The Learning Disabled and Computer-Assisted-Instruction

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INTRODUCTION

THE ANIMAL SCHOOL

Once upon a time, the animals decided they must do something heroic to meet the problem of "A New World." So they organized a school.

They adopted an activity curriculum consisting of running, climbing, swimming, and flying. To make it easier to administer the curriculum, all the animals took all the subjects.

The duck was excellent in swimming, in fact better than his instructor; but he made only passing grades in flying and was very poor in running. Since he was slow in running, he had to stay after school and also drop swimming in order to practice running. This was kept up until his web feet were badly worn and he was only average in swimming. But average was acceptable in school, so nobody worried about that except the duck.

The rabbit started at the top of the class in running; but had a nervous breakdown because of so much make-up work in swimming.

The squirrel was excellent in climbing until he developed frustration in the flying class where his teacher made him start from the ground up instead of from the treetop down. He also developed "charlie horses" from over-exertion and then got a "C" in climbing and "D" in running.
The eagle was a problem child and was disciplined severely, in the climbing class he beat all the others to the top of the tree, but insisted on using his own way to get there.

At the end of the year, an abnormal eel that could swim exceedingly well, and also run, climb, and fly a little had the highest average and was valedictorian.

The prairie dogs stayed out of school and fought the tax levy because the administration would not add digging and burrowing to the curriculum. They apprenticed their child to a badger and later joined the groundhogs and gophers to start a successful private school.1

Not all children can learn at the same rate or through the same methods. Everyone, whether adult or child, male or female, has areas in which they are gifted, average, and deficient. In one way or another, individuals learn to compensate for those areas in which they are impaired. Truly, not everyone can be a Babe Ruth, Albert Einstein, or George Washington; however, when a child's handicap affects his ability to learn, and he knows of no methods to help him compensate for this academic loss, something must be done to help the child.

All children are at different levels maturationally and intellectually, even though they may be similar chronologically. Gaps between some children's learning abilities are so wide that learning problems exist. When students' performances do not match their potentials, this is often an indication of the presence of learning disabilities. Many techniques are available that attempt to
remediate children's learning problems, but not all work for all students.

The purpose of this paper is to identify various learning disabilities and to explore some possible uses of the computer in assisting handicapped children to reach their potentials.
No federal legislation existed to aid in the public education of handicapped children, until 1968, when a bill, later to become Public Law (P.L.) 91-230, was introduced. Although this bill only "included provisions for research and for the training of personnel for the mentally retarded, hard-of-hearing, deaf, speech impaired, visually handicapped, crippled or other health impaired children," it was a start. Unfortunately, learning disabled children had no statutory rights concerning their educations until "state governments began legislating provisions for some services for the learning disabled."  

In 1975, P.L. 94-142 was passed. With this passage, education became a fundamental right for all handicapped persons. This law, known as the Education for All Handicapped Children Act, defined handicapped children as

those children evaluated . . . as being mentally retarded, hard of hearing, deaf, speech impaired, visually handicapped, seriously emotionally disturbed, orthopedically impaired, other health impaired, deaf-blind, multi-handicapped, or as having specific learning disabilities, who because of those impairments need special education and related services.

The core of the rights guaranteed to each handicapped
individual under P.L. 94-142 includes:

1. A *free public education* to all between the ages of 3 and 21.

2. An "individualized education program," or IEP, which must be a written statement developed by school officials, the child's teacher, and a parent or guardian, stating information concerning the education of the child.

3. An education in the "least restrictive environment," which is appropriate for both handicapped and nonhandicapped students. This concept embodies the idea of mainstreaming.

4. Tests and other methods of evaluation used in the labeling of a handicapped child must not be racially or culturally discriminating, and must be administered in the child's native tongue.

5. A continuous and intensive attempt must be made to *locate* and *identify* all handicapped children, to *evaluate* their educational needs, and to *determine* if these needs are being met.

6. *Priority* must always be given to those not receiving an education, and to the severely handicapped who are receiving an inadequate education.

7. The child's parent or guardian must be consulted with before a decision concerning the child is made and implemented.

8. These rights apply to handicapped children in *private as well as public schools*. Any special educational services are to be provided, at no cost to the parent, if the child has been placed or referred to
a private school by state or local education agency officials.

9. All buildings must be accessible to persons with handicaps.5
UNDERACHIEVEMENT

Underachievement, the inability to achieve or reach the potential one is capable of reaching, is a serious handicap for approximately 10 to 20% of the schoolage children population. Factors contributing to a child's underachievement can be either extrinsic or intrinsic. Extrinsic conditions are the "contributing factors in the environment, including socioeconomic conditions, cultural factors, lack of opportunity to learn, and inadequate or inappropriate instruction." Extrinsic conditions are those conditions "within the child. These include mental retardation, sensory handicaps (severe auditory or visual impairments), serious emotional disturbances, and learning disabilities." Intrinsic conditions are those conditions "within the child. These include mental retardation, sensory handicaps (severe auditory or visual impairments), serious emotional disturbances, and learning disabilities."

