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AUTHOR Hoachlander, E. Gareth
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ABSTRACT

The county education office of Mendocino County, California, serving nine school districts and 11,800 elementary and secondary students, began planning for computers in 1979-1980, purchased two central computers, and by 1983 had one computer or terminal for every 40 students in the county. The county was characterized by its very enthusiastic administrators and by their willingness to experiment and make mistakes. It successfully focused its initial efforts on using computers to improve administration and special education. An evaluation visit to four of the districts revealed that most districts used computers for administrative purposes but that computer instruction was growing. Elementary schools offered some programming and many high schools offered computer literacy, word processing, and programming courses. One alternative high school offered an extensive program of creative computing including music and graphics generation. Despite tight economic conditions, the county managed to find funding for computers from state and federal sources, grants, and discretionary funds. The county spent about $1,000,000 for hardware and software from 1980-1983 and decided to budget $175,000/year to maintain the equipment. The effect of geographical isolation on the desire for information was seen as significant to the county's successful move to computer use. (SB)

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YOUR OWN RISK

Computer Technology in Rural Schools: The Case of Mendocino County

by

E. Gareth Hoachlander

MPR Associates, Inc.
1950 Addison Street, Suite 102
Berkeley, California 94705

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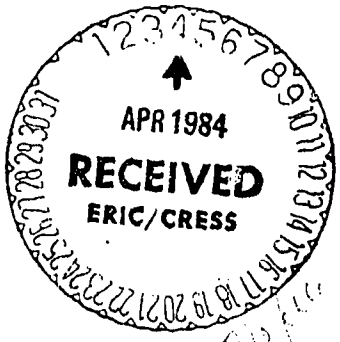

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A group of juvenile offenders demands more time in school; a sixteen year-old teaches her mother a new skill that helps her find employment; fourth and fifth graders learn to think more logically and systematically, while high school students explore the power of a new high-level language; a high school embarks on a program to provide a workstation for every ten of its students. What do all these events have in common? They are but a few of the results of introducing computers into elementary and secondary education in Mendocino County, California.

The Mendocino County Court School is a residential school for about 30 juvenile offenders who, for one reason or another, have run afoul of the law. Poorly motivated and lacking good study habits and basic educational skills, most of these youngsters do not do well in the traditional classroom. Their education is further complicated because their stay in the court school may last as little as a week or more than a month. Many are repeat offenders, passing in and out of the school many times during their high school years. Designing a curriculum that will capture their attention is no mean task. All the more remarkable, then, that last year the students petitioned their teachers for an extra hour of school. They wanted more time on the school's six Atari microcomputers.

Forty-five miles southwest in the tiny coastal town of Point Arena, a sixteen year old student, having learned BASIC in the high school's computer science program, taught her unemployed mother how to program, and she in turn landed a position teaching computing to first and second graders in the town's elementary school. Another teacher's aid, whose primary love is computer-based musical composition, works with students in grades three though six.

Further up the coast in Mendocino, a class of fourth and fifth graders begins a six-week course in BASIC on a cluster of seven TRS-80s that during the year have been moving through the school from classroom to classroom like a wandering medicine show. Michael McDonald, a computer enthusiast hired as a teacher's aide, moves with the computers, and introduces both teachers and students to the fundamentals of computer programming. He emphasizes that it is not programming per se that is the objective of the course but rather the rigorous thinking and problem solving abilities that programming requires. Across town, in the district's novel and controversial alternative school, a small class of high school students explores the intricacies of FORTH, a new high-level computer language that may some day become as common as BASIC and PASCAL.

Still further north in Fort Bragg, the high school uses an

Alphamicro mini-computer with 11 terminals, one Apple and an IBM PC to teach six sections of computer technology to nearly a fifth of the school's 450 students. In addition, the school employs two Apples in its business department courses, and its special education program relies on two Ataris for help with spelling drills, math, capitalization, typing, and computer games.

