DOCUMENT RESUME

ED 241 245 RC 014 670

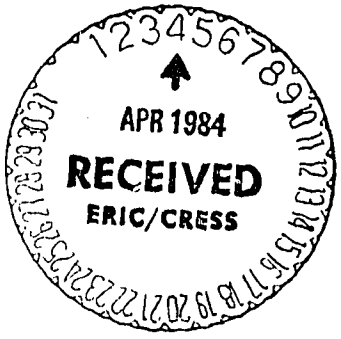
AUTHOR McNeil, Linda M.
TITLE Learning Together: Micro-Computers in Crosby, Texas, Schools.
INSTITUTION Rice Univ., Houston, Tex.
SPONS AGENCY National Inst. of Education (ED), Washington, DC.
PUB DATE Nov 83
NOTE 37p.
PUB TYPE Dissertations/Theses - Doctoral Dissertations (041)

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS *Administrator Attitudes; Computer Literacy; Computer Programs; Curriculum Development; Educational Administration; *Educational Finance; *Education Service Centers; Elementary Secondary Education; Gifted; Instruction; *Microcomputers; *Program Implementation; Programing; Remedial Instruction; Rural Education; Rural Schools; School Districts; Staff Development; State Departments of Education; Student Attitudes; Student Teacher Relationship; Teacher Attitudes
IDENTIFIERS *Crosby Independent School District TX; Texas (Crosby); *Vendors

ABSTRACT

The Crosby Independent School District near Houston, Texas, planned to introduce microcomputer instruction to its nearly 3,000 students in slow stages that had teachers and students learning at the same time. The initial impetus for computers came from an administrator who found useful information at a Regional Service Center of the State Education Department. The Center, known for its emphasis on technology, offers training, purchase assistance, software information and exchanges, library materials, trade shows, time-sharing, and workshops to help introduce computers to area schools. Using federal and grant funding, the district purchased 12 Radio Shack microcomputers. The vendor assisted in staff training and software choice. By the spring of 1983, seven microcomputers were used in the high school to teach computers as a tool. Courses in computer literacy and basic programming were available. Student interest was high but teacher interest was low. In the elementary school, five microcomputers were used to augment remedial math with practice drills and to augment the gifted and talented program with BASIC programming. The district planned to add 20 microcomputers during 1983-1984. Crosby's plan to purchase hardware and introduce it slowly had both advantages and disadvantages. The most important variables in shaping the plan were district size, finances, and location. (SB)

LEARNING TOGETHER: MICRO-COMPUTERS IN CROSBY, TEXAS, SCHOOLS



Linda M. McNeil
1408 Milford Street
Houston, Texas 77006
713/523-5556

August, 1983
(As Revised November, 1983)

This paper was written to fulfill consulting contract #NIE-P-82-0074 for the Rural Schools division of the National Institute of Education for the project on the use of technology in rural schools. The author is indebted to NIE for the funding to conduct this research; the paper represents the ideas of the author and should not be taken to represent NIE policy nor that of the U.S. Department of Education.

In the shadow of Houston's high technology economy, Crosby Independent School District has introduced micro-computer instruction in a plan whose successive stages of implementation has teachers and students learning together. Crosby I.S.D. represents computer usage in a rural area gradually affected more and more by exurban development. It was chosen as a field site because its essentially rural character has not yet yielded to the homogenization of urban sprawl; yet the economic influences of the nearby urban area, especially in technology, are rapidly restructuring employment possibilities for the young people of outlying areas such as Crosby. In addition, the school district was selected because it is located within an area served by a regional service center of the state education department which promotes computers in schools through a variety of support services. Finally, Crosby was an appropriate site to look at implementation of micro-computer education because the original impetus came from administrators rather than a computer-enthusiast teacher and because of the variety of classes and grade levels of computer usage, in comparison with districts of similar size.

The District

Crosby Independent School District draws students from the small town of Crosby, from a black neighborhood slightly separate from the town, from outlying rural areas and, lately, from a new exurban housing development on a nearby lake. Approximately one-third of the students are black; 3-4% are hispanic; and the remaining approximately 63% are anglo. The school

population has increased thirty percent in the past five years, to the current figure of just under 3,000 students. A primary school, grades K-1, has 500 students; grades 2-4 comprise an elementary school of about 750 students; the interim school, fifth grade, has about 225 students, with a semi-departmentalized program. The middle school, grades 6-8, has about 750 students and the four-year high school, a similar number.
One teacher explained that space needs rather than pedagogical theory created the division among elementary school grades. The school's buildings are modern, one-story structures, with the administrative offices in prefabricated buildings near the lower grade schools. The middle and high schools are on a separate campus, set in an isolated portion of a road that joins the major residential area to the state road that links Crosby to its urban neighbors.

To the south of Crosby is the Houston Ship Channel area, Houston's link to international commerce. Some of the Crosby I.S.D. teachers live in Baytown and other industrial towns along the ship channel. Parents of some Crosby I.S.D. students work in the industries and refineries and other businesses of these towns or in Houston, about forty miles to the southwest. To the northeast of Crosby is the East Texas piney woods area known as the Big Thicket, subject of long-standing environmental controversies over commercial usage and conservation.

The economy of Crosby itself does not match the complex skylines of chemical plants and petroleum refineries typical of its nearest neighbors. "Ten years ago, you could ride a horse through downtown Crosby," according to one school official. The town retains its rural

character. When a tornado ripped through the town on a day of interviews for this research, the resulting electrical outages shut off phone and water service as well. One administrator said that the small town culture was evident in the school system's main discipline problem: in the upper grades, students occasionally skip class, sometimes going to sit in the park, a tradition their parents started and apparently expect students to want to do now and then.

