Radio Shack®'s

TRS-80™ MICROCOMPUTER SOURCEBOOK for EDUCATORS

Price $1.00

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A Special Message For Educators

The computer age is barely 30 years old. During that time, we have seen the evolution of the giant computers of industry into compact, low-cost desk top units. Technology once available only to a few for highly sophisticated applications is now being used for everyday jobs such as supermarket check-outs and flight reservations. Today, computer technology touches and influences every aspect of our daily lives.

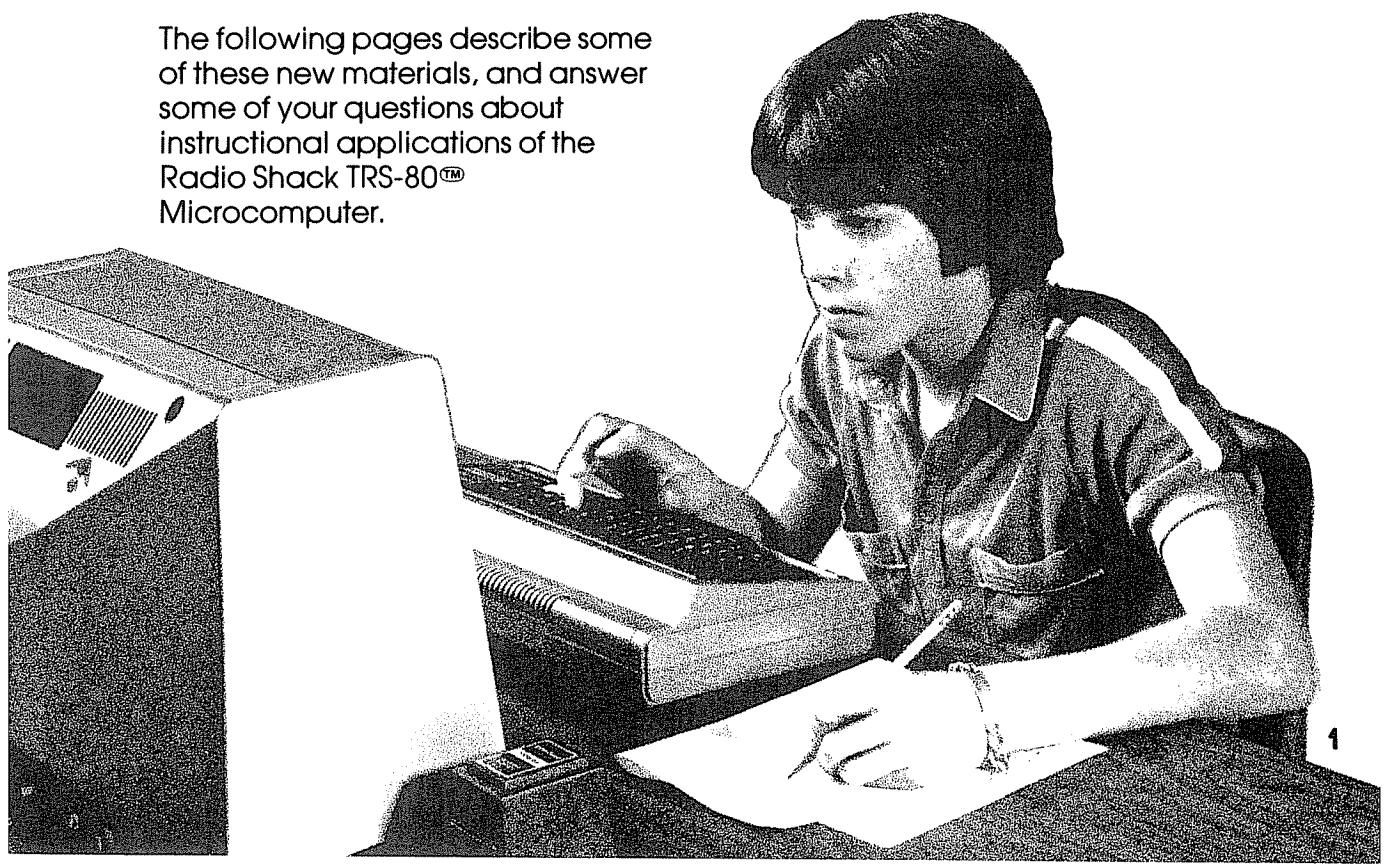
Your students were born in the computer era. During their lifetime they will find that it truly has just begun . . . . . that the benefits and challenges of computers will continue to grow at an increasing pace.

Radio Shack: A Commitment to Education

The people at Radio Shack believe that along with the development of a practically priced microcomputer, there exists an attendant obligation to make the system and its potential available to the educational community.

To meet this obligation, Radio Shack has undertaken an extensive development effort to produce instructionally sound, effective, and properly validated microcomputer-based educational materials for use in the classroom.

The following pages describe some of these new materials, and answer some of your questions about instructional applications of the Radio Shack TRS-80™ Microcomputer.



What Is A Microcomputer?

Not too many years ago, the pocket calculator we take for granted today could have passed for a powerful computer, and one worth a great deal of money. Today, however, there is much more to the definition of a computer.

Calculators work with numbers. They add, subtract, multiply and divide. Computers work not only with numbers, but with alphabetic data — names, words, stock numbers. A computer can be programmed to repeat a function over and over using new or updated data each time. It can examine a list of stock numbers and find an entry for a particular item, or alphabetize a list of names. It can store large amounts of data for future use or reference. It can logically evaluate information given to it using a set of user-prepared instructions called a "program" and act on its findings. And, it can ask questions of a student and evaluate and report the student's answers — again, according to a program.

Obviously, a computer is much more than just a "number cruncher." It is to man's mind what the lever is to his arm — a machine capable of increasing his effectiveness. It can free the user from repetitive exercises which do not require human judgment. It can provide facts and figures with extreme speed, giving the user the time to exercise his or her judgment thoughtfully.

Not many years ago, a computer with the power of the Radio Shack TRS-80 would have cost over a million dollars. The equipment would have filled several large rooms, and required a special air conditioning system. Today, the advancing technology of integrated circuits has led to the microprocessor — literally a "computer on a chip." This, in turn, has drastically reduced the size and cost.

The TRS-80 microcomputer, a product of these advances, is manufactured and sold only by Radio Shack.

Computers In The Classroom

Since the 1960's, computers have been used increasingly for instruction in schools. A growing body of data attests to the effectiveness of these systems in increasing student achievement and in motivating students. But the "computer revolution" in education that was much discussed ten years ago has not yet materialized.

Why? One reason — cost. Even the very latest of the computer timesharing systems that have been most suitable for Computer Assisted Instruction (CAI) involve an initial investment for equipment alone of almost $200,000. With usage over a period of five years, this translates into a cost per student hour of almost $2.00. When compared to costs of a few cents per student hour for traditional materials such as books, film strips, films, etc., most schools have not been able to justify the use of such systems in the classroom.

The Microcomputer as an Alternative

The history of the development of computer applications for learning has been appropriately described as evolutionary, not revolutionary.

However, late in 1977, a series of events began that has greatly accelerated the introduction of computers into the classroom. Beginning with the announcements of several microcomputers selling for under $1,000, and followed by additional announcements of modestly priced attachments such as printers and mass-storage devices, educators began to consider the microcomputer as a serious alternative to the larger and much more costly minicomputer-based timesharing systems.

