

two users of different abilities and reaction times, permits tailoring the word menus to meet individual needs, and allows the user keyboards to remain small and simple. The keyboards are rugged, reliable, and electrically safe and can be designed to meet individual motor skill and coordination abilities. But the real value of the system was apparent when, after only ten minutes of verbal instruction, she printed out MY NAME IS LOIS and immediately followed her first words with the repeated message, THANKS THANKS THANKS. . . .

## LEARNING DISABILITY

### WE HELP MORE

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*The Radio Shack TRS-80 microcomputer system has proven to be a beneficial remedial and diagnostic aid for the students in academic areas at Robert E. Lee High School, San Antonio, Texas.*

### Introduction

The program has been implemented, tested, and evaluated since October 1979. It was designed to accomplish the following goals:

1. Aid students with minimal cerebral damage arising from congenital anomalies or chemical or accidental injuries to adjust to the mainstream of school campus life;
2. Help students compensate for learning disabilities in order to lead normal, productive lives;
3. Stimulate underachievers to learn, thus helping them adjust to a regular classroom setting;
4. Aid in constructive as well as continual com-

For information on the availability of the hardware and software designs developed during this project, a self-addressed stamped envelope to the author will ensure a prompt response.

**ACKNOWLEDGMENTS**—I would like to acknowledge Lois' enthusiasm, patience, perseverance, and, indeed, her many suggestions made along the way to refine the operation of this system. The constant support of her family has also been invaluable. Without it, this project could not have come to fruition. I would also like to express my appreciation to Richard O. Savoye for his helpful suggestions, particularly in the area of human/machine interfacing.

munication for deaf students so that they may join in the mainstream of education;

5. Eliminate frustration for emotionally disturbed children, thus helping them gain the ability to cope with the normal classroom setting;
6. Improve basic skills in reading and mathematics, thus allowing students with minimal learning difficulties to mainstream;
7. Teach students with minor muscular coordination problems to compensate and adapt so that they may be mainstreamed into regular classroom settings.

### Needs Assessment, Program Testing, and Evaluation

Public Law 94-142, passed by the Congress in 1975, amended the Education of the Handicapped Act and has become known as the Education for All Handicapped Children Act. It is designed to provide free and appropriate public education to all handicapped persons aged 3 to 21 years, regardless of the severity of the handicapping condition. In addition to several other categories of handicaps, PL 94-142 defines those children who are evaluated as having specific learning disabilities as handicapped. A learning disability is a disorder in one or more of the basic psychological processes involved in understanding or in using spoken or written language; it may manifest itself in an imperfect ability to listen, think, speak, read, write, spell, or 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 that are primarily the result of visual, hearing, or motor handicaps, mental retardation, or of environmental, cultural, or economic disadvantage.

As a result of PL 94-142, more handicapped students are being educated with nonhandicapped peers in public schools. This practice is referred to as "mainstreaming." Mainstreaming, a term that is an outgrowth of PL 94-142's education in the "least restrictive environment" concept, refers to the education of the handicapped with nonhandicapped peers in school as representing the "mainstream" of education.

Reading/learning disabilities are generally considered to be a major problem in our schools. The Texas Legislature appointed a committee to investigate the extent of reading/learning disability, which is labeled by a variety of terms, such as perceptually handicapped, dyslectic minimally brain damaged, and neurologically dysfunctional. After a thorough study, the committee reported that 10 to 20% of all school children could be in this classification.

A learning disabled child has the mentality to master school material but is prevented from doing so by the disability. This may be mistaken for laziness or lack of interest, even though the child is putting forth a lot of effort. The resulting humiliation, frustration, and resentment can lead to emotional problems and then behavioral difficulties. As the pattern is continually reproduced and reinforced, the individual may be viewed (and may begin to act) as a troublemaker.

In the 1977 report of the Senate Subcommittee to Investigate Juvenile Delinquency, *Challenge for the Third Century: Education in a Safe Environment*, the following observation was made:

"There appear to be several factors intimately connected with violence and vandalism that are susceptible to some form of control by schools."

One contributing factor the subcommittee found was a possible link between learning disabilities and the development of delinquent behavior. The subcommittee pointed to a 1972 study of 444 students in custody of the Colorado Division of Youth Services that showed that 90.4% had learning disabilities that had not been dealt with adequately.

Signals of a learning disability include

1. Difficulty comprehending or using written or spoken language in listening, thinking, remembering, talking, reading, spelling, writing, or using correct grammar;
2. Poor short- or long-term memory;
3. Difficulties with spatial relations;
4. Difficulty attending to tasks or listening.