According to Assistant Superintendent for Instruction, John Canady, Jr., the Crosby school district, with a primarily residential and rural tax base, ranks in the bottom quarter of local school tax support in the state. Its chief industrial tax revenues come from two enterprises, neither of which is large, one a processor of solid wastes. By contrast, nearby district such as Goose Creek, Deer Park and Sheldon, with heavy industry in manufacturing and refining, have tax bases listed from three to six times larger than Crosby's. The challenge at Crosby, then, is to provide quality instruction whtin resources more limited than many more industrialized districts.[1] Teacher pay is not high in most Texas school districts, a problem frequently the subject of statewide political campaigns. Crosby district has tried to allocate proportionately more money to teacher's salaries than would be expected from the tax base differentials separating it from its neighbors. The teachers generally appreciate this effort to pay wages almost competitive with the nearby small but wealthier districts; they are less pleased to see high administrator salaries ($40,000 to $50,000 range for top level administrators, comparable to those of much larger districts) in light of scarcities of classroom materials and supplies.

The Regional Service Center

To give support to the widely scattered school districts in this large state, and to help administer federal title assistance programs, the state established a network of regional service centers. Crosby is in the area served by the Region IV Service Center, located on the northwest side of Houston, about an hour from Crosby. The Region IV Service Center is known for its emphasis on technology in schools, particularly its support for the acquisition of micro-computers and the training of school staff in their use in classrooms. One reason for selecting Crosby for this study was to investigate the reliance of a small school system on this broader set of resources as the school system attempted to bring computers into the schools.

Most observers of computer education credit Houston Independent School District Superintendent Billy Reagan with providing much of the pressure for the Region IV Service Center to establish a strong program in educational technology. Mr. Reagan has committed the Houston school system to computer literacy for all of its 200,000 students, a program being phased in at present. Pat Sturdevant, formerly a reading consultant, established the technology section of the service center, first to help train teachers in computer education possibilities and to serve as a clearinghouse for information regarding hardware and software related to educational purposes. Ms. Sturdevant was later hired to direct the Office of Technology of the Houston Independent School District, an office which fills a former elementary school on the city's west side, and which now trains Houston teachers and administrators in computer and other forms of technology for their application in schools.[2]

The technology office of the Service Center is now directed by Ms. Marilyn Fricke. Ms. Fricke and her very small staff conduct a broad range of workshops to train teachers to use and teach with computers. In addition, the Center offers competitive bid services to help small districts make computer purchases at lower cost, participates in software exchanges and consottia (especially the Minnesota Educational Computing Consortium), and has a library of commercial and educational publications related to computers in schools. The staff publishes a newsletter which lists workshop offerings, offers such advice as comparisons among computer warranties, lists recent publications of interest to computer educators, and lists conferences related to computer instruction.

The Center also brings vendors and school personnel together in trade shows directed at school use of computers. One of these, a software, or courseware, pot pourri gives school staffs a chance to see materials from many suppliers at the same place, a chance to compare and ask questions of suppliers.

In addition, the Center offers several forms of computer time-sharing, including administrative time-sharing for school record-keeping (two computers handle both mail-in and dial-in services); vocational time-sharing, currently being used by 10 to 12 vocational programs in schools; and both a reference bank time-sharing (in use at Crosby) and time-sharing which enables students or teachers to "up-load" from their small in-school computers when program demands exceed local capacity, or when the school has time-sharing instead of micro-computers.

Workshop topics, taught in evening sessions for the most part, include general courses in adult computer literacy, for which any community citizen may sign up, and very specific courses for particular computer models or applications. These include (from the fall, 1982 Training Program catalogue) Apple II Hands-On Micro-computer Training (for administrators, Learning Resource Center specialists, teachers and aides; eight hours in the parts and functions of Apple II); Courseware Pot Pourri, two day sessions, no charge, vendors "show and tell"; Radio Shack Color Computer Pilot Authoring Language (with a pre-requisite of Radio Shack Model III Hands-On Micro-computer Training); The Apple III and the Art Teacher (with a pre-requisite of hands-on training on this model); Computer Awareness: Planning Before Purchasing (for Administrators and Decision Makers); Texas Instruments 99/4A, Graphics and Sound; Atari 400 Courseware Evaluation for Elementary Curriculum Areas Grades K-5. This is merely a sample drawn from a catalogue of over 60 offerings that range from planning, using computers in flow charts and graphics, using computers for evaluation in specific subjects, and hands-on experience with several models in each of several brands.

For these workshops the Center has a very small teaching staff, Ms. Fricke and one other full-time person and several part-time people. Equipment for the workshops included for 1982-83 23 Apples, 10 Texas Instrument micros, 10 Ataris, and on loan 2 Radio Shack Model 3's.

Region IV is one of the leaders in computer education among the Service Centers. It would seem to be an ideal resource for small school districts, especially for scattered ones or districts far from urban vendors. Not all relations with the Center are ideal for all schools. Some schools, with declining micro-computer prices, have been able to

find lower prices than the ones secured in the Center's competitive bidding. Until Houston schools set up an office of technology to handle its own training programs, many very small school districts felt overwhelmed at the disparity between the influence of the needs of the Houston schools, in contrast to their own, over the Center's policies. Because technology is one of the few areas of public schooling that is steadily increasing in financial commitments, in staff development and most importantly in staff advancement, technology has become one of the more political issues in schools, especially in the politics of career-building. For this reason, some school systems prefer not to deal with a centralized agency, but to forge their own way in exploring computer education. Others find the services offered by the Service Center to far outweigh any advantages of trying to deal with purchases, choices and training at the local level.

There are weaknesses in the Center's offerings, but they seemed to be caused by the growth in demand for the services, which have almost outstripped the Center's staff and capacity. For example, my contact with the Center had two purposes, to find out what the Center did for/with rural school systems, and to seek help in locating a rural school with a commitment to microcomputers in instruction. Ms. Fricke was very helpful not only in explaining the Center's many services but in providing me with their publications, consortium catalogues, course listings and very necessary background information regarding patterns of computer innovations in this region.

What the Center's office did not have was a coherent picture of what is going on at the local schools. Despite its wealth of expertise in computerizing information, the Center has no staff to systematize its own information regarding who takes the courses, either by school or subject field or special program. Records are kept by session rather than

by individual (over a series of courses), by school (to determine how much breadth or specialization there is within a school in computer usage), or by subject field or special interest such as art or applications for handicapped students. Only through her own observations and informal discussions does Ms. Fricke have some of this information at hand.