This low cost is a major reason for the growing interest of educators in microcomputers for student instruction. Traditional timesharing systems require substantial initial investments for equipment and the best cost per student hour of operation is obtainable only with the larger configurations — 32 or more student stations. Special facilities are required, with telephone connections, special power requirements in many cases, and controlled temperature and humidity conditions for the computer. These factors, plus maintenance contracts for computer, terminals, and modems, as well as telephone line charges, all add up to a substantial commitment for the school system.

A microcomputer such as the TRS-80, on the other hand, requires a much more modest investment "up front," one that is directly related to the number of student stations required. And, a reasonable cost per hour of operation is obtainable regardless of whether a school buys one or one hundred systems. The section of this booklet entitled "Selecting a Microcomputer" has some specifics on costs and comparisons with other systems.

Utility is a second major advantage of the microcomputer over conventional timesharing systems. In the past, computer systems have required considerable planning for special facilities — controlled environments for the main system, telephone connections, and special power requirements — and such a configuration, once set up, is difficult and expensive to change.

While certain considerations in the location chosen for a microcomputer are important, microcomputers such as the TRS-80 are not nearly as demanding in their operating environment. In addition, since no substantial investment for special facilities is required, a learning environment based on the TRS-80 is much more flexible.

Reliability is a third major consideration in the growing acceptance of the microcomputer. Because a timesharing system depends on a single central computer, a failure of that central system means that all of the student stations are "down." With microcomputers for student stations, a failure of any single system takes only that one system out of service.

Of course, the manufacturer's maintenance support is an important consideration. With a TRS-80, all a customer has to do is deliver the defective unit to the nearest Radio Shack store or dealer. In addition, a service contract is available that allows a customer to budget exact operating costs. And Radio Shack Computer Services in Fort Worth, Texas, maintains a toll-free "hot-line" to assist in answering questions should answers not be available locally.

Courseware

What is courseware? It is a special kind of computer program designed to teach. Any computer or microcomputer is useless without a program — a special set of instructions written in a computer language — that tells the computer how to solve a problem, such as calculating a payroll, alphabetizing a list of names, or printing mailing labels. For an instructional application, a computer program must incorporate an additional level of design defining the scope and sequence of the materials to be taught. It must implement some acceptable instructional strategy.

Special courseware such as this is expensive and difficult to develop, and has been a limiting factor in applications of microcomputers in schools.

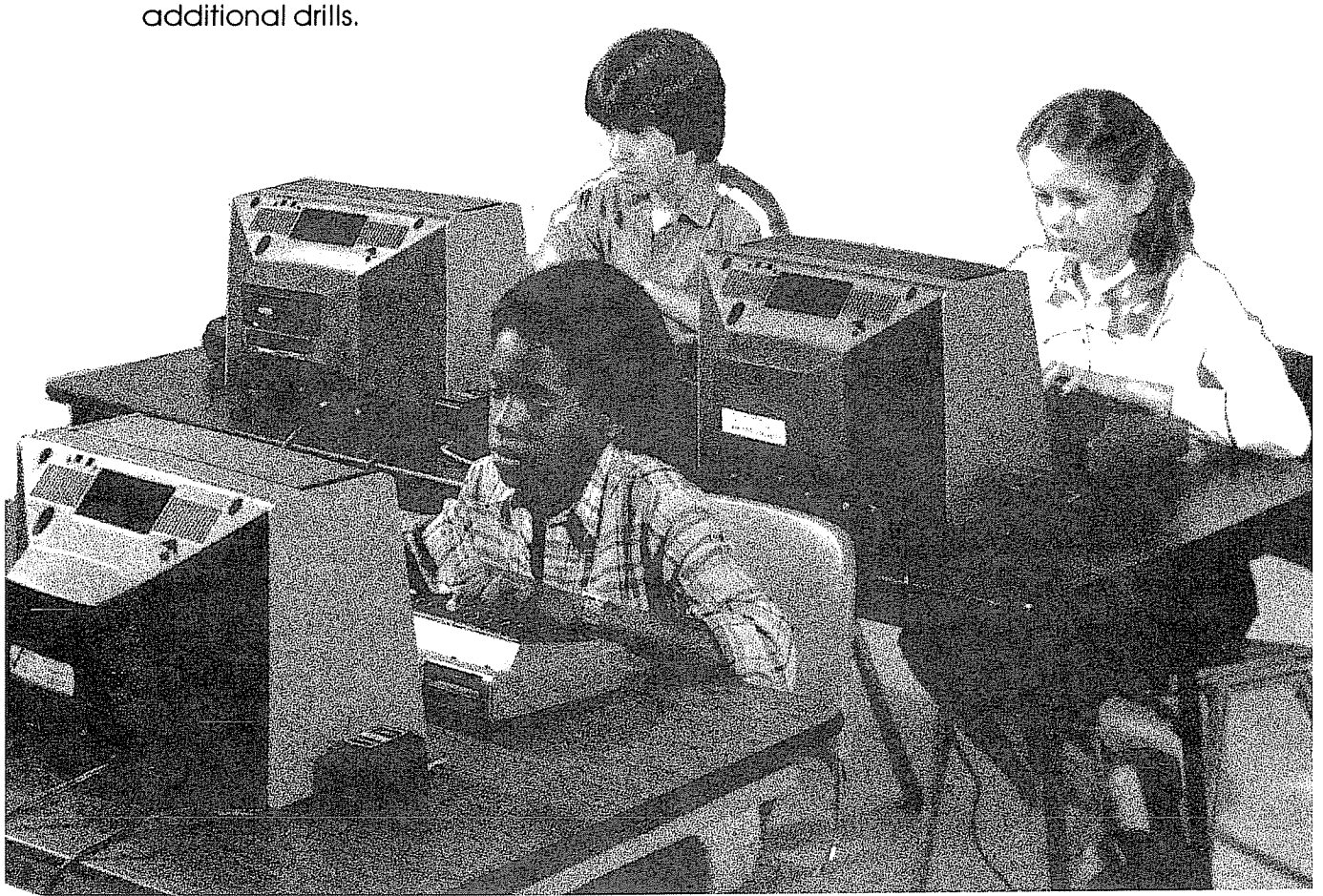
Radio Shack is addressing the problem of courseware. We have involved the experts — the teachers and curriculum developers in the schools — in designing and field testing our new courseware products. New products such as the Radio Shack K-8 Math Program represent a growing commitment to courseware by Radio Shack.

The Microcomputer As A Medium Of Instruction

Computer Assisted Instruction (CAI) is nothing new to the educational scene. Numerous approaches for the use of computers to supplement existing educational practices have been well established and have proven effective in increasing student achievement.

