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A study of applications of microcomputer technology in special education in western Massachusetts schools.

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A STUDY OF APPLICATIONS OF MICROCOMPUTER TECHNOLOGY IN SPECIAL EDUCATION IN WESTERN MASSACHUSETTS SCHOOLS

A Dissertation Presented

By

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DEDICATION

This study is dedicated to my parents, my husband and to my children.

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ABSTRACT

A STUDY OF APPLICATIONS OF MICROCOMPUTER TECHNOLOGY
IN SPECIAL EDUCATION IN WESTERN MASSACHUSETTS SCHOOLS

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The purpose of this study is to survey microcomputer applications in special education in Western Massachusetts Schools and, in particular, to assess the extent to which special education is moving beyond drill and practice software with special needs students.

Data were collected from 185 special education teachers by a questionnaire and follow-up interviews from eleven special education teachers in Western Massachusetts.

Results showed that computers and software are generally integrated in special education teachers' curricula. They used the microcomputer as a compensatory tool to sharpen students' mathematics skills, language arts and reading comprehension. Some special education teachers also used computers for language assessment, speech training, eye-hand coordination and communication. Apple computers were the most popular brand used in this study. Adaptive devices such as firmware cards, switches, and

speech synthesizers were used to help special needs students access computers. Computer-assisted instruction, word processing and games were the most popular software used. Students worked on computers generally alone, or in a small group, or in combination; the amount of supervision required depended upon students' functioning level and physical limitations. Most special education teachers did not teach any computer language; only a few teachers explored Logo or BASIC with their students. Special education teachers realized that the computer is a good tool to motivate students and to increase self-esteem and attention; they received some inservice training on computer uses, but complained that it was not enough to help their students. Factors making it difficult for special education teachers to use computers were: lack of appropriate software, teachers being behind the trend, not enough class time to use computers, and perceptions of computers as dehumanizing.

The study concludes with recommendations for increasing special education teachers' computer training via input from hardware and software experts, and for requiring special education teachers to take introductory computer courses such as Logo, BASIC programming, authoring language systems and software evaluation. Also, it recommends that school administrations give financial and technical support for such training in order to use microcomputers and related devices more effectively.

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C H A P T E R I

INTRODUCTION

The use of microcomputers and related technology in special education has increased dramatically in the United States during the last few years. Blaschke (1986) stated that the number of microcomputers used in special education was approximately 60,000 at the end of 1983. Two years later the number increased to 200,000 and the number continues to increase. This growth can be attributed to a number of factors. First, Public Law (PL) 94-142 generated a demand for technology use in both instruction and administration (Blaschke, 1985). Second, the funds allocated to special education have increased by 69% over the last decade (Blaschke, 1985). Third, the cost of microcomputers continues to drop. Fourth, as parents of special needs children become increasingly aware of the potential uses of microcomputers, they have made microcomputers more available in school and at home.

Applications of microcomputers and computer-related technology have opened up a wide range of opportunities for children with special needs. For children with severe and multiple disabilities, microcomputers and computer-related devices are used to provide both instruction and independent learning - especially in the training of specific cognitive skills, such as contingency awareness. For the hearing

impaired, microcomputers help develop speech production, communication skills, and written language. For the visually impaired, current computer technology provides synthetic speech, large print style, and Braille processing systems. For the learning disabled, microcomputers help develop their academic skills. For the physically disabled, microcomputers help them meet educational objectives through computer-assisted instruction (CAI). Also, computer-related devices help speech handicapped individuals communicate with people by artificial voice.

Since microcomputer and computer-assisted instruction (CAI) programs are proliferating in schools, the potential of widespread use of microcomputer technology in special education seems strong. However, important questions remain: What does this proliferation of microcomputers imply? Why are tens of millions of dollars being spent to explore possible uses for computers with special needs children? What do microcomputers really offer special needs students - beyond being a fad? How should teachers best use microcomputers for their students? From surveys (Budoff, M., Thormann, J., Gras, A., 1984; Mokros & Russell, 1986; Becker, H.J., 1987) it was found that most special needs students use computers primarily for drill or motivation after other work is completed and that only a few students have explored problem-solving software or programming languages such as Logo. Their results showed that students benefitted in many skills from using

computers, but they did not demonstrate that computers improved students' problem-solving skills.

This study is designed to investigate the applications of microcomputers in special education and to assess the extent to which special education is moving beyond drill and practice software with special needs students. The study is limited to Western Massachusetts schools and provides feedback to special education teachers about the application of microcomputers in this field. It also makes suggestions to those who are interested in developing software for students with special needs.

Statement of the Problem

Microcomputer applications and computer-assisted instruction (CAI) are now emerging at a rapid rate in special education. This implies that schools have followed Public Law 94-142 to emphasize special education and have designed related services to meet students' special needs. However, does the increasing number of microcomputers mean the quality of special education is getting better? Microcomputers and computer-related technology have significant potential for children with special needs to enhance their opportunities for integration, independence and personal choice. But is this potential being realized?

Recently, from a pilot study on applications of microcomputers in special education in local schools, this

researcher found that many problems remain in special education. For example, special education teachers have difficulties in operating microcomputers and computer-related devices, in selecting computer software, in integrating computer-assisted instruction in their curriculum, in generating students' individual education plans, and so on. The researcher wonders if these problems remain in schools in other areas of Western Massachusetts.

Specific questions addressed by this study are given in the next section.

Purpose of the Study

The general purpose of this study is to investigate the applications of microcomputers in special education in Western Massachusetts Schools and, in particular, to assess the extent to which special education is moving beyond drill and practice software with special needs students.

Specifically, the study will answer the following questions:

1) What kinds of computer hardware are being used in special education?
2) What kinds of software are being used in special education?
3) How is this technology used in the special education?

4) How are students introduced to computers and how much supervision is needed?

5) Is computer programming taught to special needs students? Which language? Why?

6) What are special education teachers' perceptions about the impact of computer technology on their teaching and on students in their classes?

7) What inservice training on computer uses have special education teachers received?

8) What factors make it difficult or easy for special education teachers to use microcomputers?

9) What are special education teachers' attitudes toward the use of microcomputer technology with special needs students?

Significance of the Study

This study will provide information which will assist the Western Massachusetts Department of Education administrators, public and private school special education administrators and special education teachers, and others, to know to what degree applications of microcomputer technology has been adopted in Western Masschusetts.

Secondly, this study will provide feedback which will assist special education teachers to select appropriate hardware and software for their students. And finally, the researcher hopes that data gained as a result of this

research will be available for individuals and agencies such as state education agencies, local education agencies, state operated and supported programs, parent advisory committees, and the State Advisory Panel. This would provide an empirical data base for evaluation and planning. It will also be useful to the Department of Special Education in Western Massachusetts and others in order to assist in the determination of regulations, policies, procedures, and funds.

Limitations of the study

The scope of this study is limited to Western Massachusetts (Berkshire, Franklin, Hampden, and Hampshire counties). The Western Massachusetts area includes urban, suburban and rural schools with the following characteristics:

1) School enrollment (from nursery school to college): Berkshire county has 40,130 students, Franklin county has 17,301 students, Hampden county has 122,256 students, and Hampshire county has 54,252 students. 95.73% of all students in Western Massachusetts are Caucasian, 2.39% are African American, .01% are American Indian, .45% are Asian or Pacific Islander, and 1.31% are other races (Chapman, 1980). In Massachusetts, there are about 130,115 students enrolled in special education programs, representing 15.4% of the State's total public school enrollment (Bertonazzi,

1986). Assuming this percentage applies to Western Massachusetts, the enrollment of special education students can be estimated at about 36,000.

2) Educational attainment: 8.42% of the total Western Massachusetts population completed elementary school, 21.85% completed high school, and 10.85% completed college or beyond.

3) Family income: Berkshire county average is $19,300 per family, Franklin county is $18,311, Hampden county is $15,596, and Hampshire county is $20,230.

Another limitation is due to the use of some open-ended questions in the questionnaire and of some unstructured interviewing which may have allowed the researcher to impose subjective interpretations of responses. Further, misunderstanding may be due to omission, misplaced emphasis or bias. Every attempt, however, is made to avoid these pitfalls.

C H A P T E R II

REVIEW OF RELATED LITERATURE

Introduction

The use of microcomputer technology in special education is influencing special education development and training and appears to be improving the quality of education. In this chapter no attempt is made to review comprehensively literature in both special education and microcomputer technology. Rather, it is intended to examine pertinent research and overlapping developments emerging from these two fields. Two areas of literature are useful in understanding this study. One is some information on current computer applications to children with various kinds of special needs. The other area is research specifically on the practice of microcomputer use in special education.

In this study the special needs children are defined as those who have special mental, emotional, learning, social, physical, sensory, or communication needs and require assistance to achieve in school or to reach their full potential and become happy, self-confident, self-supporting and contributing individuals. Also, they are separated into six groups: (1) blind and visually impaired, (2) deaf and hearing impaired, (3) physically or multiply impaired,

(4) severely mentally impaired, (5) speech and language disordered, and (6) mildly handicapped.

Applications of Microcomputers with Blind and Visually Impaired Children

Current microcomputer technology enables visually impaired individuals to interact with a computer through combinations of several types of information, such as synthetic speech, large print, low-vision, and braille print. The special devices developed for visually impaired are classified into three categories: 1) voice applications, 2) braille applications, 3) enlargement.

Voice Applications

Many computerized devices are available to translate visual data into usable form for visually impaired individuals. For instance:

1) Kurzweil Reading Machine: The machine will 'read' out printed material in an artificial voice. It allows the user to control speed, volume, tonality and other variables in the quality of speech output (Behrmann, 1984). Furthermore, this reading machine can also send anything it reads directly into a computer. The primary limitation to the Kurzweil Reading Machine is the high cost, approximately $21,000. Kurzweil's $24,000 VoiceWriter, capable of recognizing 10,000 words and printing them as quickly as they are spoken, will also

be an invaluable computer for visually impaired and seeing persons (Lindsey, 1987).

2) Total Talk: This is a computer equipped with a speech synthesizer and appropriate software. It will provide the user with auditory as well as visual feedback (Behrmann, 1984).

3) Universal Laboratory Training and Research Aide (ULTRA): This is a portable talking computer developed to help visually impaired students conduct their own chemistry experiments (Hilldrup, 1984). The ULTRA is easily connected to a variety of measurement instruments and sensors commonly found in the typical science laboratories. It converts the data readings from various instruments to speech or some other auditory output. Thus, a visually impaired person can independently perform measurements of physical and chemical quantities and perform pertinent calculations (Lindsey, 1987).

4) Audio Typing Unit (ATU): ATU is developed by IBM. It is talking typerwriter which provides the blind user with a synthesized feedback.

5) Talking program. Stat Talk is a talking program for the Apple II series. It is designed to meet the needs of the professional or student working with statistical formula. This program is developed by Dr. Dennis Shulman, a clinical psychologist who is blind himself, Stat Talk performs elementary statistics such as mean and standard

deviation, as well as correlations, hypothesis testing, model testing and evaluation, multiple regression, non-parametric statistics, etc. Keystrokes, as well as the row and column of data entry, are spoken. In addition, data can be stored on disk (Horn, June 1987).

Braille Applications

These applications are generally based on a software rather than on specially designed hardware. The software acts as a translator or transcriber, moving information from English text to braille and back again. The command features of such programs include text editing, voice output, print, and the option of creating a hard copy via a brailler or sending the braille code to the screen. (The latter option is useful for the sighted braille user who needs to transcribe music or mathematics into a more technical braille code.) Examples of such applications are as follows:

1) VersaBraille II System: This system is developed by Telesensory System Inc. It is a portable, disk based microcomputer. The difference between this display and the regular computer is this system has a unique paperless braille display substituting for a video monitor. Braille is displayed on a field of 20 cells containing six holes each through which rounded pins project to form the braille characters. This system can be used to do word processing, data analysis and

calculation for business uses. It can link to other computers when hooked to a modem. So the user can dial up CompuServe, Bank of American's Home Banking System, The Jones Financial Network, and other data bases (Telesensory System, January-February, 1986).

2) Optacon: The Optacon is a compact portable reading aid which gives the blind user immediate access to printed material. The user holds a camera in the right hand and moves it over the text. The optacon system then translates the paper printout or the electronic video display into a raised, vibrating, tactile print that is not braille but a tactile counterpart of the text (Ruconich, Ashcroft, & Young, 1984)

3) Tactile Graphics Display. The American Foundation for the Blind has developed a new Tactile Graphics Display under a grant from the National Science Foundation. As Maure (1984) reports, the Tactile Graphics Display

> can be configured in single-line, multi-line, or full-page displays (Library of Congress standards). Because of its symmetrical dot configuration, multiple alphanumeric fonts, conventional six-dot braille, computer braille and graphics can be generated. Black pins on a white background provide a sharp contrast which enables the partially sighted to use the display, as well as the blind. (p. 134)

Enlargement

Print enlargement can be generated through either software or specially designed hardware. Software control is an inexpensive way to change the visual size of the computer text. Examples of such software are as follows:

1) Large Type: This program can be interfaced with the TRS-80 microcomputer. It will double the size of characters and it also provides some text editing capabilities.

2) Vista System: This system is developed by Telesensory System Inc. It is now available to enable visually impaired individuals to use IBM PC by producing enlarged characters and images on the screen. This program has many features that help visually impaired individuals process information in the computer such as, enlarge graphics and text, provide a mode for viewing single line for text, transfer data through a telephone, etc. It is really helpful for the visually impaired (Leahy, 1986).

3) Magic Slate: This program can be interfaced with the APPLE computer. It has an enlargement function for visually impaired users.

4) Large print programs: Some computer-assisted instruction with large print features are available on the market. Boston Educational Computing has developed two programs, AddSub and Mult-Beci. These programs can be run on the Commodore 64, VIC 20, and Atari computers. The programs generate one, two or three inch characters on the screen, the size depending on the number of numerals displayed. In both programs, problems to be solved are randomly generated by the computer, though the user can select the degree of difficulty (Horn, 1987).

An example of hardware to enlarge text is DP-10 from Visualtel. This is a monitor and interface box that works with APPLE II microcomputer. It enlarges letters up to 16 times. A problem with large print computers is that they reduce the amount of material displayed at one time and make review tedious and difficult (Goodrich, 1984).

Applications of Microcomputers with Hearing Impaired Children

Computer prostheses for the hearing impaired have undergone significant developments over the years. The computer, with its visual output, is a prosthetic tool for the deaf and with its interactive features it has been an excellent learning tool for these children (Goldenberg, Russell, & Carter, 1984). Since interfacing with a microcomputer is based on visual and motor skills, hearing impaired individuals do not require major hardware modifications to interact with the computer itself. In other words, computer-assisted instruction (CAI) with feedback will be appropriate to use to motivate students with hearing impairments.

There are three kinds of computer-assisted instruction (CAI) which use the microcomputer to teach skills specific to hearing impaired individuals: (1) Vocalization, (2) signing, and (3) lip reading (Hagen, 1984).

Vocalization

One of the problems for the hearing impaired individuals is in speech production. There are several programs which have been developed to analyze the speech spectrum, and to give visual representation. The hearing impaired speaker can then see his speech and modify it to the pattern produced by a hearing person, and thus improve intelligibility. Nickerson's group (Nickerson, Stevens, Rollins, & Zue, 1983) has a similar program for the use of the microcomputer in speech training. Their system can measure pitch and nasalization and analyze the speech spectrum. The students then can see the visual feedback. Adams (1987) found that the Visual Speech Feedback Unit, which provides visual feedback of the speech, can improve the prelingually deaf child's temporal and pitch phenomena of utterance and thus improve their speech proficiency improved.

