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ABSTRACT

This paper reviews research conducted at the Institute for Social Research at the University of Michigan for the Agency for Instructional Technology as part of "Solutions Unlimited," eight instructional units that integrate computer software, videocassettes, and related print materials. The units are designed to improve the problem-solving skills of students in grades 6, 7, and 8, and to make them familiar with the problem- solving applications of computers. This report on microcomputer use in the middle school summarizes the findings of a national survey (Henry Becker, 1983) and supplements it with case studies of five schools that typify the varieties of use. The focus is on the present--how micros are being used today--and the future--what the teachers and principals think about current applications and what they think will happen in the coming years. An outline of a videotape showing how microcomputers are used in middle schools and guides for principal and teacher interviews are appended. (Author/JB)

Research Report

NUMBER 93

MICROS IN THE MIDDLE SCHOOL

A SNAPSHOT IN 1984

agency for instructional technology
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MICROS IN THE MIDDLE SCHOOL:

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Research Report 93

November 1984

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Bloomington, Indiana 47402

Research conducted at The Institute for Social Research, The University of Michigan for the Agency for Instructional Technology as part of *Solutions Unlimited* -- eight instructional units that integrate computer software, videocassettes, and print to improve the problem-solving abilities of students in grades six, seven, and eight and to make them familiar with the problem-solving applications of computers.

The Agency for Instructional Technology is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television and related printed materials for use as major learning resources. It makes many of these materials available in audio-visual formats. From April 1973 to July 1984, AIT was known as the Agency for Instructional Television. Its predecessor or organization National Instructional Television, was founded in 1962. AIT's main offices are in Bloomington, Indiana.

EXECUTIVE SUMMARY

This report on microcomputer use in the middle school summarizes the findings of a national survey and supplements it with case studies of five schools that typify the varieties of use. The focus is on the present -- how micros are being used today -- and the future -- what the teachers and principals think about current applications and what they think will happen in the coming years.

As of the spring of 1984 more than two-thirds of the nation's middle and junior high schools have one or more microcomputers. The dominant use of the machines is in an experimental computer literacy course begun by one or more computer enthusiasts on the staff. The courses vary in content, but all of them familiarize students with how to operate the machine (e.g., insert a disk, load and run a program, clear the screen, and enable the printer). Other types of use -- drill and practice, word processing or other tool uses -- are very rare, except in schools serving large numbers of under-achieving minority students. While the staffs in computer-using schools are almost universally supportive of making students computer literate, they are ambivalent on the issue of using micros as an instructional tool in teaching traditional subject matter.

Micros are here to stay. The meteoric rise in school acquisitions will continue; however, the use of micros in middle schools is going to change. The current emphasis on programming will change for two reasons. For the computer to be useful it is no longer important for a user to "program" it. The most useful applications are available as software for purchase. Also, programming as a vocational skill is best taught at the high school level -- a point closer to entry into the job market. Programming languages are evolving and elementary skills in BASIC will not long be considered useful.

As today's most prominent uses of micros disappear, other uses will replace them and expand the role of micros. These uses will be too attractive to do without because they motivate the students, provide important instruction, and help teachers manage the classroom.

What does this study say about adoption of *Solutions Unlimited*? Adoption and implementation depend on several enabling conditions. Clearly a school must have enough

machines with the capabilities to take advantage of the most popular software. These machines will become available when an administrator and a few teachers and parents press for computers in the school. Central school offices and the public are currently responsive to pressures in this area. The key to getting sufficient ferment in school buildings is exposure and training of teachers and administrators -- most of whom are ignorant about the potential of micros. All districts seem disposed to support workshops for teachers at which participants are introduced to computers and their educational potential. The creators of *Solutions Unlimited* should get their software demonstrated as part of such workshops. Given the paucity of exciting software at the middle school level we predict that *Solutions Unlimited* will be welcomed. Efforts should be made to have workshops specifically for middle school teachers.

Special teacher training should be offered which deals with several kinds of issues. Teachers in the curricular areas targeted for *Solutions Unlimited* are least likely to find the computer a natural ally and need to be made comfortable with the machine itself. Additionally, most teachers have difficulty imagining how to manage a classroom with a micro. It would be useful to show a videotape of teachers using *Solutions Unlimited* with different classroom configurations. Finally, successful use of *Solutions Unlimited* may require special teaching and management skills; these should also be incorporated into the training.

THE FIVE SCHOOLS DESCRIBED IN PART II

Central Middle School: Micros are used only for computer literacy training. Four volunteer teachers began the 9-18 week elective last fall. The 12 new micros are housed in a converted classroom. Some other teachers would like to try a micro to help teach their own subject, but most lack knowledge of computers or the software available.

Grant Junior High School: In a district with an outstanding elementary and senior high computer program the junior highs have been left behind. This school has eight older micros for individual classroom use. Only two teachers make use of them, and this is for a two-week unit in math designed to acquaint students with how computers work. These teachers are hoping for new machines, useful software, and a district mandate to expand the junior high curriculum in computer literacy. Too many antiquated machines hinder additional curricular use.

Carver Middle School: In this inner-city school the lowest-achieving students in reading and math attend special remediation classes in which part of their work is with micro-based drill and practice software. They also take a computer literacy class to prepare them for tomorrow's jobs. Bought with special grant monies for the educationally disadvantaged, the machines cannot be used by average or above average students. Teachers are excited to expand the use of micros in other areas.

Beecher Middle School: The 25 micros in this school are used in a wide variety of ways. Seventh graders are required to take an introductory course in computers. Many teachers incorporate micros in their regular classes in math, reading, and social studies. There is a special center for drill and practice remediation in basic skills. Active encouragement by the assistant principal and the presence of some teacher enthusiasts are important ingredients.

Hill Junior High School: Computer literacy and programming courses are very prominent in the curriculum; clubs and free time provide other opportunities for students. Most of the faculty are open to but very cautious about implementing computers in their own curricular areas.

THE AUTHORS

Jerome Johnston is a researcher at The University of Michigan. For many years now he has been reporting on the use and impact of educational television. More recently, his work includes the new technologies such as microcomputers and videodiscs.

Richard Luker is in the Department of Communication at Michigan where he has been studying television use among adolescents.

John Mergendoller is at the Far West Laboratory for Educational Research and Development in San Francisco. As part of the "Secondary School Improvement Program," he has been studying how math and science are taught in high school classrooms. His case studies have provided useful insights about ways to improve instruction.

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INTRODUCTION

The Agency for Instructional Technology is a nonprofit American-Canadian organization established in 1973 to strengthen education through technology. In cooperation with state and provincial agencies, AIT develops instructional materials using television and computers. AIT also acquires and distributes a wide variety of television and related printed materials for use as major learning resources.

In 1982 AIT issued a prospectus for a cooperative project called "Advancing the Use of Computers in the Schools." The proposed project would develop high-quality computer software to help students improve their problem-solving skills. It would also study and report on policy issues related to the use of computers in schools.

A consortium was formed to provide direction and financial support for the project, AIT's first involving computers. This report is part of the policy research undertaken by the project. The instructional materials that were developed are called *Solutions Unlimited (SU)*. They combine video segments, some of which are from the AIT classroom television series *ThinkAbout*, new microcomputer software, and printed materials for students and teachers. Available beginning in Fall 1984, *SU* is designed to help students in grades six through eight develop their problem-solving skills.

In a needs assessment conducted prior to *ThinkAbout*, language arts and social studies teachers in the target grades identified problem solving as an area in which they would welcome curricular help. But teachers in these curricular areas have not been among those clamoring to inject microcomputers into their collection of instructional tools. In fact, many of them might overlook the value of *SU* simply because it requires a microcomputer. To properly design plans for disseminating *SU* to this target group, more information was desired about how microcomputers are currently being used in middle schools and how various staff members feel about them. To help guide planners at the state, regional, and local levels, this report was prepared.

The report is in four parts. The first provides an overview of microcomputer use. It is drawn from Henry Becker's national survey entitled "School Uses of Microcom-

puters" (1983). Based on a representative sample of U.S. schools, his study provides a statistical profile of computer use as of winter, 1983. This is a starting point for understanding the use of microcomputers and the potential implementation problems faced by *SU*.

To put some flesh on these numbers, case studies of five middle schools were conducted especially for this project to provide the kind of in-depth picture that is difficult to capture with survey statistics. The schools were selected to illustrate the different kinds of microcomputer uses identified by Becker -- computer literacy and programming instruction, drill and practice, and tool uses. The schools serve a range of community and student types. Several days were spent in each school documenting current uses of micros and interviewing teachers and the principal. Each case study describes how micros are being used in the school, and then details staff perspectives on the value and future of microcomputers in education. The staff members give their views on whether micros should be part of the curriculum, where they fit, and what value they have for their own curricular area. They also speculate on the conditions necessary for micros to be used more extensively. Taken together, the case studies provide the reader with insights into the range of applications and staff views that will be encountered in middle schools at this point in time. Part Three of the report draws from all of the case studies, summarizing the barriers to utilization of *SU* and suggesting ways they might be overcome.

Part Four presents a case study of effective instruction in computer programming -- a subject widely perceived to entail problem-solving. The vignette of the teacher's instructional practices provides some insights into the pedagogical and classroom management skills that may be needed if *SU* or any other problem-solving curriculum is going to actually improve students' skills.

In addition to this written report, there is a videotape showing how micros are being used and presenting some of the same interviews. The contents are described in the appendix.

PART I
THE NATIONAL PICTURE

Microcomputers have clearly been the most prominent innovation in pre-college education in recent memory. No other information technology has been adopted so widely and so rapidly -- certainly not instructional television. In a very short span of time, schools have responded to pressures from several directions to incorporate the machines into the school. Many feel that the future lies with those who know and understand how computers work; for them, the push has been to familiarize students with the machines and give them experience writing computer programs. Others feel that some instruction is better when taught on a computer. Parents in particular have been vocal on this issue; their message is to get computers into the curriculum. Schools have responded as best they can with limited resources.

Numbers of Micros

Micros are a new technology. Henry Becker in his 1983 survey "School Uses of Microcomputers" charted its meteoric growth. He found that in July of 1980 only six percent of the nation's elementary schools had one or more micros. Two and one-half years later, 42 percent had one or more. (A more recent survey by Quality Education Data puts the current figure at 61 percent.) Secondary school acquisitions have occurred at a faster rate. Less than 10 percent had a micro in July of 1980. By January 1983, 85 percent of all high schools and 68 percent of all middle and junior highs had at least one micro. The number of secondary schools with five or more micros was 40 percent by the summer of 1983. Extrapolating from the acquisition curves, it is reasonable to expect that by 1986 virtually all high schools and most middle schools will have one or more machines.

What kinds of machines do the schools have? During this revolution, only a few districts developed policies regarding equipment purchases. The grass-roots thrust coupled with the rapid evolution of hardware made it difficult for even the far-sighted. In the aggregate, the most popular machines have been the Apple (II, IIplus, IIe), Commodore (Pet), and Radio Shack (TRS80). But this says little about what machines would be found in any particular school. One school may have a single Apple IIe with 64K of memory capable of running LOGO and the vast majority of available

educational software. Another school a mile away may have 10 inexpensive Timex Sinclairs purchased at the recommendation of the building computer buff, because -- while these computers were much more limited in what they could do -- the greater numbers permitted more students access to a machine. As computers are becoming a more accepted part of the curriculum, districts are establishing guidelines and insisting on uniformity of purchases to create economies for both purchase and maintenance of hardware.

Types of Use

How are the machines being used? The most frequent use in both elementary and secondary schools is in a unit or course designed to introduce students to computers -- 64 percent of the elementary schools and 85 percent of the secondary schools use their micro(s) in this way. Secondary schools are more likely to emphasize computer "literacy" and provide instruction in programming -- 76 percent of secondary schools use them for this purpose. They are used to a much lesser extent for drill and practice (31 percent). In elementary school the primary use is drill and practice (59 percent) with programming second at 47 percent. However, Becker argues that much of the drill and practice in elementary schools is probably little more than familiarizing students with the computer.

A "Typical" Elementary School

Becker supplements these statistics with these descriptions of the "typical" elementary and secondary school.

> The typical microcomputer-owning elementary school has two microcomputers, each used for about 11 hours per week, or a total of 22 hours of use per week by students under the direction of a teacher or other staff member. About 62 students (in the student body of 400) share these 22 hours of use, which is equivalent to about 20 minutes per use per week... Approximately 40% of all instructional time on the microcomputer is spent by having students use computer programs for practicing math and language facts, spelling drills, and various other memorization tasks. Approximately one-third of the instructional time...is spent having students copy, write, and test computer programs. Students spend most of the rest of the time (about 20% in all) playing games under the direction or approval of the teacher. Many of these are "learning" games, presumably designed to be "drill-and-practice" assignments presented in a more entertaining, and

presumably more motivating, guise.

> The typical microcomputer-owning secondary school has approximately five microcomputers, each in use for 13 hours per week, or a total of 65 hours of use. About 80 students (in a student body of 700) use the equipment in an average week -- a little more than 45 minutes per user. Programming and computer literacy activities occupy fully two-thirds of the instructional time on computers in secondary schools. Drill-and-practice activities take up another 18% and the remainder is split among "learning games," various advanced applications such as word processing, science lab work, business courses, and other activities.
>
> (Becker, 1983:2, pp. 6-7)

A "Typical" Junior High School

Where do middle schools and junior highs fit? Are they more like elementary or high schools?