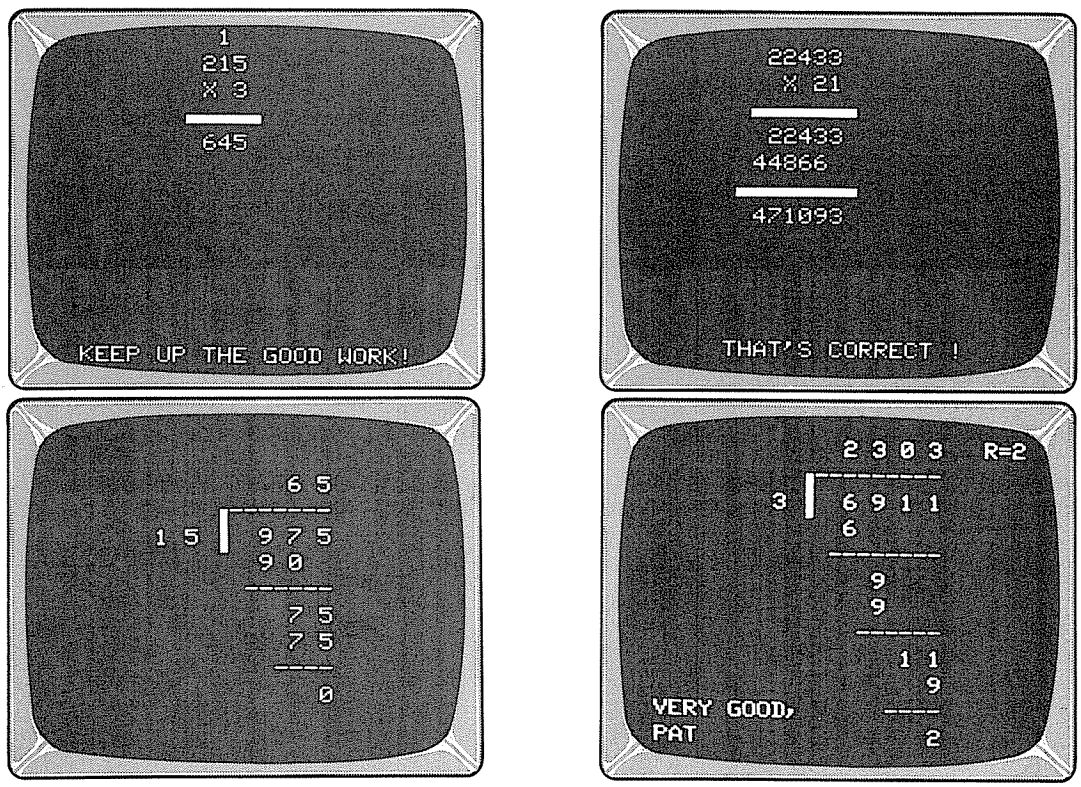
CAI is based on the use of the computer as a medium of instruction — as a means to assist in teaching subjects such as reading, mathematics, language arts, physics and chemistry. The techniques that have proven effective for this use of computers for instruction have centered on individualized learning sessions where the computer generates and presents exercises in an appropriate subject area for a student to solve.

The computer measures the student's performance and adjusts the difficulty of the problems. As a student's performance indicates an increased level of understanding of a concept, the computer generates more difficult problems to solve. If a student's scores indicate a problem in a particular area, the computer adjusts the difficulty level to provide easier problems in that area for additional drills.

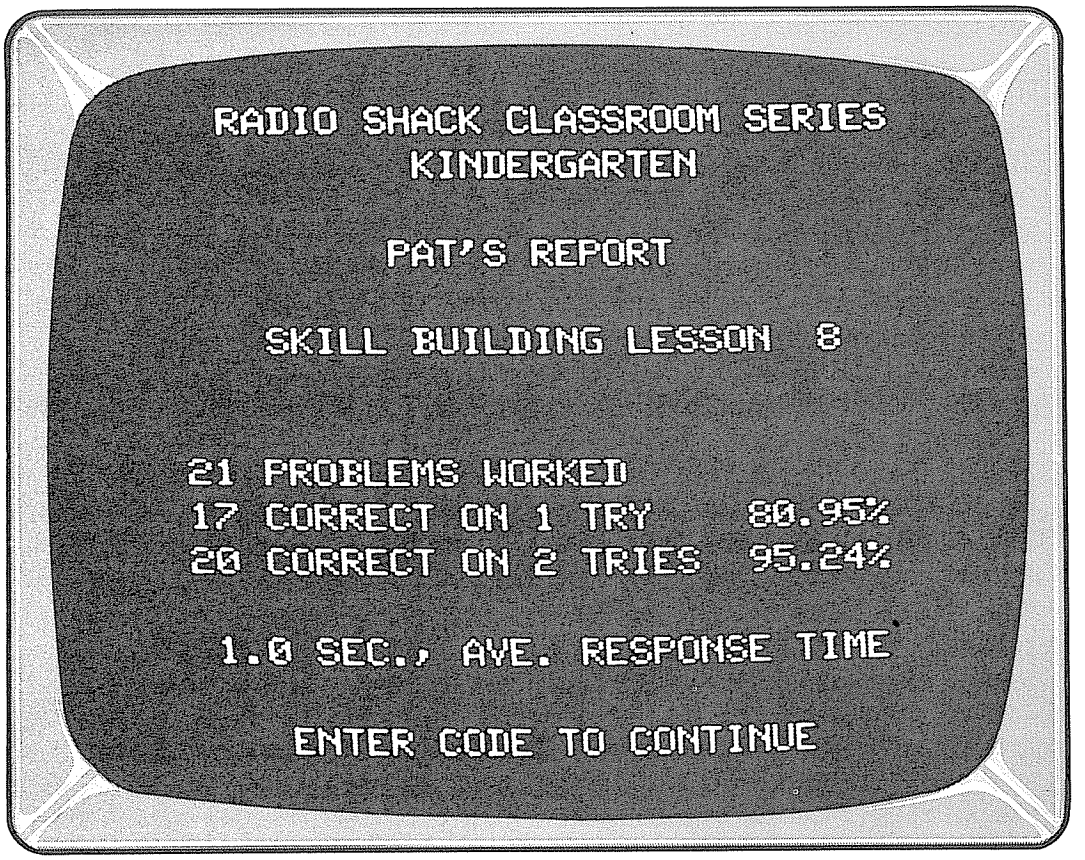


There are several strengths to this use of computers for learning:

- Instruction is highly **individualized**. A student moves at his own pace. He is constantly engaged, constantly challenged, but never threatened.
- The computer assists the teacher as a **diagnostic** tool for measuring individual strengths and weaknesses. As a student moves through the lessons, the computer records performance information and provides reports to the teachers.
- The individualized learning process is **non-threatening** to the learner. The computer can be programmed to correct and praise in the ideal way. A session at the computer becomes an exciting game.
- The approach is commonly a **supplemental** one. The teacher introduces and explains new concepts; the computer drills students on those concepts, provides immediate feedback and reinforcement to the student, and records the scores. The teacher teaches; the computer assists the teacher by drilling, collecting performance information, and reporting that information to the teacher.
- The computer is a **time-saving** device for the teacher. Since it not only generates drills, but also grades those drills and reports the grades to the teacher, it frees the teacher to spend more time with individual students.



Students get immediate feedback and reinforcement from the computer. Shown above are typical problems from Radio Shack's K-8 Math Program.



Using the computer to grade students progress on drills frees the teacher to spend more time with individual students. This drill report is part of Radio Shack's K-8 Math Program.

CAI systems have been commonly implemented using expensive minicomputer timesharing systems. Now, the microcomputer offers educators an alternative to the timesharing systems — an alternative that not only costs less, but one that provides the added benefits of portability through freedom from modems and telephone lines.

With the TRS-80 microcomputer and Radio Shack K-8 math programs, a school can have a CAI system with the features we have described and more, and at a lower cost per student hour than has ever been possible before.

The Microcomputer As An Object Of Instruction

Computers are becoming more and more common in today's world. No longer limited to applications in research institutions or large businesses, computers — and new small microcomputers — are turning up in applications ranging from supermarket checkouts, automated bank tellers, and small business systems to such consumer items as improved thermostats, television tuners, microwave ranges, and carburetors on some new automobiles. No other product of twentieth century technology seems destined to have such a profound influence on the way we conduct our daily lives — the way we operate our businesses, manage our homes, and educate our children.