Signing

There are several computer assisted programs available to teach fingerspelling and signing. Four programs of this type were entered in Johns Hopkins First National Search for Applications of Personal Computing to Aid the Handicapped in 1981. These programs are similiar in that they use graphic representations of the alphabet signs and provide drill and practice (IEEE Computer Society, 1981).

Lip Reading

For lip reading, a program called Lip-Reader Trainer is available to teach and drill the user in the 19 distinguishable lip position of the English language speaker. The program converts typed sentences into appropriate sequences of mouth positions. The speed of presentations of these sequences is adjustable to allow the user to build up to regular speaking speed (Hight, 1981).

In addition to specific skill training software, hearing impaired educators also use regular computer-assisted instruction (CAI) to enhance students' reading comprehension, mathematic skills, written language and problem-solving skills. The most popular type of software used with hearing impaired students is the word processor. The word processor has been used as a tool to develop hearing impaired students' language skills. The word processing provides a convenient means of editing. The message can be sent to a printer or, via telecommunication, it can be sent across telephone lines. The capability of communication with nonhandicapped peers and immediate feedback are important factors to motivate students to produce more and better written language. Thus, the language and written skills are improved (Watson, 1978; Goldenburg, 1979; Hagen, 1984).

Real-Time Graphic Display

In addition to the specific training software and regular CAI, Real-Time Graphic Display is also an intriguing

application of the computer to the communication needs of the hearing impaired. This system was developed under the leadership of Ross Stuckless at the Technical Institute for the Deaf, Rochester Institute of Technology in Rochester New York. With the Real-Time Graphic Display System, a court stenographer will sit in a class and transcribe speech into shorthand, which is decoded by a computer. Within five seconds the spoken English can be displayed on the television screen. Hard copy of a lecture student discussion can be printed out for student use immediately after class (Stuckless, 1983).

Logo

Logo is used frequently by educators of the hearing impaired to develop students' spatial visualization, problem-solving and spoken language. Grant and Semnes (1983) demonstrated the efficacy of Logo with preschool age hearing impaired children. They felt Logo improved "language usage" and abstract conception. After the experiment of using Logo with 14 profoundly hearing impaired school aged children, Stone (1983) indicates Logo provides a learning environment in which children create their own problems and then look for strategies to solve the problem and are able to share their discoveries with others.

Additionally, for the deaf person living independently a microcomputer has the pontential to monitor a large number of signal inputs (i.e., doorbell, telephone, smoke alarm or

intrusion alarm), prioritize alarms and generate distinctive lampflashing patterns (Mitchell, 1981).

A tactile system called Vibrating Platform was developed by Ray Bonnell of Florida University. The platform's vibration is coordinated with music by a software program for the APPLE Computer, allowing hearing impaired students to feel the music through their feet and dance to it (Milich, 1982).

Applications of Microcomputers with Physically or Multiply Impaired Children

Children with physical impairments generally have the same learning characteristics as nondisabled children. These children have significant disabilities in posture and movement. These disabilities might be acquired through accident or disease, such as paralysis (e.g., quadriplegia or paraplegia). Some individuals are born with movement disabilities that range from mild to severe. Individuals may be totally unable to move their heads or eyes (Lindsey, 1987). The type of physical impairments include spina bifida, cerebral palsy, traumatic spinal cord injuries resulting paralysis, amputations, arthritis and among others (Behrmann,1984). Physical impairments may also be a result of such as Legg Perthes Disease, which affects bone growth and subsequent motor functioning, poliomyelities, hemophilia, fibrosis, muscular dystrophy,

and multiple sclerosis, the latter two being degenerative and generally fatal (Behrmann, 1984).

As stated earlier in the beginning of this section, children with physical impairments generally have the same learning characteristics as nondisabled children but the motor impairments can inhibit their ability to learn by interfering with "normal" interactions with the environment. Motor impairments, particularly in individuals with cerebral palsy, often prevent verbal communication, which is important in social, cognitive, and language development, as well as the ability to use the fine motor control needed for written communication. Motor impairments can also inhibit individuals from independently interacting with their environment. For young children, this can hinder learning experiences, and for older individuals it causes frustration and dependence. Microcomputer technology can help these children to interact with their environments.

Some physically impaired children may also have multiple impairments such us vision, hearing or cognition problems whose impairments are so severe that learning and functioning in many areas are adversely affected. These conditions may affect such educational areas as communication, language development, intellectual and academic development, recreation and leisure skills. In an individual with multiple disabilities, mental retardation is probably the most common handicapping condition. For example, almost 60% of the cerebral palsy population, which

is probably the largest group of motor impaired children, has some degree of retardation. Hearing impairments are also found in 10% to 15% of the institutionalized retarded population. The movement characteristics of physical impaired and multiple impaired are some control of upper extremities or no fine motor control, good head control, no head control and no control of uppers, control of eye gaze, control of specific muscle (facial or otherwise), unilateral (e.g. one arm, one hand), and so on (Lindsey, 1987). Microcomputer technology has tremendous flexibility in addressing these multiple impairments in various degree so that they can communicate or interact in a learning environment. For example, a head or mouth stick can be an interface option for children with no head control; voice input, puff and sip switches can be an interface option for children with no head control and no control of upper limbs.

The flexibility of computer technology for physically impaired or multiply impaired person is to use various adaptive devices to take input or send output in order to meet individual needs.

There are several types of adaptive input devices:

1) Adaptive Keyboard: For those with inaccurate fine motor function or head stick control systems. Examples are:
   a) Expanded Keyboard: it has a larger key surface than a regular keyboard.

b) Keyguard: a template which leaves holes for the keys. These holes help children who have shaky motor problem to type in the right places.

c) Keyboard software: a program which divides the keyboard into two parts, left and right. Pressing any key on the left side provides a "yes" response and any key on the right is a "no" response.

d) Custom keyboard: a system which has a tactile alphabet for a blind or nonspeaking or physically disabled person.

2) Touch Switches: these switches require pressure or touch to activate the system. Types include:

a) Push Switches: these switches require the user to press or squeeze to activate. Teeter Switch (activate by a light sweeping motion), Flat Air Cushion Switch (a light pressure exerted at any point within the surface of the switch), Rocking Lever (activated with gross hand, arm or other body part movements or with a mouth stick or head stick), Joystick (push for directed scanning), arm slot control (push by gross arm hand, or foot movement), Brow Wrinkle Switch (activated via brow or wrist movement) and Wobble Switch (activated via gross body or head movement).

b) Pneumatic Switch: this switch requires sucking or blowing on a tube or pressing an air cushion.

c) Tongue switch: Activated via moisture or minimal pressure from tongue, nose, chin, cheek or slight

finger movement. It is connected to a bracket clamp for easy mounting.

3) Bioelectric Switches:

   a) Electromyographic Switch (EMG): This requires only a slight muscle contraction. An electrode is placed over the muscle site and "reads" the nerve impulse, which activates the switch to indicate the choice to the computer.

   b) Electroencephalographic (EEG): an electrode is placed on the scalp directly over areas of the responsible for a particular function and senses the electrical brain activity, which activates the switch (Gillespie-Silver, 1985)

4) Voice recognition: This is a sound activated switch. It is useful for quadriplegies with good verbal ability. Example of this kind of device is "Voice Input Module (VIM)" from Voice Machine Communication, Inc.

5) Video Pointing Devices:

   a) Light Pen: allows a user to give information to the computer by pointing directly to location on the screen which may contain words, pictures, or other information.

   b) Touch Tablet: The user is required to hold and move a stylus across a surface of touch tablet. Alternatively, the user can touch the screen by his/her finger.

c) Mouse: it can move cursor directly to a desired position by lightly pressing the device.

d) Ultrasonic Switch: This switch uses ultrasonic technology to determine X-Y coordinates. When a beam is interrupted, the switch is activated. The ultrasonic technology also permits obstacle detection and cruising functions.

The computer input devices mentioned above often custom modifications to the software. Software packages in communication environmental control, mathematics and reading ready-made for switch activation are available, but limited in number. Fortunately, the technology is available for us to access commercially available software. Alternative ways to use regular software are:

a) To change the commercial program code: several utility programs can be used to search the commercial program code for all input statements and change them to accommodate switch input. Two examples of these utility programs are "Single Input Disk" from the University of Washington, "Handi-Scanner" from Rushakoff at New Mexico State University (Rushakoff & Lombardino, 1983). Unfortunately, the majority of commercially available programs are copy-protected.

b) To use an adaptive firmware card. These cards can run standard, unmodified software such as Logo, subject software, VisiCalc, or other spreadsheets and can

sixteen different kinds of input methods, from two switch mouse code to single switch scanning and expanded keyboard, into computers. It also features in a slowdown mode and game paddle emulation to permit many commercial games to be played by means of one or two switches.

c) Keyboard emulator: emulators are used to enter input, and the device then generates the appropriate information for the computer. The information is X-Y coordinates or ASCII code. Some of emulators consist of a matrix of connectors which are activated with pressure. The X-Y coordinates of a pressure point is sent to the computer, and the software determines the meaning of the input. On a touch screen, when the screen is touched, two light beams are broken and the X-Y coordinates of the beam are calculated and sent to the computer. "Minspeak" from Prentke Romich Company is a highly specialized keyboard emulator. This system uses a modern linguistic coding system based on thoughts or ideas rather than words. Sentences are stored under a set of pictures and when the user enters the sequence of pictures that represent the idea to be communicated, the corresponding sentence or phrase is reacted verbally (Backer, 1982; Creech, 1983). "Express 3" and "Autocom" from Prentke Romich Company and "Tetrascan" from ZYGO Industrial Inc. are similar to Minspeak. They enable severely physically impaired children to be effectively integrated into mainstream classes actively rather than to participate in the

educational process passively. Severe physically impaired students can access almost all commercially available software via these communication aids.

Assesssment and Training Applications

Determining the best type of interface for children to use with computers and the location of the device requires systematic assessment. Also training in the use of a switch to access computers is important before being able to use the computer for educational, recreational, communication, or other functional uses (Behrmann & Lahm, 1985; Campbell, Bricker, & Eposito, 1980; Bourland, Jablonski, Allen, & White, 1984). Several systems for assessment and motor skill training have been developed and are commercially available, such as the TA-2 training aid device and the EX-3 evaluation system developed by Prentke Romich Company. These devices operate a number of assessment and training programs using built-in software (Campell, 1985).

Communication Applications

Many communication aids are available to help impaired persons to communicate expressively (Vanderheiden, 1985). Most communication aids have oral and written expressing functions, such as the Minspeak system and the Touch Talker marketed by Prentke Romich Company, which use self-contained software. Many of the software programs that use commercial hardware have been developed for use by specific individuals with disabilities (Hagen, 1984b; Jung, 1980; Shirriff,

1980), while others have been developed for more general use.

Vocational Applications

Microcomputers can be vocational tools for physically impaired persons. Several programs open up vocational pursuits that were traditionally only available to workers with upper extremity dexterity, such as Computer Assisted Drafting (CAD) and Computer Assisted Manufacturing (CAM), all operated using a mouse to move the computer cursor. Computer-based tools for an employee with disabilities can be a business necessity (e.g., word processing, bookkeeping, accounting, or payroll). The use of the computer must fit the needs of the jobs so that the equipment enhances employee performance or allows accomplishment of a job that would not be possible without the computer. Currently, most physically impaired persons employed with computers are performing single function business applications using existing software packages developed for the business community and accessed through voice, control switch, or other interface methods.

Living Skills Applications

Computer systems can help physically impaired or multiply impaired persons to perform appropriate living skills, such as operating appliances, controlling environmental devices (e.g., turning on/off electric

devices, locking/unlocking doors), and performing bookkeeping skills (e.g. writing checks). Many living skills can be performed using single switch interfaces with a computer. In addition, a personal robot, HEAROID, designed by Tomy Tech Corporation (TTC) has become a useful helper of the person with disability. HEAROID can be programmed to respond to his owner's voice, can be trained to perform an unlimited number of programmed useful tasks. The owner of this personal robot can program it in as little as five minutes and no knowledge of computer language is required. The robot is controlled either by preprogrammed tape, voice-recognition, or radio control. The programmed control robot will clean up the room, serve coffee or lunch, entertain with jokes, poetry or music. It can also mind baby and waken the family (Tomy Tech Corporation, 1986).

With the usage of computer hardware and software adaptations, individuals with physical and multiple impairment can have basic living skills, communications tools and skills and individualized instructional opportunities. Their lives will be richer and more complex.

Applications of Microcomputers with Severely Mentally Impaired Children

The major characteristics manifested of children with severely mental impairments are: 1) aggression toward others, 2) no attention to even the pronounced social stimuli, 3) self mutilation such as head banging and biting

oneself, 4) rumination: self-induced vomiting, 5) durable and intense temper tantrums, 6) imitation: to mimic or repeat a behavior, and 7) extremely brittle medical existence: presence of life-threatening conditions (Gast & Berkler, 1981). Some of them may have poor motor control.

The primary features of learning needs for this group are toileting, dressing, feeding and other self-care skills, social skills and expressive communication skills (Reynolds & Mann, 1987; Lindsey, 1987; Sailor & Guess, 1983).

The computer has potential for offering valuable learning experiences to advance self-care and language skills (Lindsey, 1987). Computer-assisted instruction (CAI), communication, and environmental control programs are very helpful for this kind of population. Many severely mentally impaired children have to use adaptive devices to access microcomputers. The adaptive devices have cited in the early part of this chapter.

Current Microcomputer Applications

Academic skills. Distractibility is one of major problems to this group. Computer-assisted instruction can use various visual and auditory techniques to draw attention to learning task. Moving graphics, music, and color may also attract attention (Allen ,1975). Low expectancy for success is also a major problem to this group. This may be caused by frequent failure experiences and may result in a low level of motivation.

The computer can present material within the range of a student's competence, reinforcing correct answers and allowing for and emphasizing successes. Reinforcement which is the form of music (Holloway, 1980) and verbal praise has been found to increase task performance and achievement of mentally impaired individuals. The computer could provide such reinforcement consistently. Many CAI programs have been published to teach letters, numbers and colors, such as "Learning with Leaper", which uses the graphic capabilities to teach color, number, and the alphabet. "Kindercomp" has programs for matching shapes and letters, writing names, drawing and filling in missing numbers. "Facemaker" allows the child to create animated faces that wink, smile, and wiggle their ears. Survival-skills software such as that developed by MCE address such needs as money management, home safety, banking skill, job readiness, etc. (Lindsey, 1987; Hagen, 1984; Behrmann, 1984). Much commercially available software can be modified for special input and output by a utility program to meet instructional needs. For example, math drill and practice and problem solving games can be used to improve their cognition.

Motor training. For perceptual motor training, a series of programs, "Motor Training Games," is available to teach tracking and motor coordination necessary using a single switch. The "Motor Training Games" can also be used

as recreational software. The programs are all presented in a game format, some with scoring features. "Facemaker" software can serve as recreational or cognitive skill development. The student constructs faces from a variety of choices available in each category (Lindsey, 1987).

For Vocational training, there are several programs available. These programs cover money, time, and work habits.

Logo has a drawing mode. The images they create motivate mentally impaired children to use computers to create pictures. Some software has Logo-like facilities, such as the Koala Pad. It provides easy access to many drawing methods, such as fill-in, background, and erasing. Figures such as circles and squares can easily be drawn and used to construct pictures. With programs like this, the creativity of the children will be evoked.

