMMERCIAL

Maryland Computer Services
2010 Rock Spring Road
Forest Hill, Maryland 21050
Contact People:
Michael Mason, Vice President, Marketing, 301/879-3366
Rebecca Stanton, Rehabilitation Consultant, 301/879-3366
Jack Gilson, Educational Consultant, 404/478-3481
Selected Products of Interest to Special Educators:
Cranmer Modified Perkins Brailler--A computerized version of the popular Perkins Brailler. Microprocessor based, the unit enables users to interact with computers and produce hard-copy Braille

documents, graphs, and maps. Documents are stored on standard cassette tape cartridges.

Information thru Speech--Adds speech output to the computing power and data storage capacity of the HP 85 microcomputer. Product No. TCP-200, Price: $7,995-$11,995.

Total Talk and Total Talk II--An interactive computer terminal that vocalizes data displayed on the video screen. Product No. TCP-150, TCP-180, Price: $4,990-$5,995.

Speak Easy--A talking output device...an audible equivalent to your printer or video display. Product No. TCP-170, Price: $3,000.

Software Programs--Talking Information Management (TCP-110, no charge); Automatic Form Writer (TCP-120, $500); The Spoken Word (TCP-130, $750); Braille Production* (TCP-140, $1,000); Large Print Production* (TCP-145, $750).

*Spoken Word Required

Prentke Romich Company
8769 Township Road 513
Shreve, Ohio 44676
Contact People:
Carol Fusco, Director of Marketing, 216/567-2906
Selected Products of Interest to Special Educators:

Shadow/VET--Voice control of Apple computer (spinal cord injured, muscular dystrophy population). Price: $995.

EXPRESS 3--Keyboard emulator for access to standard computers for the severely physically handicapped. Portable communication aid. Price: approximately $5,000.

ZYGO Industries, Inc.
P.O. Box 1008
Portland, Oregon 97207-1008
503/297-1724
Contact People:
Lawrence H. Weiss, President
G. S. Reardon, Marketing Director
Selected Products of Interest to Special Educators:

Manufacturer, developer, and distributor of assistive electronic devices for the profoundly multihandicapped (including communication, reading, readiness skill training, mobility, and computer access).

CONFERENCE CASSETTES

National Conference and Training Workshops on Technology in Special Education

Reno, Nevada **25–28 January, 1984**

TW-2 — Developing & Implementing Assessment, Remediation & Instructional Management Systems. (4 Tapes)
TW-4 — Planning, Designing & Implementing Data Base Management Systems in Special Education. (4 Tapes)
TH-0 — Opening General Session—"The Information Age: Accountability Revisited."
TH-4 — Authoring Systems: Their Application in Special Education. (1 Tape)
TH-5 — Leadership Training for Administrators of Sp. Ed. in Emerging Technology: A Project Overview. (1 Tape)
TH-6 — Utilization of Microcomputer Technology by the Visually Handicapped User. (1 Tape)
TH-7 — Education Management Through Software Applications. (1 Tape)
TH-9 — Micros & Minis in Michigan: A Potpourri of Management Programs for SEAs, ISDs, & LEAs. (2 Tapes)
TH-10 — Access to Computers for the Severely Physically Handicapped. (2 Tapes)
TH-12 — Research on the Psychoeducational Effects of LOGO & Assorted Software/Courseware for Preschool Exceptional Children. (1 Tape)
TH-13 — The Selection & Use of Microcomputer Software in Career/Vocational Programming for the Handicapped. (1 Tape)
F-1 — Raising the Performance Levels of Mildly Handicapped Students on Standardized Math Tests Using Computer Assisted Instruction. (1 Tape)
F-3 — Training Sp. Educators to Use Microcomputer Technology in Educating the Handicapped. (1 Tape)
F-4 — Emerging Technologies in Public Education: Addressing Equity for Handicapped Students. (1 Tape)
F-6 — SEIMS. (2 Tapes)
F-10 — Environmental Control: Selecting & Training Multi-Handicapped Individuals. (1 Tape)
F-11 — CAI & Sp. Ed. Teacher Prep. (1 Tape)
F-13 — Computer Managed Sp. Ed.—A Comparison of 3 Types of Districts. (1 Tape)
F-14 — Don't Touch that Keyboard: Listen to Me through My Voice Input. (1 Tape)
F-15 — New Directions in Courseware/Software: Development & Adaptation. (1 Tape)

____ F-16 — A New Instructional Technology to Enhance Transition fı School Community for Mildly Handicapped Individuals (1 Tape)
____ F-19 — Goal Attainment Scaling. (1 Tape)
____ F-22 — Sp. Educators & Vendor Expedition: Findings & Product (2 Tapes)
____ F-24 — A Microcomputer Controlled Videodisc System for Biling Math Assessment. (1 Tape)
____ F-25 — Help for Administrators—Decision Making for the Imı mentation of Computer Systems in Schools. (1 Tape)
____ F-26 — The Direct Instruction Educational Model: Hardware & S ware Applications.
____ F-28 — Project RETOOL: Training Sp. Ed. Teacher Educators Microcomputer Applications. (1 Tape)
____ F-30 — Developing Computer Literacy in Preservice Teacher Tra ing. (1 Tape)
____ F-32 — Microcomputer Sp. Ed. Data Management System. (1 Taı
____ F-33 — Microcomputers in Sp. Ed. Highlights of Current Resear (1 Tape)
____ S-0 — Second General Session—"Computers: An Opportunity, N a Problem!" (1 Tape)
____ S-1 — Mighty Math—Prototype of an Interactive Educational S ware System. (1 Tape)
____ S-4 — Computers & Counseling in Special Education. (1 Tape)
____ S-5 — Computerized Assessment Information Management—D Need It? (1 Tape)
____ S-6 — Technology Trends & New Sp. Ed. Applications: An Upda (1 Tape)
____ S-7 — Improving Productivity with Local Area Networks. (2 Tape
____ S-9 — The Effects of Microcomputer Based Instruction on t Academic & Social Progress of Autistic Students. (1 Tape
____ S-10 — Kids, Computers and Competence: How to Train Others. (1 Tape)
____ S-11 — Word Processing for the Gifted. (1 Tape)
____ S-16 — How Are We Really Using Micros? (1 Tape)
____ S-17 — Implementing a Statewide Software Evaluating Model. (1 Tape)
____ S-23 — A Computer Application for Severely Handicapped Children. (1 Tape)

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