It is not surprising that more and more educators are investigating the impact of computers on the education process — not just as tools for teaching, but at the need for schools to prepare students to function in a world increasingly influenced by and dependent on the use of computers. In a matter of only a few years, people who know nothing about computers may well be among the educationally disadvantaged portions of the population.

Radio Shack is addressing these needs with a new Computer Education Series designed for use in the classroom. Part I of this series, **Introduction to BASIC**, will be available in January, 1980. It is a complete teaching program designed for classroom use with the TRS-80 microcomputer at the secondary and college level. It includes a teacher's manual, student workbooks, and a set of transparencies for an overhead projector. Developed and field-tested in public schools over a two-year period, this material is designed for use by all teachers regardless of their knowledge of microcomputers and programming skills. Additional programs will be forthcoming in the Computer Education Series.

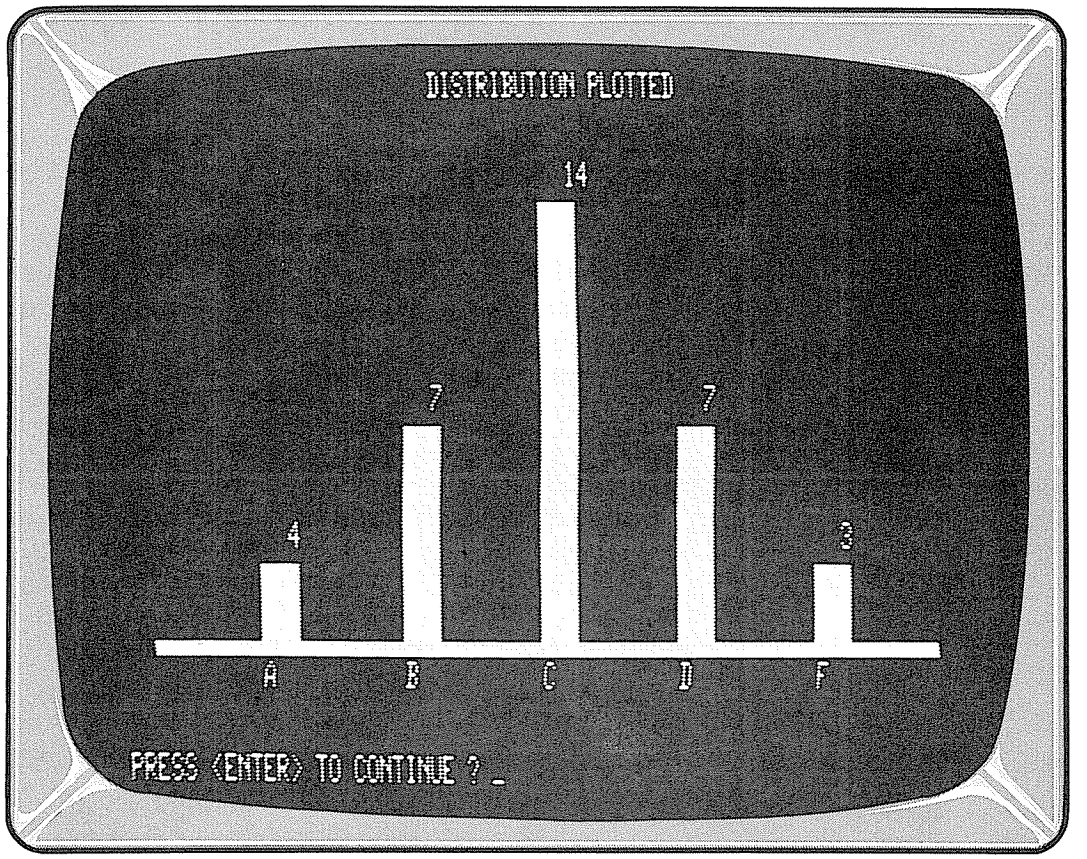
The Microcomputer As A Tool For The Administrator

Many school districts use large computer systems for payroll, inventory, student scheduling, grade reporting, and numerous other administrative functions. In many states, smaller school districts jointly support and share in the use of large computer systems through area or regional centers that provide computing services to participants.

As microcomputers become more capable, and as features such as large capacity disk storage, faster printers, and communications interfaces become available for these small systems, there is a growing interest in using microcomputers to supplement, and in some cases to supplant, these large systems.

In applications in individual school buildings and classrooms, microcomputers are beginning to be used for local building and classroom management functions where it has not been reasonable to use a computer before. These new applications for microcomputers range from grade recording and reporting, test scoring, and attendance reporting in individual classrooms, to inventory systems for textbooks and library books, word processing, and substitute-teacher files for the building principal.

Another exciting prospect involves microcomputers connected to large central computer systems to form "networks" for exchange of information and access to data files maintained on the central system. Networks will make it possible to operate student attendance reporting, test scoring, and grade reporting systems on a microcomputer in individual schools, and periodically to merge this information into a student data base maintained on a large centrally located computer.



Courseware such as Radio Shack's Teacher Aide program helps the teacher determine the class grade distribution.

Networks can also provide a means of storing and distributing courseware or instructional programs for use on microcomputers to users in individual schools. Revisions and updates to these programs can be incorporated into one central file, which can then be quickly transmitted to individual sites.

When will these applications be available on the TRS-80? Several already are. Teacher Aide, for example, is a grade processing and recording system for use by the elementary school teacher. Statistical Analysis and Advanced Statistical Analysis are two other ready-to-use programs which will prove useful to the educational researcher or evaluator in analyzing student achievement data. New inventory and word processing programs from Radio Shack will be of interest to the educator for many applications. And the new Radio Shack Network I Controller, a low-cost system allowing the local interconnection of up to 16 TRS-80's, represents a first step towards the sophisticated information exchange and software distribution networks of the future.

Selecting a Microcomputer

Planning Your Application

There seems to be an endless variety of ways to use a computer with students. Some we have encountered are:

- A number of computers or "student stations" are placed in a special room or learning lab, where students attend scheduled sessions. A special teacher or teacher aide may be in charge of the lab to help students load and run specified programs, to record scores, and to help with operation of the systems. This scheduled approach provides maximum computer utilization and makes possible the lowest obtainable cost per hour of usage.
- Individual computers are placed in regular classrooms, where they are available to the teacher for use with individual students at the teacher's discretion. This use is becoming more common with the new microcomputers because of the low cost for each system, and because of the portability of these systems (no special telephone lines or modems are required).
- A single computer is used in a classroom, with the monitor placed so it can be seen by all of the students. The computer is used to generate math problems for students to solve, using large characters drawn on the screen using the graphics capability.
- Individual computers are loaned or "checked out" to students to take home and use to solve special assignments, or as an incentive for individual studies.
- Computers are provided for general student use in a library — during school, or after hours — for periods of time that a student can reserve in advance.
- Computers are provided for use by teachers at a central service center or audio-visual library. A teacher can check out a system for use in class. Again, the portability of the microcomputer and its freedom from telephone communication lines makes this use convenient.

Numerous combinations of these and other uses are possible. Your own unique circumstances — subject matter to be taught, number of students, number of computers available — will influence your plans. The following information is designed to help you in considering the suitability of microcomputers for use in your school, and to give you the benefit of others' experience in planning a realistic and satisfactory application in your own facility.

Saving and Loading Programs: Cassettes vs. Diskettes

The audio cassette is the least expensive method of saving and loading programs for a microcomputer. The basic version of almost all microcomputers includes a cassette tape recorder for this purpose. Due to its reasonable cost, the cassette recorder merits consideration for use as a program storage device in a classroom; it makes possible the lowest obtainable hardware cost per student hour of operation.