Examples of socioeconomic conditions, that may lead to underachievement, include the home life of the child, the economic class of her parents, and her parents. If her family cannot afford what so many others take for granted, she may have grown up without many, if any, "educational toys" and/or books. A poor nutritional diet is also a factor that may be a causal factor of a child's underachievement. Also, the child's home life is an important influence on the child's achievement. A child learns primarily from role models, and if the parents are undereducated or uneducated the child has little chance of learning fundamentals at
home, and as a result is disadvantaged from the beginning.

Another contributor to extrinsic factors of underachievement are cultural factors. Teachers, especially first year ones, must remember that they are there for the students and that not all students come from similar cultural backgrounds, let alone ones similar to that of the teacher. As a result many differences in language, such as the concepts of words, phrases, and symbols, and differences in their values, exist. Parents also play an important role in this area.

Finally, inadequate or inappropriate instruction may be a cause of underachievement. If the child has no understanding of a previously "learned" skill, when it comes time for that skill to be recalled and used at a later time, the child is unable to do it. This is the same for inappropriate instruction. If a child is taught something he will rarely or never use, or something that is not relevant, the child will not be able to achieve to his fullest potential, and possibly not be able to keep up with the other children in the basics.

Mental retardation, an example of an intrinsic factor of underachievement, "refers to significantly subaverage general intellectual functioning existing concurrently with deficits in adaptive behavior, and manifested during the developmental period." This means that some characteristics of mental retardation include: a significantly low or below average intelligence which exists at the same time as problems with
adaptive behavior. Intelligence is defined as a measure of one's "basic learning ability." Adaptive behavior is defined by The American Association of Mental Deficiency (AAMD) as "the degree and efficiency with which the individual met 'the standards of personal independence and social responsibility expected of his age and cultural group.'" More easily stated, it usually means how well an individual adapts to the demands put upon him by his environment. The child's developmental period is the time period in which he learns the prerequisite skills necessary for success in later learning. So, mental retardation can simply be defined as a significantly below average intelligence which exists with an inability to meet certain environmental demands appropriate for one's age, and is obvious during the period when the majority of learning takes place.

Another intrinsic factor resulting in underachievement is sensory handicaps. If one has auditory and/or visual problems, one's ability to learn and achieve will be affected. Deaf children aren't able to achieve to their maximum potential because their deafness interferes with their language development, and the visually impaired, specifically the blind, are unable to learn as easily as "normal children" because their educational materials are greatly restricted.

Serious emotional disturbances are also an intrinsic underachievement factor. The emotionally disturbed child must be looked at and analyzed in an attempt to determine if her
underachievement "has influenced the social or emotional maladjustment, or whether the emotional disturbance has affected educational progress."¹¹

The final intrinsic underachievement factor, learning disabilities, is the main topic considered. "The question of when underachievement should be interpreted as a learning disability is something that the experts debate. . . . When the child's performance is approximately two years behind that expected for his level of intelligence,"¹² is the usual consensus.

Specific learning disability, one of the eleven handicapping conditions, means

da 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 disfunction, dyslexia, and developmental aphasia. The term does not include children who have learning problems which are primarily the result of visual, hearing, or motor handicaps, of mental retardation, of emotional disturbance or of environmental, cultural, or economic disadvantage.¹³

More simply stated, a learning disability exists when an apparent discrepancy between one's ability to perform and his actual performance exists. Contrary to a misconceived fallacy, a learning disabled child is not mentally retarded, rather he has average or above average intelligence. The learning disabled are capable of learning, but have trouble learning in one or more
specific academic areas.

As previously stated, a characteristic common to all learning disabled students is that they have average or above average intelligence and appear "normal" in every physical aspect, but they are different or "abnormal" in the fact that they do not learn like their "average" classmates do. A significant discrepancy between their actual achievement, or performance, in one or more academic subjects and their intellectual ability, or what they're "capable" of doing, exists. Nothing could possibly be more frustrating than having the ability to think, know, achieve, and reason in many academic areas, and without explanation, not be able to read, write, spell, verbally express yourself, or do mathematical calculations.

A basketball player, like a learning disabled child, may be completely outstanding in one area, such as offense, and may need a little work in another, like defense, but still maintain his ability to compete with others. Once his defense interferes with his ability to perform on the court, his problems begin. He is no longer able to keep up and competitively succeed with his peers. Similarly the learning disabled student's potential to learn exists, but something keeps him from keeping in stride with his peers academically.
DEVELOPMENTAL AND ACADEMIC LEARNING DISABILITIES

There are two types of learning disabilities, developmental learning disabilities and academic learning disabilities. Developmental learning disabilities "involve those prerequisite skills that the child needs in order to achieve in the academic subjects." Some developmental learning disabilities include attention, memory, perceptual disabilities, thinking disorders, and oral language disorders. It is a result of any combination of these disorders, and the child's inability to compensate in some way for her handicap, that her academic learning disability or disabilities appear.