> The typical junior high has three to four microcomputers...to serve a typical student population of about 700. The median student-to-computer ratio in junior highs with micros, 181 students per micro, is about equal to that of the typical elementary school (183:1). (The typical elementary school has half as many microcomputers, but also has about half as many students.) In contrast, high schools, particularly non-public high schools, and combination junior-senior highs, have much more favorable student-to-computer ratios than do junior highs (88:1 and 125:1)....
>
> Junior high schools provide microcomputer access to a greater number of students than do high schools. Typically 13% of the students at a junior high get some time on a microcomputer during an average week, slightly more than the 11% that do so in high schools... The typical micro user in a junior high school gets 30 minutes of access time per week -- six minutes per day. This amount is half as much as the typical high school student user gets and not much more than the 24 minutes per week typical of elementary school student users.
>
> Programming instruction, in particular, is much less frequently reported to be an "intensive" use of microcomputers at junior highs (32%) than at high schools (64%). More junior highs concentrate on programming instruction with students than K-6 elementary schools do (18%), but elementary schools

> more frequently report intensive use for drill-and-practice (22% vs. 14% for junior highs and 10% for high schools). BASIC is the language almost universally used in junior high programming instruction. LOGO or Pascal, two more structured programming languages, are seldom used.
>
> In summary, use in junior high schools falls between the patterns found in elementary and high schools, but seems closer to the former. There is more programming instruction than drill-and-practice use in junior highs and the opposite is the case in elementary schools, but the total intensity of micro use in junior highs more nearly resembles that of K-6 elementary schools than it does schools serving older students.
>
> (Becker, 1983:3, pp. 3-4)

The above profiles are based on national averages. There are variations by region and by the rural/urban location of the schools. The most interesting variation, however, relates to one combination of characteristics. Schools in urban areas, serving predominantly minority children from poor families, are most likely to be using their micros for drill and practice in the basic skills; within these schools the group most often using them for this purpose are the low achievers.

PART II
A LOOK INSIDE FIVE MIDDLE SCHOOLS

A statistical profile like the one presented in Part I can be very useful for circumscribing the broad parameters of a phenomenon. However, with such diversity around the country, the profile inevitably characterizes only a few actual schools. Additionally, the profile fails to capture an interesting dimension for those concerned about future directions of micros in the middle school. How does the instructional staff of a school feel about this intrusion? To supplement this statistical profile we conducted five case studies, describing the community, the school, the type of use being made of micros, and portraying the staff reactions as discovered in interviews with them. The schools were selected to provide examples of computers deployed in the ways most commonly found in middle schools: a computer laboratory set up to teach a semester-long computer literacy and programming course; a math class in which a two-week unit on computers is inserted; a laboratory for basic skills remediation; and individual classrooms in which micros are used as tools to enhance instruction in regular curricular areas. The demographic characteristics of the sites ranged widely: a large metropolitan inner-city school serving very low income black families; an adjacent blue collar, low-to-middle income suburb; a white collar suburb with no minorities; another white-collar suburb with a wide range of social and racial characteristics; and a high income, well-educated university town. Four of the sites were in a midwestern industrial state and another on the west coast near Silicon Valley. The actual identity of the schools and towns has been altered in this report, as have the names of teachers who were interviewed.

The demographic characteristics of communities are mentioned because they have had two complicated influences. The communities with greater wealth have had more parents pressuring the schools to include education about computers in the curriculum. By contrast, poor communities with large numbers of underachieving minority students have tended to adopt computers for drill and practice to help remediate basic skills deficits.

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Plymouth is a middle to upper middle class residential community in a midwestern industrial state. While there are a few factories, most of Plymouth's working residents commute to other cities where they hold mainly technical, managerial, or professional jobs. The Plymouth area is one of the faster growing parts of the state. Most of the new housing is aimed at a higher status clientele. Many of the families at Central Middle School have microcomputers in their homes. Plymouth's school system is developing rapidly, and microcomputer use has been growing as well.

The school district has had microcomputers in its senior high and elementary schools for several years now. The middle school computer program was initiated just a year ago, with the first machines coming to Central last fall. There, in a school of 875 students, one crowded classroom serves as a computer lab, housing five Commodore VICS and seven Apples, model IIe. There are no microcomputers in the regular classrooms. The computers are used almost exclusively to teach different sections of a student computer course that lasts nine weeks for younger students and 18 for the older. The classes are conducted by four teachers trained just last fall by a volunteer coordinator. The coordinator is a self-trained computer buff whose talents came to the attention of an administrator in the spring of 1983. At the time the coordinator was teaching elementary school and using micros with his students. He was transferred to the middle school to teach science, but with the unofficial assignment of setting up the computer program. The four teachers were also volunteers with a keen interest in computers. One of them, a science teacher, was interested enough to emerge during this year as a leader of the district's planning committee for computer curricula.

For the most part, the other teachers in the school are not familiar with microcomputers. A few teachers and administrators use the machines after hours for record keeping, test construction, and word processing. Several teachers are anxious to be introduced to the machines and shown what computers might do for them. A few language arts teachers have asked if there is tutoring software to drill

noun/verb distinctions and other remedial content for students who failed to learn these things in lower grades. The social studies teachers have shown the least interest as a group. On the whole, staff interest is probably not very deep. A district-wide, after-school workshop was set up to demonstrate available software. The 25 slots for the elementary school workshop filled quickly, but the middle school workshop was cancelled when too few students signed up. The instructor was not especially disappointed since she felt there wasn't much software available for middle schools.

The Computer Literacy Class

The computer classes are designed to familiarize the students with the hardware, teach them the structure of the programming language BASIC, and provide them with a number of opportunities to write BASIC programs. When observed, Ms. Branson's third hour class for seventh and eighth graders was midway through an 18-week session. There were 29 students in the room. With only 12 machines, 24 students were doubled up at machines and five more worked at a central table while waiting their turn at writing, entering, and debugging programs. Students were at various stages. Some at the center table were drawing flow charts for a programming problem described in a handout, or writing answers to workbook questions. Those at the machines were typing in the program statements which they had already written on paper. Ultimately, they would see if their program would "run" successfully. One program created a rainbow; another made a "ball" bounce off the "walls" at different points around the screen; another formatted and listed names and addresses. All of these were problems posed in the workbook. The students were attentive to their task, as though the task itself plus the reinforcement of machine feedback stretched their interest. Only one student was inattentive; he let his partner do most of the work while he talked to the next group.

The class had all the appearances of any science lab, with students working in small groups to complete carefully structured tasks. There was about the same amount of creativity required as in a chemistry lab. The teacher -- herself the eighth grade science teacher --confirmed this impression. She reported that the students' orientation to computer class is to do the assignment and get the right answer. When their programs don't work, most of them do not go back over their programs to diagnose the error; they wait for the teacher to tell them where to look. She says that in all of her classes -- computer or science -- "the students don't come to the task with a problem-solving orientation; they must be taught that problem solving takes mental effort, and even risk." Years of structured classes with

little opportunity for problem solving probably limits severely the extent to which a potentially rich opportunity in problem solving can be exploited.

Teacher Views

Five teachers and the principal were interviewed for their views on microcomputers in middle schools. The teachers represented a variety of curricular areas. Three of them were familiar with microcomputers and were either involved with the computer uses at the school or had their own microcomputer at home. The other two were generally unfamiliar with microcomputers.

Barb Branson has taught in the district for the last six years. For three of these she has taught science and math courses at Central. This is the first year of computer instruction at the school and Barb coordinated the computer instruction and taught a computer class as well. Arlene Bush has taught in the district for over 20 years. She has been at Central for the last 12 years and is currently the chair of social sciences and English. She teaches seventh and eighth grade classes. Kim Slauson has been teaching for five years, the last four at Central. She teaches seventh grade developmental reading and math classes, ninth grade general business classes, and one of the computer classes. Dolores Dawson has been teaching for 15 years, the last five years at the middle school level and at Central. She teaches mostly English classes but also has a course on local history and another on survival reading. Barbara McClintock is a social studies teacher. The last five of her 12 years as a teacher have been spent at Central. Jerry Rider, the principal, has been in education for over 20 years, the last twelve in administrative positions. He became the principal of Central in 1983.

The views of the teachers were similar in many respects. Their combined comments fall into three categories: thoughts on microcomputer use in the school or district, applications of micros to different curricular areas, and factors in successful use of microcomputers in school.

The teachers generally feel that the use of the microcomputer is growing in the school and the district. This is reflected not only in equipment purchase, but also in teacher in-service opportunities and the increased status of microcomputer instruction in the curriculum. While the first year focus has been on teaching programming, Ms. Branson indicated the program is changing. "We are evolving... What started as just programming is evolving to applications. Our philosophy in the district is that applications is where to focus rather than programming... That

gives the student the opportunity to see where computers can be used to increase ease of jobs..."

The perception of a "supportive attitude" is evident to the teachers not only from their peers, but from the administration and parents of the students. The three teachers most familiar with micros felt other teachers in the school endorsed the use of microcomputers generally. They also felt the principal had been supportive of the growth of microcomputer use in the school. The school district has been committed to the growth of microcomputer use in middle schools. As Ms. Branson stated: "The district has been clear in their commitment. They started a three-year plan to get more machines and software into the schools. Even though there have been budget problems and some areas have been cut, they have stayed with their commitment." Prior to this the burden for microcomputer growth was at the school level and often depended on the principal raising the funds. As the principal noted, "...they look to me for the money. There were times we would have bake sales or save pop tops to get the machines... My major role is to get the funds." The parents are very much in favor of having courses about computers. "Many of them have computers at home or work with them at their jobs so they see how important it is for kids to get familiar with them."

There were several comments regarding the current method of concentrating microcomputers in the computer lab. Ms. Branson, the computer coordinator, felt this gave the most students exposure. At the same time she supports the additional use of microcomputers in classes as "floaters." The social studies coordinator, who shares this view, expressed the frustration it presents too. "What bothers me most is that when I need it for a classroom there is a course being taught in the lab. If I take one then that deprives two or more kids who might use it during that same 45 minutes and I don't like doing that even though I would be using it for 35 students during that same period.... If I try to take a class to the lab and everything works just right, I might get 32 minutes out of the 45; and that's if nothing goes wrong. One thing happens, and you get nowhere, that's really a shame." Ms. Slauson pointed to additional problems that come from multiple teachers of the classes. "It can be hard enough keeping your own room or lab organized. It gets chaotic at times with five different teachers using the same lab. Things end up missing; people do things in different ways. It can be tough. But I think there is basically a supportive attitude."

The two teachers who were least familiar with micros had varying views on support for micros. Ms. Dawson felt the teachers in the building were quite supportive in general. "In this building there is a tremendous amount of support for everyone in every area. It's a unique building

because there isn't a great deal of competition between people. It's more of a cooperative effort. If we chose to do that, then we would all work together and share." At the same time her expressions of support were more generalized than those coming from the teachers who were familiar with microcomputer use. "I would imagine that any new tool that would help them do a better job would be something that they would be very receptive to." Her perceptions of support did not vary by curricular area. She thought the administration was also supportive and pointed out the additional concerns they would have to deal with in managing microcomputer use. "There are all the housekeeping tasks to be taken care of: where are we going to house them, do we have the electricity, how are we going to guard the room?" Ms. Dawson believes the parents are supportive. "I think that all parents want their children to benefit from what science has to give their children. Many of them feel that Plymouth is a very progressive school system, and they are really upset when we don't use [microcomputers] and don't have a lot of them to use." She was also aware of the district support for increasing microcomputer use in middle schools.

Ms. McClintock, on the other hand, does not share the others' perception of general support. She feels that it is important to teach microcomputer use only if it is not available at the elementary level. She is aware of software that can be used in social sciences and can see the utility of some applications in the class, but only "...as an expansion of the curriculum. I don't see it as taking over any function of the curriculum, but as an activity that expands the learning of what is being taught." But when it comes to actual support by the teachers in the building: "Well, I'm not sure. I think a lot of people are afraid of computers; it kind of scares them. I know one social studies teacher who took two or three weeks of in-services to learn how to operate the computer and still doesn't know how to do it."

Ms. McClintock also has a different perspective on the support of parents. "Oh I think some parents view it like anything else, anything that is out of the ordinary, anything that doesn't go along with sitting at a desk learning the "three R's" the same way they learned them. It doesn't seem right. But I think a lot of parents are in favor of them. A lot of my students have microcomputers." She was also aware of the current changes in financial support at the district level but wasn't sure what that would mean from a curricular standpoint.

Neither Ms. Dawson nor Ms. McClintock saw the microcomputer dominating education in the near future. Ms. Dawson classified it as one of many educational tools. "I think it is just one of the things we are going to use; it is just like filmstrips. It's just another tool; it is not the teacher itself. The teacher is the one who has to plug

it in to see where it is beneficial to the children or it just becomes a plaything. You need skill from the teacher to put it in the right spot to get the most out of it." According to Ms. McClintock, "I think if they don't do something more with them, other than having a computer class for the kids to learn how to turn the computer on, and go for some more basic programming, I think they will be a fad and will disappear."