Under proper conditions, the cassette recorder can be a satisfactory storage device for use with microcomputers. However, there are some special considerations that should be given before deciding on the cassette for program storage over another medium such as the diskette.

First, the quality of cassette tapes used for storage of computer programs (digital information) is more critical than for audio use. In addition, static electricity can damage information recorded on cassettes in a carpeted area, or in a dry climate. And, since a program stored on a cassette takes longer to load into a microcomputer than a similar program stored on a diskette, operational considerations may make the use of the cassette recorder to load programs unrealistic for classroom use.

Consider an example: A third-grade computer lab, with 20 microcomputers and one teacher aid to operate the machines. An average session length for a third-grader, based on his attention span, is about 15 minutes. It can take up to two minutes to load some programs from a cassette, so that with a one-program-per-lesson approach, the logistics of trying to load and run 20 programs every 15 minutes are not reasonable.

An Alternative: Avoid Frequent Loading of Programs

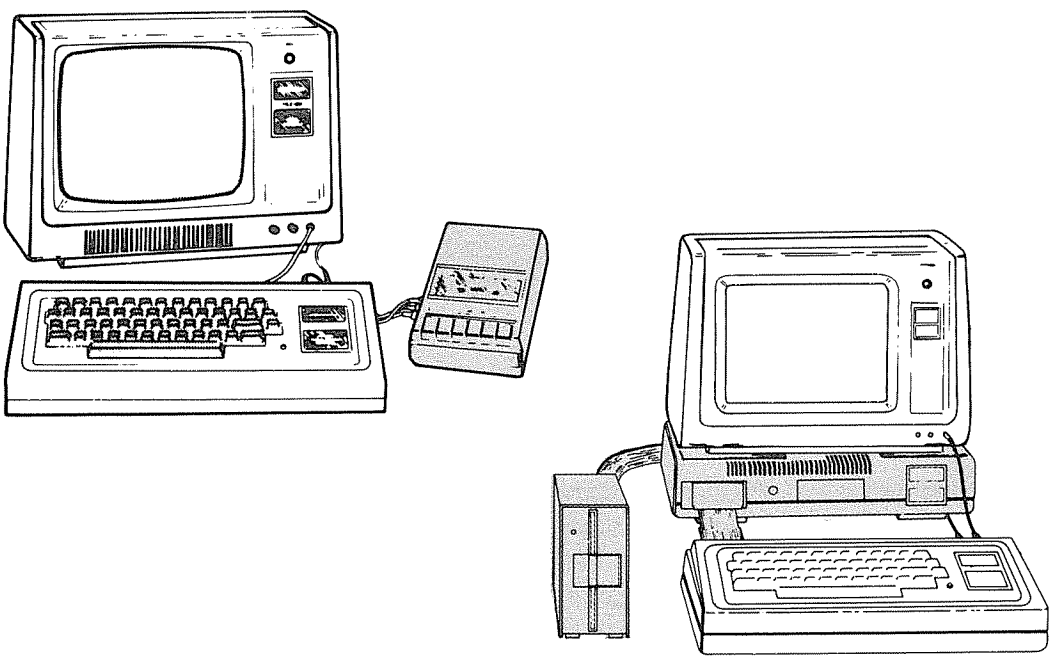
This is possible with the Radio Shack K-8 Math programs, which **do not use** the one-program-per-lesson approach. The Radio Shack Addition program, for example, spans seven grade levels and contains seventy individual lessons. It can generate a minimum of 1700 different math problems in Addition. The programs for Subtraction, Multiplication, and Division are similar **so that a single program, once loaded, can be used with a large number of students.**

With a little planning, a teacher can go even further. Consider our example of a math lab with 20 TRS-80's. On the first day of school, Addition can be loaded into five of these systems, Subtraction into five, Multiplication into five, etc. As long as the teacher leaves the keyboards turned on, he won't have to load the programs again. The keyboards are UL-listed, and don't use much power. The monitors can be turned off at night; the keyboards left on. Unless there is a power failure, the programs won't have to be reloaded. Students can be rotated through the groups of TRS-80's so they get to run all of the programs.

This has worked very well where it's been tried, and is the approach Radio Shack recommends with the K-8 Math programs.

A Second Alternative: An Expansion Interface and Disk Drive for Each Student Station

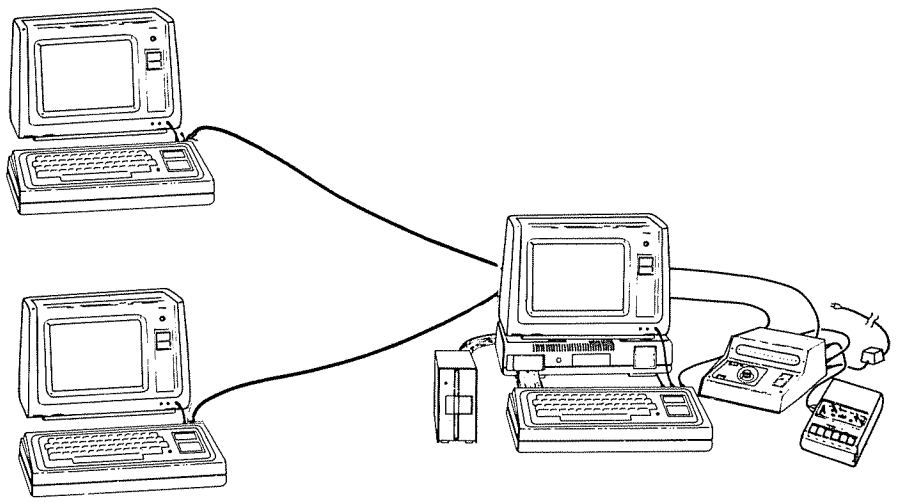
Although this increases the cost per student station (see cost summary), this is still considerably less expensive than a conventional timesharing system, and there are several advantages over a cassette. First, several programs can be stored on a single diskette and loaded into the computer conveniently by merely typing the program name to be loaded. In addition, no rewinding or tape positioning using an index counter is required with the diskette. And, most important, programs can be loaded from a diskette many times faster than from tape, making the diskette much more desirable from an operational standpoint. A program that requires a couple of minutes to load from a cassette can be loaded in a few seconds from a diskette.



These drawings illustrate two alternatives for storing programs. The cassette recorder, on the left, is the least expensive. The disk drive on the right, is more expensive but quicker and easier to operate.

A Third Alternative: The New Radio Shack Network I System

This is a low-cost alternative to cassette tapes for saving and loading student programs for the classroom. The Radio Shack Network I Controller allows from one to 16 TRS-80's to be connected to one TRS-80 disk system. Using the central disk system, student programs can be saved on disk, and instructional programs can be loaded into the TRS-80 student stations from the central disk system conveniently and reliably. All 16 student stations can be loaded simultaneously with a program, or any combination of stations can be loaded at a time.



As a third alternative for storing programs, sixteen TRS-80 microcomputers may be connected to one central TRS-80 with a disk drive. Each TRS-80 can transfer programs to the central disk system to be saved on disk, and programs can be loaded from disk and transferred to the individual TRS-80s.

Finally, remember that a method of loading programs is important when the TRS-80 is used as a medium for instruction with programs such as the Radio Shack K-8 Math. However, where the TRS-80 is used as an object of instruction for teaching about the computer, the ability to load and save programs may not be as important. **Introduction to BASIC**, the first part of the new Radio Shack Computer Education Series, does not require that any prepared programs be loaded for instruction or demonstration. All program examples are brief and designed to be entered by the student using the keyboard. (One section of this course does teach the proper use of the recorder for saving and loading programs.)