Probably the most common problem found in learning disabled children is failure in learning to read. Being able to recognize letters and produce words does not entail the entire reading process, more components exist. The ability to comprehend the meaning of the passage being read, associate "words" with their intended meaning, fluently read orally or silently, and use proper voice inflections when necessary, are some examples of various aspects of the entire reading process.

Three important developmental stages that one goes through when learning to read are "(1) mass action, (2) differentiation, and (3) integration." In the first stage, "mass action or reading
wholes," the child doesn't differentiate one word from another. The child is able to say the written word, but has no understanding of the meaning of that word. In the next stage, "learning details, or differentiation," the child learns to recognize the written word and gains some understanding that each word is different. Once the child reaches the final stage, "reading without awareness of detail, or integration," she no longer needs to decode the written word, "the perception of words becomes automatic," therefore she can concentrate on the content of the passage rather than on the letters of the word. At this stage, the ultimate purpose of reading, to understand the thought units of the printed page without having to spend time concentrating on the details of the letters and words, is achieved. When the child is having difficulty at one of the stages, or in passing from one stage to the next, a reading disability exists.

Common problems for the learning disabled child at the second stage, the stage of differentiation, are auditory and visual discrimination and dyslexia. Comprehension is a common problem at the third stage, the stage of integration. If a child has a problem hearing different sounds, when he reads orally he will mispronounce the word he sees. Visual discrimination problems differ from dyslexia in the manner that they usually are reversals of a letter, such as a b for a d or a p for a q, while the latter concerns reversals of words. Dyslexia means "trouble with reading." Characteristic of this reading problem, words are reversed, such as was for saw, or tap for pat. Also, many times, a different word will be
substituted or even an entire word or phrase may be omitted. For example, "since the words themselves escape him individually, he may try to follow the general meaning of the entire sentence and read mother instead of parent."18 Also

his confusion may carry over into his speech, and he often has a great deal of difficulty in coming up with the correct name for a specific object. He will say "the thing you cook on" or "the thing you fix supper on" instead of being able to state "stove" or "oven."19

Comprehension is a frequently encountered area of difficulty at the third stage, the stage of integration. The child has difficulty decoding words and must concentrate on decoding words and letters instead of automatically perceiving them, he will have great difficulty in getting any meaning from what he is reading. He will be concentrating so intensely on "trying to read" rather than "reading," that each word will become an individual idea unrelated to the next, and the passage will have no significance to him. As a result, he will experience a high level of frustration.

Another common academic learning disability is handwriting. "Handwriting is a prerequisite skill to spelling and to written expression."20 If a child cannot master his handwriting, he has a difficult time with spelling and with written expression. Frustration similar to that encountered by the child who cannot learn to read is experienced by the learning disabled child who has difficulty when writing.

Another academic area where many children are classified as "learning disabled" is in spelling and written expression. Even as
adults, when one who knows how to spell encounters a word infrequently used, one will use phonics to spell it. However, "some children fail to learn to spell,"21 even the frequently used words. Following is a sample of a piece of writing done by a 12-year-old girl, with an approximate I.Q. of 115 (100 is average.)

the race but wat she der not know wase that sum won frum the roto was worsening her. He went over to her aftre the race and sed (Woad you lick a jod thes roteow seasoned) Wat is it? Riting on awer tem wet your hors we net a good rite and if you woud (oh yes!! oh yes!!) hors we praktes on Saturday all be thar.22

The correct translation of her paragraph reads:

. . .the race but what she did not know was that someone from the rodeo was watching her. He went over to her after the race and said (Would you like a job this rodeo season) What is it? Riding on our team with your horse we need a good rider and if you would (oh yes! oh yes!) horse we practice on Saturday. I'll be there.23

At the sixth grade level many of these spelling errors should not exist. The same being true for the grammatical errors. A possible reason for difficulty in written expression may be the obvious disorganization the learning disabled exhibits. This "general disorganization that characterizes her entire school work becomes most obvious when she attempts to put her thoughts down on paper."24 But verbally, the dysgraphic child, one who is unable to write, can express what she is trying to say. The child must find this inability to transfer from the brain to the paper extremely frustrating.
Some spelling errors may exist as a result of a speech or hearing difficulty. If the child mispronounces or incorrectly hears a word, he is trying to phonetically spell, it is going to be misspelled. This is one reason why, in order to be eligible for classification as learning disabled, a child must first pass the vision and hearing screening. In other words, a child cannot be labeled "learning disabled" if the reason he is not learning is a result of problems connected with his vision or hearing.