Differences by Curricular Area. As might be expected, the social studies and English teachers are less enthusiastic about microcomputers than are science and math people. The differences were explained by some of the teachers. The chair of social studies noted, "Social science and English people are supportive, but not as much as they might be with more exposure. Math people use it a lot more so they are comfortable with it... [Social science teachers] are afraid of two things: they will erase the disk, or the machine will fall apart and then they will be stuck with it. Sometimes the district gets a discount for its purchases. These companies should give discounts to the teachers so they can become more familiar too; then [the teachers] would be more supportive." Ms. Slauson, who teaches math and one of the computer classes, agrees with the need for more exposure: "I think some social science people might think that math teachers are more versed in microcomputer use. It is not so much a math background that is needed for application, but math people get training in their education which helps. Some people are fearful and they just need to get more exposure. It would help if there were more in-service opportunities, both for experience and so teachers can see how the microcomputers can be used in their areas." The principal echoed the same sentiments: "I suppose there are some who are still afraid to turn it on... I would think that would be more in the social sciences... the teachers and administrators have to be willing to change, to be amenable to new ways of doing things. That will be easier for the new teachers who are just coming out, but not so much for those who are used to their approaches to teaching."

The teachers were asked how micros might be used to help in teaching their subject matter. There were not many differences by curricular area. Both math/science and social science teachers talked about drill-and-practice applications (particularly, but not exclusively for remediation). Math/science teachers mentioned drills on fractions and chemical elements. The English/social science teachers offered parts of speech, states and capitals, and more. Drill and practice was seemingly similar with one exception. Ms. Branson, the science teacher, mentioned the use of problem-solving programs as useful for all science classes, where in math she only mentioned programs for remediation. Ms. Branson also indicated that a machine in every classroom

would make a difference in her science teaching, because she would be able to incorporate it into the routine periods. However, hardware is not the answer. "More software is needed. In eighth grade we are teaching chemistry and it is impossible to get software for that."

In contrast to drill and practice, tool uses seemed to be categorized as a dominantly social science domain. Teachers suggested that tool uses were important, but were less able to articulate to their own areas if they taught math or science. They might mention "a student could write papers on a word processor."

Non-instructional possibilities were similar regardless of curricular area. Some used a microcomputer for some form of course management (grades, assignments, etc.). Some did the work themselves, others had students do it for them. Ms. Slauson had students come up with new and more efficient ways for keeping records, in essence, turning the record keeping by microcomputer into a tutorial experience for one or two students.

Keys to Success

The teachers were all asked what conditions are required to get more microcomputing into their curricular area. Of course, they all mentioned money; but given proper financial support, the critical factors involved teacher-support services. Ms. McClintock -- least familiar with computers -- was, perhaps, the most outspoken on the importance of in-service. "I think it's a critical point, because I think eventually if they have computers in the elementary school, by the time the kids get to the middle school they are going to need something more.... [They] aren't going to take a class on how you turn the computer on, which is what we now offer. If we don't have something that goes beyond that, (and I'm not sure what goes beyond that for kids)...I'm not sure that there is really something that is there for them... then the way I see computers being utilized is by the classroom teacher to extend the curriculum. And if teachers aren't in-serviced on how to do that, then they aren't going to be used."

Ms. Branson, the computer coordinator, is perhaps the most active in support areas. She keeps informed on what other schools and districts are doing. She often passes along information to other teachers and has volunteered to help in Central's program. To her, the key to success is how the microcomputers are used. "If they are taught as a tool with potential future applications for the student... if the program is organized and supported [and] if they get the software, microcomputers will be an important part of education in the future. If they are not carefully and use-

fully implemented, then it will just be a fad... but I don't think it is a fad."

Ms. Bush, the social sciences chair, listed three critical factors. "You have to have good materials (software and computers), the district has to support the idea of growth of microcomputer use, and the people who run them have to be good and organized." Others echoed that same last point. Where you have one or two interested teachers in a building who are willing to invest in the use of microcomputers, it seems much more likely that use will expand. Ms. Bush suggested without that, they will gather dust.

Ms. Slauson focused on teacher training: "[Teachers] need more exposure, more experiences, in-service times and after school sessions to find out how microcomputers can benefit them and their students... They have to get active to get over their fears." She added, "the applications have to keep advancing. I feel I am always growing as I work with my students. That stimulates me and I can see the value in microcomputers."

For Ms. Dawson, a veteran English and history teacher and a teacher unfamiliar with micros, more central guidance is important. "I think a curriculum has to be written. I think we have to look for real goals and our objectives have to be clearly defined to say this computer is going to do this job." She also stressed the importance of not expecting too much, that trial and error is part of the learning process.

The principal labelled the key factor as people. "People have to be willing to change. The parents have to support it. It takes a couple of good people who care to organize it, and I think we have people like that here at Central, and I think you will see the program go.

Central Middle School in Summary

Several generalizations can be made about the experience at Central Middle School. The micro "program" is brand new and evolving. It is the result of the fortuitous blend of two factors: the community and school administration becoming enthused by the computer revolution, and a small group of computer "buffs" on the school's staff volunteering to shape an acceptable curricular response. These teachers discovered the attraction of micros for themselves; they use them for word processing, constructing and storing tests, and managing their grade books. They responded to a call to establish a computer literacy program because they were excited about micros and felt it was important to teach students <u>about</u> them. The limited machine resources were al-

lotted to this use entirely and located in a single secure location in the school. Their first year's program familiarized students with the basics of machine use and taught them how to write programs in BASIC. The students were all enthusiastic about such a course. After a year's experience teaching the course, the teachers are ready to change and spend less time on programming and more showing students the tool uses of micros: word processing, spread sheets, etc. Even this new focus will probably be short-lived; by definition, tools are meant to be used for other work. Why teach word processing as an object of study unless students are going to be allowed or encouraged to use this facility to write and revise papers for the traditional courses in middle schools?

The program at Central owes its shape to a small group of enthusiasts who see the machines as new tools to help them accomplish their own work. This is an important ingredient in getting micros used in this school. The buffs were all associated with math and science, and were perhaps predisposed to this electronic innovation. They were aided by a principal who saw the value of a micro for his administrative work. The other faculty are largely positive about computers in general, but are playing the waiting game before getting personally involved. Some are intimidated by the machine itself. More often these teachers are in English and social science rather than math or science. All of them are wanting to be shown how the machines can be useful to them. They are literally ignorant of the possibilities. They are waiting to be shown software that will be useful in their curricular area. For most this translates to drill and practice. They can easily imagine the "automated workbook," so they think about (or have heard about or seen) drills on math computations, states and capitols, and parts of speech. The novelty of *SU* should be very attractive: problem solving, tool uses of computers, etc. But currently any of this new software would present a problem at Central. The computer literacy effort is tying up all of the micros. If more teachers get excited about possibilities of using the micro(s) with their classes, many more machines will be needed. Plymouth is a relatively affluent, but not wealthy, community. As is true in most districts in the mid-1980s, budgets for education are tight. It will take a combination of creative administrators and declining hardware prices to make possible sufficient machines.

Grant Junior High School: In a district with an outstanding elementary and senior high computer program the junior highs have been left behind. This school has eight older micros for individual classroom use. Only two teachers make use of them, and this is for a two-week unit in math designed to acquaint students with how computers work. These teachers are hoping for new machines, useful software, and a district mandate to expand the junior high curriculum in computer literacy. Too many antiquated machines hinder additional curricular use.

The city of Oxford has a population of 130,000. It is home for a prestigious university and has a fast expanding base of high technology firms. The school district has 14,000 students. While the inhabitants show great diversity in educational attainment and in their aspirations for their children, the better educated have shaped the educational character of many of the school district policies and practices. For decades the community has prided itself as a showcase district. In 1959 James Conant singled it out as having a model comprehensive high school. Not surprisingly, the district had a microcomputer program in advance of most surrounding districts, and indeed the program was singled out in a recent federal effort to identify "lighthouse" programs. The district has 400 micros spread throughout the system. Computer literacy and computer assisted instruction begins as early as kindergarten and is sprinkled through the elementary grades. In high school there are many opportunities to learn programming, mostly using terminals connected to the district's mainframe computer. But the junior high program is floundering. A vignette of one of its junior high programs is included because it highlights the point that in many districts middle schools and junior highs are the last to get the technology.

Grant Junior High is one of five in the district. It draws students from families who are unlikely to have computers in the home. Jane Flynn is a typical "product champion" --excited about the prospects for microcomputers, biding her time until a more formal program and additional equipment is available in the junior highs. She teaches seventh and eighth grade math. Each term, for a period of two weeks she brings microcomputers into the class to provide the students with a rudimentary understanding of how computers work and what basic applications they have in business and commerce. There are eight machines in the

building. They are on carts so they can be moved from classroom to classroom. Most of them are 8K Commodore PETS; a few are 64K PETS. During the two-week program the classroom setting is much the same as any classroom where there are rows of desks and 25 to 35 students. The computers are in a row against one wall stationed on tables where two students can easily be seated in front of each machine. Others stand and watch from behind the two seats during the work sessions. There is one computer at the front of the class that is used by the teacher for illustrations. It is the most versatile machine and is used also by students who already have prior micro experience, either from their elementary school or from home.

The first class periods are used to familiarize the students with the parts of the computer. Instruction is done by lecture with the use of an overhead projector. There is an introductory microcomputer workbook with easy tasks for getting started. Ms. Flynn begins with review of the previous lecture material, perhaps a quiz on terms, and then introduces the day's lesson. Students then break into pre-assigned work groups of two to four on a computer. Each student does a section from the workbook and all in the group write down the output which is then submitted for a grade. Most of the 10 class days are spent writing programs in BASIC. Since many students come to junior high familiar with the machines, she provides programming problems with a range of challenge.

Why isn't there more use of computers at the junior high? Part of the problem is clearly equipment. Oxford was on the cutting edge of the computer revolution eight years ago. They aggressively trained teachers using an incentive program that rewarded buildings with a new machine for every three staff members that went through 12 hours of training. The machines are the Commodore PETs with small memory and cassette tape storage. Today, it's hard to argue for fancier machines when there are a large number of basic ones available. Yet much of today's revolution is fueled by attractive software that runs only on 48K machines and is available on diskette, not tape. In the absence of a mandate, expanded use of computers for instruction depends on informal demonstration opportunities. Unlike Plymouth there are no teachers maintaining their grade books on a computer. What little educational software is available for junior highs can't be shown informally in the building.

A second factor is the source of the impetus for computers in the district: the math curriculum specialist. For many years computers were promoted with special attention to their possibilities for math instruction or as objects of study in themselves. It's not that language arts and social studies applications were resisted; they were simply not promoted. Add to this that the principal at

Grant is not an enthusiastic supporter of micros and one concludes that the requisite conditions for further dissemination are absent.

A proposal is pending to the school board to make a significant investment in new hardware for the junior highs. This is coupled with a proposal for expanded use in "literacy" and in curricular support. If the proposal is funded, then further work will be necessary, as in Plymouth, to acquaint the staff with the possibilities.

Carver Middle School: In this inner-city school the lowest achieving students in reading and math attend special remediation classes in which part of their work is with micro-based drill and practice software. They also take a computer literacy class to prepare them for tomorrow's jobs. Bought with special grant monies for educationally disadvantaged, the machines cannot be used by average and above average students. Teachers are excited to expand their use in other areas.

Iron City is a large metropolis is in the industrial heartland of the U.S. The 1.5 million residents count heavily on employment in the city's many large manufacturing concerns. For many of the males this has amounted to unemployment in recent years. In an economy that has been failing for a long time the city and its schools have struggled to survive. The tax base is low and the educational problems severe. Issues of vandalism and safety frequently attract more attention than academic achievement.

Carver Middle School is in the center of Iron City, serving 1200 of the most underprivileged students. It is a well-run, orderly school; the children enjoy being there. Microcomputers have contributed to making it this way -- at least for the most educationally handicapped. All of the 18 Apple computers were purchased with federal funds which designate that they are to be used only by students who qualify for Chapter One assistance. This designation is applied to students who are judged to be achieving at a level two or more grades below their placement in either math or reading. One-third of the 1200 students are so designated; for this reason they spend part of their school day in one or more of three special classrooms equipped with microcomputers.

The principal of Carver, Dr. John Jefferson, is quite supportive of the efforts to use computers as instructional aids. Dr. Jefferson is familiar with computers himself. "I have more than a nodding acquaintance with microcomputer uses and applications. I probably know about as much as any of the people (at Carver)." One teacher noted that he has even been known to fix them when they broke down.

Dr. Jefferson is concerned about the limitations on use imposed by the strict governmental funding program. "We have more imagination than you will see in the building. What is here is limited by the restrictions. Only Chapter

kids are able to get at the computers." When the first Apples came to the school, Dr. Jefferson had broader applications in mind. At that time he procured software that would be useful for applications beyond remediation. However, tight restrictions of purchasing and use were introduced the second year they had microcomputers and they have not been able to expand beyond that use since.