The Center does help facilitate informal software exchanges among schools where local personnel are developing their own courseware. And it keeps a list of key contact persons in each district to receive the Center's newsletter. This list was helpful to me in my search for a school and in my informal telephone survey of what the "state of the art" of computer education was in this region. It is also helpful to the Center staff to help put people in contact with each other. There is needed, however, a system (perhaps a computer card filled out by each enrolling person) of tracking the schools and subjects for which people take the training sessions, and a follow-up to see what results came about. Some individuals may take the courses for professional enrichment credits or for personal use; others may teach in school systems that give pay bonuses or increments for computer training. Others may be getting the training in the hope that their schools will one day acquire the hardware. The Center trains such a large number of school staff people that having some picture of how this training is applied in schools would be of great benefit, not only to curious researchers, but to personnel in scattered schools whose slim resources require avoiding others' mistakes or profiting from others' innovations where possible.

The Center, then, provides many resources a system as small as Crosby could never provide on its own. It is not a perfect link among school systems but it comprises a set of services not available to small school districts in many states.

Implementation in the District

Despite its wide range of computer education services, the regional center was minimally involved in the acquisition of computers at Crosby. In contrast to the hypothetical model of "computer-buff teacher builds program based on training and software exchanges at Region IV," Crosby computer acquisitions were centered first in administrative initiatives and then in vendor services. Crosby schools demonstrate a school system that found useful ideas at the Center, but pursued them independently. The benefits and potential weaknesses of that strategy will come to light as we look at how computers came to Crosby classrooms and how they came to be used.

My initial interest in Crosby schools had been in their expected relation to the Service Center and to the influence of the nearby Houston Independent School District, with its increasing emphasis on computer literacy. What I found was a system operating quite independently of the Center and more influenced by Dallas, five hours to the north, than by Houston.

Assistant Superintendent John Canady, Jr., recalled that four years ago, as principal of the elementary school, he had attended a convention in Dallas, the Foundation for Quality Education. Although later some conflict of interest with Dallas Independent School District emerged to raise questionsabout the Foundation, the vendor booths at the convention provided visitors like Mr. Canady with a chance to examine computer exhibits. He saw the Radio Shack TRS-80 and its kindergarten-through-eighth-grade math program at this convention and became interested in the possibility of using such a micro-computer with remedial classes. He got his teachers

excited about this innovation and kept in touch with a colleague in Dallas who was finding micro-computers a good addition to his school.

Mr. Canady presented to the superintendent and school board his plan to bring micro-computers into the elementary school for remedial use. To his surprise, when approval came for micro-computer purchases, it was for the high school rather than elementary. His plan for remedial computer usage would have to wait.

The initial funds for micro-computers came from federal funds released by the elimination of the ESEA facilitator position. The first funds made available through such a policy shift were used to buy videotape machines, to enhance cultural communication. Later released funds were used for the high school micro-computers. For micro-computers for the elementary school and middle schools, Mr. Canady wrote a proposal to use Chapter II funds for purchase of machines and initial software and supplies to promote basic computer literacy. Chapter II funds are federal funds administered to schools through state and local allocations, for local use. Under Section 577 ot Chapter II, programs eligible for this funding included

1) the acquisition and utilization --
of school library resources, textbooks, and other printed and published instructional materials for the use of children. . . , and of instructional equipment and materials suitable for use in providing education in academic subjects for use by children and teachers in elementary and secondary schools which shall be used for instructional purposes only, . . .
2) the development of programs designed to improve local educational practices in elementary and secondary schools, and particularly activities designed to address educational problems such as the education of children with special needs (educationally deprived children, gifted and talented children,). . . .

His request to purchase micro-computers with these funds was approved. That purchase was completed early in 1983.[3]

Prior to
priwary compute
Region IV's adu
and the like.
expensive: aro
interested in p
time-sharing th
omputer educati
In liter
indicated that
would be taking
got their messa
the Region IV b
bothered by wha
for these machi
invited a vendc
the Radio Shack
cost and the ne
offered a black
than color scre
The curr
principal, had
explained compu
instruction, Mr
the remedial cl
vendors display
introduce their
were interested

Prior to the introduction of micro-computers, the district had two primary computer uses: time-sharing for student use with Region IV and Region IV's administrative computer services for grade reporting, scheduling and the like. Time-sharing for students was found to be prohibitively expensive: around $600 per year for only five or six high school students interested in programming or computer assisted instruction. An additional time-sharing that functions more as a data bank or reference center for omputer education has been maintained in the library.

In literature it mailed out and conferences it sponsored, Region IV indicated that micro-computers were the "thing of the future." The Center would be taking competitive bids from vendors. The Crosby superintendent got their message about the importance of micro-computers. However, when the Region IV bid report came out in favor of Apple computers, he was bothered by what he felt was a lack of administrative or institutional software for these machines. He and Mr. Canady had seen the Radio Shack models and invited a vendor presentation for the school staff. He decided to purchase the Radio Shack machines. He said that part of the decision was based on cost and the network controllers of Radio Shack's system. Also Radio Shack offered a black and white model, which he felt would be safer for users' eyes than color screens.

The curriculum coordinator at that time and Mr. Canady, as elementary principal, had attended an Awareness Workshop, given by Region IV, that explained computer hardware. Later, as assistant superintendent for instruction, Mr. Canady and the teachers of the gifted and talented and the remedial classes would attend the Region IV software "pot pourri," where vendors displayed computers, software and catalogues and offered seminars to introduce their systems to attenders. The teachers attending the pot pourri were interested in examining all choices before they made selections for

micros for their elementary school classes. From the pot pourri they learned that the Apple II models offered the best machine and widest software selections related to their courses. Mr. Canady, on the other hand, indicated that the choice had already been made to purchase Radio Shack micros when computers were purchased for the elementary grades. The teacher of the gifted and talented classes felt that this would be a waste of money and expressed this opinion. She had already been using a $100 Texas Instrument home computer, which she brought from home, to teach her gifted students BASIC in anticipation of the planned computer acquisitions. In comparing the TI inexpensive model with the Radio Shack models already in use in the high schools, she found that the TI could perform all tasks planned for the students to do on Radio Shack, at a substantially lower cost. The pot pourri seminars confirmed her feelings that brands other than Radio Shack offered far more functions and far more software (then available, as well as planned for the future) and continued to press for Apple II. For TRS-80 functions a TI home model would do.