A fourth academic learning disability is one related to arithmetic. Arithmetic problems may exist in areas other than in the child's inability to add, subtract, multiply, or divide. Many children may appear to be at their "appropriate grade level" without exhibiting any apparent problems, until they get into higher and more abstract levels of mathematics. However, "not every learning disabled child encounters problems in mathematics, in fact some find this their one experience with academic success."25

As with written expression, "difficulty in organization"26 is apparent in the learning disabled's mathematical calculations. Their numerical columns tend to wander all over the paper. And often, in the early stages, numbers are written in reverse. Also, the ideas of time and money seem to be a difficult concept for the learning disabled to grasp.

Dyscalculia refers to "a developmental mathematical disorder."27 Various contributing factors of arithmetic disabilities include language, attention, visual-spatial discrimination, sensory integration, concept formation, and problem solving.
"Since mathematics is a communicating skill based on the relationships of abstract symbols," a "numerical vocabulary" must be developed and comprehended by a child in order for him to understand and achieve in mathematics. If he cannot associate add with a plus sign, he will not be able to associate add with the concept of addition. The same is true for subtract, multiply, and divide.

As with the other academic areas, a child must attend to an idea being discussed if he intends to understand the concept that is being taught. For failure to attend in any subject area will hinder the child's ability to learn. Causes of a child's inability to attend are many, and may range from intrinsic physical conditions, such as a poor nutritional diet to an impairment in vision or hearing, to extrinsic physical conditions, like someone talking in the hallway.

Visual-spatial discrimination affects a child's mathematical ability in the sense that numbers can be rotated, a 6 for a 9, or reversed, 21 for 12 or 41 for 14, in a manner similar to the way visual discrimination or dyslexia affects the learning disabled child when trying to learn to read. Learning the concept of place value is also an area of difficulty for the mathematically disabled. They have a hard time realizing that "the 3 in 31 has a higher value than the 3 in 13."

Another cause leading to difficulty in mathematics is sensory integration. When a simple arithmetic problem, such as 1+2+3, is performed, many sensory channels are called into action. Once the child recognizes the number, visual discrimination is called into
play, then auditory memory and verbal expression if the child voices the number, then visual memory again when the child recognizes the +, and auditory memory is again relied upon when the child thinks two, and so on. As a result, it helps to "determine if a child has difficulty receiving information or responding through various combinations of the visual, auditory, and kinesthetic channels." 30

Concept formation, another contributing factor of disabilities in mathematics, is the inability of a child to generalize the use of a previously learned concept. For example, "a child may learn that 1 + 2 = 3, but this same child might insist that 2 + 1 are not equal to 3." 31

A final factor is problem solving. Many learning disabled children have a difficult time learning to problem solve because they use trial-and-error approaches if they attempt to problem solve instead of using a systematic approach. A general approach to problem solving in mathematics includes (1) developing an understanding of the problem to be solved, (2) devising a plan or method of solving the problem, (3) using a method to work the problem, and (4) checking the answer.
ACADEMIC REMEDIAL TECHNIQUES

As a result of the difficulties faced by a learning disabled child, various remedial methods have been developed. Although each academic area has specific remedial techniques, a general overview concerning all of the academic areas will follow.

Special education, society's answer to the learning disabled's academic problems, is a way of helping the child gain the knowledge and understanding of a concept through the use of any methods, materials, or curriculum necessary. In other words, "if it works, use it."

One "learning strategies model of instruction for learning disabled adolescents is designed to teach students how to learn rather than to teach students specific content."32 Another remedial practice is the belief in teaching the learning disabled to acquire "efficient thinking and problem solving strategies"33 in order to prepare him for life after high school. A quote that supports these beliefs states "Give me a fish, and I can eat for a day. Teach me to fish, and I can eat for a lifetime."34

In order for learning, "the process through which an individual develops or acquires knowledge, skills, or attitudes,"35 to take place, there are many factors about the the learning disabled that must be considered. Some general guidelines to take into
consideration when planning a remediation strategy include finding out what the child needs to be taught (goal), and what intervals or steps these needs will be broken into (objectives). Then one must determine the present level of the child so instruction with appropriate methods can begin at or below this level. It is very important that the child experience success rather than failure, as has been the case before. Immediate feedback and reinforcement (some type of reward, such as verbal praise or something concrete,) are also important components of the remedial technique. Along with this, the child's progress should be charted so that both the student and teacher can see the progress the student is making.

These general "rules of thumb" are met in various ways. Special materials and methods and drill and practice are two of the main methods by which remedial techniques are implemented. If, for example, the child is unable to learn to write letters from simply copying them, she may be taught the letters by tracing them with her finger. This method "helps develop the muscular sense of how letters are formed. . . . She may also be taught to feel large shapes with her eyes closed."36 This method, which involves the sense of touch and how the letters would feel, concentrates on the kinesthetic sense.

In mathematics, special materials and methods are incorporated by allowing the children to "relate their calculations to tangible objects."37 If the child is involved in sports, basketball for example, and the topic being taught concerns percents, one might use an example such as "John shoots 10 freethrows. If he makes 6,
approximately how many can he make out of 100?"