Choosing a Location: Environmental Considerations

Large computer systems require temperature and humidity-controlled environments with air filtration systems to eliminate dust and other contaminants. Fortunately, the TRS-80 is not so demanding.

At the same time, certain considerations in the location you choose for your microcomputer will have a direct effect on its operation and reliability. For best results, you should keep them in mind when choosing the location.

Static Electricity

In dry climates and certain seasons, you can walk across a carpet and feel a static discharge when you touch a metal object. Under some climatic conditions, even your clothing can build up this kind of charge, normally too small for you to feel. These static charges can damage magnetically stored computer data. Larger charges can even wipe out your computer's memory or cause it to appear to "lock up." If you're in a part of the country where humidity is lower than about 40%, be wary! The ideal humidity level for the operation of a computer is 50% or above. The safest bet is to use a noncarpeted room for your computer; if you find a really stubborn problem, a humidifier should do the trick. An anti-static floor mat at the computer operator's position can also help.

This is a rather infrequent problem in actual practice, so rest assured we are not suggesting that you will have this or any of the other problems discussed. We're simply explaining why choice of your installation location should be given consideration and what to do just in case you do encounter a problem.

Power Line Interference

Any complex electronic equipment is sensitive to power line conditions affecting the voltage and current coming out of your wall socket. Computers are probably more sensitive than other electronics because even the loss of one bit (one tiny electrical charge) of information can cause a program to "bomb out" or a data file to be lost. This is rarely a problem unless you are operating in an environment where heavy electrical machinery is in operation.

Yet you might experience trouble if an appliance or office machine has a defective switch which arcs when turned on or off. If this happens you will have to fix the appliance or isolate the power going to the computer either by:

1) installing a separate power line, or

2) installing a line filter (Radio Shack offers an inexpensive power line filter that requires no installation and will solve 90% of all power line problems.

In a severe case, both measures may be required. "Brownouts," periodic drops in line voltage to unusually low levels, or power lines "spikes," transient surges of very large voltage levels lasting only a fraction of a second, may require the addition to your system of a "constant voltage transformer."

Power line problems are rare and many times can be solved before they occur by proper choice of installation location for your computer system. The more complex the system, the more consideration you should give to your installation.

Some Plain Talk About Costs

As schools consider wider applications of computers with students, costs for purchase and operation of these systems become a major consideration. In order to facilitate comparison of the various systems available, costs for initial purchase and operation over a period of time are commonly combined and averaged to obtain a "cost per student hour" of operation. The following cost summaries combine the initial purchase price and operational costs for representative timesharing systems and for several TRS-80 configurations to arrive at a cost per student hour of operation over a projected use of five years.

The timesharing system identified as "System A" is used for training in industry, colleges and some secondary schools. The timesharing systems identified as "System B" and "System C" are current commercial products presently in use for instruction in many elementary and secondary schools. Prices for these systems are representative of figures quoted during the last year, but may not reflect very recent price changes. Manufacturer representatives in your area can provide current pricing and availability information on the various timesharing systems.

The validity of cost comparisons between minicomputer-based timesharing systems for student instruction and microcomputer systems is sometimes questioned, since these systems have varying features and capabilities, and varying degrees of software support. Is it reasonable to compare costs for these systems? The answer is, certainly — provided each system compared is capable of meeting your needs in your particular application.

For convenience in comparison, only purchases during the first year of operation are considered in the following summaries; however, the timesharing systems listed have multi-year lease options as well as lease/purchase options that allow a school to spread the system cost over a period of three to four years.

Please note that annual maintenance costs for some of the systems include **courseware charges**. The instructional programs are not sold to the user. Instead a user is licensed to use the programs on a year-to-year basis.

Although no breakdown on the combined "maintenance/courseware" charges for these systems is available, courseware charges obviously amount to several thousand dollars per year.

The costs for Radio Shack equipment include a service contract but no courseware charges (either for license or purchase). **This is a difference** in the cost comparisons; however, the retail prices of the various Radio Shack educational packages are not significant when compared to the annual courseware charges on the larger systems.

Note also that the large timesharing systems require 32 or more student stations in order to achieve their best cost per student hour; with the Radio Shack stand-alone systems, the best cost per hour is obtainable with a single station.

Finally, prices for Radio Shack equipment used in the cost comparisons are based on current retail prices. Quantity purchases by schools can qualify for a discount that can lower the cost per hour of operation even more.

Some notes on how the following costs were calculated:

- Evaluation is in terms of cost per student per year, or cost per student hour. The size of the initial investment is also indicated.
- Usage is based on 1000 hours per year per student station. Individual installations may vary from this usage.
- Costs for computer systems are based on usage over a period of five years.

The formula used for calculating cost per student hour:

$$\text{Cost per student hr.} = \frac{\text{average cost per year}}{\text{number of student stations x 1000}} \quad \text{or,}$$

$$\text{Cost per student hr.} = \frac{\text{total cost over 5 years}}{\text{number of student stations x 5000}}$$

SUMMARY OF COSTS

System	Configuration	Minimum Investment (operation for 1 yr)	*Cost/Student Station/Yr. (5 yr. utilization)	*Cost/Student Hr. (5 yr. utilization)
System A	8 student stations	$ 94,080	$ 11,760	$ 11.76
System B	32 student stations	168,981	1,885	1.89
System C	96 student stations	419,152	1,468	1.47
Radio Shack TRS-80 Model II	1 student station	3,967.50	1,207.50	1.21
Radio Shack TRS-80 Disk System	1 student station	2,065.40	628.60	.62
Radio Shack/ TRS-80s with Network I	16 student stations	18,603.00	353.88	.36
Radio Shack/ TRS-80 Cassette-based System	1 student station	976.35	297.15	.30

*All costs per student hour are based on 1000 hours of annual use for each station.

ITEMIZED COSTS

System A — Timesharing Service, special terminals

Lease of Equipment (module containing eight student stations)	$ 7,840/mo. 94,080/yr.
Maintenance included in lease price	—
Total	$94,080
Each additional year of operation	$94,080
Cost per student station/year	$11,760
Cost per student hour (1000 hrs/yr)	$11.76
Cost per student hour (1500 hrs/yr)	$ 7.84

System B — Minicomputer-based Timesharing System

Optimum configuration — 32 student stations

Purchase of Equipment (timesharing system and 32 student stations)	$129,825
Maintenance (1 yr.) & courseware charge	33,156
Installation	6,000
Total	$168,981
Each additional year of operation (Maintenance and courseware charge)	$ 33,156
Cost for 5 years of operation	$301,605
Cost per year (5 year utilization)	$ 60,321
Cost per student station/year	$ 1,885
Cost per student hour	$ 1.89

(Does not include telephone charges)

System C — Minicomputer-based Timesharing System

Optimum configuration — 96 stations

Purchase of Equipment (timesharing system and 96 student stations)	$332,600
Maintenance (1 yr.) and courseware charge	71,352
Installation	15.200
Total	$419,152
Each additional year of operation (Maintenance and courseware charge)	$ 71,352
Cost for 5 years of operation	$704,560
Cost per year (5 year utilization)	$140,912
Cost per student station/year	$ 1,468
Cost per student hour	$ 1.47

(Does not include telephone charges)

Radio Shack TRS-80 Model II

Optimum configuration — (operation cost per student hour obtainable with a minimum of one student station)