Environmental Control. Some of mentally impaired individuals have poor motor control. The computer is a tool of environmental control for severely mentally retarded individuals. The meaning of environmental control is to use verbal and written communication, environmental manipulation, and self-help. The mentally impaired children can use computers as tools for accommodation to handicaps in recreation, learning and vocational settings. For recreation and learning it is not hard to select appropriate software from commercially available software. The potential of the computer is being investigated by the

Association for Retarded Citizens Bioengineering Project (Kneedler, Hallahan & Kauffman, 1984). They have identified a list of devices that assist this population in accessing the technology. Beyond what is currently available, they have investigated sensors that can be used to activate various stimuli for feedback. Automatic memory devices have been investigated for their potential for providing cues or prompts to individuals while performing a task. Additionally, self-help devices have been reviewed such as the Bladder/Bowel Sensation Exaggerator and the Self-feeding Tray. Although these examples go beyond microcomputer technology, certainly the advances in microcomputer technology have influenced other technologic development.

Devices used for environmental control are also useful for mentally impaired individuals. "Waldo" or "Motor-Handicapped Support System, "two systems that are developed for use with different computers from Artra Inc., are multiple-function devices that provide the means for controlling electrical appliances, generating sounds for alarm systems. Any of these systems can be activated by using on-board voice recognition, keyboard or switch.

Communication Applications. For communication, some systems are available to assist the nonverbal or individual with unintelligible speech, such as the Echo II Voice Synthesizer from Street Electronics (Lindsey, 1987; Vanderheiden, 1985; Behrmann, 1984). This system allows the user to enter unstructured text into the computer and have

immediate feedback. Since this population consists of many nonreaders, a modification of this kind of system is necessary. The "Picture Communication Program" from Input-Output Research Enterprises is an example of such a modification. Sixteen pictures with written words are displayed in a four by four matrix on the video screen, The user can select a word picture by a screening procedure controled by sensors or switches (Behrmann, 1984). For written communication, some easy word processors with graphic indicators are used in some curricula. However, written communication will not be available for most of these children.

Applications of Microcomputers with Speech and Language Disordered Children

Speech and language disorders can be defined in many ways. According to one of the most widely used definitions, a speech and language disorder exists when an individual's speech deviates extremely from what is normal and draws unfavorable attention, impedes communication with others, or causes social problems (Van Riper, 1972).

Speech disorders are generally problems with articulation, voice, or fluency. Language disorders go beyond the production of sounds and is involved with the generating and understanding of words and sentences. Hearing impairments, cerebral palsy and mental retardation may result in speech and language disorders.

According to the survey from the American Speech-Language Hearing Association, there was a steady increase in the use of computers by speech and language pathologists; in 1982, 23.8%, in 1983, 28.6%, in 1984, 38.3%, in 1985, 47.2 % of speech and language pathologists used computers at their work (Lindsey, 1987).

Current Computer Applications

Diagnostic Applications. Computers are very good at counting and analyzing. Currently several diagnostic programs are available in the market. This software can improve accuracy and save language pathologists' time so they have more time with clients. These programs are designed to evaluate communication disorders. Some programs are used to do phonological analysis and some programs are used to do language analysis. Examples of phonological analysis programs are:

1) Comprehensive Phonemic Inventory for School-Age Children: This is a phonological analysis package that provides information on phonological delayed or disordered individuals. It is an Apple compatible program (Blache, 1984).
2) Lingquest 2 : This is an Apple or IBM compatible program that performs a phonological analysis on a set of phonetically transcribed utterances or the results of formal or informal articulation tests (Palin & Mordecai, 1982).

3) Computer Managed Screening Test (Fitch, 1984a), Computer Managed Articulation Diagnostic Program (Fitch, 1984b), and Computer Articulation Treatment Program (Fitch, 1984c): This series of programs can be used to assist language pathologists in the screening, diagnostic and treatment of a articulation disorders.

4) Articulation Error Analysis: This is a software program that takes the results of any standard articulation test or speech sample as input. The program provides the information such as total number of phonemes analyzed, total number and percent of correctly produced phonemes, total number and percent of error phonemes, etc.

Examples of language analysis are:

1) Systematic Analysis of Language Transcript (SALT): Currently this program is widely used by language pathologists. This program provides a detailed interactive analysis of a client's free speech samples, then it will perform numerous language assessments, such as mean length of utterance in morphemes and words, distribution of utterances by words and morpheme length, distribution of number of utterances by speaking turn, frequency of occurrence of each word in the sample, and etc. (Miller & Chapman, 1986).

2) Computerized Language Sample Analysis: This program provides inventories of the frequency and accuracy of

occurrences of fourteen different grammatical categories (Weiner, 1984).

Communication Applications. Most severe disabled individuals have difficulties in communication. Currently computer technology allows them to communicate with friends, play games, do homework and make their lives better than ever before. This type of system consists of an input device, communication software, and written, spoken or pictorial output. The input device could be a regular keyboard or adaptive keyboard, voice input, a switch or a sensor depending on the user's motor condition. The communication software is selected according to the user's needs. A user having visual impairment may require one type of system that uses pictures instead of printed words. The output device could be voice synthesizer talk for the user or braille text sent to a printer. An example of communication software is TALK II. This program is keyboard-based and provides speech output. It can also be used by single switch users through an adaptive firmware card. Additionally, telecommunication software allows nonspeaking individuals to communicate thousands of others.

Therapy Applications. In a speech and language therapy setting, the computer is used as a instrument. Language pathologists are using a variety of computer hardware and software programs to develop exceptional individuals' speech and language abilities. The software

program used in language therapy includes drill and practice, tutorial and simulations. Examples of these applications are:

1) Visi-Pitch: This program provides a visual and numeric data representation of the speech signal (Rontal, Rontal, Jacob, & Rolnick, 1983).
2) Video Voice: This is a speech therapy system that includes hardware and software. It will provide the user with a visual display of the acoustic signal (Lindsey, 1987).
3) The MicroLADS system: a series of programs designed to teach the fundamental rules of grammar (Wilson & Fox, 1983b).
4) PEAL is a collection of programs based on activities found in the daily lives of children through beginning stages of language learning.
5) LOGO is also used as a therapy tool (Bull & Cochran, 1985). Children who have speech and language disorders may be afraid to communicate with others. They may have limited chances to explore their environment or experience the power of language. With LOGO and adaptive access devices (which some individuals may need) children can explore spatial concepts, increase the amount and specificity of the language required for such activities and the image of the LOGO graphics can motivate them to share programming experiences with others. From these

experiences their self-fulfillment and self-esteem are increased.

Administrative Applications. Language pathologists use a number of picture-based materials in therapy, such as stickers for reinforcement, stimulus materials. These are consumable rather than reusable. Now in many schools the computer software such as "Print Shop" is used to generate stickers, signs, greeting cards, banners and other visual materials. Language pathologists also use computers to keep student records and make student reports.

Applications of Microcomputers with Mildly Handicapped Children

The category "mildly handicapped" is a relatively new classification used in special education and related services areas to group heterogeneous handicapping conditions. The population of individuals with mild handicaps includes the classifications of mildly mentally retarded, learning disabled (LD), and emotionally disturbed/ behaviorally disabled (BD) (Lindsey, 1987; Behrmann, 1984).

For the definition of the mental retardation, Section 121a.5 of the Rules and Regulations of P.L. 94-142 and the American Association on Mental Deficiency (AAMD) (Grossman, 1983) provide the following definition:

> Mental retardation refers to significantly subaverage general intellectual functioning existing concurrently

with deficits in adaptive behavior and manifested during the developmental period.

Retarded students have in common their difficulty in mastering school work and coping with environmental demands. As a group, they are characterized by delayed language development, problems in attending to relevant stimuli, short-term memory deficits, deficient memory strategies, and restrictions on the level of attainment possible (Reynolds & Mann, 1987). Since mentally impaired students who function at different levels of retardation have different long-term prognoses and require different educational programs, curricula, methods and materials, therefore in educational planning these students are grouped into four levels: mild, moderate, severe, and profound (Reynolds & Mann, 1987). The mildly mentally retarded students are those whose IQ are in the range of about 55 to 70. They are capable of learning basic academic skills of reading, writing, and arithmetic. Most can learn vocational skills needed for competitive employment, although the work is likely to be semiskilled or unskilled. Their academic works usually are 1 to 2 years lower than grade level. During the earliest school years, they may be given instruction in simple arithmetical concepts, understanding home and community, and early development of good work habits. The etiology is uncertain, although most are classified as cultural-familial, a designition suggesting that a combination of environment and polygenic inheritance is involved (Reynalds & Mann, 1987; Lindsey, 1987; Miller & Davis, 1982).

For the definition of the learning disabled, PL 94-142 provides the following definition:

> "Specific learning disability" means a disorder in one or more of the basic psychological processes involved in understanding or in using language, spoken or written, which may manifest itself in an imperfect ability to listen, think, speak, read, write, spell or to do mathematical calculations. The term includes such conditions as perceptual handicaps, brain injury, minimal brain dysfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily a result of visual, hearing, or motor handicaps, or mental retardation, or of cultural, or economic disadvantage.

In September, 1984, the board of directors of Asociation for Children and Adults with Learning Disabilities (ACLD), Inc. provided its definition. The ACLD definition emphasizes that the condition persists throughout life and does not "go away" even with special instruction. The ACLD definition is:

> Specific Learning Disabilities is a chronic condition of presumed neurological origin which selectively interferes with the development, integration, and/or demonstration of verbal and/or nonverbal abilities. Specific Learning Disabilities exists as a distinct handicapping condition in the presence of average to superior intelligence, adequate sensory and motor systems, and adequate learning opportunities. The condition varies in its manifestations and in degree of severity. Throughout life the condition can affect self-esteem, education, vocation, socialization, and/or daily living activities (cited from Foundation for Children with Learning Disabilities (FCLD) Resource Guide).

From the definitions, we realize that LD persons' disorders can be related to problems in acquisition, integration, and expression of academic concepts and skills

due to some suspected type of central nervous system disorder (Lindsey, 1987). For example, LD students may have difficulties with sentence structure, spelling, grammar or inability to copy correctly from a book or blackboard. Their problems are often inconsistent. For example, the problem may present in today, but not on yesterday. The problem may manifest in only one specific academic area, such as math or foreign language.

For the definition of emotionally disturbed/ behaviorally disordered (BD), PL 94-142 provides the following definition:

(i) The term means a condition exhibiting one or more of the following characteristics over a long period of time and to a marked degree, which adversely affects educational performance.
   a) An inability to learn which cannot be explained by intellectual, sensory, or health factors;
   b) An inability to build or maintain satisfactory interpersonal relationships with peers and teachers;
   c) Inappropriate types of behavior or feelings under normal circumstance;
   d) A general pervasive mood of unhappiness of depression; or
   e) A tendency to develop physical symptoms or fears associated with personal or school problems.

(ii) The term includes children who are schizophrenic.

From this definition, we realize that the emotionally disturbed students' problem are related to their inability to respond to their environment in an acceptable or satisfying way.

The population in mild handicaps is heterogeneous, each individual has unique characteristics and learning needs. In general, mildly handicapped children's characteristics may be distractability, hyperactivity, or low frustration

tolerance. Additionally, children may exhibit a variety of inappropriate social behaviors that interfere with learning, such as aggressiveness, inhibition, or bizarre or self-abusive behaviors. These behavioral problems often make it difficult for teachers to motivate children to work. They may also intefere with an individual's ability to work cooperatively with teachers and peers or to work independently. In addition to the behavioral problem, intellectual, language, academic and vocational difficulties can also be found in this group. Thus learning needs for these areas are necessary.

Intellectual difficulties are related to retardation or neurologic difficulties or behaviors. Various disabilities such as emotional disturbances may affect performance on intelligence tests, resulting in "pseudoretarded" populations (Blake, 1981). Intellectual difficulty includes in memory, perception, conceptualization and thinking. These problems make children with mild handicaps work more slowly than other people.

Language difficulties often can be found in these children's oral and written language. These problems can inhibit the ability of an individual to understand others and can adversely affect academic and social development (Miller & Davis, 1982).

Academic difficulties are affected by behavior, intellect and language. In the assessment of children for special education placement, most mildly handicapped

children will perform at least one year behind expectation in at least one academic area, if this kind of child can get appropriate remedial education in regular classroom or resource room, they will probably not be identified as handicapped (Lindsey, 1987).

Vocational training is one of foci in the education of the mildly handicapped. With technology changing the work environment, many skills and work habits will be more and more important. If these employment skills can be taught, then job opportunities for the mildly handicapped will be increased.

Computers have a number of advantages in meeting the characteristics and learning needs of mildly handicapped children. For example, the computer provides consistent, immediate feedback and preasureless repetition. Schiffman, Tobin, and Buchanan (1982) have discussed a number of advantages for learning disabled students. Beckerman (1983) and Arms (1984) both reported that use of word processing software with exceptional students produced increased instructional involvement. Rosegrant (1985) indicated that the computer provides visual, auditory, and motoric modes of support for learning disabled students. Carman and Kosberg (1982) found that the software programs accelerate the rate of mathematics studies for behavior disordered studentsd.

Microcomputer Applications

Assessment. The microcomputer is a tool to do gathering, computing and analyzing. Special education teachers use computers to do labor saving chores such as pretesting, conducting formative or periodic evaluation, and providing summative evaluation and feedback as post testing. Many of the drill and practice programs on the market are able to provide mildly handicapped students and their teachers with this kind of assessment service.

Record Keeping. Microcomputers can be used to generate and revise individual education plan (IEP) and they can make them more accurate and less time consuming. Some Individual Education Plan (IEP) software is available in the market. A program called "Grade Management" can help teachers record and maintain varied test scores and results. This program can also address scores that numerical, letter, raw, or percentil. Some programs allow teachers to create their own grading or reporting system.

Instruction. Computer-Assisted Instruction (CAI) is the most pervasive and visible use of computer technology with mildly handicapped learners. A speech synthesizer attached in a computer will "speak" written information to the user. This meets the special needs of the user who has difficulty with reading. By providing auditory information with written output on the screen, the user can have the same information as his/her peers. Commercially available software has different formats such as drill and practice,

tutorial, simulations, game, and problem solving. Teachers have to select the appropriate one to meet the student's special needs.

In addition to the use of CAI, there are two major tool applications of microcomputers that are currently being explored extensively. The first is using word processors as a means of developing reading and writing skills, and the second is utilizing programming language as a means of developing problem solving skills. Many children with mild handicaps have difficulty with written language, such as misspelling, grammatical errors, graphic imperfections (size and spacing irregularities, pencil pressure mark, reverse and etc.). With the advent of microcomputers in the educational setting, the pencil and paper blockes can be lessened or limited. The time and energy formerly spent on laborious rewriting of rough drafts can be spent developing ideas in a legible and acceptable form. Therefore, word processors can help learning handicapped children by improving their abilities to communicate their thoughts or ideas through a written language (Budoff, Thormam & Gras, 1984).

Learning to program and think in the manner in which a computer processes information will benefit mildly handicapped children's problem solving skills (Halpern, 1984; Schiffman, 1982). Skills developed in this process include the problem solving ability of breaking tasks down into small, sequential steps. Additionally, searching for

"bugs" that cause the program to stop can sharpen children's problem solving and logical analysis skills. LOGO has been found to be such a problem solving and educational tool. It is designed to let children explore problems by themselves and is meant to improve their thinking abilities rather than to train them as programmers. When children involve the turtle drawing, they utilize and refine their spatial concepts and coordinate various types of tactile, visual, and motor information into the control of the turtle. Additionally, self-concepts may be improved through the prestige gained by being able to make the computer do what they want it to do. Children may also learn that trial and error is a legitimate problem solving strategy, they will not be afraid of facing the failure again (Maddux, C.D. & Cummings, R.W., 1987).

Literature on Using Computers in Special Education

This section explores literature specifically on the practice of using computers in special education, including earlier reviews of the literature and research on microcomputer use with special needs students.