Appropriate materials for the learning disabled child should always be used. Children cannot learn when they are constantly failing, and as a result experiencing frustration. Each child's curriculum should be programmed for success, everyone needs to experience success rather than constant failure. If one wanted to learn to ski, but continuously experienced failure, sooner or later, that person would turn to another form of recreation. For the learning disabled, it's not that simple. If they are not able to get the "hang" of reading, they cannot "trade" in their books for a pencil and a sketch pad. The books that the learning disabled read need to be adjusted to fit their ability and academic needs, but the majority of the time "the books from which the learning disabled study are either meant for the non-learning disabled, or simply revised into watered-down texts, with the facts diminished into nothingness."38

"In addition to providing special techniques, special education to a great extent is simply extra repetition and drill on a more individualized basis."39 This only makes sense. Why else do our high school, college, and professional athletes spend hours upon hours practicing running, catching, throwing, batting, fielding, swimming, etc.? "Practice may not make perfect, but it usually makes a skill somewhat better."40 "Constant practice and repetition are mandatory, if the improvement is to be permanent."41

The learning disabled child needs special help in the classroom and at home in the area of learning how to learn. "The right environment can make a big difference"42 in the success of a
learning disabled student. At school the teacher needs to learn to be knowledgeable and understanding of children and their situations, and as a result individualize the student's curriculum and teach accordingly.

To be a successful teacher one must always be in control of any given situation. This does not mean that the teacher dominates or does not allow for flexibility, but that a group of students can be directed in the participation of any activity in such a way that the purposes or the objectives are achieved.43

Stated another way, "the major task of the learning disabilities teacher or specialist may be viewed as that of influencing learning in the desired direction."44 Various materials, such as the computer, can be used as an aid to the teacher in this area.
COMPUTER-ASSISTED-INSTRUCTION

Computers are frequently used in the "regular" education classroom as a way of learning. Also found in the "regular" classroom are the learning disabled, and because of the difficulties these children face, "each needs a special set of circumstances in order to learn to the best of his or her ability."\(^4\)\(^5\)

But does a child's need for a "special curriculum mean that "'special ed' software for each exceptional child or small group of children"\(^4\)\(^6\) must be used in the "hope of meeting the unique needs of that child or group? Not necessarily. According to some of the most experienced teachers of special children, a better solution may be to choose 'regular' software whose content can be modified by the teacher to fit the needs of individual users."\(^4\)\(^7\)

Many advancements are being made daily in the field of computer-assisted-instruction (CAI). "Since the early 1960's CAI has been touted as the most significant educational advancement since the printed book."\(^4\)\(^8\) This statement was made in 1985, and there have been many great strides since then. Computers are used in various areas of education. Now, instead of children learning to use computers, computers are helping children learn to learn. Drill and practice, tutorials, simulations, gaming, problem solving, and tool applications are six different categories into which CAI can be
divided.

"The most widely used type of computer program is drill and practice. This application is easy for most teachers to understand, as it is not unlike other common approaches such as flashcards or programmed textbooks." Drill and practice was "designed to reinforce previously learned information and to provide the student with practice in using this information." This approach, also known as repetition, is "an activity similar to the homework assignments of many teachers and to the exercise sets of many textbooks."

CAI drill and practice is much more effective than traditional learning. With the aid of a computer, instruction can be directed towards the unique needs of each individual, interacting on a one-to-one basis. Drill and practice also allows for immediate feedback for the user. Typical positive reinforcement may include the appearance of a "smiley" face, "personalized" message, or the playing of a piece of music. If the software is designed appropriately, the "boredom" of learning may be eliminated. A file of what a student has done and how well that student has performed may be kept as the student completes a unit.

Many educational drill and practice software programs exist. In just about any academic area, concerning almost any topic, a CAI program can be found. Spelling, capitalization, punctuation, typing, memorization of capitals, states, definitions, basic concepts, and especially, math problems, can endlessly be practiced and reinforced until comprehension and/or memorization has been
Tutorials differ from drill and practice in the sense that drill and practice exercises concentrate on the concept of repetition, while tutorials operate on the belief in additional, appropriate and individualized instruction. "It attempts to teach the child about some subject matter area in much the same way as a parent or teacher would do interacting with the youngster on a one-to-one basis."52

Tutorials can be very beneficial for those students who were absent for a specific lesson, had difficulty comprehending a lesson, or for those who continuously have problems grasping a concept, such as the learning disabled. By using CAI tutorials, learning can take place because of the extra instruction the student receives after regular teacher instruction has failed to have had an impact on the student. It is very important though that the "computer should serve as an adjunct to the teacher,"53 not as the primary or sole means of instruction.