Back inland in Ukiah, the district has embarked on an ambitious program to make computing routinely available to every student in the elementary and high schools. At Ukiah High School, with a total enrollment of about 1,600 students, there are already more than 100 classroom terminals (mostly Apples clustered on hard disk systems) with 50 more slated for purchase next year. In short, by the opening of the 1983 school year, the school will have one computer terminal for about every ten students, a ratio enjoyed by few other schools in the country.

Why is it that one finds all of this activity in Mendocino County, a rural, sparsely populated region about two hours north of San Francisco? To be sure, not all has gone well with educational computing in Mendocino County, but these districts and their county office have developed programs that would be the envy of any other school system in the country. To find out how they have done it, what problems they encountered, and what they plan for the future, we spent five days visiting the County

Superintendent's Office and four of the county's nine independent school districts. What we found will prove useful to other schools struggling with how to use computing more effectively.

SOME GENERAL BACKGROUND

About equal in size to the state of Connecticut, Mendocino County encompasses over 4000 square miles that range from rugged coastal mountains to fertile valley farms and vineyards. Officially, lumber products are the number one industry, followed by grapes, pears, and tourism; unofficially, marijuana tops the list, and during the recent economic recession that sent the market for lumber products tumbling, it provided a major economic mainstay begrudgingly welcomed by even some of the county's more conservative residents.

Ukiah, the county seat, is the county's largest town, numbering about 13,000. Located 120 miles north of San Francisco on US Highway 101, it is separated from a number of small coastal towns by a mountain range that greatly inhibits transportation and communication. Thus, Point Arena on the county's southwest coast is an hour and half away by car, as are Mendocino and Fort Bragg, despite the fact that they are less than 40 miles distant as the crow flies. Piercy, the northernmost town in the county, lies over 70 miles north of Ukiah.

The county's population of about 70,000 is a hodgepodge of oldtime loggers, farmers, and vintners and newcomers that include artists, writers, maverick intellectuals, rural entrepreneurs, retirees, and an odd assortment of escapees from the various movements of the 1960s. The Round Valley Indian Reservation occupies a large chunk of the northeastern part of the county, and there are a number of smaller reservations in the coastal mountains. All of this diversity stirs the usual amount of controversy and craziness that has come to be associated with California. The Reverend Jim Jones of Jonestown fame got his start in Mendocino County, and reputedly a Hells Angels' burial ground for the victims of assassinations lies up in the hills outside of Ukiah. But the diversity also breeds a great deal of ingenuity, energy, and tolerance that allow creative things to happen.

The public schools have benefited from this creative energy. Organized into nine independent school districts serving about 7,800 elementary and 4,000 high school students, the schools are usually small, enjoying informal administration that encourages experimentation and change, both administratively and in the classroom. Thus, the county pioneered a self-insured health plan and a program that allowed employees to bank sick leave that can be loaned to others or redeemed for extra pay.

Mendocino Unified School District was one of the first districts to take advantage of the state's new independent study program, and, along with the Point Arena district, it has used creative forms of contracting to create alternative schools.

The county office is particularly strong, perhaps because in a county where almost all of the districts are too small to provide specialized services, the county office can do collectively what none could do individually -- from overseeing special education services to coordinating joint purchases of supplies and equipment. Whatever the reason, the county office figures prominently in the development of computing in the schools, and its efforts provide a good departure point for our story.

PLANNING EDUCATIONAL COMPUTING

There are some 1,040 independent school districts in California, each with its own superintendent and board of trustees. Additionally, each of the 58 counties operates a county board of education, headed by an elected superintendent and county board of trustees. The county offices oversee the administration of state education funds and provide a number of administrative services such as payroll and accounting. In the more rural counties, where most districts are too small to operate

specialized programs efficiently, the county office has responsibility for administering such programs as special education and vocational education (through Regional Occupation Programs and Centers). The county office, therefore, wields considerable influence. Local districts, however, enjoy much autonomy, especially over the regular school program, and technically could choose not to deal with the county office at all. Under these conditions, planning any educational undertaking is a lengthy process of pushing, prodding, negotiating, backtracking, and otherwise moving forward in small, incremental steps.