Semmel and Lieber (1986) reviewed the literature on effects of microcomputer applications. They found that most of the early studies focused on comparing computer-assisted instruction (CAI) to teacher-based instruction and the report revealed equivocal results. For example, one study found CAI to be superior (Watkins & Webb, 1981), and two found no difference (Carman & Kosberg, 1982; McDermott &

Watkins, 1983). Two studies that compared a task on the computer to the same task using paper and pencil had similarly inconsistent findings. One found that the paper-and-pencil task led to better performance (Varnhagen & Gerber, 1984), and the other found generally no difference, but found that more work was accomplished with the microcomputer (Kleiman, Humphery, & Linsey, 1983). More recently the focus has expanded to effects of microcomputer technology in special education contexts.

In 1982, Thormann completed a survey of microcomputer use in special education settings in Oregon. She sent questionnaires to the special education coordinators of all 208 public school districts in Oregon. Questionnaire data identified user and non-user districts as well as factors that facilitated and inhibited the incorporation of microcomputers into the schools. Then 25 special education teachers were interviewed in order to gather more detail descriptions of microcomputer use. These interviews focused on the teachers' perceptions of current issues and problems in microcomputer use with handicapped students. A range of issues were covered, including extent of microcomputer use with handicapped students, perceived problems with software, and issues in the integration of CAI into the regular curriculum. 79% of participants were using computers in some capacity in the schools, but only 37% were using computers with special education students. It appears that special education students do not spend large amount of

instructional time working on computers. Teachers interviewed said they primarily used computers as a reward for students when regular work was completed. This finding parallels the case study research of Sheingold, Kane, and Endreweit (1983) on microcomputer use. These researchers concluded that in none of the sites were microcomputers intended to change or replace existing curriculum; rather, they were to be additions (Thormann, Gersten, Moore & Morvant, 1986).

Thormann (1985) conducted a similar survey in Massachusetts in 1985. Questionnaires, completed by special education administrators focused on the extent of use microcomputers and the range of software applications. 90% of districts reported using computers in the schools, and virtually all of those districts (96%) reported using computers in special education. With the range of software used, 98% of the software used for special needs students was drill and practice, 89% games, 82% tutorials, 51% simulations and 39% programming. The teaching of programming skills seems to have a clear increase. In Oregon survey, there were only 4% in programming.

Mokros and Russell (1986) conducted a nationwide survey on the use of microcomputers with special needs students. They interviewed a random sample of 50 special education administrators selected from all computer-using school districts at the elementary level by telephone. The interviews focused on: a) uses of learner-centered software

with children who were learning disabled and emotionaly handicapped; b) teacher training; and c) factors which facilitated or impeded the use of microcomputers with this population. The result showed that most students used computers primarily for drill. The average teacher was just beginning to use learner-centered software. Only a few teachers were familiar with a range of software and used these software in their curriculum. The results of this survey suggest that improvement in the field of educational computing for the special needs students be focused on three areas: improved staff development, more curriculum options, and expansion of the research base.

Semmel, Goldman, Gerber, Cosden & Semmel (1985) conducted a survey designed to examine microcomputer access and use patterns with mildly handicapped learners in California. Rather than surveys and interviews, these researchers conducted extensive observations across a broad range of educational settings, including special class settings, resource rooms, and regular classrooms. They found that 96% of teachers used microcomputers for drill and practice. 66% of the teachers used microcomputers for games or for instruction in computer use, 40% for programming and tutorials, and 25% for writing and simulations. In 1985, one of results from The Second National Survey of Instructional Uses of School Computers commissioned by the United States Department of Education revealed that the effect of computers on low-ability students is improved

behavior and attitude (Becker, 1987). Dudley-Marling and Owston (1988) stated that educators have become increasingly interested in using computers to teach problem solving skills to their students. Machrthur (1988) reported that computers are powerful and flexible writing tools that can have a significant impact on the writing process and on the social context for writing in the schools. Watkins (1989) gave 126 learning disabled elementary school students computerized math and spelling drill and practice for a year. The result stated that students had more positive attitudes toward academic tasks and more favorable opinions than did 89 learning disabled students not using computerized math and spelling instruction.

A Summary of Past Research Findings on Computer Uses in special Education. 1) the dramatic increase in computer use is typical of a nationwide trend. 2) although computers are used extensively, the type of software or the type of instructional use has not changed dramatically. 3) drill and practice is still the most prevalent use of software. 4) there are more teachers appear to be using games in some fashion since 1985. 5) programming by students was almost nonexistent in 1982. There were only 4% of teachers using computer to teach programming skills to students. In 1985, the Massachusetts and California studies separately showed that the programming teaching increased to 39% and 40%. These may be due to the growing popularity of Logo as well as in teacher comfort and expertise with

computers. 6) students had more positive attitudes toward academic tasks. 7) much of the software they used could not be modified to meet the needs of their students.

This review of literature, offering both background information on microcomputer use in special education and specific research on the practice of microcomputer use with special needs learners, is designed to provide a context for this study. The methodology of this study is described in the next chapter.

CHAPTER III

METHODOLOGY

Introduction

Described in this chapter are the methods and procedures which were employed in this study for sampling, instrumentation and research design.

This study was designed to investigate applications of microcomputer technology in special education in Western Massachusetts Schools and to assess the extent to which special education is moving beyond drill and practice software with special needs students. Specifically, this study answered the following research questions:

1) What kinds of computer hardware were being used in special education?
2) What kinds of software were being used in special education?
3) How was this technology used in special education?
4) How were students introduced to the computers and how much supervision is needed?
5) Was computer programming taught to special needs students? Which language? Why?
6) What were special education teachers' perceptions about the impact of computer technology on their teaching and on students in their classes?

7) What inservice training in computer uses had special education teachers received?

8) What factors made it difficult or easy for special education teachers to use microcomputers?

9) What are special education teachers' attitudes toward the use of microcomputer technology with special needs students?

To address these questions, the researcher conducted two separate but related studies. For the first study, the researcher designed a questionnaire (see appendix B) based on the research questions above and distributed it to all special educators who were using microcomputers in Western Massachusetts (300 teachers). Once the primary data were obtained, they were organized into three categories: (1) special educators' backgrounds, (2) uses of microcomputer technology with special needs students, and (3) attitudes toward the microcomputer applications. Then, descriptive statistics such as frequency, central tendency, correlation and other statistical analyses were produced using SPSS. Also, respondents were ranked on their overall computer use into three categories: strong, average, and weak.

For the second study, the researcher randomly selected eleven special education teachers from each of three categories and conducted follow-up interviews. The interview data were summarized and correlated with the results from the questionnaires in order to address the research questions.

Sampling

The population was comprised of all special education teachers and administrators who were using microcomputer technology in Western Massachusetts, a total of 300. After the survey, eleven special educators were selected for follow-up interview. Each interview employed a structured interview guide to ensure that similar topics were addressed by all those interviewed (see Appendix C). Each also contained some unstructured questions to encourage interviews to raise ideas which might have been omitted from the guides.

Instrumentation

The primary data gathering procedure involved the design and administration of a questionnaire (in Appendix B). This instrument encompassed five categories of thematic issues in the application of microcomputers in special education: (1) uses of computer technology in special education, (2) uses of computer software with students with special needs, (3) teacher training on the operation of microcomputers, (4) factors which facilitate or impede the use of microcomputers with this population, and (5) teacher's attitudes, hopes, fears and predictions for the future.

In addition, the questionnaire elicited some relevant information about special education in Western Massachusetts such as size of the special education class, budget for or funding of computer technology, etc. Background data on both the special education teachers and special education administrators were obtained in several areas: (1) number of years employed as a special educator, (2) number of years using computers, (3) age, (4) sex, and (5) number of credits earned in formal study of applications of microcomputers in learning. The total number of items in the questionnaire were fifty-six; it required 20 minutes to fill out.

The questionnaire was independently reviewed by special education teachers in Western Massachusetts. The reviewers were asked to assess the instrument on the basis of relevance, inclusiveness, and validity of each question. The responses of the reviewers guided the preparation of the final instrument.

Observation and interview skills were needed to visit schools and interview special education teachers. Each interview employed a structured interview guide to ensure that similar topics were addressed by all those interviewed. Each interview also contained some unstructured questions to encourage interviewees to raise ideas which might have been omitted from the interview guide. The interview guide focused on: (1) how students were introduced to the computer, (2) how much supervision was needed, (3) where the computer was located, (4) scheduling use of the computer,

(5) problems with software, (6) reasons to use computers in classrooms, (7) effects of computer use on special education students, plus spontaneous discussion of related issues.

Statistical Analysis

Once the primary data were obtained, they were onto into three categories: (1) special educator's background, (2) uses of microcomputers with special needs students, and (3) special educator's attitude toward the microcomputer applications. Then descriptive statistical analyses such as frequency, central tendency, correlation and other statistical analyses were presented by crosstabulations. Also, respondents were ranked on their overall computer use into three categories (strong, average, and weak). Then eleven special educators were selected randomly from each of the three categories for follow-up interviews. The interview data were summarized and correlated with the results of the questionnaire in order to address the research questions.

C H A P T E R IV

RESULTS AND DISCUSSION

Section I: Findings of the Questionnaire

Part A:

Part A requested background information about special education teachers in Western Massachusetts. The items were coded as: sex, age, type of school, level of school, position, types of students, size of class, teaching experience, and amount of computer experience.

FREQ = Frequency
PCT = Percentage
Missing = no response in a certain item

	FREQ	PCT
1. Sex:		
Male	36	19.5%
Female	149	80.5%
2. Age:	FREQ	PCT
Under30	27	14.6%
30-39	87	47.0%
40-49	49	26.5%
50-59	16	8.6%
Over 59	4	2.2%
Missing	2	1.1%

3. Type of school

	FREQ	PCT
Public school	162	87.6%
Private school	19	10.3%
Other: special education program in hospital, etc.	4	2.1%

4. Level

	FREQ	PCT
Preschool/nursery school	13	7.0%
Elementary school	78	42.2%
Junior high school	32	17.3%
High school	44	23.8%
Other: collaborative, college, etc.	15	8.1%
Missing	3	1.6%

5. Position

	FREQ	PCT
Teacher	150	81.1%
Director	6	3.2%
Coordinator	5	2.7%
Other: language/speech therapist, occupational therapist, technical therapist, nurse in special education program, collaborative educational coordinator in early intervention, coordinator/teacher, itinerant vision teacher, bilingual teacher resource room teacher, adjustment counselor, etc.	24	13.0%

6. Type of student

	FREQ
Learning disabled	120
Visually impaired	34
Severe emotional/behavior disorder	59
Limited intellectual functioning	93
Hearing impaired	39
Multiply handicapped	39
Other: speech/ language disordered, motor impaired, mild mentally impaired, autistic	28

7. Class size (mean) 8

8. Teaching experience

	FREQ	PCT
Less than 1 year	5	2.7%
1-5 years	38	20.5%
6-10 years	41	22.2%
11-15 years	55	29.7%
16-20 years	27	14.6%
21-25 years	9	4.9%
More than 25 years	7	3.8%
Missing	3	1.6%

9. Computer experience

	FREQ	PCT
Less than 1 year	48	26.0%
1 year	22	11.9%
2 years	37	20.0%
3 years	23	12.4%
4 years	16	8.7%
5 years	11	5.9%
More than 5 years	23	12.4%
Missing	5	2.7%

Part B:

Part B addresses items on computer technology used in special education programs and inservice training in computers.

FREQ = Frequency
PCT = Percentage
NUM = Number
STD DEV = Standard Deviation

1. What types of computer technology are used in your program? (Check all which apply.)

	FREQ
Computers	156
Auditory devices	25
Motoric devices	5
Communication devices	14
Adaptive switches	15
Other: printer, braille printer, touch screen, touch pad, Muppet board, etc.	9

2. What brand(s) of computers is (are) used in your program? (Check all which apply and indicate how many.)

	FREQ	NUM/SCHOOL (MEAN)	STD DEV
Apple II Series	136	2.13	3.6
Commodore	12	0.13	1.0
Macintosh	5	0.02	0.2
Radio Shack	0	0.00	0.0
IBM	11	0.29	2.1
Other: Atari 800, Sanyo, Digital Vax, Digital PDP 11, Franklin, etc.	15	0.14	0.8

3. How often is a computer available to your program? (Check one.)

	FREQ	PCT
Permanently	117	63.2%
3-4 hours a day	3	1.6%
1-3 hours a day	10	5.4%
Less than 1 hour a day	26	14.1%
Missing	29	15.1%

4. How are the computers used with your students? Please indicate the percentage of time spent at computers for each of the following purposes.

	PCT	STD DEV
Communication	8.99%	18.7
Education	56.70%	30.6
Entertainment	21.90%	23.8
Other: self esteem enhancement, etc.	2.60%	11.4
Missing	9.81%	20.5

5. What types of software are used in your program? (Check all which apply.)

	FREQ
Recreational	81
Computer assisted instruction	103
Word processing	86
Data base management	16
Problem solving/programming	33

6. What is the average amount of time that each student is assigned to the computer every day? (Check one.)

	FREQ	PCT
No regular time	85	46.0%
0-5 minutes	5	2.7%
5-15 minutes	28	15.1%
15-30 minutes	29	15.7%
30-60 minutes	7	3.8%
60-90 minutes	0	0.0%
More than 90 minutes	1	0.5%
Missing	30	16.2%

7. What extra devices do you use to make the computer more accessible? (Check all which apply.)

	FREQ
Switches	22
Joy stick	56
Mouse	20
Light pen	6
Voice synthesizer	21
Music synthesizer	4
Adaptive firmware card	12
Other: color ribons, muppet keyboard, printer, etc.	13

8. On the average, when a student is working on a computer, how much of the time does he/she require teacher assistance?

	FREQ	PCT
100% of the time	11	5.9%
75-99% of the time	11	5.9%
50-74% of the time	21	11.4%
25-49% of the time	34	18.4%
10-24% of the time	38	20.5%
Less than 10% of the time	31	16.8%
Missing	39	21.1%

9. Where does funding come from to provide hardware and software? (Check all which apply.)

	FREQ
School budget	137
Parents	19
Local community	3
Grants	67
Business/industry	2
Other: teacher self support, State/Federal funds for visually impaired, loan, etc.	12

10. Where do (did) you get training in the use of computers? (Check all which apply.)

	FREQ
Workshops	106
Courses	62
Self-study	106
other: from a lady who lent the computer to the program, business, etc.	13

11. Describe the inservice training on computer uses you have received.

60.5% of the special education teachers have received training on computer uses from their school systems during in-service training or workshops. Generally, the computer training was focused on introduction to computers which includes word processing, evaluation of software, uses of computers for special needs students, such as Individual Education Plan (IEP) software plus some computer assisted instruction.

37.2% of the special education teachers have not received any computer training from the in-service

training or workshop. 2.3% of the special education teachers have no response for this item.

Some special education teachers complained that the schools did not offer computer workshops specifically for them. Workshops were offered for all teachers (regular teachers and special education teachers) and the content was focused only on word processing. Some teachers indicated there was no workshop addressing how to integrate software in special education curricula, and/or how to evaluate software for special needs students. Some school districts had a computer teacher to present teachers with technical assistance. Some teachers who were working with moderately and severely multiply handicapped students indicated that they got the training from the computer company where they bought a talking computer, adaptive switches and some hardware.

Some teachers said the computer company provided one and a half hours of explanation about how the software works to a group of them.

12. Do you teach any computer language? Which language(s)? Why?

93% of the special education teachers did not teach any computer language. They said it was not appropriate to teach their students a computer language because their students had difficulty with learning keyboards. Also, some of these teachers were not aware

of Logo or BASIC programming, which was why they did not teach any computer language. One teacher said "teaching programming is a waste of time unless someone is planning to make living at it."