Signals of emotional disturbance include

1. Poor response to group instruction and need for a great deal of one-to-one help;
2. Frequent absences or illnesses;
3. Frequent fantasizing;
4. Difficulty in making plans that are realistic to his needs or abilities.

The TRS-80 microcomputer system has been used at Lee High School for computer-assisted instruction

to mainstreamed learning-disabled and emotionally disabled students for improvement of basic life skills such as memory, concentration, computation, reading speed, spelling, perception of spatial relations, comparison, comprehension, and vocabulary usage. Observations by teachers of student behavior during computer-assisted instruction include the following:

1. Student levels of concentration appeared higher while the student was working on the computer.
2. Student motivation levels appeared higher, while levels of frustration and anxiety greatly decreased.
3. The students appeared to achieve higher levels of self-satisfaction and a greater awareness of their own needs and progress during the computer sessions.
4. The students appeared to progress at a faster rate because of the individuality of the program.
5. Fewer students were absent on the days of the computer sessions, and discipline problems appeared to diminish greatly.
6. Students were involved in active rather than passive learning.
7. Students benefited from immediate reinforcement of correct responses and an immediate explanation of incorrect responses.
8. Because it coordinates classroom lessons with computer-assisted instruction, an eclectic approach to the teaching of reading skills reached a wider range of student learning styles than if the computer had not been used.

Ninth grade students were found to be reading on the average at a 6.8 grade level, while tenth grade students were found to be reading on the average at a 7.2 grade level. Students were pretested with Jamestown Timed Readings, which determined the beginning reading speed to be 276 words per minute.

After the four-week study was completed, students continued to participate in computer usage twice a week for the remainder of the 1980-81 school year.

In April 1981, eight months after pretesting, students were post-tested with the Gates-MacGinitie Reading Test. Ninth grade students gained 1.3 years in reading ability, averaging a post-test reading grade level of 8.1. Tenth grade students gained 1.1 years in reading ability, averaging a post-test reading grade level of 8.3. Considering the eight-month time span, the students gained an average of five months or more beyond what can be expected traditionally. The results of the four-week study on a class average were as follows:

1. The students increased their reading speed from 276 words per minute to 320 words per minute, while maintaining 81% comprehension.
2. The students increased 2.06 levels in reading according to a reading analysis done by computer (Radio Shack is the developer of Reading Analysis).

3. The computer allowed for a 16.6% greater increase in vocabulary comprehension as compared with noncomputer-assisted instruction.

Handouts and standardized tests are used in academic classes of 15 to 22 students to assess the needs of students who have varying degrees of learning difficulties.

The instructor also observes for indications of physical problems in areas such as hearing, vision, and muscular coordination. Signs of mental stress and anxiety should also be watched for during the initial testing period.

If students begin to form peer relationships, they are encouraged to work together in groups of two or three students per computer terminal as they are introduced to the TRS-80 microcomputer system. An observation can then be made of the student's ability to work in small groups.

The initial contact with programmed instruction is through math skill and word skill games, which allow for an introduction to operational practice of computer mechanics. The games increase the students' powers of observation, concentration, and comprehension. The games also initiate a relaxed environment in which the students become motivated and interested in learning. Their immediate success encourages them to seek visual rewards for correct responses.

*“. . . a teenage student with an attention span of three minutes and functioning at second or third grade level would be able to increase his or her learning skill just as well as an average tenth grade student.”*

Once the students have gained confidence, they work individually on the computer. Both individual and group level instruction can now be obtained while the students progress at their own rates, governed by their individual abilities and needs. Careful records are kept of their progress. Flow charts for this purpose are designed to meet the needs of the individual class.

Because of achievement, the student will accept deficiencies and limitations; however, because of the strong motivation, students will set higher goals for themselves and work to achieve those goals.

Each student willingly accepts the responsibility and accountability for following his or her own progress. Each begins to learn organization by keeping records of his or her own computer grades. Self-esteem and a realization of progress become evident as the student demonstrates eagerness to face new challenges. The students at this point have begun completing both classroom assignments and computer instructional material daily.

It is important to note here that the time limit per student on the computer is confined to less than ten

minutes. This time limit was constructed and is maintained to avoid boredom and to continue the motivation and progress that have been established.

Through this type of classroom management and computer instructional programs, the computer has become a patient, impartial, and enjoyable learning aid. It has expanded the regular classroom setting to an individualized instructional program for the student with learning disabilities.

### Overview of Software Design

The first precept used in designing the software was strict adherence to the asserted learning objectives for the students. The golden rule that was followed was: keep the program simple and to the point. Extra graphics or visual displays were found to distract and hinder the successful completion of the learning objective.