As for the Service Center, it had supplied the initial inspiration and background information for computer adoption. In addition, it had given the teachers a chance to see the array of software and machines in a comprehensive, close-up comparison. Specific development of the uses of micro-computers at Crosby and further staff training and software selection were handled by the vendor, Radio Shack, and district personnel with little consultation with Region IV. At the time of the interview with school personnel, spring semester 1983, micro-computers were in use with remedial and gifted students in the elementary and middle schools and with data processing classes inthe high school. The elementary and high school computer uses differ in the application of micro-computers to teach "computer" as a subject and independent skill, and to use computers in teaching subject matter content.

The High School

Mr. Canady and his elementary teachers had not planned to generate enthusiasm for micro-computers, then watch while the machines were delivered to the high school. But this is what happened. When I asked Mrs. Maxwell, who teaches computer in the high school, how she managed to acquire the computers, she replied that she had "no input into the purchase. They were purchased by the Board." She had taught programming at the University of Houston when working on an education degree. She was hired in the Crosby High School Business Education Department and was pleased to learn that the school needed someone to teach computers.

Mrs. Maxwell basically teaches the computer as a subject, in the tradition of an office machines course. Her goal is to allow students to work at their own rate until they become proficient at data processing and elementary programming. She is instructing them in the use of a tool, and in learning to use a tool, students need practice. The 1982-83 school year was the second year for a programming course in addition to data

processing. A Programming II course was planned for 1983-84.

Mrs. Maxwell teaches four computer classes in the fall and three in the spring. She aims the classes at the general student interested in the overall processes of computers and the general purposes of programming, not just at math-science whizzes. She had talked with the counselor about limiting the course to "serious" students, but several had managed to enroll who expected "video games." She said that one difficult class was made up of "36 of the worst boys and 4 girls." Her other classes worked with enthusiasm.

Because the district did not introduce computers in earlier grades while these students were younger, a part of the course had to present elementary computer functions. From these, the course built from following a pro[illegible] to constructing a program. The final month of the course was devoted to independent programming by the students.

The teacher kept a file of programming assignments. Each student was to work twelve of these in four weeks, moving from "easy" to "medium" to "complex" levels as confidence and proficiency were gained. She said that those who had made bad grades earlier could do more than twelve to raise their grade; many did. She described her students as "very motivated" and excited about their independent programming work.

"Easy" programming assignments are represented by these examples:

1) Write a program with multiple INPUTS and with one INPUT.

   Write a program to compute grade point averages for a class of 30 students. Use REM, PRINT, INPUT, LET and END statements. Tell the computer to print out "How Many Units of A? B? C? D? F?;" and then follow with an INPUT statement for each.

   Formula for units U = A + B + C + D + F
   Formula for grades G = (4XA + 3XB + 2XD + 1D)/U
   And then PRINT out "Your Grade Point Average Is": G using multiple INPUTS.
   Then write a version of the same program to compute GPA for 30 students using only one INPUT and one PRINT statement to tell the computer how many units of A, B, C, D, F.

2) a. Write a program which will find the time required to travel by jet plane from San Diego to Boston, if the distance is 3000 miles and the plane travels at 500 mph.

b. If the circumference of a circle is found by multiplying its diameter times π (3.14), write a program which will find the circumference of a circle with a diameter of 35 feet.

c. If the area of a circle is found by multiplying π times the square of its radius, write a program to find the area of a circle with a radius of 5 inches.

3) Write a program that will calculate the hours it will take for a boat going 35 miles per hour to travel around the earth, 25,000 miles.

Write a program that will allow you to enter the speed of the boat.

Write a program that will allow you to enter the distance in miles that the boat will travel.

Assignments labeled "medium" included more steps:

1) A program is needed to calculate the gross pay for several employees. The employee name, rate of pay, and hours worked will be given in data statement. The output is to be a report in this form:

EMPLOYEE	HOURS	RATE	GROSS PAY
XXXXXXXXXX	XX	X.XX	XXX.XX
XXXXXXXXXX	XX	X.XX	XXX.XX

Follow these steps:

1. Clear space for character storage. Example 10 Clear 500.
2. Print the headings at the top of the report.
3. Read the employee name, the hours worked, and the rate of pay.
4. Check to see if the terminator (stopper) was read in the data statement. If it was, go to the end statement.
5. Calculate the gross pay by multiplying the hours worked by the rate of pay.
6. Print the employee name, the hours worked, the rate of pay, and the gross pay.
7. Go back to step 3 and read the next record.
8. End.

2) Height to Centimeters----------

Write a program to convert a person's height into centimeters using the fact that 2.54 cm = 1 in. Here's what a run should look like:

```
RUN
TYPE IN YOUR HEIGHT (FEET, INCHES)? 5,10
THANK YOU
YOU ARE 177.8 CENTIMETERS TALL
```

Write another program to give this output:

```
WHAT IS YOUR AGE?  21
YOU ARE ELIGIBLE TO VOTE

or

WHAT IS YOUR AGE? 12
YOU WILL BE ABLE TO VOTE IN 6 YEARS
```

3) ROLLING TWO DICE:

Write a BASIC program to simulate eighteen rolls of two dice. Your program should print the values obtained on both dice.

The "complex" assignments called for still more steps and data inputs, or for open-ended resolutions to the problem. Two examples demonstrate the difference:

1) THE HOTDOG PROBLEM ----------

Suppose you're running the hot dog stand at your next ballgame. You decide to post a computer printout showing how to order all the possible combinations by number. Let's assume that there are only YES/NO decisions allowed for hot dog, bun, mustard, mayonnaise, and catsup. To discourage overindulgence, we'll also print a calorie count for each combination.