Uses of Micros

Most of the 18 computers are in the computer literacy lab where they are set in two rows facing a color monitor, overhead projector screen, and blackboard. The students work one or two to a machine and go through workbook tasks as instructed by the computer teacher. To the side is a single Apple connected to a printer. Often a student is working at it on more advanced word processing tasks for the school office. Because all the students are in the remediation program, the pace of learning in the lab is slow. Some students have trouble proceeding because they misspell words such as "color." But the students are all interested in the work, quiet, and very attentive to the instruction.

The second setting is a math remediation center. Here a teacher and five aides work with as few as ten students on basic math skills. Students are assigned approximately 15 paper and pencil worksheets each week to be turned in on Friday. In addition, they have related problems on the computer and are required to work until they get them correct. Many of the applications are in computer game formats to make it more interesting for the studer

The reading lab is similar in setting to the math lab. On one day 15 students were divided into five teams, each hovering around one of six computers where different programs were providing practice in identifying synonyms, antonyms, and parts of speech. Each was modeled after an arcade game. For example, in the synonym program a new word would appear in the middle of the screen and the student had to select its synonym from a "sky" full of words, move the cursor there, and "shoot it down." Score was calculated by the time it took to find the word and shoot it down. Students are so fascinated by the computer task that the teacher sits quietly at her desk. They do not even look up when strangers -- the case study observers -- enter the classroom and begin videotaping the activities.

Teacher Views

According to the teachers at Carver, the federal support has allowed them to do things which would not have been possible otherwise with students who are behind in basic

curricular areas.

The reading lab teacher was excited about what micros have done for student motivation and learning. "Textbooks are important," she reported, "but for slower learners the software provides so many more opportunities to help the students get the point. It provides repetition and a slightly different perspective on the material, and it does so while maintaining a high interest level. It's not just vocabulary drills; we have programs that help them with their reading: getting the sequence of ideas, details in the story, and drawing inferences. [The drills] help them see between the lines in stories. When I taught these things with 30 students it was very hard to hold the attention of any but the few I was questioning. Now they're getting almost individual attention on the same material." She is excited about what she currently has for hardware and drill-and-practice software, but is concerned whether sufficient resources will be found for other classes not in the special program. She also hopes that software continues to be improved. What would constitute improvement? "The speed of feedback is important; I like it when I can change it to suit the student. Another nicety is to be able to customize questions at the end to fit the specifics of what is being taught in the class."

Ms. Adams, who teaches the introductory computer class, said she rarely has a problem motivating her students to learn. "You can see that they have trouble. Some can't spell the words so we have to go slow. I'd like to do more but you can't. Still, they are motivated to learn, and the computers show them just how important it is to spell to do other things." Indeed, when we visited the class with our video cameras, the students were much more interested in what was going on in class than in our activities. Ms. Adams said, "It is not at all uncommon for kids to come in during lunch, before school, or during free periods to see if they can work on the computers. I've even had the high school kids come back because we have more here."

Ms. Adams was also frustrated over federal and state restrictions. "Most of the kids who would have the best chance to use the knowledge of computers are not allowed to use them. The program restricts it to slower learners, so the kids who might get a chance at a computer job in the future aren't able to learn or get motivated to learn now."

It is clear that, though frustrated by the limitations of access, the teachers involved in the program and the principal are generally encouraged by the potential for microcomputers in middle schools -- especially with the kind of students they serve. As Dr. Jefferson stated, "These microcomputers are valuable for the kids. [Computers] are the wave of the future, and these programs can and do help

them learn about them right now. It improves them, and moves them toward their potential."

Teachers outside the program share the perception that it is important for students to learn how to use microcomputers. George Chandler, a sixth- and eighth-grade social studies teacher for 17 years and at Carver for the last four years, said; "The kids should get exposed to microcomputers. They are awed by it, they are afraid of breaking it. Actually, it would be good if they could get started even earlier. They would be coming on even more; they would be more interested."

There were two themes in the remarks of these teachers. They recognize the importance of computers in their own lives. The difficult financial situation in the Iron City Schools, as well as in the broader community, has threatened everybody's job security. Shelley Davis started teaching eight years ago in language arts and social studies; today she teaches math. She captured the sentiment of many of the teachers interviewed. "Everywhere you go, whatever you do, there are computers involved. Students just need to know about it. I tell my students there are no factory jobs. Teachers are a dime a dozen. You've got to know a lot of skills to adapt to two or three jobs and computers are key in most of them."

The second theme is student motivation. Whether in or out of the remediation program teachers see how much computers contribute to classroom management as well as student learning. Noted an eight-year veteran of social studies and math, "I had a chance to take my class to the computer room at the end of one week. For three days I maintained order in my regular class by threatening to take away the privilege." He was equally impressed with what he anticipated computers would do if he had them in his own classroom -- even though he was unfamiliar with any particular software programs save a few math games. "I think they can help in any area. The computer motivates students and keeps them quiet, freeing me up to help those who need special attention. I watched one student doing a math computation drill set up in an arcade-game format. At one point I said 'You're learning math, you know.' The student shot back in all seriousness, 'No I'm not; I'm having fun.'"

The success of the remediation program has led many teachers not involved with it to assume that its apparent benefits should work for any curricular area. The principal suggested, "[Teachers] would have no objections if I came up with the money so they could get exposure and access to the machines, but again, we are stopped by the restrictions," Jefferson said. He added, "This summer, every field will have workshops in every subject area. As people get used to them, they will want to use them more, then the issue will

be resources. There are things available if you have the money."

The enthusiasm for micros is not universal. Mr. Chandler said math and language arts teachers are familiar with micros and therefore more supportive than might be the case in social studies, where "some might say 'fine' to the use, others would say no. Some would try it, maybe 50 percent, then others would follow, but there still would be some who would resist. You know, there are just some who have done things one way for a long time and it is hard to want to change."

The assistant principal noted that many of the teachers -- especially the 30- and 40-year veterans of teaching would be quite resistant. He suggested two reasons. The software content represents a threat to time-honored lesson plans. Equally important, they are very unsure how they would manage the classroom of 30 students. They have developed techniques for maintaining order in a class of 30 students by lecture, recitation, and seat work. What can be done with one micro? It is too small to be seen by 30 students. If a teacher were lucky enough to have three or four this would entail rearranging the classroom, and this might result in losing control. Could anything alter their resistance? "Show them how [the micro] can make their job easier." Start with teacher aids such as test makers and grade book managers. When it helps in their administrative work, the instructional uses will follow.

Support for growth in microcomputer use at Carver is linked solidly to money issues. Mr. Chandler owns his own microcomputer but would not bring it to school for security reasons. He doubts there will be funds forthcoming from the district, so thinking about the purchase of additional microcomputers is not very realistic. "I get eight dollars a year for all my supplies. You are talking about $1,800 for one of these [microcomputers]."

There is not much parent support for classroom use of microcomputers. "The PTO encouraged us to purchase an attendance program," said Dr. Jefferson, and the PTO gave them the funds for that. Mr. Chandler didn't think the parents in the Carver area would be familiar with microcomputers. They were not saying much to encourage use in the schools.

The future of microcomputer use at Carver (as everywhere) seems to hinge on money and the increased exposure to microcomputers by the teachers. Dr. Jefferson sees his role as "...giving the teachers the opportunity to get familiar with the machines. Then, they are going to look to me for the money to be able to use them." Dr. Jefferson was also concerned about the allocation of teacher time to instruct computer classes. "How is it going to work

if you have 50 students for each teacher?"

Mr. Chandler believes computers will be in Carver's future regardless. "There is a tool use with the microcomputer. I can't use a filmstrip except to teach. A computer will help the teacher with grading, organization, assignments. As long as he can use it, it will stay and there is a chance he will use it in the classroom."

Carver Middle School in Summary

Several generalizations can be made about the experience at Carver. Computers were first introduced to solve a management task -- scoring and recording hundreds of court-mandated reading tests every week. This use made many teachers and administrators receptive to computer use in other ways. Other schools now using micros for instruction had a similar history; some teacher or principal discovered that a computer could help with school or classroom administrative tasks.

The most prominent current application at Carver is drill-and-practice instruction in basic skills. According to Becker's national study, this is rare except in schools such as Carver with large numbers of predominantly black students. Here there is a strong feeling that the microcomputer is more helpful in remediating deficiencies than any other techniques they have tried. The similarity of the drills to arcade games is part of its magic for students.

The catalyst for such use was targeted government funding that made the purchase of hardware and software possible. But other necessary ingredients were a supportive principal who was enthusiastic about the potential of micros and a handful of teachers who were very receptive. For many of these teachers the motivation for learning about micros and using them with students is complex. Becoming competent with micros is an avenue for their own job security in a district with declining enrollments. But more than that, they hold the strong conviction that students do learn a lot from drill-and-practice work, and that this activity familiarizes students with computers. This can only help them in the future. Teachers believe that, for students whose parents are frequently laid off because of jobs held in American heavy industry, the key to employment of youth in the future lies in their being computer literate.

Teachers are also impressed with the way micros facilitate classroom management. The students are very orderly because they find the micros exciting. In this inner-city school there is great openness to electronic innovations in instructional software if only money can be found for machines. While the openness is not universal with many

teachers threatened by this unfamiliar tool, greater exposure and experience are likely to reduce the resistance.

Beecher Middle School: The 27 micros in this school are used in a wide variety of ways. Seventh graders are required to take an introductory course in computers. Many teachers incorporate micros in their regular classes in math, reading, and social studies. There is a special center for drill and practice remediation in basic skills. Active encouragement by the assistant principal and the presence of some teacher enthusiasts are important ingredients.

Middletown (population 21,000) is one of many small cities that border Iron City. Most families in the area are service or factory workers. Average incomes are very modest. There is a pocket of upper middle class families in one area of the city. The Beecher Middle School has 585 students; 95 percent are white. Fifty percent of the students are on a subsidized lunch program.

There have been computers in the school for the last four years. The first year they had only one; students used it mostly for games, and teachers to "play around" with and figure out how micros might fit in the school curriculum. The following year the school purchased another microcomputer and began using it for teaching purposes, placing it in the media center. For the 1982-83 school year, thirteen 10K Texas Instruments microcomputers (TI99) were purchased through district funding. Six more were bought with funds from the student council. These nineteen machines were placed in a computer lab.

This year they added six Apples which are used mainly as "floaters" in the building. Currently, one is in an administrator's office. There are two Apples in a math remediation lab and one in a reading lab or learning center. Another is moved from room to room and is often used by social studies teachers. A math teacher uses one daily to supplement instruction. He has set up a schedule which allows all his students to do math games. While two students are at work on the microcomputer, the teacher conducts the rest of the students in a typical math class format as if the computer was not in the room.

How the microcomputers are used, for the most part, has been left to the staff at Beecher to decide. Currently, every seventh grader must take 10 weeks of computer instruction in an introductory programming class. Ninth graders are allowed to take more advanced computer electives. When Beecher first started microcomputer classes there were only

electives in programming for upper grades.

There is another middle school in the district which combines with Beecher to feed one high school. Both middle schools have the same basic equipment, but the other school has lagged behind the development at Beecher. The use of microcomputers at the middle school level is not strictly controlled by the district. There is a district committee which works on software and like issues, but its activity is geared more toward the elementary schools. Although the high school is hooked into the district's mainframe computer through 21 terminals, little is done with microcomputers on the high school level.

Beecher's administration has changed in the last six months. While the new principal and assistant principal have been in the building for a number of years, both are new to their positions.

Leonard Morrison, the assistant principal, has been teaching in various curricular areas for the last 16 years. Two of those years he served as the media director at Beecher where he became familiar with microcomputers. Mr. Morrison has been very active in development of microcomputer use on the district level as well as at Beecher. Although he does not yet have a microcomputer of his own, he has one in his office at school and is able to take one home during the summer.

Other teachers are encouraged to use the school's microcomputers as well, and a few have taken them home. "The teachers who experiment with them are most often the ones to use them in class." says Morrison. "The district offers courses for the teachers and many of them have taken advantage of them."

According to Doug Frazier, the computer instructor at Beecher, five of the building's 33 teachers are familiar with microcomputers. "A lot of [teachers] are afraid of [computers]," says Mr. Frazier, "I have offered to work with them on uses in their classes. Some of them have said yes, but I've gotten no real response from social studies. I helped one math teacher develop a program for organized use in the classroom. He uses it every day."

All but one of the courses Mr. Frazier teaches is a computer course. Last year it was only a half-time position. Next year it will be full time.

Only two teachers (in the areas of language arts and social studies) were formally interviewed. They were chosen because of their lack of familiarity with microcomputers. Gary Hendrix teaches eighth grade history, English, and geography. He has been at Beecher for the last 16 years.

At one time he signed up for a district computer course but was unable to attend because the class was oversubscribed. He has not been able to take a class since because of coaching, teaching, and family obligations. Hendrix is familiar with the names of microcomputers but says he knows little more about them. One of his children is interested in microcomputers and may attend computer camp this summer. Mr. Hendrix acknowledges the role of computers in today's society and sees the importance of basic computer skills being taught in the schools. "Like all progress, the students should learn about it, if you can call computers progress. They will be around and grow in use, but I'm not sure you can call that progress."