Only 4% of the special education teachers explored Logo or BASIC programming with their students.

13. What factor(s), if any, have made it difficult for you to use computer technology?

The major problems that special education teachers encountered in using computers were:

a) Inappropriate or limited software, particularly software that is either age-inappropriate or of an inappropriate reading level.

b) Lack of computers, software, adaptive devices and chairs to position handicapped students.

c) Lack of money to purchase computer equipment.

d) Lack of knowledge to preview equipment, software and adaptive devices.

e) Not enough class time to use computers.

f) Inadequate computer training.

Discussion

The results showed that one hundred and fifty six special education programs (84.3%) have been using computers with special needs students. Of these, one hundred and seventeen special education programs (63.2%) have computers permanently assigned to their programs. Some teachers have one computer in their classrooms for developing curriculum,

for making an Individual Education Plans and for student use; some teachers have to share computers with other special education teachers. If there is no computer permanently belonging to the program, then special education students have a certain schedule to use the school computer lab. 73.5% of their computer brands are APPLE Series, such as Apple II, Apple II+, Apple IIe, Apple IIc, Apple IIGS. The rest of brands of computers used are Macintosh, Commodore 64, IBM PC, Radio Shack, and Digital Vax system. Some special education programs have adaptive devices so their special needs students can access computers. These adaptive devices include auditory devices, motoric devices, communication devices, switches, etc. The auditory devices used are ECHO II speech synthesizer, voice synthesizer, Phonic Ear, etc.; motoric devices used are power pad, key guard, joy stick, etc.; communication devices used are modem, beeper, Unicorn Board, touch screen, etc.; adaptive switches used are head, foot or hand switches, plate switch, button, leaf, lever, adaptive firmware card, mouse, etc.; other adaptive devices are braille printer, regular printer, touch pad, etc.

The results of the survey indicated that there was a certain percentage of time spent at computers for communication, education, entertainment and other, but teachers revealed in interviews that the time spent at computers and the time for monitoring students varied and depended on the students' age, functioning level and

physical limitations. One itinerant teacher said that she spent the most time transcribing braille. Some students used large print software for reading and entertainment. Some teachers used the Unicorn Board to train hand manipulation for their multiply impaired students. Some non-verbal students used computers to communicate with teachers. Some students used word processors to do written work; used the Print Shop program and printer to create signs, greeting cards, birthday cards and to celebrate other special events. Some students used computers to do math problems and check spelling. Some students after an initial demonstration need help less than 10% of the time.

The funding for software and hardware mostly came from school budgets (74.1%). Some were from special grants (36.2%) or parents (10.3%). Very few were from business or the local community. 60.5% of the special education teachers had some training on uses of computers. Most of the teachers' training on computers were from workshops, in-service training, and self-study. In-service and workshop training offered evaluation of software, uses of computers for special needs students, use of "Individual Education Plan" software and some word processing. 37.2% of the special education teachers never had training on how to use computers to help special needs students.

There were only eight out of one hundred and eighty five special education teachers (4%) who had taught Logo or BASIC computer language. 93% of the special education

teachers never taught a computer language. Some teachers indicated that it is not appropriate to teach special needs students computer language because they thought that their students had difficulty accessing computers.

Part C:

Part C reveals special education teachers' attitudes toward use of microcomputer technology with special needs children. Items were coded as: Strongly Disagree (1), Disagree (2), Neutral (3), Agree (4) and Strongly Agree (5). If there was no response to an item, it was coded as missing.

Definition:

Relative Frequency -- a proportionate frequency (in percent) of the total number.

Adjusted Frequency -- a proportionate frequency (in percent) that does not count missing value(s).

TABLE 1

Frequencies and Percentages of Participants' Responses to Items on Computer Attitude Survey

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
1. Microcomputers motivate special education students to learn.				
Strongly Disagree	1	0	0	0
Disagree	2	2	1.1	1.2
Neutral	3	13	7.0	7.5
Agree	4	94	50.8	54.3
Strongly Agree	5	64	34.6	37.0
Missing			12	6.5
Mean 4.27				
Standard Deviation .64				
2. Students have longer attention spans with computers compared to other class activities.				
Strongly Disagree	1	0	0	0
Disagree	2	8	4.3	4.7
Neutral	3	37	0.0	21.5
Agree	4	89	48.2	51.7
Strongly Agree	5	38	20.5	22.1
Missing		13	7.0	
Mean 3.91				
Standard Deviation .78				
3. Computer assisted instruction can improve students' reading skills.				
Strongly Disagree	1	0	0	0
Disagree	2	3	1.6	1.8
Neutral	3	30	16.2	17.8
Agree	4	113	61.1	67.3
Strongly Agree	5	22	11.9	13.1
Missing		17	9.2	
Mean 3.91				
Standard Deviation .61				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (percent)	Adjusted Frequency (Percent)
4. Some words used in computer assisted instruction are hard for special needs students to understand.				
Strongly Disagree	1	0	0	0
Disagree	2	12	6.4	7.3
Neutral	3	37	20.0	22.6
Agree	4	94	50.8	57.3
Strongly Agree	5	21	11.4	12.8
Missing		21	11.4	
Mean 3.75				
Standard Deviation .76				
5. The computer is a good tool for developing students' hand-eye coordination.				
Strongly Disagree	1	1	0.5	0.6
Disagree	2	3	1.6	1.8
Neutral	3	24	13.0	14.0
Agree	4	109	58.9	63.7
Strongly Agree	5	34	18.4	19.9
Missing		14	7.6	
Mean 4.00				
Standard Deviation .68				
6. Students increase their self-esteem by using computers.				
Strongly Disagree	1	0	0	0
Disagree	2	3	1.6	1.7
Neutral	3	33	17.8	19.2
Agree	4	102	55.1	59.3
Strongly Agree	5	34	18.5	19.8
Missing		13	7.0	
Mean 3.97				
Standard Deviation .67				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
7. The computer helps students to show abilities that are impossible to develop with pencil and paper.				
Strongly Disagree	1	0	0	0
Disagree	2	12	6.5	7.0
Neutral	3	36	19.5	21.0
Agree	4	82	44.3	48.0
Strongly Agree	5	41	22.2	24.0
Missing		14	7.5	
8. Computer graphics distract students' attention from key points of instruction.				
Strongly Disagree	1	5	2.7	3.1
Disagree	2	94	50.8	57.7
Neutral	3	46	24.9	28.2
Agree	4	16	8.6	9.8
Strongly Agree	5	2	1.1	1.2
Missing		22	11.9	
Mean 2.48				
standard Deviation .76				
9. Students like doing drill and practice on computers better than with paper and pencil.				
Strongly Disagree	1	0	0	0
Disagree	2	4	2.2	2.4
Neutral	3	17	9.2	10.0
Agree	4	97	52.4	57.4
Strongly Agree	5	51	27.6	30.2
Missing		16	8.6	
Mean 4.15				
Standard Deviation .69				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
10. Applications of computers have improved students' cognitive development.				
Strongly Disagree	1	0	0	0
Disagree	2	3	1.6	1.9
Neutral	3	61	33.0	38.6
Agree	4	84	45.4	53.2
Strongly Agree	5	10	5.4	6.3
Missing		27	14.6	
Mean 3.63				
Standard Deviation .63				
11. Students like to have sound with computer assisted instruction.				
Strongly Disagree	1	1	.5	.6
Disagree	2	6	3.2	3.6
Neutral	3	39	21.1	23.1
Agree	4	89	48.1	52.7
Strongly Agree	5	34	18.4	20.0
Missing		16	8.7	
Mean 3.85				
Standard Deviation .83				
12. Students like computer animation.				
Strongly Disagree	1	1	.5	.6
Disagree	2	0	0	0
Neutral	3	7	3.8	4.1
Agree	4	107	57.8	62.6
Strongly Agree	5	56	30.3	32.7
Missing		14	7.6	
Mean 4.26				
Standard Deviation .59				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
13. Computer games played by at least two people improve their social relations.				
Strongly Disagree	1	2	1.1	1.2
Disagree	2	5	2.7	3.0
Neutral	3	36	19.5	21.6
Agree	4	91	49.2	54.5
Strongly Agree	5	33	17.8	19.7
Missing		18	9.7	
Mean 3.88				
Standard Deviation .79				
14. Immediate feedback from a computer gives students positive reinforcement.				
Strongly Disagree	1	0	0	0
Disagree	2	0	0	0
Neutral	3	4	2.2	2.3
Agree	4	117	63.2	68.4
Strongly Agree	5	50	27.0	29.3
Missing		14	7.6	
Mean 4.26				
Standard Deviation .49				
15. LOGO programming helps students develop geometry concepts.				
Strongly Disagree	1	0	0	0
Disagree	2	2	1.1	1.5
Neutral	3	82	44.3	60.7
Agree	4	47	25.4	34.8
Strongly Agree	5	4	2.2	3.0
Missing		50	27.0	
Mean 3.39				
Standard Deviation .57				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
16. Students like to create pictures on the computer using turtle graphics.				
Strongly Disagree	1	1	.5	.7
Disagree	2	0	0	0
Neutral	3	63	34.1	45.0
Agree	4	68	36.8	48.6
Strongly Agree	5	8	4.3	5.7
Missing		45	24.3	
Mean 3.58				
Standard Deviation .63				
17. Computer graphics bring out students' interest in art.				
Strongly Disagree	1	0	0	0
Disagree	2	9	4.9	6.0
Neutral	3	95	51.4	63.8
Agree	4	43	23.2	28.9
Strongly Agree	5	2	1.1	1.3
Missing		36	19.4	
Mean 3.25				
Standard Deviation .58				
18. Computers help my students who have physical problems in writing.				
Strongly Disagree	1	0	0	0
Disagree	2	1	.5	.6
Neutral	3	26	14.1	16.8
Agree	4	83	44.9	53.5
Strongly Agree	5	45	24.3	29.1
Missing		30	16.2	
Mean 4.11				
Standard Deviation .58				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
19. Computers help my students to produce better writing.				
Strongly Disagree	1	0	0	0
Disagree	2	9	4.9	5.9
Neutral	3	42	22.7	27.6
Agree	4	77	41.6	50.7
Strongly Agree	5	24	13.0	15.8
Missing		3	17.8	
Mean 3.76				
Standard Deviation .78				
20. Most commercial software does not meet my students' special needs.				
Strongly Disagree	1	2	1.1	1.2
Disagree	2	54	29.2	33.5
Neutral	3	48	25.9	29.8
Agree	4	41	22.2	25.6
Strongly Agree	5	16	8.6	9.9
Missing		24	13.0	
Mean 3.09				
Standard Deviation .65				
21. Teachers should adapt more computer assisted instruction to the curriculum.				
Strongly Disagree	1	0	0	0
Disagree	2	6	3.2	3.6
Neutral	3	43	23.2	25.6
Agree	4	104	56.2	61.9
Strongly Agree	5	15	8.2	8.9
Missing		17	9.2	
Mean 3.76				
Standard Deviation .65				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
22. Teachers need to spend more time when monitoring students working on the computer than during traditional types of teaching.				
Strongly Disagree	1	9	4.9	5.6
Disagree	2	76	41.1	46.3
Neutral	3	45	24.3	27.4
Agree	4	29	15.7	17.7
Strongly Agree	5	5	2.7	3.0
Missing		21	11.4	
Mean 2.66				
Standard Deviation .93				
23. Students are excited about using computers.				
Strongly Disagree	1	1	.5	.6
Disagree	2	1	.5	.6
Neutral	3	11	6.0	6.6
Agree	4	105	56.8	60.6
Strongly Agree	5	55	29.7	31.8
Missing		12	6.5	
Mean 4.22				
Standard Deviation .63				
24. Computer workshops can help teachers to do a better job.				
Strongly Disagree	1	0	0	0
Disagree	2	4	2.2	2.3
Neutral	3	9	4.9	5.2
Agree	4	94	50.8	54.7
Strongly Agree	5	65	35.1	37.8
Missing		13	7.0	
Mean 4.22				
Standard Deviation .63				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
25. I have time to learn computer skills.				
Strongly Disagree	1	22	11.8	12.8
Disagree	2	51	27.6	29.7
Neutral	3	26	14.1	15.1
Agree	4	64	34.6	37.2
Strongly Agree	5	9	4.9	5.2
Missing		13	7.0	
Mean 2.92				
Standard Deviation 1.18				
26. There is enough class time to use computers.				
Strongly Disagree	1	12	6.5	7.0
Disagree	2	48	25.9	28.1
Neutral	3	19	10.3	11.1
Agree	4	86	46.5	50.3
Strongly Agree	5	6	3.2	3.5
Missing		14	7.6	
Mean 3.15				
Standard Deviation 1.18				
27. I have to spend more time preparing lessons when I use computer assisted instruction.				
Strongly Disagree	1	5	2.7	3.1
Disagree	2	64	34.6	39.8
Neutral	3	63	34.1	39.0
Agree	4	26	14.1	16.1
Strongly Agree	5	3	1.6	1.9
Missing		24	13.0	
Mean 2.73				
Standard Deviation .83				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
28. There are enough computers and software in my program.				
Strongly Disagree	1	56	30.3	33.7
Disagree	2	64	34.6	38.5
Neutral	3	21	11.3	12.7
Agree	4	21	11.3	12.7
Strongly Agree	5	4	2.2	2.4
Missing		19	10.3	
Mean 2.11				
Standard Deviation 1.08				
29. There is enough technical support from my school system.				
Strongly Disagree	1	39	21.1	23.2
Disagree	2	49	26.5	29.2
Neutral	3	36	19.4	21.4
Agree	4	39	21.1	23.2
Strongly Agree	5	5	2.7	3.0
Missing		17	9.2	
Mean 2.53				
Standard Deviation 1.16				
30. I enjoy working with students on the computers.				
Strongly Disagree	1	1	.5	.6
Disagree	2	5	2.7	3.0
Neutral	3	21	11.4	12.4
Agree	4	105	56.8	62.1
Strongly Agree	5	37	20.0	21.9
Missing		16	8.6	
Mean 4.01				
Standard Deviation .71				

Continued

Table 1 Continued

Statement	Code	Absolute Frequency	Relative Frequency (Percent)	Adjusted Frequency (Percent)
31. Special education teachers require some knowledge about computers.				
Strongly Disagree	1	0	0	0
Disagree	2	3	1.6	1.7
Neutral	3	10	5.4	5.7
Agree	4	107	57.8	61.1
Strongly Agree	5	55	29.8	31.5
Missing		10	5.4	
Mean 4.22				
Standard Deviation .62				
32. I think I can be creative in working with computers.				
Strongly Disagree	1	2	1.1	1.2
Disagree	2	9	4.9	5.3
Neutral	3	33	17.8	19.3
Agree	4	98	53.0	57.2
Strongly Agree	5	29	15.7	17.0
Missing		14	7.5	
Mean 3.83				
Standard Deviation .81				
33. My job could be replaced by a computer.				
Strongly Disagree	1	155	83.8	88.1
Disagree	2	18	9.7	10.1
Neutral	3	1	.5	.6
Agree	4	1	.6	.6
Strongly Agree	5	1	.5	.6
Missing		9	4.9	
Mean 1.15				
Standard Deviation .49				

Discussion

The responses to items 1, 2, 3, 6 and 13 in the survey revealed the special education teachers believed that computers motivated students to learn, increased students' attention span, improved students' reading skills, self-esteem, and social relationships. Responses to items 7, 18 and 19 showed that computers helped physically handicapped and cerebral palsy students in writing and verbal communication. Items 5, 11 and 12 indicated that special education teachers agreed that computers provided severely mentally impaired students with visual stimulation and hand-eye coordination. Items 23, 30 and 32 revealed that 90% of the special education teachers agreed that they enjoyed working with students on the computers and they thought they could be creative in working with computers because their students were excited about using computers. Items 11, 12 and 14 showed that students liked computers' immediate reinforcement, music and animation. Items 15 and 16 showed that the special education teachers believed that LOGO turtle drawing helped students develop geometry concepts and spatial relations. Items 24, 28 and 29 indicated that special education teachers thought that they did not have enough computers and software. Also, they needed more technical support and computer workshops in order to do a better job. Items 33 indicated that 98.3% of the special education teachers believed that their jobs could not be replaced by a computer.