Use your imagination and show me what you can do !!!!!!!!!!!!!!
Give your Program and sample output below:

The Sakowitz stores want a Summary Sales Report for upper level management on their three best-selling designers, St. Laurent, Chloe, and Givenchy. They want to know how many items of sportswear, daytime dresses, and evening dresses (for each designer) were sold in the last month and the amount ($ value) the store made from each designer's line. The Summary report will be printed in the following format:

Summary Sales Report

Designer	# of items Sportswear	# of items Daytime	# of items Evening	Total $ Value
AAAAAAA	XXX	XXX	XXX	XXX.XX
BBBBBBB etc.				
Total	XXXX	XXXX	XXXX	XXXX.XX

The following data should be used;

Designer	Code	# of Items	$ Value
Giv	3	50	5000.00
Chl	1	25	5010.00
Giv	2	45	6025.00
Stl	1	15	2505.00
Chl	2	20	2020.00
Chl	3	17	3556.00
Stl	2	10	1575.00
Giv	1	5	785.00
Stl	3	21	2055.00

The nine sets of data indicate the designer by the following:

Giv - Givenchy
Chl - Chloe
Stl - St. Laurent

The following codes are used to indicate type of item:

1 - Sportswear
2 - Daytime Dresses
3 - Evening Dresses

Do <u>not</u> change the data or the order of the data.

Mrs. Maxwell made several interesting observations in summary. One is that even though the micro-computers are not in use during her planning period, she has not been able to interest any other teacher in using them.[4] Student interest is very high in her classes; she stated that several of her accelerated students have been working on their own since the second month of school. Student interest, or lack of feelings of being intimidated, may exceed teacher interest. The other business teachers do not seem interested, according to Mrs. Maxwell. She has been talking with a math teacher about beginning to use micro-computers and feels that as one or two other teachers become trained on this model and begin to add computer work to their courses, others may follow. The seven student computers are in a room next to Mrs. Maxwell's classroom, where she has one micro-computer for demonstrating; the others could easily be used by other teachers when she does not have students using them.

Also, when asked if she sees any significant differences between the enthusiasms or competencies of boy and girl students in learning programming, she said she saw none. Both groups are eager to use micro-computers and learn equally well. This is in direct contrast to the predominance of boys in one suburban high school's application of micro-computers and computer graphics to higher level mathematics. Mrs. Maxwell sees micro-computers in practical, daily applications that her non-college-bound students may need as much as her more academic students. The programming, while dealing with some numbers, is otherwise subject-neutral, perhaps eliminating thereby the stratifications among students that computer-math or computer-science applications might imply.

Inch by Inch: Remedial Applications

Mr. Canady's first enthusiasms for drill and practice in remedial math had to follow the high school computer acquisitions by more than a year. Mrs. Lyons now teaches remedial math to fourth graders who score below a certain minimum on the standardized Texas Assessment of Basic Skills test. A part of her remedial activities center around micro-computers.

In coordination with classroom teachers, Mrs. Lyons brings the students who need remedial help to her room for half an hour each day (forty-five minutes, she explains, including time to get the students and take them back to class). She teaches in a small classroom, probably designed as a testing center or office, in the suite of guidance offices. The room is pleasant, with a large window facing the school play yard, but has few furnishings except for the teacher's desk and several student desks. There are few supplies and no decorations in the room. Apparently, when the fifth grade campus opened, many supplies were sent there from the lower school. Teachers are described as buying some of their own supplies.

For the remedial class observed, two kinds of remedial activity were provided: drill and practice with pencil and paper, and drill and practice on the micro-computers.

Five TRS-80 micro-computers sit on rolling carts in the entry hall outside Mrs. Lyon's classroom. Above them is a colorful bulletin board with garden flowers illustrating the words to a song made famous by Pete Seeger, "Inch by Inch" ("row by row, gonna make this garden grow, . . .").

Mrs. Lyons would like to roll the micro-computers into the classroom but is prevented from doing so because of security precautions: her classroom does not have adequate window coverings to hide the machines from public view. (The window faces an expanse of school lot that does not face a street. However, insurance regulations make security a major issue in the use and storage of school computers in this and many other schools.) One teacher said that a better, secure room was available but the administrators chose to put the micros in this crowded hall area instead.

Not being able to move the machines has forced Mrs. Lyons into a different strategy, which has its own benefits. She divided each group. Those students who have finished desk work may proceed to the micro-computers. The computers act, therefore as an incentive for these "slow" students to proceed with their work and to do so accurately. The students, according to Mrs. Lyons, prefer the machines. The substance of review in each case is the same -- simple arithmetic operations. The TRS-80 K-8 math diskette is "the only thing they've bought me." Like the worksheets, the program provides a sequence of arithmetic problems, followed by a slighter more difficult set of problems. At the end of each sequence, the computer registers a tally of right and wrong answers, then directs the student to the next appropriate activity.

The format is familiar to anyone who has used SRA reading sequences, except that the computer offers feedback as praise or chastisement or encouragement. As the students take their seats at the micro-computer, the teacher checks to see if each is at the appropriate level and makes sure each enters his or her own name. The name entry serves two purposes: to provide the teacher with a report of accuracy and to provide the student with messages.

For example, Barney (student names are pseudonyms) saw the division problem $8\overline{)32}$ and entered 5 for his answer. The screen flashed the response, "That's too much!" A wrong answer to a different problem elicited the screen message, "Wake up, Barney." A right answer on a second try brought "You got it, Barney!" A pause between the presentation of the problem and the attempt at answering yielded "Come on, try it!" Right answers were followed by such praise words as "Right, Sally," or "Terrific, George."

The exercises were devoid of conceptual or even functional explanations. Division, in the exercise observed, was reduced to steps. A blinking square indicated where a number was to be supplied, either in the answer or calculation of remainders. The blinking square directed the eye in where to go next, perhaps providing a basis for habit in tracing out the steps of long division. But just as possibly, the reduction of long division to blinking digits could cause students to miss larger relationships among numbers. It must be reiterated that the same reductive tendency was characteristic of the worksheets, except that for those exercises the teacher was present for explanation.

As the group at the micro-computers finished, the teacher came out to note their scores, which were also recorded in the master terminal. A screen might read, "Andy's Report. Level 7.

39 attempted
38 correct
1 missed
6 correct on second attempt
12 seconds average response time.
Promoted to Level 8."

It was interesting to note the personalization of the computer by both teacher and students. When one girl said that the problems were too hard, the teacher replied, "They (my emphasis) promoted you to 8. I didn't have anything to do with it. They're saying you should be able to do it."