Mr. Hendrix has some fairly strong opinions regarding computers. "I hate computers myself, I don't like them. I have found no great need to use them. I guess you could say I'm something of a traditionalist. I'm for order... Computers are just another part of the whole electronic media which are functioning to dehumanize our society. I don't like what it is doing. People end up spending less time together, talking together. I use a group approach. I don't want to separate the kids, I want them to work together. I suppose if you had 15 machines in each room you could do something with them because then you could work with the group. But with just one or two it can get chaotic."

While Mr. Hendrix's statements reflect his personal assessment of the overall state of society, he is not against teaching computer use. "People do need to have knowledge of what is going on in their world... I just think we are losing something of the values of the slower pace we used to live. It is dehumanizing. This is a hectic society."

He is interested in the possible uses for remediation in general. "I know there are programs in English [for remediation] and I suppose the kids could input data [for other uses]." But part of the problem as he sees it is "...you have the games and some of the basics but there is little to build on. Certainly, I use [noncomputer] games in teaching. Using computer games would probably be no problem, but having only one computer in a class doesn't help." He also sees a problem with varying levels of student ability. "The kids are in different tracks. It's difficult to isolate [the needs of each student]. I don't want chaos in the class. There is not enough room always for what you would want to do."

If there is an area that can be helped by microcomputers, it is strengthening basic skills, which Mr. Hendrix indicates is a concern of other teachers as well. "I don't think computers are a burning issue... If I was told to use

it I would, but I would have to have the right equipment and I doubt that would happen. The other teachers don't seem to be jumping at it either."

"Unfortunately, the parents in the area don't seem that concerned about educational aspirations." There is not much encouragement from home. "We gave forms on an inexpensive computer camp. Only six of my students even took them home, yet they will pay $20 to go to [an amusement park]."

Gary Hendrix, who is more concerned with doing a better job with the basics, does not see an immediate need to use computers in his teaching. While he personally "hates" computers, he is neutral on their use and instruction in school. He says the key to his using them well (if he had some) is "whether or not I know how to use them and have the right equipment. I need to understand them."

Jack Hall has taught at Beecher for the last 17 years. He is currently teaching ninth-grade English and social studies. He admits to having little knowledge of microcomputers, "...do you mean the little ones, or the [mainframes] we use in the district?" He had an understandable tendency to intermingle microcomputers with cable TV and film use, lumping several of the electronic media into one category.

His lack of familiarity does not translate into lack of support for use. "It is very important for kids to learn about [computers]. They won't be able to do much in the future without them." But he sees use more in terms of helping teachers with their teaching, "...for correcting tests, otherwise, I can't see any use for me, maybe some library work..." He has nothing against computers, but "I never had time to take the courses."

Mr. Hall thinks other social studies teachers might feel the same. "It's new, it takes time, they are used to doing things. They aren't opposed, but I don't foresee especially the older teachers being that supportive. The other teachers are at least as good if not better than other schools in their knowledge and support."

Computers have the potential of presenting much newer materials according to Mr. Hall. "I'm using a textbook dated 1973 right now. With these computers the material would be fresh, but it would take time for the teachers to keep up with it." He also thought computers would be useful as word processors for learning how to construct paragraphs and write letters. Again, funding was a factor. "Parents are willing to go along if they don't have to pay more taxes."

There are also negative aspects of computers in

schools. "This is not the best age bracket. They have this energy to work off... there will be a hard time getting them to settle down...also more likely to be vandalism, breaking it, at this age specifically."

Mr. Hall suspects the growth in use will not last. "It is like a fad; it will go back the other way the same as progressive education and the open classroom. It will level off, stay at the same basis, but only where it is valid." Critical to success is the availability of resource materials which Mr. Hall feels the administration has to work to get. "If you are going to go, you should go big... do it all, use everything available even if it is not accepted at first, if you are going to do it right."

Beecher Middle School in Summary

The intensive use of micros at Beecher is the result of active promotion by computer enthusiasts in the building -- in this case an administrator as well as a few teachers. For them the computer is serving an important role in day-to-day instruction.

The non-using teachers who were interviewed display responses seen in the other schools: modest interest even in the face of personal negative feelings about computers. Like other teachers they have yet to see software that can help in their particular courses. They also have difficulty envisioning how to manage a classroom with a microcomputer resource. The screen of a single machine is clearly too small to be a visual resource for the entire class of 30, and managing a class with two to four machines as resources is a novel idea for them.

In this school where hardware is generally available, two things would be needed to get increased use: teacher in-service that presents compelling software and which illustrates how to manage a classroom in which one or more micros are being used. Good models of effective management are available in adjacent classrooms of the same school, but some teachers never look inside a colleague's classroom. Teacher in-service can provide this view.

Hill Junior High School: Computer literacy and programming courses are very prominent in the curriculum; clubs and free time provide other opportunities for students. Most of the faculty are open, but very cautious about implementing computers in their own curricular areas.

Bayport is south of San Francisco and not far from Silicon Valley. Hill Junior High is a sprawling school built on the side of a hill overlooking the San Francisco Bay. Approximately 30 teachers serve a student body of roughly 580 students from both professional and working class homes. The school is truly multi-ethnic; 30 percent of the student body are Philippino, 25 percent are White, 20 percent are Asian, 12 percent are black, and 13 percent are Hispanic.

Hill students are energetic, polite, curious, and adolescently silly, demonstrating impressive accomplishments in both academic areas and in industrial arts. Jere Sloan, the industrial arts teacher, and Ellen Green, the mathematics and computer teacher, both commented on the motivation, energy and pleasantness of Hill students.

The Computer Lab

Normally, microcomputers are found in two places at Hill: the special education classrooms and the computer laboratory/classroom. The computer laboratory was created this year in a room that was previously used as a science laboratory. The lab occupies two classrooms separated by an accordion-like partition. The perimeter of the rear part of the laboratory provides room for a number of computers. Desks and tables in the center provide space for writing programs. There are currently two IBM compatible Olivetti desktop computers, six Commodores (three 4032s, two 4016s, one 8032) and five Apples (IIe). The front of the laboratory is a standard classroom with five rows of desks with six or seven desks in each row. The teacher's desk and reference library are at the front left of the room, and an overhead projector and wall-mounted screen dominate the front right side. File cabinets protrude from various corners. The front classroom is clean, crowded and efficient-looking, and the rows of desks contrast strongly with the sense of space in the rear.

Five years ago Ellen Green, the warm, outgoing, and efficient teacher who created the computer program at Hill, attended a summer National Science Foundation workshop. At

the end of the summer, Ms. Green returned to Hill with two Commodore computers. During the ensuing years she has written grant proposals and been allocated special project money to purchase more hardware. This year, she convinced the Olivetti corporation to donate two prototype computers. Although the number of computers has grown, Ms. Green still feels that more are needed, and looks forward to the day when she will be able to provide each student in the class with individual access to a computer.

Ms. Green expressed appreciation for the support the computer program has received from the principal. Before converting the science lab into a computer lab, she was forced to keep the computers in her regular math classroom. Not only did that crowd the room, it obviated the possibility that students could work on the computers while she was teaching math. Now, if scheduling necessitates, and a student shows the motivation and ability, it is possible to provide independent study during the three periods a day that Ms. Green teaches math. Students who have finished projects in other classes ahead of schedule, or who have free time for some reason can also come in and work on the computers.

Such usage during regular math classes, however, is rare compared to the troop of students populating the computer lab before and after school, and during lunch. Ms. Green opens the computer lab early, and supervises after school three days a week. Another math teacher takes over the after-school supervision two days a week. Some students spend all their non-class time in her room. One boy learned that Ms. Green was returning to the school for an evening meeting, and requested that she open the computer lab so he could work while she was at the meeting. Some students "hang out" in the computer lab in the same fashion that others gravitate toward the shop or the basketball court. The thirst of these enraptured students for computer wisdom seems insatiable.

The white, Asian, Philippino, black, and Hispanic students who live for (and in) the computer lab are not necessarily characteristic of the student body as a whole. Approximately 140 (out of 290) eighth graders enroll in one of the four semester-long computer classes given each year. A class in computer literacy and a class in computer programming are offered as eighth-grade electives. There is no prerequisite for the computer literacy class, but the programming class requires enrollment in pre-algebra or algebra. Students enter the classes with widely varying expectations. Many electing the computer literacy course expect to spend the semester playing games and are quite surprised at the rigor of the curriculum. The computer programming students have a better sense of what the class is about, and there is enough of a demand for the class that

Ms. Green can ensure that there are equal numbers of boys and girls in the class. (The computer literacy class is predominantly boys.) Some students who elect computer literacy the first semester take the programming class the following semester; most, however, do not, and these two classes generally serve different student populations. Once students have completed the computer programming course, Ms. Green has been willing to work with them individually, depending upon the mutual constraints of time and interest. One girl, after completing the computer programming course (which uses the BASIC language for programming), spent part of the following semester learning to program in Pascal with Ms. Green. When I asked the student about this, she did not seem particularly proud of her accomplishment. Instead, her sights were set on the next goal she had set for herself: "I want to learn Assembler [the language used internally by computers]."

The talents of Ellen Green and the accomplishments of her students have received frequent local recognition within the educational and computer communities. Her enthusiasm for computers, however, has not infected most of the other faculty at Hill. Perhaps 10 to 20 percent of the faculty are actively interested in using microcomputer technology in their classes. The teachers who were interviewed indicated that for the faculty as a whole, "there was no bubbling enthusiasm" and many teachers approached computers with "fear," "misconceptions," or "resistance." This lack of interest seems matched by a lack of familiarity with the current capabilities and future potentialities of microcomputers. While most teachers seem to support Hill's computer program in one way or another, they see little use for microcomputers in their own classrooms.

The Views of the Staff

The superintendent and board of Peninsula School District are strongly in favor of providing students with the opportunity to become computer literate. They have mandated the offering of elective computer courses in the eighth grade as well as high school computer offerings. Although some teachers view this support as faddish, the teachers who were interviewed did not doubt that the district would use whatever funds and other resources that were available to foster computer courses for students and training for teachers.

Frederick Moore, the principal at Hill is similarly supportive of the infusion of microcomputer technology into the curriculum. He sees programming and literacy classes as only the beginning, and hopes to encourage teachers to use micros for grading and attendance, word processing, graphics and simulations. He views his role as helping teachers to

see the utility of microcomputers: "The key is to get the teachers using them; they will cause the students to use them."

Mr. Moore is no blind enthusiast, however. He has yet to be convinced of the academic payoff of drill and practice software, and is wary of those who see computer assisted instruction as a panacea for all that plagues education. He notes that computer assisted drill programs -- like most other remedial programs targeted at basic skill acquisition -- may bring about temporary gains, but these gains are generally not long-lasting. At the same time, he believes that computer assisted drill with low-achieving students may have affective benefits in the areas of student self-concept and motivation. The use of computers for instruction must be kept in perspective: "They are just one of the many elements that help kids learn how to learn."

Mr. Moore's own experience as a vice principal, where he used the county mainframe computer for scheduling, grading, attendance, and general data processing, taught him the value of computers. He currently does not have access to a computer with sufficient capacity and software to take over the scheduling and other administrative routines at Hill, but he believes his own efficiency -- and that of his administrative staff -- would be considerably improved should such support be available. He is currently attempting to acquire a computer for administrative purposes.

Mr. Moore envisions the most important audience for microcomputers to be teachers rather than students, and considers the computer as a tool to help skilled practitioners teach better and more efficiently. He is looking forward to implementing an in-service program for the teachers in the school that will familiarize them with the benefits to be gained from computers, and would like to be able to place a computer in the classrooms of those teachers requesting one. He is well aware that it takes time to feel at ease with microcomputers; an effective in-service program must be "persistent, consistent, and continuous."

While the infusion of computer technology into the curriculum and classrooms of Hill Junior High is only one aspect of Mr. Moore's mission as a principal, it is one he is thoughtful about and takes seriously. He noted that for a schoolwide computer program to succeed, an administrator must believe that computers have potential value for instruction and management, and demonstrate this belief in his or her own behavior. Within the computer laboratory, the quality of the program depends on many things, including the skill of the teacher, a tradition of excellence, and the aspirations of those students in the course. Finally, Moore noted that the school does not function in a social vacuum, and if computer usage and knowledge is going to prevail,

then society must value and reward those individuals who are skilled in using computers.

A Science Teacher

Three teachers who expressed a range of views about the importance of computers at Hill and as part of the junior high and middle school curriculum were interviewed. Richard Bright has taught in the Peninsula District for 13 years. Most of this time his assignments have been seventh- or eighth-grade science courses, but he has also taught physical education and Mathematics. He is now finishing his fourth year at Hill. Richard is not personally familiar with computers, but he is acquainted with others who have purchased them. He has noted that these individuals generally show an initial flurry of interest in learning about their computers, and then their interest fades. This leaves him somewhat skeptical, and makes him wonder if personal computer usage is more fad than substance. He is sensitive to the ethical and privacy issues raised by computer data banks, and expressed concern that privileged information may too easily become public knowledge.