Section II: Findings of the Interviews

Eleven out of one hundred and eighty-five special education teachers were selected for interviews. Two were from high school special education programs; two from collaborative developmental learning programs; two from junior high school special education programs; two from elementary special education programs; one from a preschool special education program; one from a hospital special education program; and one is an itinerant special education teacher. All these teachers have been using computers with special needs students. They all felt the computer is a teaching tool and compensatory tool for special needs students. Interviews were focused on uses of microcomputer technology with special needs students, opinions about computer uses, teacher training and factors which impede or facilitate computer use. The interview guide is included in Appendix B. In this section the researcher has tried to represent relevant thoughts of interviewees as carefully as possible. Relevant quotes were selected and presented here.

Computer experience with students

1. Where the computer is located?

"The computers are located in my classroom. I can use them any time."

"The computers are located in the computer lab. I bring students to computer lab to use computers. We are scheduled to use twice a week."

"The computers are in my resource room."

"The computer and the braille printer are located in the library."

"My cerebral palsied student owns a Touch Talker which is set up with the wheelchair. The Touch Talker is a customized computer equipped with an application program that enables the nonspeaking individuals to meet communication needs."

"The computer is put on a cart. I share the computer with the other special education teacher."

"I have a terminal which is connected to the school computer system on my desk for me to create worksheets and update students' IEP. The students use the Apple IIe computer which is located in the classroom."

"The computers are located in the resource room."

2. How much supervision is needed?

"I have learning disabled, severe emotional/behavior disordered, and mentally retarded students in my classroom. For learning word processing or typing with correct finger placement, 25-49% of the time is needed for supervision. If working with most courseware - computer assisted instruction, I only need 10-24% of the time for supervision."

"In this school, there are two classes at this collaborative program. One class is for students with mild to moderate mental retardation, and one class is for students with moderate to severe multiple handicaps. I use computer graphics as a stimulus to develop students' motor skills and hand-eye coordination. Some students have low functioning motor skills, so the teacher has to put the student's palm on the switch and encourage him/her to press the switch. Since students are moderate/severely disabled, the teacher has to spend 100% of the time to supervise the students when they are working on the computers for motor training."

"I am a language pathologist. I am not comfortable with integrating software into assessment and language therapy. I only use the computer as a tool for reinforcement. When students use the computer, they usually do not need much supervision. Once I help the students start the entertainment program, then the students can play by themselves."

Several resource room teachers had the following responses:
"I use the computer as a compensatory tool. Students use the computer to practice spelling and math kills. Some students come here for 15-20 minutes every day, some students stay an hour or all day depending upon the student's special needs. Those students who come here to enhance math and English skills usually work on the computer by themselves. After they complete the drill, they have to report their scores, so the teacher can compare the students' former scores to see if they made any progress; and then decide what material and strategies are needed with these students. With new students the teacher spend 15-20% of the time to assist them. Once students know how to operate the computer, then the teacher spends less than 10% of the time to monitor them."

"For my preschool students, they use computers fifteen minutes a day. I have a teacher aide in my classroom. While I supervise a group of students on the computers, she help other students do something else."

3. Are the computers networked?

(Most teachers mentioned that their computers are not networked. Basically they use computer assisted instruction individually. They said that it is not necessary to use computer networking Because they use computers only to enhance their students' academic works.)

"The computers in the special education classroom are not networked. They are independent systems. The rest of the computers in my school are networked. Faculty members and students have an account number so they can send mail to each other. Once a week we go to computer lab to learn word processing. Students have fun sending mail to each other."

4. What peripheral equipment is used?

"I have color monitors, a disc drive and one printer."

"We have a color monitor, two disc drives and a printer with color ribbon."

"I have switches and adaptive firmware cards for my students with multiple impairments."

"I have head microphones, muppet keyboards and key guards that make the computers more accessible for my students."

"We have two computers; one has a touch screen, the other has a regular screen. We also have a printer."

"I have a foot switch and head switch connected to the computer for my students."

"I have no physically disabled students at present but I have two vision disabled students. The school bought a program that enables the printer to transcribe regular words to braille output for the students."

"The school has Macintosh computers with mouses, several Apple IIes, a voice recognition machine, a projector that projects the computer print on a big screen, laser printers and several regular printers."

5. How is software being used?

"I use computer assisted instruction (CAI) to sharpen students' math skills, language arts and reading comprehension."

"We use recreational software for motivation and reward after completing assigned works. We also use Bank Street Writer to teach kids writing."

"I use recreational software to enhance students' attention spans and eye-hand coordination."

"I use Magic Slate (a word processor with a letter enlargement function) to improve students' language skills. I made sentences that included many mistakes in spelling, punctuation and grammar. Students are instructed to find the mistakes and edit the teacher-generated sentences."

"My multiply disabled students use software to communicate with people. This communication software is given by a university computer program. I also have some other programs used to train their motor skills and color perception."

"My students are junior high school students who are emotionally disturbed. This year my students are taking a computer graphics class with the computer teacher in the school computer lab, and they like to share completed work with me. At my own class, students use AppleWorks to write papers or do the assignments."

"I use computer assisted instruction in conjunction with social studies class. For math class I designed a schedule for all students to use the computers at least once a week for drill and practice in basic math skills."

"I have experience in computer programming. Therefore, I use BASIC programming to design math programs for my

students. For the math programs, a student must give a series of correct answers to addition, subtraction, multiplication or division problems within a certain period of time. If the student succeeds, a game appears. If he gets a high enough score on the game, he gets one or more merit credits."

"In my preschool special education program, I use Sunburst's software for visual stimulation. I also use Deltadraw to develop students' concepts in spatial relations and angle."

"I use typing software to train keyboarding skills. I also use computer assisted instruction to teach some vocabulary."

"With the computer printer and the use of 'the Print Shop' software, the class is able to create greeting cards, signs, and banners for celebrating birthdays or other special events. One cerebral palsy student uses a Unicon Board and a customized program for hand manipulation and verbal communication."

6. How do students work on the computers?

"Students work on the computers alone, in pairs, with two other students or with the teacher depends on the software and individual needs. Students' needs vary greatly. Some need the teacher to work with them all the time, some need just setting the program up. Or after initial demonstration, they can work alone. For games students like to play in pairs."

"I work at an elementary special education program. I feel that my children require constant assistance. I have to leave an adult to monitor other students in the classroom when I work with students on the computers."

"For recreational software, no assistance is needed for students to play by themselves. For educational programs, students need more or less assistance."

"My students are hearing impaired. I use "NEWS ROOM" for writing class. I serve as a consultant; students act as editors and reporters. First, I ask students to make a draft on the computer, then students exchange the disk and try to find their partners' mistakes in spelling and grammar. After they are finished their error searching, they then hand it back to their partners and everyone corrects his/her own writing. After completing the correcting process, students bring their writing to see me in order to make sure the writing is okay. Then I give comments and suggestions to them. After students are

satisfied with their writing, they pass the disk to the editor, who is the best writer and the best computer operator. The editor then choose pictures from a picture disk to match articles and organizes them into a type of newsletter. The bimonthly news letter is then sent to all classes in the school and nationwide hearing impaired programs. My students love to come here to work on the computers."

7. How is word processing used with special needs students?

"I take my mild needs students to the library and help them search related material, organize the material for the assigned project and then have them use AppleWorks to type the paper on the computer. I also teach BASIC programming in order to enhance the students' logical thinking skills."

"My hearing impaired students always have language problems, so that the word processing is being used as a compensatory tool to develop students' written language. Since computer editing is very easy and the printed copy is neat, students are motivated to produced more and better writing. Confidence and self-esteem were increased, as well as skill acquisition."

"I use Magic Slate - a word processor for my students' to write. This word processor is particularly good for special needs children because it features large characters and the options (menu) are expressed in graphics. Also I use Newsroom which enables children to create a panel to write an article. Within the panel children can put a picture selected from the picture disk to place where they like. Because of the novelty and easy editing, children produce more work than they could writing by hand."

"Word processing is one of the vocational training items for special needs students. It is for job preparation."

"My kids use word processing to write stories and notes. Since it is so different with using paper and pen, they enjoy writing very much."

"Word processing is used for practicing spelling, language arts, etc. for my mild needs students."

"Word processing is not appropriate to use in my class. They only use some ready-made program to increase their perceptual- motor skills."

"Most hearing impaired students have problems with language. I use word processing to develop their written language."

8. How do the parents of your students feel about their children learning with computers?

"Parents are very happy about seeing their children become more interested in academic studies through the uses of computers."

"My parent was very impressed with the computer-created birthday card that was sent to her from her low functioning son."

"My parents said that computers changed their son's life. People always think their cerebral palsy son has mental retardation. Through the computer technology their son can communicate with people either in voice or writing and has good comments in his school report card."

"One student has a problem with hand writing. He writes letters in reverse. After using computer his writing looks beautiful. He increased his confidence and produced more work on computers. His parents are very happy about that."

"One of my parents donated a computer to the special education program so we have two computers in the classroom. Students can have more time using computers."

"My parents never say anything."

"One of my parents works at a computer company. He asked the company to donate software programs to my program."

"One parent always give us technical support."

Opinions About Microcomputer Uses With Special Needs Students

1. Do you think computer technology increases students' self-esteem and confidence?

"While most of the literatures claims that children naturally go for computers, I have been involved with a child who is totally turned off by computers and will not get into a game that is popular with his peers."

"Students in this program have moderate to severe impairments in cognition, perception, language and communication. I use the computer as a prosthesis tool for vision-motor coordination and motor skills. I found that students' self-esteem and confidence are significantly increased because of their accelerated performance and enjoyment of working on computers."

"I use computers to help students catch up their grade level. Students use computer assisted instruction for math drill and practice, reading comprehension and spelling and language arts. Students increase self-esteem and confidence when they improve their scores. But some of my students do not like the computer because they are afraid of making errors and getting the embarrassing beep signals."

"My students only have mild needs. Two students have trouble with hand writing. In regular class, teachers always flunk them because they can not read their hand writing. After they use computers as a pen, their grades improved. Their self-esteem and confidence seem to be increased significantly."

"I don't use computers everyday. Basically, I still use traditional ways to teach kids. The computers is used as a treat for my students. Once they complete the work or they well behaved then they can play the computer game."

2. Do you think Logo has provided opportunities for development of problem solving skills?

"Yes, Logo and BASIC have enhanced my students' logical thinking skills. When students debug their programs, they have to find out problems from the computer provided messages."

"Yes, I integrate Logo and BASIC into the curriculum. I feel that the immediate visual feedback and colorful graphics encourage my severely emotionally disturbed adolescents to work harder than doing worksheets. Debugging a program needs logical thinking and reading error message. Therefore they learn how to reason and how to catch errors by the clues. These circumstances appear to increase their attention spans and improve their reading comprehension."

"I have limited background in computer programming so I never teach Logo."

"We have just received an overhead projection system to work with computers. Logo is a great tool. Especially when we deal with spatial relations such as angles, shapes, etc."

"I don't teach any computer language. The children I teach would have too much difficulty learning a computer language to make it a viable option."

"Logo is the language used in our elementary school. However, it is not appropriate to teach a computer language

in my special education program, because the students come here only 20 minutes a day for their weak subjects, such as Math or Language arts."

"I have eighteen mildly disabled students in my Junior high special education program. I use Logo to develop their cognitive abilities. I think Logo not only provides opportunities for development of problem solving skills but also has many features that can be used with special needs children. Logo can be a dynamic medium for teaching content subjects such as Math and English. Logo is a interactive language. That is when the student types a command, the response is immediate."

"I only use ready-made programs such as Deltadraw, Oregon Trail, etc. I have not done any study to see whether LOGO can develop students' problem solving skills so I can not answer your question."

"Yes, because Logo involves more problem solving strategies and thinking skills than final products. Also, Logo offers a learning enviroment and self-expression to all children, especially to special needs children. Children seem to be happy because they can control the computer environment by a small triangular turtle than just reacting to preprogrammed tasks."

3. What is your opinion about the computer as a tool for communication?

"The computer technology help children with severe physical handicaps to communicate with people, do homework and play games. The computers help children feel better about life."

"Yes, the computer is a tool for communication. It provides on-line services; with a microcomputer and modem we are able to contact large computer data banks and access that information at will personal or professional use. This can be done from the convenience of home, school or office, by having the computer dial the number of on-line service, establish a connection, and under the direction we can communicate with large data banks for information we want."

"For non-verbal children and children with motor problems, the computer is a great tool for communication."

"For my hearing impaired students, the computer is a tool for communication. They send a mail to friends through

computers, they show feelings from computer outputs to teachers and friends."

"I think it is a great communication tool if you know how to operate it; otherwise it is a waste of time to find computer errors and read those difficult manuals."

"From problem solving software, I can more or less understand students' problem solving skills. Then I can integrate the skills they need into the curriculum."

"If students work together on the computer, they can share ideas or get ideas from each other. The computer does improve social skills and make students feel better to communicate to each other."

"I believe that computer use evokes more interaction in a short period time than other classroom activities because students share a computer and the game that they play with requires more collaboration. Also students working together as partners can help each other in both computer skills and the content matter of math, reading, social studies, etc."

"Students' interests in learning are increased by working with other students."

"I think the computer is great for communication. Not have many programs addressed for special education students. We need more manual so kids can use computers with minimal assistance."

Summary of Findings

The results of this research provided the following information to special education teachers who wanted to integrate computer technology into their classroom curriculum.

1. What kinds of computer hardware has been used in special education programs?

For most children with mild special needs, regular computers with joy sticks were commonly used, usually on

Apple IIe's. For severely low functioning children and severely physically handicapped children, the adapted wheelchair, environmental control system, head switch, light sensor, communication aid or firmware card was attached to the computer to help them communicate with people, do homework or play games. For hearing impaired children, teachers used regular computers to enhance students' academic learning. In addition, they used software to assess students' language problems and use electric equipment to give students oral training. For instance, a voice indicator will change voice to sound waves so that the student can see the feedback right away from the screen or hardcopy. For the visually impaired, computers with speech synthesizers or Braille were commonly used for word processing or data analysis for business uses. Kurzwell Reading Machine and Optacon were used to read printed material. DP-10, a monitor and interface box that works with Apple II computers, was used to enlarge text for the visually impaired.