Mrs. Lyons learned to use the micro-computer by taking the training session offered by Radio Shack, at which they compressed "two days of training into one," she said. Her son has an Apple computer which she has also used. Other Saturday workshops have been offered, which she says are helpful. She said that when the machines were first delivered, Radio Shack had not shown the staff how to hook them up. A student's father got them ready for use.

Mrs. Lyons also works with remedial reading. Fifteen students in fourth grade need both math and reading remediation. She feels the TRS-80 remedial English program available at the school is geared more for language arts (grammar, punctuation, composition) skills than for reading skills. She uses old textbooksfor her remedial reading instruction. For math, she has only the K-8 diskette and whatever written exercises she can collect or develop. The computer, for all the limitations of the only program she has, helps her divide the groups in order to individualize at least her explanations and gives students a format they enjoy for working through the practice lessons.

Gifted and Talented

The introduction of micro-computers to the students grouped as "Gifted and Talented" offers the clearest example of students learning just slightly behind the teachers, and of teachers willing to stretch course limits to expand learning possibilities for their students.

The gifted and talented program at Crosby, apart from its computer applications, represents excellent use of teachers' professional expertise in the designing and carrying out of instructional activities. The interest of the instructional superintendent in this area, and the efforts of teachers, two in particular, in developing curricula for these students provided a rich backdrop into which the micro-computer would be one of many learning tools.

Mr. Canady reads widely on the subject of gifted students and has written some "short pieces" for professional journals on this topic. Under his leadership, the elementary school staff developed a five-year plan for identifying and teaching gifted students.

Mrs. Raskin, who had previously worked with her mother, an Ohio teacher, in writing curricula, wrote the gifted and talented curricula for second through fourth grades. (Another teacher designed courses for grades 5 and 6.) With a budget of $1500 per year for the early years of the program, Mrs. Raskin was able to purchase materials for the courses, beyond the usual texts and materials adopted for these grades. State funds were applied for because a survey of 100 items showed gifted and talented programs to rank fifth, among parents and staff surveyed.

Thematic units formed the basis for these courses. Within the thematic units, basic and higher order skills were organized. For example, the fourth

graders were to spend six weeks on photography, including making a handbook and developing pictures. Medieval times, with history, literature, math and art projects, was another major topic. "Monster Mania" was a second grade unit. Third graders studied electricity, including learning to make a short-circuit or a series circuit. Castles, medieval banners, electrical circuit boards and explanatory posters and monsters decorated the room, the students' physical products from these units.

In addition to the independent, creative projects, students within each unit learned vocabulary, worked with the factual information and concepts of the unit topic, heard teacher explanations, and conducted research. For all this, each student kept a "rough copy" notebook and a "good copy" notebook.

Students were chosen for gifted and talented classes according to seven criteria: a creativity test, an achievement test, a test of cognitive ability, past grades, parent inventory, teacher inventory and IQ. Three to five percent of the students, between 11 and 14 per grade, were selected.

Soon after the micro-computers were delivered to the elementary school, after Christmas, Mrs. Raskin left for a maternity leave. Her plans to take her students through BASIC I during the spring semester as an introduction to micro-computers seemed unreachable. Her hopes had been to spend Monday, Tuesday and Wednesday of each week on the regular course activities. Some time on Thursdays would be spent in the regular classroom demonstrating, using transparencies or her computer from home, the week's computer lesson. During the week the students would also write a simple program. On Fridays she would take the class to the remedial classroom to use those micro-computers, again using them in place because of the security problems involved in moving them. The students would have hands-on time and run their own programs. This schedule had to be suspended during her absence.

According to the teachers' estimates, the students would work through BASIC I in their first year of computer (second grade). By third grade, they would finish BASIC II. Grades four and five would be expected to work

through BASIC III and IV. (The first years of implementation would of course have all students in these grades, in the gifted classes, beginning with the first level of BASIC; the upper grades were expected to go more quickly through the succeeding levels.) The rationale was that by the time the students, with their limited computer time each week, would progress through BASIC enough to use the machines for applications in substantive areas, the teachers would have had time to investigate and choose appropriate software related to the content of their courses. Mrs. Raskin especially had plans for typing software, as soon as she could determine the cost and put in a request. And for their course units, she envisioned using micros for research, simulations, calculations and other procedures directly beneficial to unearthing medieval treasures or designing electrical systems.

The mention of her maternity leave becomes relevant at this point: despite a six-week hiatus, the students in the lower grades worked through BASIC I in a few short weeks, even when limited to less than one hour per week on the machines. The day I observed one class, the students in second grade were taking a test on computer errors (program errors, operator errors, and so on). Most seemed at home with the new terminology; most of the papers I saw had a high percentage of correct answers. Clearly the plan to delay computer applications until students had mastered BASIC I and II would be a delay of a few months rather than of two school years at the rate the students were progressing.

Mrs. Raskin had planned to attend the next courseware pot pourri at the Service Center and begin making her list of request priorities. She learned near the end of the spring term that her husband was to be transferred out of the state; she was remaining only to finish the semester.

Her printed curriculum guide for the gifted and talented program would remain a central part of the elementary school's plan for ability grouping. The administration was left with searching for a teacher willing to learn computers, even if learning just ahead of the children, as Mrs. Raskin said she was. While the continuation of the gifted and talented program had firm administration support and was not in danger of being eliminated by her leaving, Mrs. Raskin's vision of computer applications to broader conceptual and substantive content was far-reaching and will be hard to replace. It could have served as a useful model for the many schools, including in neighboring Houston, where security and other efficiencies keep computers in separate rooms, often divorced from course content and reduced to ends in themselves, or to machines whose simulation programs are thinly disguised video games. Mrs. Raskin's broader view of computer usage, and her students' facility for learning the technicalities of computer applications and simple programs, even in their first weeks with micros, provided the best example of teacher and student learning together what computers as learning tools could add to students' tools of inquiry.