Purchase of Equipment (1TRS-80 Model II with 32K memory, 1 disk drive)	$3,450.00
Maintenance Contract (1 year est.)	$ 517.50
Total	$3,967.50
Each additional year of operation (Maintenance est.)	$ 517.50
Cost for 5 years of operation	$6,037.50
Cost per year (5 year utilization)	$1,207.50
Cost per student station/year	$1,207.50
Cost per student hour	$ 1.21

Radio Shack TRS-80 Disk-based System

Optimum configuration — (operation cost per hour obtainable with a minimum of 1 student station)

Purchase of Equipment (1 Level II, 16K TRS-80, 1 disk drive, 1 16K expansion interface)	$1,796.00
Service Contract (1 year)	$ 269.40
Total	$2,065.40
Each additional year of operation (Maintenance Estimate)	$ 269.40
Cost for 5 years of operation	$3,143.00
Cost per year (5 year utilization)	$ 628.60
Cost per student station/year	$ 628.60
Cost per student hour	$ .62

Radio Shack TRS-80 Level II, 16K Cassette-based System

Optimum configuration — (operation cost per hour obtainable with a minimum of 1 student station)

Purchase of Equipment (1 16K Level II System)	$ 849.00
Service Contract (1 year)	$ 127.35
Total	$ 976.35
Each additional year of operation (Maintenance estimate)	$127.35
Cost for 5 years of operation	$1,485.75
Cost per year (5 year utilization)	$ 297.15
Cost per student station/year	$297.15
Cost per student hour	$ .30

Radio Shack TRS-80 Network I System

Optimum configuration — 16 student stations

Purchase of Equipment (16 16K Level II TRS-80's, 1 Radio Shack Network I Controller, 1 TRS-80 disk system with 16K expansion interface and 2 disk drives)	$16,379
Service Contract (1 year)	$ 2,457
Total	$18,836
Each additional year of operation (Maintenance estimate)	$ 2,457
Cost for 5 years of operation	$28,664
Cost per year (5 year utilization)	$ 5,733
Cost per student station/year	$ 358
Cost per student hour	$ .36

Service and Reliability

The availability of convenient and dependable service is an important consideration in selecting any computer system. For an application in a school, where extended "down time" could disrupt class schedules, this is especially important.

Radio Shack has a nationwide network of over 50 service centers to minimize down time. If repairs are ever needed, the component in need of service is returned to the nearest Radio Shack store. We do the rest.

We also have repair facilities in the Radio Shack Computer Centers if one is nearby. Computer specialists there can answer questions beyond the scope of some store personnel.

Radio Shack Computer Services in Fort Worth, Texas, can answer many questions, should satisfactory answers not be available locally. Their phone number is (817) 390-3583 or 1-800-433-1679.

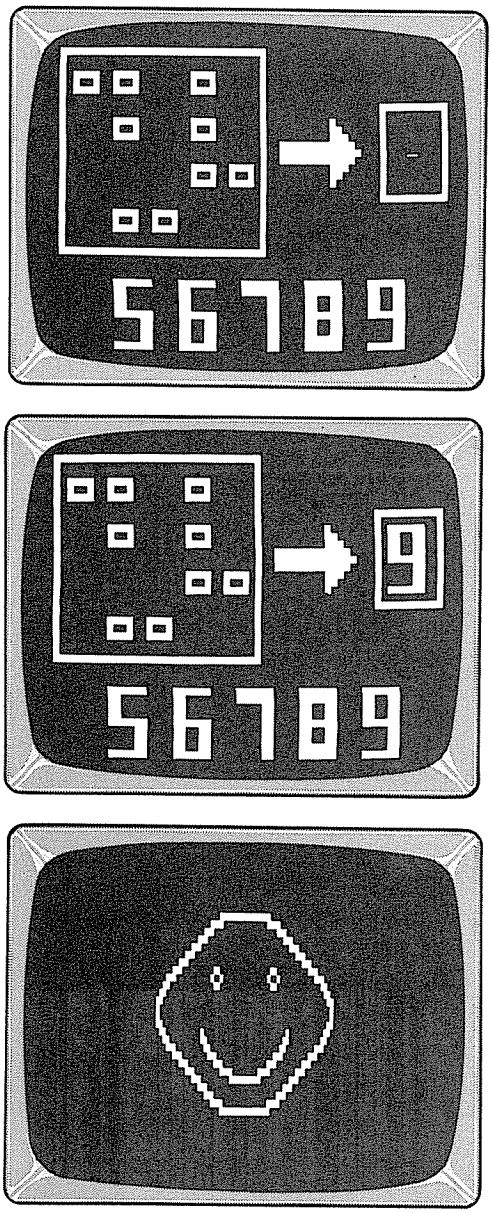
And, a new service contract is available which allows warranties to be extended for 12 months, allowing a customer to budget exact operating costs.

Courseware

Courseware — a special kind of computer program designed to teach — is expensive and difficult to develop. Yet the availability of good courseware is a major factor in any successful instructional program using computers.

The process of developing courseware requires a cooperative effort between computer specialists and educational specialists to design programs that not only are compatible with the capabilities of the computer, but that are based on a sound approach to teaching. In addition, these materials, once developed, need to be tested, evaluated, and refined in actual use. This development and validation process is a time consuming one, and long lead times in producing suitable courseware have frequently been a limiting factor in the use of computers in schools.

Over the last 15 years, a large amount of courseware has been developed for mainframe and minicomputer timesharing systems. Much of the research and development that has gone into these materials has been supported by the federal government and by the manufacturers of these systems. As a result there is currently a wider variety of courseware available for these larger systems than for the new microcomputers.



Kindergarten students learn to count with one of the first lessons of Radio Shack's K-8 Math Program.

This situation is improving, however! The techniques that have proven effective in teaching applications on the larger systems are being adapted to the microcomputers by a growing list of computer users. This compatibility of microcomputers such as the TRS-80 with these accepted and proven methods, and the advantages of the micros — lower cost, portability, and, in many cases, improved display and graphics capabilities — is causing more and more educators to consider the microcomputer as a serious tool for instruction.

Radio Shack is committed to supporting educational uses of the TRS-80. We have involved the experts — the teachers and curriculum specialists in the schools — in the designing and field testing of our new educational products.

Look for a growing list of courseware from Radio Shack.