"A CAI simulation models or recreates a real-life event not easily shown in a traditional teaching environment."54 An example of some good educational simulations may include "scientific experiments, social and genetic growth patterns, historical events, economic situations, "55 and even driver education. A popular simulation that teaches many concepts is the social studies simulation "Oregon Trail."

"Oregon Trail" simulates a settler family's journey by covered wagon, from Missouri to Oregon. Budget
allotments must be made before the journey; the settlers' survival hinges on the judicious allocation of funds for clothing, medicine, supplies, ammunition, food, and emergency cash. Settlers can periodically choose between hunting for food, stopping at a fort (purchasing expensive supplies), or moving on. Hunting is simulated with the space bar on the keyboard (rifle) which fires bullets at a deer running across the screen. The settler may select the degree of perception and eye-hand coordination required to kill the running deer, or attacking bandits. Hailstorms, breakdowns, illnesses, injuries, and bandit attacks take their toll on the settlers and their resources. And, if their marksmanship or planning is inadequate, the families will not survive.56

Simulations are a very helpful and less expensive way to introduce students to dangerous and expensive "real life" situations, but "students must understand that the simulation is only a representation of the real-life activity."57 And as many educators have suggested, "learning derived from simulation is different from that derived from other means."58 It is also believed that simulations should be used only with the older students because concrete learning is extremely important to the younger students. Computer simulations should not "replace a valuable hands-on activity with an unnecessarily vicarious and abstract one."59

"Computerized simulations have been turned into games (simulation games) by adding competition to the decision activities of the user,"60 and when these decisions are "related to school objectives, they are called 'instructional games.'"61 The use of games to teach students is viewed as inappropriate by many. A reason, especially at the older levels, is because adults believe
"learning should become more like work." Like any appropriate teaching technique, the use of games can raise a student's achievement, "if they are carefully selected to match curricular goals." They have to fulfill a purpose.

Much discovery learning, at all age levels, occurs through the use of play and games. Games "require the learner to use logic and skill in ways that other learning tasks do not," are very motivating to the user, and are capable of holding one's attention for a longer period of time than are periods of verbal instruction.

While using CAI gaming as an instructional method, it can also be used as a reinforcer or reward system. For example, Johnny knows that if he finishes his math assignment he can use the computer to "play a game," which may concurrently happen to further reinforce the concepts he just learned in math.

"Programs prepared by other sources and . . . programs prepared by the user," are two ways in which computers can be used in the area of problem solving. The student is involved with problem solving by providing the information necessary to the program to enable it to generate the answer. Also, involving the student in problem solving in having the student write the program allows the student to gain a deeper understanding of the problem, learn how computers work, as well as how their own thinking works; and they also learn logical thinking and problem solving.

The final division of CAI, tool applications, explains how CAI can be used to aid in daily learning activities. Software used in CAI can be either manufactured and purchased or self constructed. Some
packaged software is available now, but there is room for many more good educational programs.

Marketed CAI extends over a large spectrum. It can range from Big Trak to LOGO to packaged software. Big Trak is a programmable vehicle made by Milton Bradley that children learn to move forward, backward, left, and right with instructions. By using this, students can learn important concepts about the number line, such as, the distance from -2 to 3 is five, or directions, such as left, right, forward, and backward, or basic geometrical concepts, such as a circle is composed of 360 degrees, and a triangle needs to consist of 180 degrees.

Somewhat similar to Big Trak, but far more advanced, is LOGO. LOGO is a programming language which was "originally developed as a computer-based learning environment in which children could learn computer programming, problem solving, and mathematical thinking."66 Seymour Papert views "the computer as a teaching machine . . . that . . . may affect the way people think and learn."67 Today, CAI often means the computer teaches the child. "One might say the computer is being used to program the child,"68 but Papert believes that in LOGO "the child programs the computer."69 By this it is meant that the user and computer can "understand" each other because the "turtle is able to accept commands expressed in a language called TURTLE TALK."70 Some common commands include: FORWARD, BACK, RIGHT, and LEFT. "And in teaching the computer how to think, children embark on an exploration about how they themselves think."71
LOGO contains the feature of "turtle graphics." Turtle graphics allows the student to program the "turtle (a small triangular object) to move around the screen and construct geometric and graphic designs." Because "the child, even at preschool ages, is in control," and is the one to program the computer, Turtle geometry (LOGO) is more concrete. If they do not understand how to draw something then they can "become the turtle" and from this "discover" the necessary commands. Since LOGO is easy to learn, many can write easily "readable" programs which construct complex pictures.

Packaged software available now is mostly drill and practice, especially in the area of mathematics, but other applications exist. Spelling programs, reading comprehension programs, grammar usage programs, programs concerning areas in science and social studies also exist.