Mr. Bright feels that courses teaching computer literacy are a worthwhile part of the junior high school curriculum, but questions whether students benefit from learning programming. Pointing to the accelerating pace of technological change, he feels that the programming skills students learn as eighth graders will be outmoded by the time they enter the work force. Programming is also taught in high school, and he suggests that it might be more effective to teach programming at that point in a student's educational career. In junior high school, he notes, teachers are still trying to teach basic computational skills.

Mr. Bright spoke persuasively of the costs in personnel and material resources that accompany a computer program. First, mathematics teachers are usually called upon to staff the program. This diminishes an already scarce resource. Second, buying hardware and software requires large expenditures of money -- money, in his eyes, that might better be spent in other ways. Finally, because school enrollments continue to decline, and with declines in enrollments come inevitable staff layoffs, it becomes harder and harder to justify maintaining a computer program -- especially if this must be done while cutting back in other areas. "With declining enrollment, teachers have fewer choices and more pressure to teach out of their areas." Those teachers whose specialty is computers, like the rest of the staff, may be forced to reduce the number of computer classes they teach and increase their load in other

subjects.

Mr. Bright does not currently use computers in his life science courses, but can imagine their utility in providing drill and practice for low-achieving students, and enrichment for high achievers. Noting that it is necessary to teach to the "middle" student, Mr. Bright felt that this sort of supplemental instruction could be valuable. In addition, he could envision using a computer to access data bases containing the latest scientific information. This would allow the teacher to select and distill what was important for students to learn, and communicate it to the students. With new discoveries changing science so quickly, this would help the teacher to stay current, and would provide examples to students of how scientific knowledge grows and changes.

Using a computer for clerical tasks or for word processing was not seen as a high priority, and Mr. Bright questioned whether it would take longer using a computer than to do these things manually.

Given the above hypothesized uses, Mr. Bright noted that he did not need a room full of computers. Instead, several at the back of his classroom would suffice. He noted that the principal and the district administration were supportive of computer usage in classrooms and "money is available." He emphasized, however, that his <u>own</u> instructional purposes could be better served by spending money on specimens for dissection rather than for computer software simulating such laboratory work. Although not greatly familiar with what is available for life science instruction, he did note that what he had seen was "basic and primitive."

Mr. Bright's concern and commitment to the appropriate usage of that most scarce of all educational resources -- time -- was most apparent. His students needed basic skills, they needed laboratory experience, they needed to learn the order of nature. If computers could assist this process, he was willing to consider their usage. At this point, however, he felt his students could best be served by the instructional methods with which he was most familiar, and he was wary of taking time and resources away from these approaches.

<u>A Social Studies Teacher</u>

Bill Tithe has taught at Hill for 12 years; except for one year of teaching English, he has taught seventh- and eighth grade social studies in Peninsula schools since he began teaching in 1968. Currently he is chair of the social studies department, and the local representative of the

National Council of Social Studies.

Like the other teachers interviewed at Hill, Mr. Tithe is "not very" familiar with computers. He does not own one, but has played computer games. After having examined the software available for seventh- and eighth-grade social studies, Mr. Tithe has concluded that most material "we can do without." He supports the presence of the computer lab at Hill and the provision of courses in computer literacy. Their current status as electives strikes him as appropriate, although he doesn't feel that students should be able to graduate from high school without demonstrating familiarity with computers. At the junior high level, however, "courses shouldn't be mandatory; kids are still trying to learn to read and write."

In his own teaching, Mr. Tithe envisions the use of computers as tools to access data bases, produce graphics, and compile data. This year he required his entire eighth grade social studies class to complete the "Oregon Trail" simulation game. He feels the computer provides a valuable learning tool, and would like to call on the programming abilities of his students to develop appropriate software for his classroom. As yet, however, he finds students' programming skills inadequate to this task. Reflecting on the use of computers for drill and practice, Mr. Tithe commented that "the thrill is gone" and noted that computers are a "very expensive way" to teach basic skills. He feels that computers "aren't needed for drill, rote learning or quizzes," and suggests that he can do a better job than a computer program in directing necessary drill work.

Like Mr. Bright, Mr. Tithe raised the issue of whether it is sensible to allocate already scarce instructional resources to the utilization of microcomputers. The time students spend with a computer takes time away from other instructional activities. "There are 180 instructional days; a period is 50 minutes long. We are required to have five to seven days of testing. In the time that's left I'm expected to cover the entire US experience from discovery to Vietnam. In addition, I'm expected to spend nine weeks on the Criminal Justice System. Still, I took the time for all eighth graders to do 'Oregon Trail.'" The implication is clear: computer instruction must be valuable in its own right; more valuable, in fact, than what might otherwise occur.

Because Hill is limited in the number of computers available to students, Mr. Tithe had to organize his class in groups of eight to complete the "Oregon Trail" simulation and he had to coordinate this with Ellen Green. Although this was an awkward arrangement, it was feasible. Adding one or two more computers would not make this type of instruction any easier: "Adding one computer to a classroom

wouldn't help; I need 35."

If he were a rich man, Mr. Tithe would buy a computer for personal word processing. He spends summers writing curricula and papers he gives at professional meetings. He questions, however, the use of word processing in daily curriculum preparation. "We change so much (e.g., the curriculum changes qualitatively; it is not a question of incremental additions and deletions); I have a file cabinet full of materials . . . having it on paper seems preferable to having it on discs."

Mr. Tithe noted that there is no money currently available that is targeted for computer or software purchase. Other resources, however, are available. Ellen Green is happy to provide whatever tutoring teachers need to familiarize themselves with hardware and software. The Peninsula School District offers courses in computer literacy, and the local junior college offers more advanced programming courses. Social Education, the journal of the National Council of Social Studies Teachers, reviews software to help teachers select appropriate simulations for their courses.

During the interview, Mr. Tithe projected an openness to new approaches; at the same time, he was quite concerned that these instructional approaches be worthwhile. He did not see computers as glamorous or magical. Instead, they were tools to enhance instruction and make formerly inaccessible information accessible to students. Perhaps Mr. Tithe's friendship with Ellen Green as well as the location of his classroom across the hall from the computer lab had influenced his positive appraisal of the instructional potential of computers. In any case, both Mr. Tithe and Ms. Green expressed pleasure regarding the impact of computer simulation for the learning of social studies content.

An Industrial Arts Teacher

Jere Sloan is completing his first year of teaching Industrial Arts at Hill, and his first year in the Peninsula District. He previously taught Industrial Arts for seven years in Sweden, and taught briefly in other Bay area middle schools before coming to Hill.

Although "not excessively" familiar with computers, Mr. Sloan feels a "responsibility" to his students to include robotics in his shop classes: "The whole world is not doing work by hand; I want to show students where industry is heading." Although Mr. Sloan is "not very attracted to computers," and thinks that "in some ways they're like the boob tube," he is aware of their importance to kids. Currently "ignorant" of how computers work, Mr. Sloan will be

taking computer courses in the fall at a nearby junior college to expand his knowledge.

His wife uses spreadsheet and word processing applications in her work, and he envisions a place for spreadsheet applications in his shop classes. He requires students to estimate t' time and materials necessary to complete projects, a d expects that a computer would speed up the process o categorizing and organizing. Next year he is starting a drafting department at Hill, and he hopes to use a computer for graphics. If possible, he would also employ a computer for record keeping and word processing, but at this point he is unsure whether this is feasible. Calling it a question of "duty rather than interest," he expects there will be computers in his shop classrooms within two years: "The opportunities are there; it's up to me."

Mr. Sloan supports the computer literacy and programming courses at Hill, but he questions whether students who are not accomplished in math can succeed with computers. He would hope that all of his students, no matter what their intellectual ability, could use the computer in shop, but he is concerned that students' deficiencies in mathematics (which already make it difficult for them to estimate) will get in their way. Recognizing that for many students computer usage is equated with game playing, Mr. Sloan has yet to be convinced that computers are effective in teaching thinking skills. He is more sympathetic to their use in rote learning. "Learning is still hard work. Having a computer available does not necessarily accelerate learning."

Hill Junior High in Summary

No teacher who was interviewed was hostile to the computer literacy elective offered at Hill. Beyond this, however, their opinions varied. Mr. Sloan seemed most willing to make microcomputers a part of his curriculum; Mr. Bright was the most skeptical. All teachers expressed a concern with not wasting students' time with novelty, and providing content-based instruction that leads to learning rather than computer literacy. In one way or another, each teacher expressed concerns about computers taking time or money away from basic instruction. Implicit within the comments of these teachers was both professional respect and the expression of professional distance from Ellen Green. They both respected her curricular prerogative, and insisted on their own.

Teachers varied in their expected utilization of computers for drill and practice as a tool and as a clerical machine, but all of the teachers saw the computers as an adjunct to their basic instructional content and methods. Mr. Sloan and Mr. Tithe implicitly suggested that the computer

could be used for problem-solving; Mr. Bright saw it more as a tool for drill and practice, and to keep the teacher up to date. Their comments about the rest of the faculty suggested that the individuals who were interviewed were generally more open to computer usage in their classrooms than the bulk of the instructional staff. (This may be borne out by the fact that one English teacher with whom an interview was requested said that she was not interested in talking with me about computers.)

Hill Junior High appears to be a school with a (limited) lab-based computer program of local renown (Mr. Sloan: "From everything we hear, the students in the computer programming course are more skilled than most high school programming students"), a supportive principal and district administration, and a proximity to the microcomputer capital of the world. In spite of this, enthusiasm for microcomputer use is not exhibited by most faculty members, and some are reported to be distinctly hostile. As a result, it appears that an outstanding computer laboratory program is not as important in facilitating computer usage as the attitudes and experience of the whole school staff. This seems to be implicit in the comments of Frederick Moore and the in-service approach he hopes to implement. Currently, most faculty are either uninterested in or genuinely negative about microcomputer use; this does not differ among academic departments. The few who are interested -- the science, social studies, and industrial arts teachers -- are receptive, but have yet to see much software central to their particular curricular areas. The teachers' comments point to a belief that microcomputer usage is faddish, detracting from or inferior to traditional instructional methods, and complicated to implement. If the staff at Hill are representative of those to be offered the *SU* software, it may be best to target dissemination efforts to the few teachers who already use computers in their instruction. Otherwise, the press for content and basic skill coverage felt by most teachers may overwhelm implementation efforts.

PART III
MICROTRENDS AND *SOLUTIONS UNLIMITED*

The Snapshot in Spring, 1984

As of the spring of 1984 more than two-thirds of the nation's middle schools and junior highs have one or more microcomputers. The dominant use of the machines is in an experimental computer literacy course. The school may have had a token machine or two for a few years, but the acquisition of sufficient machines to have an articulated program for student use probably occurred in the 1983-84 school year -- perhaps one year earlier. The particular use being made of them is likely to be the result of initiatives made by one or more "product champions" or computer hobbyists on the staff, aided by a supportive administrator. The most common use of machines is for an introductory course about computers. The courses vary in content, but all of them familiarize students with how to operate the machine (e.g., insert a disk, load and run a program, clear the screen, and enable the printer). Beyond this the courses vary widely in how much they teach about the uses and applications of computers in society, and how much programming is taught. The courses last anywhere from two to twenty weeks. Other types of use -- drill and practice, word processing, or other tool uses are very rare, except in schools serving large numbers of underachieving minority students.

The staff in computer-using schools are almost universally supportive of making students computer literate -- teaching them about computers and even teaching them a limited amount of programming skills. More ambivalence is expressed on the issue of using micros as an instructional tool in various subject matter areas. Lack of sufficient equipment is one reason offered, but ignorance and lack of experience are given as equally important reasons. Few teachers own a micro or even know how to use one. Almost none of them were exposed in their teacher training. They have not seen teacher aids such as grade book managers or test construction programs. Similarly they haven't viewed useful software for their subject area, whether it be drill-and-practice programs, simulations, or tool software such as word processing and data base managers. School administrators and boards of education are insisting that computers be objects of instruction; but few have urged their teachers to use them as tools for instruction.

Another reason for their ambivalence is the challenge that micros pose to existing instructional routine. Many years of experimentation and practice have resulted in tried-and-true lesson plans and well-honed classroom management techniques. Lectures, recitations, seat work, and occasional small group projects have worked smoothly over the years to maintain classroom order among 25 to 30 students. These teachers wonder where they would put just one machine if they had it. Could it be used with the whole class like an overhead projector or movie? If only a few students use it at a time, which ones would it be? The micro and its software is not just another workbook or text; when it is used as a tool -- as a word processor, for example -- it is a novel educational tool. Little wonder, then, that faculty can feel positive about training the next generation to be familiar with the new technology but ambivalent about using it themselves.

Moving to the Future

Micros are here to stay. The meteoric rise in school acquisitions will continue because computers are deeply imbedded in the fabric of American business, commerce, and entertainment; they promise to become even more so. Parents, administrators, and teachers alike believe that being familiar with computers is important for survival; it's proving so in their own lives and they want today's youth to be prepared for a world that's permeated by the microprocessor.

However, the use of micros in middle schools is going to change. Today the most common use is in a unit or course on computer "literacy." As the term implies, it is designed to give students minimal skills in operating a machine, acquaint them with applications of computers in society, and teach them rudimentary fluency in a computer language -- usually BASIC. More and more this type of literacy is being provided in elementary schools, or students are learning it at home. In communities where this happens the middle school computer literacy course will disappear.