2. What kinds of software has been used in special education programs?

The software used in special education programs depended on the type of students' special needs and the level of their difficulty. Software used in special

education programs can be organized by the following categories:

a) Computer Assisted Instruction (CAI). These were subject-oriented and based on drill and practice or tutorial programs. They were often used in special education programs. They included such programs as Circus Subtraction, published by Continental Press, for math and appropriate for grades 1-6; Climates of the World, published by Health Company, for science and appropriate for grade 6; Getting Ready To Read And Add, published by Sunburst, for reading and math and appropriate for kindergarten and first grade children; Hide And Sequence, published by Sunburst, for language arts and appropriate for grades 4-6; Apple Presents...Apple, published by Apple Company, a tutorial program for all beginners to learn the keyboard and the functions of the computer. U.S. Constitution Tutor is a program to give the mildly disabled students drill and practice on the Constitution and the rights and responsibilities of American citizens under the Bill of Rights.

b) Productivity software: included word processors, system programs and management programs. Word processing programs were the most widely used utility software. Typical programs were Bank Street Writer, published by Scholastic, for elementary school children; Magic Slate, published by Sunburst, a good word processor for first and second grade

students because the graphic menu and large size of characters motivates students to write. listen To Learn is an easy-to-use word processor with speech output designed by Rosegrant. It includes a choice of color for text, on-line access to word definitions, and the ability to program alternate pronunciations for words. This program is easy for use with young language-delayed and learning disabled children.

c) Programming software: most special education programs had Logo and BASIC programs. Most special education teachers did not use them with students, only a few teachers used them for the training in logical thinking and problem solving.

d) Problem solving software: Odd One Out, published by Sunburst, was for problem solving with pictures, letters and numbers; Scrapbook was used to help students to solve problems by computer generated clues. If the student did not understand what the clue meant, then he or she could check the dictionary included in the software to get the information. This kind of software was not popular in special education programs.

e) Computer Management programs: including database, spreadsheet, diagnostic software and IEP programs (Individual Education Plan programs). Teachers used this software to create lessons, organize materials, generate IEPs, produce student reports, and assess intelligence, academic level, and modality. A typical program is IEP

system, published by Learning Tools in Cambridge, Massachusetts, used in many school districts. This software had a computerized data bank of goals and objectives. Teachers input codes and information that the computer requested, then the computer can provide some uniformity and precision in objective writing. Create-Lessons, published by Hartley, enabled teachers to create lessons to meet student's special needs without any computer experience. Motor Training Game, one of the projects of the Alternative Communication System at Child Development & Mental Retardation Center at the University of Washington, was good for perception-motor testing; PELSA Language Analysis Program is a language diagnostic program. Systematic Analysis of Language Transcripts (SALT) is a diagnostic program for language analysis developed by Miller and Chapman. VIideo Voice, a speech therapy system that includes hardware and software, provides the user with a visual display of the acoustic signal. In addition, some special education programs had some software in evaluation, intervention and IEP which were published by Speech Bin Company and PEAL Software Company.

3. How was this technology used in special education programs?

The researcher found that word processing was the most popular software used in special education programs. Teachers had children work on the mechanics of writing by means of teacher-directed exercises in editing, vocabulary,

spelling and dictation. For example, some teachers typed sentences that included many mistakes in spelling, punctuation, and grammar. Students were instructed to find the mistakes and edit the teacher-generated sentences. One teacher instructed his student having problems with the left hemisphere of the brain to do homework by word processor. This student could thus write his homework and never worry whether written letters would be in reverse. Some teachers had students type assignments with the word processor. While these activities could be accomplished without the aid of the computer, teachers indicated that there was particular value in having the child type the assignments. These activities improved perceptual-motor skills. Also it was easier for students to see their mistakes when the words were typed. Teachers working at a school for the deaf indicated that their hearing impaired students always had language problems, so that word processing was being used as a compensatory tool to develop students' written language. Since editing was very easy and the printed copy was neat, students were motivated to produced more and better writing. Confidence and self-esteem were increased as well as skill acquisition. One teacher's teaching strategy with the software called "Storytree" (Scholastic Software, Scholastic, 730 Broadway, New York, NY 10003) was very impressive. This software was a creative writing tool and a word processor. The teacher asked students to read a story that already resided in the disk, then they discussed this

story and brainstormed to see what was going to happen if something was changed. After this question was raised, students were motivated to express their ideas. Then, every student talked about his/her imagination of this story. These branched stories were also written down and saved on the same disk, so that students could share and enjoy the stories.

In addition to the word processing, computer-assisted instruction (CAI) was also popular in special education programs. Teachers commonly used CAI for drill and practice in order to enhance math skills, language arts and/or reading comprehension. Some teachers used CAI for reward and motivation.

Few teachers used a database software to enhance students' organizational skills. But one teacher asked her junior high students to use a data base to gather information on the food, habitation, culture, history, and language of various races of people. This teacher wanted to demonstrate to students that the computer is a powerful storage and retrieval device, which can manipulate information in many ways in order to meet the needs of the users. For children with difficulties in organizing and processing information, the data base was an extremely useful tool in teaching social studies.

There were only a few teachers who taught BASIC programming, and they served as tutors. The reason they taught it was because students would rather do programming

than math. Interestingly, only two of the special education teachers interviewed used Logo in their classroom. The rest of special education teachers knew Logo was helpful for children to develop concepts in geometry and to improve other mathematical skills but they were not confident enough to use it with special needs children.

In medical settings, computer technology was not only used for physical therapy but also was used to develop children's cognition and academic studies. Some children stayed in hospitals for a long periods of time for medical care. In order to help them to catch up their academic studies, the special education programs located in the hospital provided them with individualized learning through the computers.

4. How were students introduced to computers and how much supervision was needed ?

Most teachers said that they took a lot of time to introduce students to computers and then more time to supervise their actual use. A teacher from a collaborative program indicated that he took two weeks to show a moderately mentally retarded girl how to load a disk in a disk drive and start the system. Students were introduced to computers in three ways: individually, in small groups, and in a combination of small groups and one-to-one instruction. The amount of supervision required depended upon the age and ability of each student. Usually teachers spent a lot of time to teach them how to use the computers.

Once students learned how to use a computer, not much supervision was necessary. But for moderately and severely special needs children, teachers indicated that they had to spend a great deal of time in supervision.

5. Was computer programming taught to special needs students?

Most special education teachers did not teach any computer programming such as Logo or BASIC. They used computers to enhance students' skills in English, Math, typing or other subjects. Some teachers used computers for motor or speech training. Some of teachers were not aware of Logo or BASIC programming, which was why they did not teach any computer language.

There were only a few special education teachers (4%) explored Logo or BASIC With their students. These teachers were aware of Logo or BASIC and they knew these computer languages were helpful for developing problem solving skills. Also, some students would rather do computer programming than math problems.

6. What were special education teachers' perceptions about the impact of computer technology on their teaching and on students in their class?

The computer was a good motivator for students, and it increased self-esteem and attentiveness. Students responded very well to the use of computers. Since special needs children have problems in various modalities - hearing,

visual, auditory, or motor - they were not able to study through the regular modality. Computers give them alternative opportunities to express their potential. Additionally, the computers provided novelty for children having writing problems, spelling problems, or language problems thereby evoking or increasing their interest in learning.

7. What inservice training on computer uses have special education teachers received?

Most special education teachers said that their schools did not offer computer workshops specifically for them. Some workshops were offered for all teachers (regular teachers and special education teachers), and the content was focused on word processing. Teachers indicated there were few workshops addressing how to integrate software in special education curricula and/or how to evaluate software for special needs children. Teachers learned about computers and software mostly from friends, colleagues or books. Some school districts had a computer teacher to offer teachers technical assistance. Some teachers who were working with moderately and severely multiply handicapped children complained about the lack of training for using technology with their students.

8. What factors made it difficult or easy for special education teachers to use microcomputers?

The major problems that special education teachers had encountered in using computers were:

a) Inappropriate or limited software, particularly software that is either age-inappropriate or of an inappropriate reading level.

b) Lack of computers

c) Not enough class time to use computers.

d) Inadequate or inappropriate computer training.

9. What are special education teachers' attitudes toward the use of microcomputer technology with special needs children?

Special education teachers realized that this is an era of specialized technology. They knew that computers could accomplish some tasks more efficiently and more effectively. They were interested in further training or information so they could apply new skills in the curriculum.

C H A P T E R V

CONCLUSIONS AND RECOMMENDATIONS

Summary

This study was designed to investigate applications of microcomputer technology in special education in Western Massachusetts Schools, particularly to assess the extent to which special education is moving beyond drill and practice software with special needs students, and to explore special educators' attitudes toward applications of microcomputer technology.

A review of the literature exposed a clearer picture of current microcomputer applications in special education. The review was focused on two areas: (1) literature concerning the information on current computer applications for children with various kinds of special needs; (2) literature concerning the practice of using computers in special education.

The method used in this research consisted of distributing a questionnaire and conducting interviews for selected special education teachers and administrative people. The data were organized according to the respondents' answers. Findings of the research concerning the uses of microcomputers with special needs students, special educators' attitudes toward microcomputer

applications and special educators' backgrounds were organized, analyzed and summarized. Conclusions and recommendations generated by this study are presented in this chapter.

Conclusions

The conclusions were based on the questionnaire and interviews of special educators. The conclusions were fortified by the researcher's review of related literature of applications of current microcomputer technology as well as the researcher's pilot study.

From the findings of the study, it was shown that most teachers surveyed integrated software into their curricula. They used the computer as a compensatory tool which could sharpen students' mathematics skills, language arts and reading comprehension. Since the objectives of teaching focused on academic remediation, problem-solving software and Logo were seldom introduced to the special education students. In addition, classroom time was generally insufficient, therefore problem-solving software and Logo were not introduced to students with moderate and severe mental retardation. Teachers surveyed indicated that continuous frustration from computer exploration caused a decrease in learning motivation by severe mental retardation.

Although most special education teachers already introduced computers to the students, there were a few special education teachers do not know how to use the computer technology. The question arises as the need for school districts to provide computer training to teachers. Also, the Department of Education should require future special education teachers to have some knowledge and skills on the computer technology before the teacher certification is issued.

After visiting special education programs and interviewing special education teachers, the researcher found that several teachers were very good at using computer technology with special needs children. These teachers were familiar with a range of software, had used software in conjunction with their regular curriculum, and had begun to identify specific benefits that they hoped would accrue to their students as a result of using this software. These teachers were also familiar with adaptive switches, sensors, and communication aids. Some other teachers were just beginning to use word processing for themselves. They had heard about Logo but did not have any experience with it or other programming languages. Because a lot of time was required to become familiar with a piece of software before using it, these teachers chose to stick to the traditional mode of teaching. In this circumstance, software was a kind of reward to the students. These teachers usually let students choose software to play with. The researcher

observed students changing disks when they were tired of playing with a certain piece of software or they become stuck in a computer game.

From the results, it was also shown that applications of microcomputer technology with mild special needs children were still in the drill and practice style, and applications of microcomputer technology with moderate and severe special needs children were still at the experimental stage.

The literature review indicated that microcomputer technology is designed not just for academic compensation, which is what most teachers are doing, but also to improve cognitive development, perceptual-motor skills and the learning of abstract concepts. As mentioned before, the factors that make it difficult for teachers to use computers beyond drill and practice are:

1. Lack of appropriate software. A teacher related that there were only a few of the commercially available software that could be used for his students. Although these were labeled "special education," basically they were based on drill and practice and could only be used for mild special needs children. For moderate or severe special needs children, there was only a little which could be used. These were designed by some reaserchers by experimental purposes only. Because of the general lack of high quality instructional software, teachers think they had to become programmers in order to use computers, and that ultimately made them lose interest in computers.

2. Microcomputer technology has been growing so fast that many teachers were still behind the trend. Since teachers had no time to read manuals or explore the systems, they were still afraid of using computers. Even though the school offered one or two workshops, it was not possible to learn this new technology and acquire skills in one or two workshops.

3. There was not enough class time to use computers. Many students came to the special education class for twenty to thirty minutes a day in order to get extra help on a specific subject. To play with problem-solving software or Logo turtle drawing usually requires a longer time than that needed for drill and practice. In addition, teachers' attitudes and knowledge are not developed for this kind of software, so teachers do not use problem-solving software and Logo very often.

4. Teachers had a number of concerns about this new technology which affects their profession. They thought the computers were generally viewed as dehumanizing; since children concentrated on the computer screen, the interaction between children and teachers had a tendency to decrease. They also thought the students might become addicted to playing computer games.

Recommendations

Addressing the problems mentioned above, the researcher has several suggestions for improving the field of educational computing for special needs children, especially with regard to teacher computer training, curriculum design and research.

Teachers' Computer Training

Applications of microcomputers with special needs children depend critically upon teachers' knowledge and experience in this field. Most special education teachers begin by becoming familiar with computers and software (most often, word processing) and become enthusiastic about acquiring computer knowledge and skills. Since some teachers already know about database, computer programming, problem solving software, simulation and telecommunications, they may adopt these tools in their curricula. What special education teachers should know is not only computer knowledge and skills in operating computers but also the knowledge to choose appropriate software and how to integrate it into the curriculum. Productive goals of using computer technology thus can be attained. But these applications cannot be learned in an overview course or one after-school workshop. This suggests that training in computer education is a long-term endeavor, that the most significant computer applications must be introduced carefully, and that enough time must be spent on each so

that teachers can develop a clear sense of how it is used and why. In addition, issues must be discussed in teachers' training, such as what difficulties students are likely to encounter, how to monitor students, how to manage computer time, and how to evaluate student's work. The training should focus on computer literacy and applications based on how to choose, how to use, and how to integrate the software and hardware into curriculum. After teachers have a sense of using computer technology in their classroom, then they can consider taking computer programming in local colleges. In other words, the teacher's computer training is not for producing programmers but for making good quality special education teachers. In order to encourge special education teachers participating a long-term workshop, a stipend for training is strongly recommended.

Special education administrators should take at least a couple of introductory computer courses in order to have the minimal familiarity that will allow them to approach the computer with relative comfort and know the impact of the computer on the special needs child. Also they should understand what was involved as a way of being more supportive of the teachers' efforts.

The steps helpful for effective training appear to be:

a) Input from knowledgeable persons on how to use hardware and particular applications. For example, special education teachers should learn what kind of hardware (adaptive cards,

switches, sensors, communication aids, and etc.) are available to help their students. In addition, they should learn how to use them. Regarding software, teachers should know how to select and evaluate the software's strengths and weaknesses for particular special needs, such as learning style and reading level. Therefore, in the beginning of training, the instructor should give these special education teachers a guideline to evaluate the software. After that, the participating teachers should review several pieces of software and write down their evaluations so they can be shared with colleagues and distributed for other interested teachers. In addition to writing down the evaluations of software, participating special education teachers should also use a computer to present their experiences with and impressions of software they reviewed, discussing salient characteristics and needs they can address. All evaluations of the software and discussions from special education teachers should be put in a database and then distributed to all special education programs as a software reference.

b) Learn an authoring system. An authoring system is a specialized type of high-level computer language that allows teachers to create computer-assisted instruction without computer programming experience. A major problem for special education teachers is having computers serve the particular instructional needs of a student in a timely manner. The teacher may know how to structure a task for a particular student and want to use materials familiar to the

student or materials that are likely to evoke a positive response. However, the teacher's choice of software is limited by the small amount of software available, time and the budget. Authoring systems allow the teacher to develop software that meets a specific instructional need. The authoring system presents the lesson format for the teacher. The teacher fills in the lesson with materials to be learned, specifications of acceptable and unacceptable answers, prompts, reinforcement, feedback options and so on. This kind of preset-format option is faster and easier to use than programming languages. Several authoring systems have been developed for use with both Apple and IBM (MS-DOS) computer systems as well as other computers such as "PASS" developed by Bell and Howell and Create-lessons designed by Hartley Courseware Company (Lindsey, 1987; Morgan, 1990).

c) Become familiar with Logo graphics. Logo has been recommended as the ideal computer language for children. It can assist in the development of the child's thinking skills by making him/her actively react mentally to learning situations. Logo turtle graphics will give children immediate feedback that helps those with very short concentration spans increase their attention spans noticeably. It is especially useful as a catalyst for both children and adults with limited verbal abilities. The simple commands help children communicate with the turtle. This motivates children to learn, because they feel they can control the computer and not be controlled by the computer.