Not only does today's software effect the usefulness of computers in education and CAI, but the hardware available also has a great impact. A few examples of the ways improvements in computer hardware has greatly improved the quality of CAI and the use of computers in education include greater memory storage, which in turn leads to faster and increased interaction between the user and computer, and the ability to transfer greater amounts of information. Because of the larger computer memories, "quicker" computers, and artificial intelligence software, CAI will come closer to what a teacher is capable of doing with the student now. As a result of the computers increased ability to store information,
compact disk technology allows larger amounts of information to be stored in smaller volumes. Many other improvements in computer hardware have put CAI where it is today, and many more are still to come.

Another very helpful program is a word processing program. A word processing program can be thought of as an "electronic word handler... A word processor allows changes in the written text with simple editing commands."\textsuperscript{74} One can insert, delete, or change letters or whole words, rearrange sentences and paragraphs, change punctuation accordingly, and even check spelling. A word processor differs from CAI software in the manner that it aids the skill of written expression and doesn't "teach" the concept in the sense that the student can see a grade for his written work.

Manufactured software is available for many academic areas, skill levels, and curricular goals. This type of software is also constructed at a high level of sophistication, but sometimes a concept that needs to be introduced, reinforced, or taught is not available. At this point, self constructed CAI software comes into play. If a teacher is able to design and construct his own software, or find someone to do it for him, then he is able to incorporate exactly what components he feels are necessary and important into his CAI program. Because this capability is so advantageous, it is important to combine the programming of CAI with the goals and objectives necessary for each student.

With any software, especially self constructed software, many considerations must be taken into account. It is believed that
"good educational software must have eight characteristics. They are: 1) Educational Soundness, 2) Ease of Use, 3) 'Bullet' Proofing, 4) Clear Instructions, 5) Appropriate Language, 6) Appropriate Frame Size, 7) Motivation, and 8) Evaluation." These characteristics should be used consistently; "whether you are writing drill and practice programs for elementary age mentally retarded children or tutorial programs for graduate students in physics."

**Educational Soundness**

The most important characteristic of CAI courseware is that it is educationally sound. By this it is meant that the material is relevant to the student's needs, is appropriate for the learning objective, and contributes to the learning process.

**Ease of Use**

This means that the program is designed to be loaded and executed by a user who has minimum skills and knowledge of the computer.

**Bullet Proofing**

This is closely related to ease of use. A bullet is a 10-year old hyperactive child who will press every key on the keyboard at every opportunity.

**Instructions**

Clear screen-oriented instructions on how to use the program is another characteristic of good educational software. The instructions must be clear and concise while giving the user sufficient information to feel comfortable in using the program.

**Appropriate Language**

Appropriate language for the audience who will
use the program should be used. Different language should be used for a gifted high school science class than a second grade mathematics class.

Frame Size
Appropriate frame size, the amount of material which is to be presented to the student in each segment of the program, should be used.

Motivation
The goals of motivation are to keep the student interested in the lesson being presented and performing at her maximum capability.

Evaluation
Evaluation is very important, and a computer provides immediate feedback to the user.77

Some other guidelines for the development of software include the use of a graphic or message whenever the user must wait for material to appear, a name routine and frequent referral to the user by name, and frequent user response for maximum interaction and learning. Concerning feedback and evaluation, immediate feedback should be provided which is appropriate for the intended audience and to the program if possible. At the end of the program, as appropriate, feedback should be provided, along with an error analysis feature so patterns of unacceptable responding can be detected and noted, and a correct response should be provided after a pre-determined number of consecutive errors. And for instructional features, prompting or "hint" messages should be included after a specified period of time has elapsed without the input of a response. And if possible, "hints" should be given to help the student "discover" the answer instead of just being given the correct one. Finally, instructional segments should be broken into small, logical units to aid the student in comprehension.78
One frequently used example of CAI often "forgotten" about is the "hand-held calculator." This use of CAI, the development of drill and practice programs, tutorials, and simulations are often used today, yet, as recently as three years ago it was believed that "CAI simply has not made a great impact on education," and that one "would be hard-pressed to make a case that CAI has made a substantial difference to education." But, as more has been discovered about computers, their capabilities, and CAI, it has also been learned that "there is enormous potential for their use in special education."

Computers, more specifically CAI, are not seen as replacing the teacher, but as a supplement to the teacher to help individualize instruction. This may be achieved through the six previously mentioned categories of CAI. As with all other debatable areas of life, there are those who believe in CAI and those who do not. Some negative aspects concerning the use of CAI in special education include the argument that computers "are too complex and students will only become frustrated trying to make them work. They can't do math or read; how are they going to operate a computer?" It is also believed that the special education students are "too rough" and that they'll break the computer. "Just look at the mess they make of their books and papers." A final argument against the use of computers includes the belief that the teacher already has too much to do and there is not enough time for the special education teacher "to learn to use the computers themselves, teach the kids, and then make sure the computers are used properly and not damaged."
It was discovered, however, that computers are easy to use. Many programs are user friendly. This means that the programs tell the user exactly what to do, when to do it, and how to go about doing it. If the eight characteristics necessary to construct good educational software are followed, then any problems connected with the use of the computer program can be avoided. Also, contrary to the concern of a student "breaking" the computer, "one of the best liked features of the computer was that it did not . . . break, tear, or wrinkle."86 And finally, it was discovered that the time it actually took to learn how to use the computer and actually use it in the classroom was less than many expected.