Each program contained four basic components: (a) a sliding scale of increments of difficulty, (b) reinforcement of the prescribed learning objective, (c) rewards for success within the learning skill used, and (d) personalization of the responses to the user.

### Specific Examples of Software Design

The degree of difficulty was designed to be self-regulating, thus providing a mechanism for the automatic lessening of the difficulty if the student was unable to complete the learning task successfully. An example of this concept is the addition math skill program. It can be used for individuals who range in math ability from second to tenth grade level. All timing loops, randomization, and responses were built into the degree of difficulty. Random retrieval of data statements within the programs provided a way to fight boredom or to avoid completion of the program without learning the desired objective. Data files were arranged in levels of difficulty to aid in matching the degrees of difficulty with the execution of the educational design of the software. Thus, a teenage student with an attention span of three minutes and functioning at second or third grade level would be able to increase his or her learning skill just as well as an average tenth grade student. The watchwords for this type of software would be success in learning from interaction with the computer. The student always has to succeed.

The reinforcement of the prescribed learning objective controlled the programming format. For example, no in-key commands were used if the learning objective did not include hand-eye coordination. Most instructions were self-taught, accomplished by using game formats whenever possible. Learning through play is a tried and true method of instruction. Traditional educational formats were avoided because they were unsuccessful in meeting the needs of these special people. Instructions, when used, were controlled by input statements rather than by timing loops. This allowed the user to advance at his or her own pace. Subroutines and branching were extensively used to provide the maximum in program varia-

tion. It was assumed that each student might possess unique learning problems; thus, flexibility was another watchword.

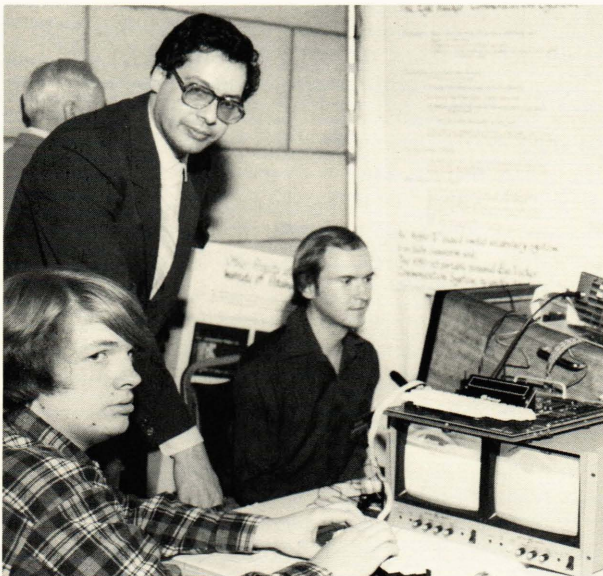
Rewards were built into the degree of success the user had on his or her level of difficulty. Short games or visual displays provided the maximum incentives for the student's success.

Another item that was given considerable attention was the security of the program. A difficult situation could arise if a student tried to break out of the program, thus erasing his poor performance. Limitations and checks on input statements, on error commands, and on masking of keys were used to eliminate many of these areas of concern.

## MOVEMENT

### THE EYETRACKER COMMUNICATION SYSTEM

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*Mark B. Friedman (standing), Mark Dzmura (left), and Gary Kiliany.*

*Our EyeTracker Communication System allows a physically handicapped person to use eye movements to control high-quality speech output efficiently. A teaching system has been in use for over six months. We are currently developing a portable, personal communication system whose main features are ruggedness, convenience, safety, and portability. The*

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*system consists of three main modules, each of which is independently useful. The video-based sensor module determines the direction of eye gaze under most indoor lighting conditions. The dynamic display module incorporates a hierarchical data base that allows quick access to a large amount of data. The accessible data include not only letters and words but also full phrases and sentences. The output module allows the data to be output in a sex- and age-identifiable voice or printed on paper.*

### Introduction

The EyeTracker Communication System has been designed to aid severely physically impaired children. It is currently in classroom use as a teaching aid. We are developing it to be used as a portable, personal communication system.

The system features safety, ruggedness, portability, and convenience. There is no physical contact with the user. The device is all solid state, powered by low-voltage direct current, and there are no moving parts or critical alignments. User control of the device is rapid and nonfatiguing. Printed and high-quality vocal outputs are available. The handicapped user can use the EyeTracker Communication System without supervision.

### Modular Organization

The EyeTracker system consists of three related modules, all of which are controlled by the same microprocessor. The sensor module allows the Eye-