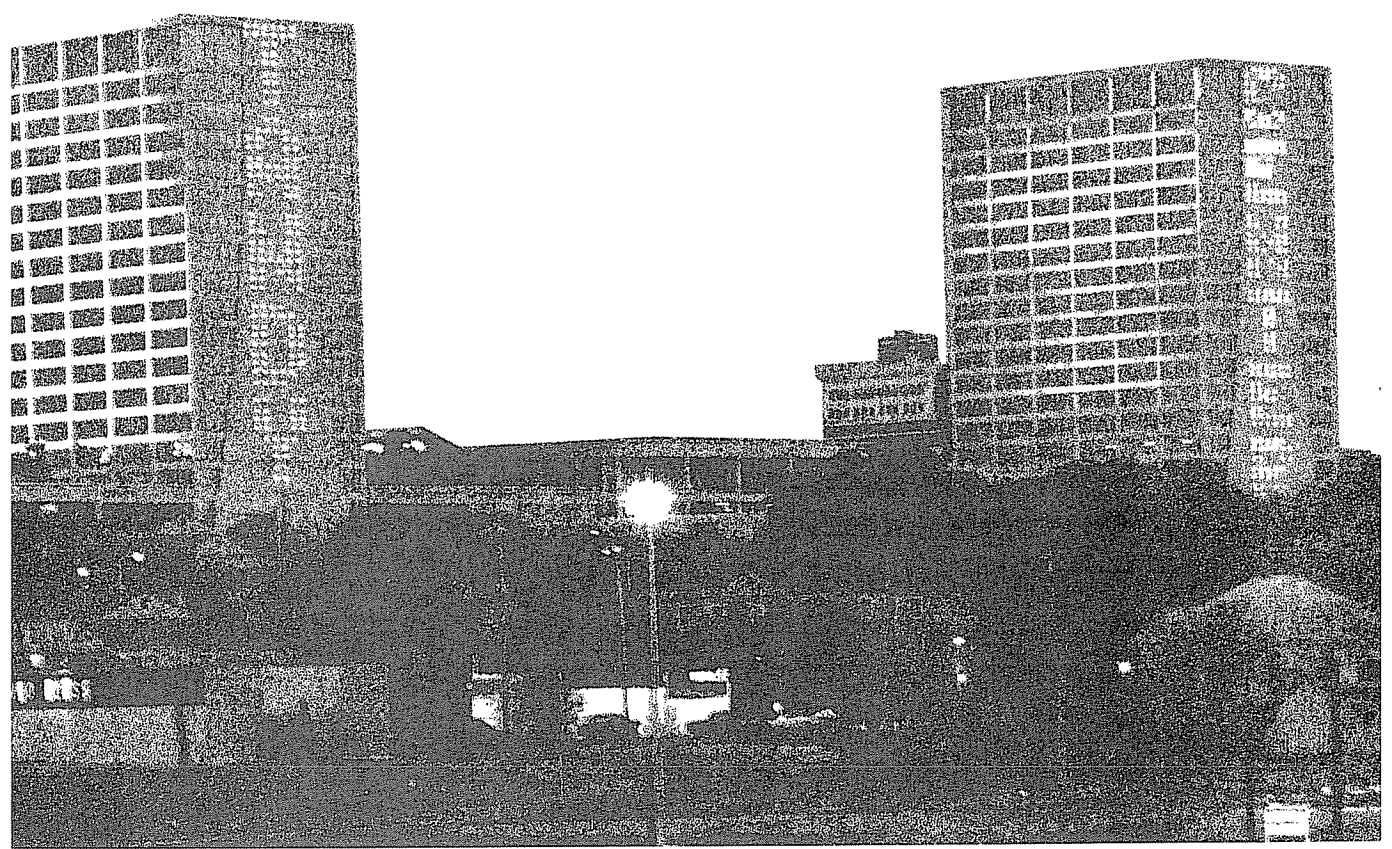
Special Services For The Educator

National Bid Department

This new department has been organized at Radio Shack Headquarters in Fort Worth. Bid invitations directed here will receive prompt attention and the best possible price quotations on quantity purchases of TRS-80's or any other item in Radio Shack's line a school may need. You may contact the National Bid Department at 1600 One Tandy Center, Fort Worth, TX 76102.

National Lease Program

This new program addresses the school's biggest problem head-on: how to secure funding to purchase a microcomputer. Radio Shack's Lease Program can put the TRS-80 in classrooms with monthly payments that meet almost any budget. For additional information on the Leasing Program contact A&A Financial at 800 Two Tandy Center, Fort Worth, TX 76102.



Radio Shack Computer Center Scholarships For Teachers

A microcomputer such as the TRS-80 is not as simple to operate as a movie projector or a tape recorder. Some instruction and training is desirable to take full advantage of the microcomputer in the classroom.

Radio Shack is addressing this need by offering free training classes to teachers at Radio Shack Computer Centers from Coast to Coast.

This program is based on the new Radio Shack Computer Education Series "Introduction to BASIC" course. And Radio Shack specialists can conduct these classes in **your** school to fit **your** schedule. Contact Radio Shack in Fort Worth for details, or your nearest Radio Shack Computer Center.

Educator's Checklist — Why The TRS-80?

- LOW COST. Seldom has such a technologically advanced piece of electronic equipment been made affordable to the general public. But Radio Shack broke the price barrier, and made the personal computer a reality for schools at a cost per student hour that has never before been possible.

- AVAILABILITY. The TRS-80 and its accessories are supplied through Radio Shack outlets nationwide and we have over 5800 locations. You can stop in at one near you and actually see and try the TRS-80 before deciding on your purchase.

- SERVICE. If repairs are ever needed, Radio Shack has a nationwide network of over 50 service centers to minimize "down time." You simply return the component in need of service to your nearest Radio Shack store — we do the rest.

- VALUE. Most people regard their TRS-80 as an investment, and often it yields a return that exceeds their fondest dreams. That's because TRS-80 is what a personal computer should be — a powerful system that's easily expandable.

- REPUTATION. Radio Shack, with 58 year's experience to our name, is the nation's leading electronics retailer. We're backed by our NYSE — listed parent, Tandy Corporation. You can depend on us in the years to come to stand behind our product and offer an ever-growing line of both accessories and programs.

- IT'S EASY TO USE. Our Level I TRS-80 system allows the user to learn programming with absolutely no previous knowledge of computers or programming. Our superb user's manual is written in a light and humorous style that makes learning fun. And the TRS-80's BASIC language is stored in permanent Read-Only-Memory (ROM), so it's ready to use the second you turn on the power.

- IT'S EXPANDABLE. Even the smallest TRS-80 system can be expanded into our largest business system — and you pay no "premium" for not having purchased the biggest system in the beginning. With the Expansion Interface you can add more memory for a system up to 48K RAM, plus printers, disk drives and much more. And you can convert to one of the most powerful microcomputer languages available, our Level II BASIC.

- WE BUILD IT OURSELVES. To insure highest quality at an affordable price, Radio Shack designed the TRS-80, and we build it in our own factories. We have taken maximum advantage of state-of-the-art engineering and our manufacturing expertise to produce the best value-to-cost ratio on the market.

- COURSEWARE. Radio Shack is committed to supplying a growing list of software for education. We understand the need for top quality, instructionally sound materials — and we have involved teachers and curriculum specialists in the schools in developing and testing our materials.

- NATIONAL BID DEPARTMENT. Radio Shack makes the best possible prices on quantity purchases available to schools through our National Bid Department.

- NATIONAL LEASING PROGRAM. Radio Shack's new Lease Program can put the TRS-80 in your classrooms with monthly payments that meet your budget. A buy-out option and a "funding-out" clause for schools allow Radio Shack's lease to fit your requirements.

- SERVICE CONTRACTS. Radio Shack's new service contract for the TRS-80 allows a user to extend his warranty for 12 months — and budget exact operating costs.

- SCHOLARSHIPS FOR TEACHERS. As a special service for teachers, Radio Shack is offering tuition-free scholarships to teachers to the Radio Shack "Introduction to BASIC" course at 50 Radio Shack Computer Centers nationwide.

- AFTER THE SALE. Radio Shack provides the answers you need before — and after — you buy. If your dealer can't answer your questions, you can call our toll-free "hot line" in Fort Worth. And, we're constantly adding software to increase the versatility of both Model I and Model II.

- SPECIAL UPDATES. Radio Shack engineers have continued to improve and refine the TRS-80. New circuits developed to enhance the convenience and reliability of the cassette recorder have been incorporated in all production units, and **these changes are available at no cost** to users with earlier units. Check with your Radio Shack store, or with Radio Shack Computer Services in Ft. Worth.

For additional information on Radio
Shack's Educational Programs, contact:
Radio Shack Education Division
1600 One Tandy Center
Fort Worth, TX 76102