Schools vary in how much programming instruction they provide. All of those visited include minimal exposure, but many schools go well beyond. Those with lengthier introduction-to-computer courses devote the majority of the course to BASIC programming; others have a separate semester-long course as an additional elective. This emphasis on programming will change for two reasons. For the computer to be useful it is no longer important for a user to "program" it. The most useful applications are available as software for purchase. These "canned" programs perform the desired operations much more elegantly than programs developed by a novice programmer. The cost of software will

decline rapidly in the coming years through more economical distribution and -- for school districts -- low-cost licensed distribution of multiple copies. A second reason is the recognition that programming as a vocational skill is best taught at the high school level -- a point closer to entry into the job market. Programming languages are evolving and elementary skills in BASIC will not long be considered useful.

One factor could change this prediction: if research should show that the process of planning, writing, and debugging computer programs is a good vehicle to teach general problem-solving skills to students, then a course in programming could be justified at the middle school level. Early results from on-going research do not suggest that this is likely.

If the most prominent uses of micros are going to disappear, what will drive their expanded use? A variety of applications will probably prove too attractive to do without because they motivate the students, they provide important instruction, and they help teachers manage the classroom.

Wherever micros are being used they have an intrinsic fascination for students and teachers alike. This is not lost on teachers and administrators who appreciate what it can do to add variety and interest to what is otherwise a fairly unexciting and predictable daily routine in schools. In the inner-city school where we observed micros in use with low-achieving students, micros captured student attention and, according to teachers' reports, built important skills in computation, identification, and discrimination. While the effects were most obvious with students in need of basic skills remediation, a similar phenomenon was observed in classes composed of students achieving at average levels. There is an almost universal expectation among teachers that drill-and-practice software exists that will help them in their classes, no matter what the subject matter. When the programs are found, and if there are sufficient machines available, teachers will delight in using them.

We observed a few avant garde teachers using micros as tools to enhance their instruction. For example, in an algebra class studying linear equations, students entered their formulae and the results were displayed graphically as a check. It is apparent that a few teachers are using word processing programs, data base management programs, and spreadsheets in imaginative ways in English, social studies, math and science. With these tools the challenge to adoption is greater; they require that teachers manage the classroom differently. Word processing challenges the supremacy of the pen and pencil. What can be done if there are only one or two machines available? Which students

enter or edit their text first? Using data base management programs may be a creative way to get students to enter and retrieve social science data like real social scientists, but the middle school curriculum calls more for learning the facts of history than drawing inferences from raw data.

A third way micros can be used is as a tool for teachers and administrators. Teachers who use them to manage their gradebooks; format, print, and store their tests; and edit their memos to students and parents find the machines more useful than any other instructional aid to date. Instructional television and overhead projectors can augment instruction, but they cannot help the teacher in classroom administration. Administrators are finding that the same micros, equipped with many of the same software tools, are helpful to their jobs as well. Word processing is the most obvious, but spreadsheet and data base management programs help with budgets and inventory. Other programs alleviate class scheduling problems. It is the utility of micros to the managers of instruction that will keep this device in regular use and demand in the school.

Barriers and Facilitators

This optimistic scenario will not proceed in all schools at the same rate. Adoption and implementation depend on several enabling conditions. Clearly a school must have sufficient numbers of machines with the capabilities to take advantage of the most popular software. The definition of "sufficient" is relative. It depends on the flexibility and creativity of staff. It depends on teachers being given a vision of ways to use just a few machines with many students. Most teachers tend to think of computers in one of two ways: like movie projectors, one of which is sufficient for an entire class, or like pencils, which must be supplied to each student in a class. While one micro or 30 can be useful for instruction, there are many configurations in between.

Whatever the "sufficient" number is, it is larger than most schools currently have. Securing additional machines is an interesting interplay between "product champions" who create a demand, and creative administrators who figure out ways to add to budgets funds for hardware and software that may be larger than long-standing line items that are being cut in these lean times.

The key to getting sufficient ferment in school buildings is exposure and training of teachers and administrators. Where a small number of computer enthusiasts were found in our case-study schools, many things were happening. Most important, the natural processes of contagion were reaching those who were not naturally disposed to

micros.

The popularity of courses about computers may initially hinder but ultimately help expanded instructional uses of micros. On the one hand it identifies micros with a single specialty such as math, science, or even computer science. On the other it gets micros into the school, permitting teachers in English and social studies to see the machines and observe the positive response of their colleagues and of students.

All districts seem disposed to support workshops for teachers at which participants are introduced to computers and their educational potential. The creators of *Solutions Unlimited* should be able to get their software demonstrated as part of such workshops. Given the paucity of exciting software at the middle school level we predict that *SU* will be welcomed. Efforts should be made to have workshops specifically for middle school teachers. It would also be useful to get one or more teachers per district to implement the software as a "lighthouse" project endorsed by the language arts or social studies curriculum coordinators.

While we predict initial enthusiasm for *SU*, special teacher training should be offered which deals with several kinds of issues. It is known that teachers in the curricular areas targeted for *SU* are least likely to find the computer to be a natural ally. They need to be made comfortable with the machine itself. Additionally, almost all teachers have difficulty imagining how to manage a classroom with a micro. It would be useful to show a videotape of teachers using *SU* with different classroom configurations. Most importantly, the ultimate value of *SU* lies in its ability to enhance children's skills in self-initiated problem solving. The experience with *ThinkAbout* and with other problem-solving curricula suggest the need for a number of special teaching and management skills. It is not clear exactly what these are for *SU*, but the last part of this report describes a likely set. The teacher training should explicitly focus on such skills.

PART IV
TEACHER STRATEGIES TO CULTIVATE STUDENT PROBLEM SOLVING[1]

This part of the report deals not with getting *Solutions Unlimited* (*SU*) adopted by teachers, but rather with helping adopters use it effectively. *SU* is an attractive set of software. For those teachers disposed to teach problem-solving skills who have a chance to preview it, and who can secur access to a microcomputer, *SU* is likely to sell itself. But if the lessons of other curricular efforts in problem solving apply, more than adoption will be required. For students to learn the "lessons" of *SU* and become better problem solvers, teachers must structure the classroom environment and activities to be consonant with the principles of *SU*. Students must have repeated opportunities to practice solving problems in the daily interchanges of classroom life. Teachers must be conscious of how they can extend the lessons of *SU*.

A case study of a teacher promoting problem solving is included in this report to provide a sense of what this different type of classroom organization and management might look like. The subject matter taught by this teache. is computer programming -- a subject widely perceived to entail problem solving. The subject is not *SU*, because at this point the materials have yet to be used in their entirety in a class. But the arallels should be obvious.

In many ways, all classroom work completed by students is problem solving. Students have the problem of writing essays in English class, solving computational problems in math classes, and mastering the problems of pronunciation in French class. It is thus not unreasonable that any teacher in any subject might profess to be teaching students how to solve problems. Although it is obvious that schoolwork consists largely of problems to be solved by students, it is also obvious that some teachers are more skilled in teaching students to solve problems in a creative, s f-motivated and industrious fashion. Our intent in this section is to portray the way in which one extraordinary teacher, Ellen

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[1]We owe a tremendous debt of thanks to Ellen Green for her participation in this project. Thanks also go to Dr. Ellen Mandinach for her comments on an earlier draft of the description of Ms. Green's teaching.

Green, attempts to foster autonomous problem solving among her students. Although the specific problems to be solved are concerned with computer programming, we believe that Ellen's expectations, instructional strategies and the effective climate she establishes in her classroom can be emulated by teachers in other subjects.

Fostering Problem Solving

As noted in the case study of Hill Junior High, Ms. Green teaches two semester-long classes focusing on the computer: Computer Literacy and Computer Programming. In the first course she covers the history of computers and their role in society; teaches students about algorithms, the binary code, and the order of mathematical operations; and gives them hands-on experience with graphics, word processing, LOGO, and other applications programs. She also discusses elementary programming, but her goal is not to develop programmers: "I want the majority of students to be able to tackle software, to use query languages, and to be comfortable with different types of computers. They should know about the ethics of computer usage. But most importantly, I want students to be able to solve problems and see the computer as a problem-solving tool. I want them to say, 'Hey! Yeah! I can do it.'" She covers these topics in traditional lecture format, and gives students problems to solve that involve the computer. When students are not solving computer problems, they are busy with "thought problems."

Her Computer Programming class revolves around gaining the procedural tools and analytical skills necessary to solve programming problems and to work out the solutions. "I expect students to be able to solve every problem I give them, to learn how to break a problem down into workable parts, and to learn how to think. I want students to learn that they can do things themselves with a computer; I want them to be in control. I want them to say, 'Nobody else did this; I taught this dumb box to do what I wanted.'" To attain these goals, she relies on the traditional methods of lecture and hands-on experience with the computer.

Ms. Green also teaches courses in computer programming at the local junior college, using many of the same lectures and assignments she employs in her junior high classes. She makes this transition easily because she demands the same intellectual autonomy and maturity from students of all ages. Before setting foot in the classroom, Ms. Green has a clear set of learning goals for her students. Every class she teaches, be it mathematics, computer programming or computer literacy, is oriented toward making students autonomous problem solvers. She has, in fact, thought of changing the name of the Computer Programming course to

"Problem Solving."

In the remainder of this section we portray Ms. Green's approach to teaching by considering the expectations she holds for student behavior, learning and task accomplishment; the instructional strategies she uses to operationalize these expectations; and the affective climate she establishes to nourish student achievement.

Expectations for Students. Ms. Green takes her work seriously and expects her students to do the same. Although displaying a sense of fun, she does not tolerate misbehavior. She expects students to engage with assigned work in a motivated manner. She expects them to know the rules of her classroom and to follow them. For the most part, students meet these expectations. Before the bell rings, students are in their seats with their homework out, ready to begin the correction ritual. Stragglers are prodded and chastened: "Homework out, passed behind you. Come on! I don't know what the problem is. Let's go." When the inevitable misbehavior does occur, it is dealt with in a rapid, serious and businesslike manner without interrupting the instructional flow: "John, I don't know what you are doing, but if you don't stop I'm going to take it away. Number three . . ."

Ms. Green expects students to learn independently. Her role is that of the resource of last resort. She first expects students to try to work out problems by themselves, then with other students, then by consulting books and program documentation, and finally by asking her. These expectations for independent work are communicated to students, and have their effect on student behavior. Two students in the Computer Literacy class were stumped on a difficult LOGO problem that had been assigned. They talked with each other and tried various solutions, erasing one and then going on to the next. After five or 10 minutes of effort, they still could not direct the turtle where they wanted it to go. Finally, one boy said to the other: "Let's put some of this on the screen so she'll know we've been working, and ask Ms. Green." The implication is clear: Don't ask Ms. Green unless you can prove that you've tried to get the answer by yourself.

Ms. Green believes in the ability of her students -- all her students -- to solve the problems she gives them. She acknowledges that some students work more quickly than others, but she does not feel that any problems she assigns are impossible if students apply themselves seriously. She allows students to take varying amounts of time to finish the work she assigns, and uses different instructional strategies to help students as needed. She maintains the common expectation, however, that students can accomplish the work she assigns. During the Computer Literacy class,

she was assigning students to computers. She called out two boys' names and like a coach in a tight game gave them the following charge: "I'm going to give you 15 minutes to complete the LOGO assignment, and you're going to do it!" As if emerging from a football huddle, the boys chorused: "Yeah!"

Ms. Green is a tough grader with demanding expectations for student performance. The criteria with which she evaluates student task performance are comprehensive. When grading student programming assignments she considers: (1) the appearance of the program on the screen while it is running; (2) the efficiency with which it performs its function; (3) the internal structure of the program; and (4) the appearance and structure of the program when it is written out. She also examines programs for the spelling, grammar, and syntax of displayed words. She does not allow students to skip assignments or use shortcuts: with "thought problems," all work must be shown. Similarly, with programming assignments, students must write out a program, trace its functioning, and debug it before entering it in the computer. She communicates these expectations clearly to students, and it is this combination of rigorous and clearly communicated criteria that affects student academic performance. Students, whose course grade depends upon meeting her expectations, take Ms. Green's standards seriously. Although expecting students to succeed, she acknowledges that not all will. Despite her best efforts, there will be five (out of 35) students who receive grades of D or F each semester.

Instructional Strategies. Like all teachers, much of Ms. Green's time in class is spent disseminating information, assessing students' comprehension of this information, and fielding student questions. She employs an overhead projector as well as the chalkboard in her lectures, and prepares handouts to summarize necessary information. Her teaching is distinguished from that of other teachers, however, by the specific instructional strategies she employs in her lectures and when talking individually with students.

When introducing new content, Ms. Green always ties it to what has been previously covered. In this fashion she helps students to extend their previous knowledge structure to incorporate new bits of information and relationships between information. While lecturing, she carefully defines and explains new principles, and then emphatically focuses students' attention on the principle necessary to solve a problem. By focusing on principles and relationships, and reminding students of this focus, she makes students aware of thinking strategies that can be applied to solve problems. While explaining a problem involving the order in which multiple mathematical operations are performed, she

told the class: "I want you to remember that multiplication is communicative, so you can multiply in either order. Multiplication is communicative." Problems are solved not merely to reach a solution, but to learn the principles and relationships that allow the solving of further problems. Rather than ends in themselves, problems are merely the vehicle through which advanced thinking skills can be explained, tested, and internalized.