Computers at Crosby

The commitment to micro-computers in Crosby schools is extensive given the district's limited financial resources. The plan to date has been to acquire affordable hardware and to introduce the machines slowly into the school program at several grade levels as teachers become trained to use them. Software has so far been limited to the BASIC instruction manuals and one math diskette. With computer literacy as a long-range goal rather than an immediate one, the district has emphasized learning to use the machines rather than beginning with curriculum and asking what needs to be taught that can best be taught by computer. The exception is the drill and practice application in remedial math, where identification of the particular instructional need pre-dated computer acquisition. In the gifted and talented classes, the computer is likely to become one of many investigative tools employed by students; their first attempts at programming are not much less sophisticated than the "easy" level of programming assignments in the high school data processing classes. If their new teacher continues Mrs. Raskin's plan to develop and purchase software related to lesson topics, these students will be able to use computers to complement other learning styles. From these three beginning innovations, in remedial, data processing and gifted and talented classes, other teachers can observe what students can do with computers and begin to make decisions regarding the appropriateness of computer-related instruction for their classes.

An advantage to the plan of slow implementation of software is that the district's computer education offerings will be developing along with the growth in subject matter software and software exchanges. Teachers

can take time to become trained and to ascertain which computer applications, if any, make sense for their own students.

A disadvantage to the plan to invest in hardware before making long-range subject matter plans for computers is that the district could be financially tied to a computer model which does not have the capacity needed, say for advanced math courses, or for storing multiple data sets for several courses; or does not have needed software. One retailer of several brands of micro-computer software said that the more expensive Apple and IBM computers had far more and better software choices than the Radio Shack models. Of course, software inventory is in constant flux, as more informal as well as commercial sources become available. But this vendor suggested that cost is the only factor that makes a business or individual choose Radio Shack micro-computers. At Crosby, cost is a critical factor, when Apple and IBM models sell for three to six times the cost of a TRS-80. Also, the TRS model is highly rated for ease in beginning usage, another advantage for a district just getting into computers.

Business consultants tend to advise their clients to "go for the software," then buy whatever hardware is compatible with it. So far the district has found a variety of uses for the TRS micros, none of which begin to tax its capacity limits. The trade-off of capacity for cost held some wisdom. Whether the software - cost trade-off was equally judicious will depend on what becomes available and what applications teachers decide on for micros at Crosby. The district may have a chance to branch out to other models or brands in the 1983-84 school year. A donation of up to twenty micro-computers has been offered by a school patron who advises business clients on tax planning; the clients would make the donations. Their contributions would more than double the number of micro-computers in service

at Crosby. The staff, in deciding which micros to accept, will consider the relative advantage of having all micros compatible for networking, under the same service contract, and similar for staff and student training vs. the chance to acquire a few other models in order to use their software and perhaps color capability when necessary. Either decision will greatly expand Crosby's computer usage and help overcome the problem of keeping the micro-computers in one place for security reasons.

Several questions brought into the research have proved not to be as central as expected. One is the issue of opportunity cost: what in time and in dollars is lost to allocations for computer instruction? According to Mr. Canady, the computer funds have so far been so separate as to avoid competition for dollars between computers and other modes (Mrs. Raskin said she had to buy the BASIC materials from her gifted program materials of instructional supplies./ The use of Chapter II funds for computer funds. acquisition has brought in new money, even though of course if those funds had not been applied for for computers, the district might have drafted proposals for other new resources, such as Mrs. Raskin's past proposals for materials for the gifted and talented courses. The creative use of these federal and state dollars and the openness to private sector contributions, a lesson well learned from Houston's school district, has allowed computer acquisition without direct subtractions in other areas. For local funds, Mr. Canady explained that requisitions are made on an individual-item basis and considered for their own merits. Reasonable, well-supported requests are rarely turned down. This contradicts the scarcity of materials and supplies in the remedial classes. Acquisition in the future of extensive software materials could challenge the peaceful coexistence between computer and other teaching resources. However, at this point the support services of Region IV, such as the participation in low-cost software consortia and interschool software exchanges, could reduce cost below vendor levels. Also, teachers like Mrs. Raskin will have an interest in developing courseware and in having their students participate in developing course programming.

Mr. Canady said many teachers did not feel competition with computer expenditures, but instead expressed eagerness to be included in the schools' plans for computers.

As for competing for students' and teachers' time, the data processing does take students away from other electives. But in the elementary school, there is little sense that something significant is dropped when computers are added. The remedial students would be working with worksheets during this time on exercises very much like those on the computer. The gifted students may give up some class or independent study time, but their facility with computers has so far made efficient use of the brief computer time they have had. The new teacher will have decisions to make as to how to integrate micros into the thematic units, lest "computer" become a separate subject rather than a complementary inquiry resource.

Other questions taken into the research seem to have less relevance to the Crosby situation. The issue of computer usage for boys and girls, as mentioned, reveals few distinctions at Crosby. In the gifted and remedial classes, both boys and girls learn to use the computers with equal ease and enthusiasm. In the data processing classes, unlike many upper level math classes in other districts, both boys and girls are enrolling, learning data processing and learning programming with no apparent differences in skill levels or recruitment to the courses.

One question of great importance to many observers of computer education is the separateness of computer instruction. Publishers are beginning to relate textbooks to course materials in software. But districts can rarely afford to replace all textbooks, except in five- or seven-year rotations. The evolution of software proceeds far too rapidly for textbooks in most instances to keep up, even when the same publisher is producing both. How regular course material relates to computer instruction is a major concern for those who would see micro-computers used as one of several learning tools. This concern was premature for Crosby; although it has far more

micros in daily use than comparable districts in this region, they are not yet in the regular classes, where teachers would have to make relational decisions.

The question of how the ruralness of Crosby Independent School District relates to computers is interesting and perhaps offers some lessons for other small districts. Distance and finance seem to be the key variables shaping the way Crosby has implemented computer education, rather than any distinctly rural application, say in agricultural courses or courses taught to a small number of students via time-sharing with a computer set-up at another school or centralized instructional service. The distances to other districts and to the Service Center mean there is little chance to interact with other teachers, get in on exchanging materials or signing up for extra workshops. The convenience of vendor-supplied training sessions which are brought to the school or conducted at nearby vendor locations has helped some teachers acquire introductory knowledge of computers who otherwise might not easily be able to enroll in similar courses at the Service Center, which is at least an hour's drive away through very heavy traffic. Many of the nearest small school districts have just begun to purchase computers and most have fewer in place than the Crosby schools. Houston, with almost 200,000 public school students, has a very strong commitment to computer literacy, and many programs worth visiting, but like some of the suburban districts, has much more financial investment and therefore applications not necessarily within the reach (or needs) of a smaller district.