As with remedial techniques, there are important characteristics of CAI. Some characteristics include "individualization, feedback characteristics, overlearning, and 'fairness'."87 As mentioned previously, individualization is instructing each child according to her strengths and weaknesses, at her own pace, until a predetermined criteria is met. Feedback is immediate information, positive or negative, given to the student to let her know how well she has just performed. Overlearning is connected with drill and practice in the sense that through enough repetition of a concept, the student will be able to retain the information longer. Overlearning is possible because of the computer's "infinite patience." The computer is willing to work at anytime and for any length of time the student is. The final characteristic, fairness, is very important because it "has no biases,"88 "it cannot discriminate whit from black, slow learner
from fast learner, the well socialized from the anti-social child.\textsuperscript{89} And it is also "emotionally neutral. . . it doesn't get mad,"\textsuperscript{90} and as a result neither the student nor the teacher gets frustrated.
CONCLUSION

"Johnny can't read, Johnny can't write, maybe he's just a little weird." Maybe, or maybe he's just learning disabled, like so many others.

Leonardo da Vinci often wrote backward: His writing shows evidence of perceptual problems. Woodrow Wilson didn't learn the alphabet until he was eight; he didn't read until he was eleven. At school, he excelled only in work that was related to speech. He was labeled as "dull and backward."

Auguste Rodin, the famous artist-sculptor, did poorly with math and spelling. He was described as "ineducable" and "an idiot." General George Patton was severely learning disabled and could not read or write at age twelve. A special reader worked with him all through his time at West Point. Winston Churchill had learning disabilities. Albert Einstein did not talk until age four or read until age nine. He was considered backward and made progress only after his family moved him to a special school where he could learn using his own style.

Thomas Edison couldn't learn anything in public school. He entered at age eight and was removed three months later by his mother who decided to teach him herself. . . His mother noted that he never learned to spell. His grammar and syntax were appalling. He was hard to teach. Whatever he learned, he learned in his own way. In fact, she said she only inspired him - no one ever taught him anything. He taught himself. 
The learning disabled child only differs from the "average" child in the sense that he has a more difficult time learning in some academic areas. Through the aid of various remedial techniques, such as the computer, the learning disabled student is able to learn and achieve to his fullest potential.
FOOTNOTES

1 Dr. G. H. Reavis, Assistant Superintendent, "The Animal School" (Cincinnati).


3 Ibid., p. 35.


5 Larry B. Silver, The Misunderstood Child (USA: Larry B. Silver, 1984), pp. 176-177.

6 Kirk and Chalfant. p. 7.

7 Ibid.


10 Polloway et al. p. 4.


12 Wender and Wender. p. 105.


15 Ibid., p. 170.

16 Ibid., p. 171.


18 Ibid.

19 Ibid., pp. 48-49.

20 Kirk and Chalfant. p. 197.

21 Ibid., p. 214.

22 Ibid.

23 Ibid.

24 Levy. p. 51.

25 Ibid., p. 54.

26 Ibid., p. 53.


28 Levy. p. 53.

29 Kirk and Chalfant. p. 240.


31 Ibid.

33 Ibid., p. 182.

34 Ibid., p. 13.


36 Wender and Wender. p. 121.


38 Ibid., p. 157.

39 Wender and Wender. p. 122.

40 Ibid.

41 Kranes. p. 183.


44 Gearheart. p. 47.


46 Ibid.

47 Ibid.


52 Clements. p. 16.

53 Polloway et al. p. 163.

54 Ibid.

55 Clements. p. 23.

56 Polloway et al. p. 163.

57 Ibid., p. 164.

58 Kepner. p. 17.

59 Clements. p. 22.

60 Kepner. p. 17.

61 Ibid.

62 Ibid.


64 Polloway et al. p. 164.

65 Kepner. p. 18.
66 Polloway et al. p. 165.


68 Ibid., p. 5.

69 Ibid.

70 Ibid., p. 56.

71 Ibid., p. 19.

72 Polloway et al. p. 165.

73 Papert. p. 19.

74 Polloway et al. p. 166.


76 Ibid.

77 Ibid., pp. 74-81.

78 *Guidelines for Software Development*.


80 Ibid.

81 Ibid.

82 Richard Swenson, Ph. D. and James Kingman, "Computer Assisted Instruction for Exceptional Children," *Views - An Early* 42

84 Ibid.

85 Ibid.

86 Ibid., p. 100.


89 Swenson and Kingman, "Special Education Students," p. 185.

90 Swenson and Kingman, "Exceptional Children," p. 11.

91 Silver. p. 192.
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