Ms. Green spends much of her lectures going over examples of how to analyze, understand, and solve problems. In the process, she models the thinking behaviors she wants students to develop. By providing explicit examples of these cognitive processes, she communicates her goals for student learning in the most direct way possible. "More than half of what we do in the Computer Programming class is program tracing," in which students examine programs line by line in order to understand the steps a computer would perform if it were so programmed. She calls on students to explain examples verbally, thus checking their understanding at the same time she provides models for correct thinking. She does not generally call on the students who first raise their hands ("volunteers"), but spreads her questions around the class to ensure that everyone participates. By using this questioning strategy, she serves notice that all students are expected to pay attention.

When giving assignments and discussing programs, Ms. Green takes pains to clarify (1) the goal of the task, and (2) the cognitive procedures which are appropriate and inappropriate for reaching this goal. Students are told what they are expected to learn while completing a task as well as the specific procedures they need to employ to complete it. At the same time, procedures not to be employed are recounted. In the Computer Literacy class, Ms. Green led an antiphonal chorus asking the class a string of questions about the steps that could and could not be taken to solve a problem ("Can you use a 2?" "No!" "Can you use five 4's?" "No!" "Can you use four 4's?" "Yes!"). In the Computer Programming class, she stressed repeatedly that students were NOT to use certain types of programming statements and were to employ others on one assignment. The effect of these admonitions is to focus students' attention on what it is important to learn while ensuring that they are not sidetracked by erroneous or unrelated solution procedures. Ms. Green is similarly clear in managing the completion of tasks: "This is your homework; it is due tomorrow at the end of the period."

Like many excellent teachers, Ms. Green shows a love of the dramatic. Her voice soars and varies in tone and intensity. She delights in teaching and capitalizes on any opportunity to create a memorable scene. Students in her Computer Literacy class were required to write algorithms

for everyday activities. The adequacy of these algorithms was then tested in the classroom. One of the assigned algorithms was the making of a salad. Ms. Green brought in salad makings, and the student who had written the algorithm read it out loud while she followed the instructions. Near the end of the demonstration the student read, "Pour salad dressing on the greens." Since no indication was given of the amount of dressing to be used, Ms. Green did as commanded and emptied into the bowl a bottle of salad dressing, which splashed out and onto the table and the floor. Students learned, in a memorable and dramatic fashion, that computers have to be told everything relevant to the performance of an action.

When working with individual students, Ms. Green also employs a number of specific instructional strategies. A number of these -- which can also be used in a lecture format -- concern the ways in which Ms. Green responds to students' questions. In the first place, she answers as few questions as possible. She does this to force students to grapple with problems by themselves instead of turning to others for solutions. The "10 Minute Rule" is always in effect during class: students are to work on assigned problems for ten minutes before asking her for help. When help is requested, Ms. Green does not answer questions directly. Instead, she uses a Socratic questioning strategy to help students recognize the information and strategies they need to answer their question independently. When asked, for example, why the computer screen did not clear, she parries the student's question with one of her own: "What's the first thing a computer needs to know if it is going to do that? Did you tell it to do that?" Not only do such responses direct responsibility for students' learning back on the students, they orient students so they can use their own knowledge to solve problems. At another point, a student asked Ms. Green for help in drawing a figure with LOGO. Her response was to take the student back to his own experience, and examine step-by-step what he had already accomplished so that he could find his error and try new ways of approaching the problem. In both cases, rather than removing the responsibility from the student and providing answers to the problem being raised, Ms. Green directs the student's attention so that he/she can use his/her own knowledge and experience to solve the problem. Another way Ms. Green responds to students' questions is to break the problem down into smaller steps. In so doing, she simplifies the problem by distorting it. Students can often solve smaller problems and then combine them to tackle larger ones. Finally, Ms. Green strives to make the abstract -- and necessarily difficult -- concrete. This is done through constant reference to examples during lectures, and by having students use their own bodies when they are stumped with the angular demands of LOGO. After several attempts one students still could not write a program that

would cause the turtle to draw a figure and then copy it after rotating the axis 90 degrees. After discussing what the student had done, Ms. Green asked him to stand up and then held his shoulder while he pivoted. As he made each quarter turn, Ms. Green asked him how many degrees he had turned from his starting place. The student sat down and completed the problem.

Although demanding independent thought, Ms. Green is not scornful of students who need to ask questions. It is worth noting here that Ms. Green always encourages students to try out their solutions -- no matter how preposterous. She seems to discriminate the act of arriving at a solution from understanding what is necessary to solve a problem so that the solution may be made elegant. When two boys were stumped on a LOGO problem and asked her whether their proposed solution was correct, she replied, "Try it. You can always erase it." Implicit in these remarks seems to be the conviction that playfulness and unconventionality may be necessary ingredients in problem solving.

Affective Climate. Without question, Ellen Green demands a great deal from her students, and they meet these expectations with good humor and serious effort. Students work hard for her, and correspondingly, she works hard for them. If students are to learn how to think on their own using the computer as a tool, they must have the opportunity to do so. Ellen opens the computer lab each morning at 7:00 a.m. Three days a week, she keeps it open until 5:00 p.m., and another teacher staffs it the remaining two afternoons each week. Although Hill Junior High has regularly scheduled supervision of the computer lab during lunch time, Ms. Green is often there as well, talking with students. Because of her availability, and the obvious effort she expends helping students and preparing coursework, students do not seem to feel that her demands are unreasonable. They know Ms. Green will help them, as long as they are taking responsibility for helping themselves. The affective climate that emerges is one where hard work is valued, but is also seen as something that is necessary. Students are expected to work hard; this is an unstated classroom rule. When they do work hard, however, it is their accomplishments -- not just their efforts -- that are recognized and rewarded. Often, teachers who have high standards for their students' performance are considered unreasonable or unfair. Ms. Green is recognized as a hard teacher, but because she makes herself available before and after school to provide help, students do not consider her demands unreasonable.

An extremely outgoing and friendly person, Ellen Green's interactions with students are characterized by warmth and concern. She celebrates students' successes with an infectious enthusiasm. She calls out the names of students who succeed in solving problems and gives them a

cheer: "Yea! Susie got it!" Her praise reiterates their own accomplishments, and recognizes their own capabilities: "See, if I give you enough time, you can do it." When a student solves a tricky programming problem, she will drop what she is doing and run across the room to watch the program "run." When it is time to assess students' work, she views the programs with an attitude of appreciation and involvement, reading the text out loud, and commenting on the graphics. When she sees something she likes she makes note of it. Other students gather around Ms. Green and the author of the program to watch and comment on the student's solution to the programming problem. Students take pleasure in each other's work, and appreciative comments are often heard as the graphics appear on the screen. Once more, Ms. Green has modeled the behaviors she wishes students to exhibit.

Ms. Green's grading standards discourage students from handing in work that is incomplete or poorly done. She recognizes, however, that final products do not spring full-grown from a student's mind. The path to success is littered with mistakes, and Ms. Green makes it known that there is nothing wrong with making them. She encourages students to monitor her own work on the board and point out errors. She told one student, "OK, Jimmy. You can challenge me any time. I make lots of mistakes. There are no halos in this class." The implicit message here is not merely that mistakes are OK, but rather that they are a necessary part of learning that one must move beyond. It is all right for a student to be wrong; it is not all right for a student to stay wrong. Students are expected to spend time going beyond their initial forays.

Summary: Teaching Problem Solving. Teaching is one of the most complex of occupations, and it is unrealistic to conclude with a list of dos and don'ts for facilitating students' problem solving. We believe, however, that three general guidelines can be formulated, and that these can be simply stated:

- Maintain high expectations for student performance, and communicate these expectations to students;
- Require students to find solutions on their own rather than relying on others; and
- Provide an emotionally supportive atmosphere where accomplishments are celebrated, and mistakes considered a first step toward success.

Different teachers with different styles can elaborate on these guidelines to best accord with their own instructional methods.

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VIDEOTAPE CONTENTS

Micros in the Middle School, 1984
Jerome Johnston and Richard Luker
June, 1984

Tape 1: How Micros Are Used in the Middle School (35 mins.)

Introduction: micros are a recent phenomenon in middle schools; current uses are varied and will evolve as schools get more experience with micros.

1. The most common use: computer literacy lab. Teaching a course in computer "literacy" in a self-contained laboratory -- usually a classroom that has been converted to a secured area capable of housing 5 to 20 micros.

2. An alternate: a computer literacy unit as part of an existing class. It may last one or two weeks and is most frequently incorporated into a math class.

3. Remediation. An inner city school in which many students have problems with basic math and reading skills. Interview with math remediation teacher; views of math remediation lab, reading remediation lab, and computer literacy lab.

4. Classroom applications. Math instruction utilizing the micro as part of the lesson; an interview with a teacher describing how she would use a micro in her social studies class if she had one; a math class in which the micro is used for supplementary math activities at the same time ordinary teacher-led instruction is proceeding.

Tape 2: Faculty Perspectives at Central Middle School (80 mins.)

Introduction

1. How micros are used at Central.

2. Interviews: value of computer literacy instruction for middle school students; applications of microcomputers to regular instruction; perceived support for more micros; future of micros in education. Interviews with: (a) computer

literacy instructor and science teacher (she's fami iar with computers); (b) English and social studies teacher (familiar); (c) math teacher (familiar); (d) English and social studies teacher (unfamiliar); (e) social studies teacher (unfamiliar); (f) principal (familiar).

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INTERVIEW GUIDES

PRINCIPAL INTERVIEW

We are exploring the views of middle school staff regarding the use of microcomputers. Your opinions will help local, state, and national groups plan to meet the needs of middle schools.

1) What grades and curricular areas have you taught? How long have you been at the middle-school level in this district?

2) How familiar are you with microcomputers? (PROBES: Do you know how to operate one? Do you own one? Is there one available to you at school? Do you use one in your work?)

3) Some schools have chosen to teach students about computers in a separate class. Here students may be taught how to operate a computer, how to program a computer, or they may study how business and society are utilizing computers. Do you think this type of instruction is important for the middle school/junior high student?

4) Microcomputers can also be used as part of instruction in regular curricular areas. Do you think they could be helpful? In what ways?

   a) (PROBE) One way microcomputers are used is for drill and practice. This is when programs are used which drill students on factual information related to the course. For example, there are programs to drill computation skills, parts of speech, and names of states and capitals. Do you think drill and practice programs would be helpful in different curricular areas?

   b) (IF YES) With whom would you use it -- with all students, with lower or higher ability students?

   c) (PROBE) Another way microcomputers are used is as a tool; this is when it is equipped with software which facilitates other learning activities in class. One example is word processing software to aid in composition and revision of text. Would this type of use be helpful in different curricular areas? How?

d) Are there any other ways a microcomputer might help in your job?

5) What differences by curricular area are there in attitudes of teachers toward microcomputer use? For example, are there different attitudes in math and English? Think about all of the teachers in an area, not just those who have expressed an interest in computers.

6) Getting new materials for instruction often depends on the support of a number of other individuals or groups. How supportive would you estimate each of these would be if you wanted to get more microcomputing into the middle school: The teachers in the building, parents, central administration, the school board?

7) Do you think microcomputers are a fad that will disappear or will they become a regular part of middle school instruction in the next 10 years?

8) What is your role in the development of computer use in teaching at the middle school?

9) Given enough funds and equipment, what is the difference between success and failure in a middle school microcomputer curriculum?

TEACHER INTERVIEW

We are exploring the views of middle school staff regarding the use of microcomputers. Your opinions will help local, state, and national groups plan to meet the needs of middle schools.

1) What grades and curricular areas do you teach? How long have you taught at the middle-school level in this district?

2) How familiar are you with microcomputers? (PROBES: Do you know how to operate one? Do you own one? Is there one available to you at school? Do you use one in your teaching?)

3) Some schools have chosen to teach students about computers in a separate class. Here they may be taught how to operate a computer, how to program a computer, or they may study how business and society are utilizing computers. Do you think this type of instruction is important for the middle school/junior high student?

4) Microcomputers can also be used as part of instruction in regular curricular areas. In your curricular area do you

think they could be helpful? In what ways?

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b) (IF YES) With whom would you use it -- with all students, with lower or higher ability students?

c) (PROBE) Another way microcomputers are used is as a tool; this is when it is equipped with software which facilitates other learning activities in class. One example is word processing software to aid in composition and revision of text. Would this type of use be helpful in your curricular area? How?

d) Are there any other ways a microcomputer might help in your teaching?

5) If you wanted to use microcomputers more in your curricular area, what would it take to get sufficient machines, software or training for you and your class?

6) Getting new materials for instruction often depends on the support of individuals or groups. If you wanted to get more microcomputing into your curricular area, how would each of these groups respond -- would they be actively supportive, neutral, or resistant?

a) other teachers in your subject area
b) other teachers in the building, but not in your area
c) the principal
d) parents
e) central administration
f) the school board

7) Do you think microcomputers are a fad that will disappear or will they become a regular part of middle school instruction in the next 10 years?

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