Besides distance between schools, distances which ironically could be partially overcome if all had compatible computer networks, there are

programmatic distances within the school district which help shape the computer innovations. The incremental innovations in computers at Crosby has been shaped by the size of the district itself. Even though it is not the smallest district in the region, the district is small enough that many teachers are "one of a kind," the only person to teach a particular level or subject. Each teacher is on his or her own to develop courses. This not only means that how computers are adopted will be highly dependent on individuals. It also means that those individuals who are interested may not have another teacher to team up with to exchange or create software or to plan how computers fit the course. It also means that if micro-computers cannot be readily moved about the buildings, a great number of them would be needed to bring computer instruction into the integral functioning of a variety of classes. In a larger school system, the math department might have its own computer lab just for upper level students, with each classroom in the math department having one or two terminals or micro-computers as well. The smaller course offerings and numbers of teachers teaching the same subject or level of students give computer applications in a smaller district problems of economies of scale and planning. At Crosby, rather than try to place computers in a great number of courses at once, the plan has been to introduce computers in specialized uses, with the intent to build a broader program as staff trainin and software are developed to fit particular programmatic purposes.

For such individualized innovations, two factors come back into play. One is the Service Center, distant, primarily tied to a different brand of micros, and not organized to help small districts in a systematic way. Yet the information provided by Region IV newsletters, the availability of workshops a small district cannot provide, and the offering of the software pot pourri (as noted by Mrs. Raskin) form an important backdrop

against which smaller districts can make computer acquisition decisions. That set of support services is there, whether it is frequently used or not. The pot pourri is more likely to be of immediate help to Crosby than are evening training sessions. Yet the real contribution may be that the Center is there, can be called on for information and consultation or referrals, and can put small district staffs in touch with each other through the "key contact person" lists the Center staff keeps. Even when not actively used, its presence serves as political support, symbolic of the state's and region's commitment to technology in education, and as a potential resource not available to small districts in many states.

The second major factor is the administrative involvement. So far, teachers in Crosby have followed rather than led administrative interest in micro-computers. The next task, with such a commitment already made to hardware and with twenty more micros promised, is to shift from thinking of how to teach computer (to staff and students) to how to teach and learn through computers. This is not a uniquely rural problem. Yet the distance and size factors make it too individualized a concern in the absence of a committee of teachers and administrators organized for long-range planning, to avoid too much attention to the computer as a machine, as well as too little. The district has taken a greater financial risk than surrounding small districts in acquiring computers; for their expenditures they have been able to acquire a number of micros. Without administrative support which is both open to short-range purchases and willing to let implementation come slowly, it is doubtful the district would have introduced computers at all.

One question remains, the influence of Houston's technological economy on small, rural districts like Crosby. Mr. Canady said that the Crosby interest in computers has nothing to do with Houston, its schools

or its high-tech economy. One teacher said the reverse, that computer literacy and programming were essential in this region, especially for students going directly into jobs after high school. Jobs which take students into the city or industrial towns or jobs which can be decentralized to home or small-business computers may require computer expertise. Both perceptions hold some truth for the students of Crosby. A district with a history of rural independence from urban influences has to serve its students where they are, as they are. In addition, with the realities of urban economies, it has to prepare them for what they may do, where they may have to go. The administrator and the teacher represent this dual purpose. It may be accurate to observe that computers have come to Crosby because of its rural character rather than despite it. While its students are not a part of the urban technology scene, neither are they to be left out of a dominant cultural development. The diffusion of micro-computers into the school affirms the need to educate these children where they are, at the same time putting them in touch with skills representative of a broader social condition.

Notes

[1]The per pupil expenditure for Crosby for 1981-82 was approximately $1,870.00. School revenues come from local property taxes and petroleum severance taxes. There is no state income tax.

[2]A number of attempts were made to interview Ms. Sturdevant regarding the development of the Service Center's technology office under her tenure. When her office finally scheduled an interview, her schedule was found to be double-booked, with no open date available. An interview with Ms. Patsy Rogers, the assistant superintendent of H.I.S.D. who had developed some of the school system's early work with computers provided background information on the Service Center, the problems with its bidding systems and descriptions of some of its services, and on computers in Houston schools. In each Houston school, no computers can be delivered to a school until the principal and at least one teacher have completed a minimum number of hours of hands-on training on the model of computer. The Office of Technology, of which Ms. Sturdevant is director, offers the training. The building on the day of the interview was a busy place, with dozens of teachers and other school staff people taking a day of professional leave to take the training sessions. Others return to consult staff about their schools computer usage or to run programs that can't be run at their schools.

[3] According to the vouchers, for just over $ 9,000 the district acquired six TRS-80 Model III 16K micro-computers; one Model III 48K; one Network 2 Controller, one Line Printer VI, and such additional pieces as dust covers, printer cable, cassette and power strip. In addition, eight printer stands were purchased, along with Volume 1 of the K-8 math program, three copies of Introduction to Computer Literacy, one each of Basic Programming, Essential Math Volumes I and II, 30 computer tapes, 3 10-packs of diskettes, one diskette file box, 20 computer cassette tapes, diskette and cassette labels, and a four-plug power strip. The micro-computers themselves accounted for almost $5,000 of the costs. (High school micros were purchased earlier.)

[4]This contradicts the administrator's perceptions that many teachers are eager to participate in computer implementations. He could have been speaking about lower grade teachers. Or it is possible that the high school teachers were interested in having classroom micro-computers rather than having to schedule usage around the data processing classes.

The author is grateful for the background information supplied by Ms. Marilyn Fricke of the Region IV Education Service Center, Ms. Patsy Rogers, of the Houston Independent School District, and Professor Joe Austin, Department of Education at Rice University, Houston. The author is especially indebted to Dr. John Canady, Jr. and the computer teachers of Crosby I.S.D. and their students for their help in this project.