Logo is often used effectively with groups. Students thereby obtain learning benefits of group activity. Discussion or debate is a normal accompaniment of Logo work as group members contribute ideas and suggestions, and try to understand those of others. Oral fluency and coherence skills can be developed as they seek to explain their views or examine those of others. Group work also increases their social interaction. With such benefits why not use it with our special education children?

d) Develop instructional scenarios for specific students, specific special needs, and specific learning styles, and search for appropriate software. Discuss these scenarios with peer teachers and knowledgeable consultants. The experiences from doing the scenarios will give teachers more confidence using computer technology in the classroom.

e) For special education major students and whoever wants to get a teacher certification in special education, the introductory computer courses such as Logo programming and software evaluation are highly recommended to them. Therefore, they will be better prepared to use new computer technology in their classrooms.

Curriculum

Computers can offer access to new curricula to special needs children, or they can enhance the already established curriculum. Since most special education teachers' teaching objectives are focused on remediation, they adopt worksheet style drill and practice software and word processing which

relates directly to standard writing objectives in their curriculum.

For special needs children, learning objectives should include more thinking skills and problem solving skills. Such problem-solving software involves classification, sequencing, spatial visualization, analyses, and so on. Logo offers opportunities for thinking and simplifying abstract concepts. Therefore, problem-solving software and Logo should be integrated into the curriculum. Computer-based tools such as spreadsheets and databases can also provide the opportunities for calculation, organization and thinking skills. These programs should also be integrated in curriculum.

For word processing, teachers should not only emphasize the mechanics of writing but also the quality of the writing. In the writing process, students have opportunities to develop perceptual-motor coordination, and can also produce good writing. Basically, the curriculum designed is dependent upon learning objectives. If learning objectives for students relates mainly to mechanics rather than the process of writing, teachers will spend their time primarily stressing those mechanics. But even more important, if teachers are not familiar with word processing, they still can not take advantage of it. For hearing impaired students, the word processing not only can be used to help children produce better written language but also at the same time to increase their social experiences

and self-esteem. A philosophy in teaching word processing from one of special education teachers is particularly recommendable to teachers: He used News Room for his writing classes. He serves as a consultant; students acted as editors and reporters. First, he asks students to make a draft on the computer. Then students exchange computers to find out their partner's mistakes in spelling and grammar. After they are finished their error searching, then everyone meets with his/her partner, and corrects the writing. After completing the correcting process, students bring their writings to the teacher. The teacher then makes comments and suggestions back to them. In the final stage, students pass their disks to the editor, the best writer and computer operator. The editor then chooses pictures from a database to match articles and organizes them into a type of newsletter. The bimonthly newsletter is then sent to all classes in the school and nationwide hearing impaired programs. This teaching strategy encourages students to produce more writing.

Research and Development

Evaluation of students' computer learning and review of software and hardware provides very important information for the improvement of computer education in special education. Since technology is changing rapidly and dramatically, if special education teachers can pay attention to it, they might find some things helpful for

their students. For example, the Macintosh from Apple computer features many non-keyboard options for its software. These might be particularly useful for low functioning and physically handicapped children. In addition, adaptations are available to upgrade or add to the capabilities of current machines such as memory extension cards, firmware cards, etc. Review of software and hardware and evaluation of students' computer learning could encourage special education leadership to give more support to training and to the purchase of more computers. Reviews from teachers also give software developers and hardware engineers ideas about what kind of software and hardware adaptation really fit children's special needs. Thus, microcomputer technology can become more accessible for special needs children in the future. Also, special education teachers should pay attention to research results.

APPENDIX A

COVER LETTER FOR THE SURVEY

February 15, 1989

Dear Special Educator,

Applications of microcomputers and computer related technology have opened a whole range of opportunities for students with special needs. Recently, the use of microcomputers and computer related technology have increased dramatically. I am conducting a research project focusing on applications of microcomputer technology in special education in Western Massachusetts.

Enclosed is a questionnaire. The purpose of this survey is to determine your reactions to the applications of microcomputers in special education. Your answers will help us to understand more about actual and potential computer use with special needs children in Western Massachusetts.

The name of your school is requested on the next page so that researchers will be sure that they have reached your school in the sample. At no time will your school be connected with any opinions you express here. You may omit your school name if you would prefer. Your responses will be reported and analyzed along with the reponses from the hundreds of other participating schools in the survey and the result of the questionnaire will be share with you.

Please return completed questionnaire by Febuary 28, 1989 in the stamped and self-addressed envelop.

The survey should take about 15 minutes to complete.

Thank you for your cooperation.

Sincerely,

Mei Ju Hwang

APPENDIX B

SURVEY OF MICROCOMPUTER APPLICATIONS IN SPECIAL EDUCATION IN WESTERN MASSACHUSETTS SCHOOLS

SURVEY OF MICROCOMPUTER APPLICATIONS

IN SPECIAL EDUCATION IN WESTERN MASSACHUSETTS SCHOOLS

A. BACKGROUND INFORMATION

Directions: Please place a checkmark in front of one response for each statement. If you check the "other" category, please specify as well as you can.

1. Name of your school: _____

2. Your sex: ___ Female ___ Male

3. Your age: _____under 30
_____30-39
_____40-49
_____50-59
_____over 59

4. What type of school do you teach in?

___ Public school
___ Private school
___ Other (specify):_____

5. What level do you teach?

___ Preschool/nursery school
___ Elementary school
___ Junior High school
___ High school
___ College or university
___ Other (e.g, Collaborative education, Alternative Learning Program, etc.) (specify):_____

6. What is your position?

____ SP ED Teacher
____ SP ED Director
____ SP ED Coordinator
____ Other (specify):_____

7. What types of students do you teach? (Check all which apply.)

___ Learning disabled
___ Visually impaired
___ Severe emotional/behavior disorder
___ Limited intellectual functioning
___ Hearing impaired
___ Multiple handicapped
___ Other(specify): _____

8. How many students do you have in your class? _____

9. How long have you been teaching?

_____ less than 1 year
_____ 1-5 years
_____ 6-10 years
_____ 11-15 years
_____ 16-20 years
_____ 21-25 years
_____ more than 25 years

10. How long is your experience with computer technology?

___ less than 1 year
___ 1 year
___ 2 years
___ 3 years
___ 4 years
___ 5 years
___ more than 5 years

B. INFORMATION ABOUT COMPUTERIZED DEVICES USED IN YOUR PROGRAM

1. What types of computer technology are used in your program? (Check all which apply.)

computers	__	
auditory devices	__	specify:_____
motoric devices	__	specify:_____
communication devices	__	specify:_____
adaptive switches	__	specify:_____
other	__	specify:_____

2. What brand(s) of computers is (are) used in <u>your</u> program? (Check all which apply and indicate how many.)

		Number	
Apple II series	__	____	
Commodore	__	____	
Macintosh	__	____	
Radio Shack	__	____	
IBM	__	____	
Other	__	____	specify:_____

3. How often is a computer available to your program? (Check one.)

permanently _____
3-4 hours a day _____
1-3 hours a day _____
less than 1 hour a day _____

4. How are the computers used with your students? Please indicate the percentage of time spent at computers for each of the following purposes.

	%
communication	_____
education	_____
entertainment	_____
other:	_____ specify:_____

5. What types of software are used in <u>your</u> program? (Check all which apply and specify the name of the software.)

recreational __ specify:_____
computer assisted instruction __ specify:_____
word processing __ specify:_____
data base management __ specify:_____
problem solving / programming __ specify:_____

6. What is the average amount of time that each student is assigned to the computer every day? (Check one.)

no regular time _____
0-5 minutes _____
5-15 minutes _____
15-30 minutes _____
30-60 minutes _____
60-90 minutes _____
more than 90 minutes _____

7. What extra devices do you use to make the computer more accessible? (Check all which apply)

switches _____
joy stick _____
mouse _____
light pen _____
voice synthesizer _____
music synthesizer _____
adaptive firmware card _____
other (specify): _____

8. On the average, when a student is working on a computer, how much of the time does he/she require teacher assistance? (Check one.)

100% of the time	_____
75-99% of the time	_____
50-74% of the time	_____
25-49% of the time	_____
10-24% of the time	_____
less than 10% of the time	_____

9. Where does funding come from to provide hardware and software? (Check all which apply.)

School budget	___
Parents	___
Local community	___
Grants	___
Business/industry	___
Other	___ specify:_____

10. Where do (did) you get training in the use of computers? (Check all which apply.)

workshops	____
courses	____
self-study	____
other:	____ specify:_____

11. Describe the inservice training on computer uses you have received.

12. Do you teach any computer language? Which language(s)?

13. What factor(s), if any, have made it difficult for you to use computer technology?

C. THE FOLLOWING STATEMENTS CONCERN THE USE OF MICROCOMPUTERS WITH SPECIAL NEEDS CHILDREN

Directions: Please circle the response which indicates how much you agree or disagree with the 33 statements below. (SD=Strongly Disagree, D=Disagree, N=Neutral, A=Agree, SA=Strongly Agree)

1. Microcomputers motivate special education students to learn.	SD	D	N	A	SA
2. Students have longer attention span with computers compared to other class activities.	SD	D	N	A	SA
3. Computer assisted instruction can improve students' reading skills.	SD	D	N	A	SA
4. Some words used in computer assisted instruction are hard for special needs students to understand.	SD	D	N	A	SA
5. The computer is a good tool for developing students' hand-eye coordination.	SD	D	N	A	SA
6. Students increase their self-esteem by using computers.	SD	D	N	A	SA
7. The computer helps students to show abilities that are impossible to show with pencil and paper.	SD	D	N	A	SA
8. Computer graphics distract students' attention from key points of instruction.	SD	D	N	A	SA
9. Students like doing drill and practice on computers better than with paper and pencil.	SD	D	N	A	SA
10. Applications of computers have improved students' cognitive development.	SD	D	N	A	SA
11. Students like to have sound with computer assisted instruction.	SD	D	N	A	SA
12. Students like computer animation.	SD	D	N	A	SA

13. Computer games played by at least two people improve their social relationships.	SD	D	N	A	SA
14. Immediate feedback from a computer gives students positive reinforcement.	SD	D	N	A	SA
15. Logo programming helps students develop geometry concepts.	SD	D	N	A	SA
16. Students like to create pictures on the computer using turtle graphics.	SD	D	N	A	SA
17. Computer graphics bring out students' interest in art.	SD	D	N	A	SA
18. Computers help my students who have physical problems in writing.	SD	D	N	A	SA
19. Computers help my students to produce better writing.	SD	D	N	A	SA
20. Most comercial software does not meet my students' special needs.	SD	D	N	A	SA
21. Teachers should adapt more computer assisted instruction to the curriculum.	SD	D	N	A	SA
22. Teachers need to spend more time when monitoring students working on the computer than during traditional types of teaching.	SD	D	N	A	SA
23. Students are excited about using computers.	SD	D	N	A	SA
24. Computer workshops can help teachers to do a better job.	SD	D	N	A	SA
25. I have time to learn computer skills.	SD	D	N	A	SA
26. There is enough class time to use computers.	SD	D	N	A	SA
27. I have to spend more time preparing lessons when I use computer assisted instruction.	SD	D	N	A	SA
28. There are enough computers and software in my program.	SD	D	N	A	SA
29. There is enough technical support from my school system.	SD	D	N	A	SA

30. I enjoy working with students on the computers. SD D N A SA

31. Special education teachers require some knowledge about computers. SD D N A SA

32. I think I can be creative in working with computers. SD D N A SA

33. My job could be replaced by a computer. SD D N A SA

Additional Comments:

_____

_____

_____

Thank you. Your contribution is very much appreciated.

Please return this questionnaire to:

Mei Ju Hwang

APPENDIX C

SPECIAL EDUCATION TEACHER INTERVIEW GUIDE

SPECIAL EDUCATION TEACHER INTERVIEW GUIDE

BACKGROUND

1. Name:_____

2. Sex:_____

3. Years Teaching:_____

COMPUTER EXPERIENCE WITH STUDENTS

1. Where is the computer located?
   _____classroom
   _____resource room
   _____computer lab
   _____ other

2. How much supervision is needed?
   _____hours per day
   _____hours per week
   _____occasionally
   _____other

3. Are the computers networked?

4. What peripherals (fill in number)?
   _____color monitors
   _____black and white monitors
   _____disc drives
   _____printer
   _____switches
   _____other

5. How is software being used?
   _____drill and practice
   _____problem solving
   _____communication
   _____motivation
   _____programming
   _____writing
   _____other (specify)_____

6. Do they work:
   _____alone
   _____with teacher
   _____in pairs
   _____three together
   _____other

7. How is word processing used with special needs students?

8. How do the parents of your students feel about their children learning with computers?

9. Which software is appropriate for your students?

OPINIONS ABOUT MICROCOMPUTER USES WITH SPECIAL NEEDS STUDENTS

1. Do you think computer technology increases students' self-esteem and confidence?

2. Do you think LOGO has provided opportunities for development of problem solving skills?

3. What is your opinion about the computer as a tool for communication.

FINAL COMMENTS

Are there any other comments you would like to make about using microcomputer technology?

APPENDIX D

PERMISSION REQUEST FOR ADMINISTERING SURVEY

Dear Special Education Administrator:

I am writing to request your assistance in my efforts to complete the requirements for the Ed.D. Degree at the University of Massachusetts, School of Education. The purpose of my study is to investigate the applications of microcomputer technology in special education in Western Massachusetts and to assess the use of software in special education.

In order to complete my study, I would like to administer a questionnaire to the special education administrators and special education teachers who are using computer technology with special needs students. I would appreciate your granting me permission to conduct this survey in your school district. Please send me a list of special education administrators and special education teachers who are using computers in your school district and your letter of permission.

Thank you in advance for your assistance and attention to this matter.

Sincerely

Mei Ju Hwang

APPENDIX E

CONSENT FORM FOR INTERVIEW

Written Consent Form

A STUDY OF APPLICATIONS OF MICROCOMPUTER TECHNOLOGY IN SPECIAL EDUCATION IN WESTERN MASSACHUSETTS SCHOOLS

To particiants in this study:

I am Mei Ju Hwang, a graduate student at the University of Massachusetts, in Amherst. I am writing to request your assistance in my efforts to complete the requirements for the Ed.D. Degree at the University of Massachusetts/School of Education. The subject of my doctoral research is the investigation of applications of microcomputers in special education in Western Massachusetts and the assessment of use of software in special education.

In order to complete my study, I have administered a questionnaire to the special education administrators and special education teachers who are using computer technology with special needs students. As part of my study, I am interviewing special education teachers who are selected from the survey participants in order to know more detailed information about applications of microcomputers in special education. You are one of approximately fifteen participants chosen for interviewing.

The interview will focus on your experiences of how you use computer technology with special needs students, what problems you have encountered when you use computer technology with special needs students and what it means to you to use computer technology. The results will be a resource for improving the quality of special education as well as software developers.

The interview will take approximately 30 minutes to complete. Each interview will be audio-taped to allow for review and accurate reporting by me. I will be the only person to know who is speaking on the tape. In all the written material and oral presentation, I will use neither your name, names of people close to you nor the name of your school or town. I will use the results of interview in my dissertation, presentations and related academic works.

You may at any time withdraw from the interview process. You may withdraw your consent to have specific excerpts used, if you notify me, in writing before May 31, 1989. I would be very happy to discuss any questions or concerns you may have. Contact me at (413) 549-4182.

In signing this form, you are also assuring me that you will make no financial claims for the use of the material in your interview. Finally, you are also stating that no

medical treatment will be required by you as a result of participating in the interview.

I,_____, have read the above statement and agree to participate as an interviewee under the conditions stated above.

_____
Signature of participant

_____ _____
Signature of interviewer Date

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