The Mendocino County Office recognized these constraints. In 1979-80, as it began to prepare a plan for computer education, the office had a number of external factors going for it -- over half of the county's districts had new superintendents eager to make some changes -- but the primary reason for its eventual success rested on an internal decision: the office decided to concentrate its planning efforts on what it could control and disregard what it could not. This decision freed the planning process from quixotic forays after objectives that, while abstractly desirable, could not practically be achieved. For example, while a number of valid reasons could be advanced for carefully planning and coordinating local districts' acquisition

of microcomputers -- compatibility of hardware and software, ease of maintenance, quantity purchase discounts, and so forth -- the fact was that local districts were free to purchase whatever they pleased. If a teacher demanded an Osborne instead of an Apple, a TRS-80, or whatever other model the county might judge the most desirable, there was very little the county could do to dissuade the choice. Besides, determining the relative merits of the various microcomputers on the market was not clear cut, and there could be advantages to diversity.[1]

Instead, county planners, with technical assistance from the Far West Educational Laboratory, directed attention to areas in which the county had real influence. Four functions emerged as the primary vehicles for introducing computers: administration, special education, regional occupation programs, and the media clearinghouse. Initially, the plan concentrated on the first two. Federal and state special education programs had generated substantial new paperwork, and there was a growing need for a management information system that would keep track of special education students and satisfy various reporting requirements. Combined with other local administrative functions such as

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1. The county office did not completely ignore microcomputer purchases. In 1980-81, it organized the purchase of 50 Atari computers for classroom use, using the combined purchasing power of several districts to obtain a more favorable purchase price.

budgeting, attendance accounting, class scheduling, grading, and general word processing, the purchase of sophisticated systems could be justified.

The decision to focus on administration to the exclusion of curriculum was made quite consciously. The county planners believed strongly that if administrators came to value computers, classroom uses would follow easily. In their estimation, computers would "force better management," changing sloppy organizational procedures and requiring a new precision in the collection, reporting, and use of information. For example, improved attendance accounting, which determines state and local aid, might alone produce additional income sufficient to justify the new computing systems. Further, they envisioned computers bringing a regimen to certain tasks that, while important, were easily ignored or performed perfunctorily because of the tedium they involved. In this vein, the county undertook the development of software to assist special education teachers with writing the Individualized Education Programs required by state and federal law.

In 1980, specifications were sent to major manufacturers, and in 1980-81, the county installed an Alphamicro computer and terminals in each district office and began a lengthy process (that continues today) of training district personnel how to use

the equipment.[2] County personnel conducted sessions in computer literacy for teachers and middle managers. They trained system operators, and gave classes in word processing and the capabilities of data base management.

The first year was very tough going, and the remarks of many of the county personnel involved in implementation reveal an interesting mixture of frustration, pride, and perseverance. "We prodded and we pushed." "We identified a person in each district with enthusiasm for the project." "We forced computers down their throats." "The computers gave schools a sense of participating in the future." "We wanted to decentralize knowledge about the budget." "We wanted to impose a form of decision-making that wouldn't tolerate impulsiveness or ambiguity." One local administrator responsible for attendance accounting recalled the first few months of implementation in her district:

> I was violently opposed to switching over to computers. Looking back, I'm not quite sure why, but it seemed like such a major change and I didn't think it would work. Now [two years later], I can't imagine doing it any other way. One person now does what three or four did before, and much more accurately.

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2. The Alpha Micro computer is a powerful machine. It belongs to that class of computers costing between $20,000 and $30,000 that are neither micro nor mini. They are capable of handling 10 to 15 users simultaneously without much drop in performance.

Not every district in the county, however, has been won over. In one, the Alphamicro has been relegated to a closet where it now sits unused. "It makes too much noise," was one explanation given to county staff for the district's unwillingness to use the equipment. Some districts have been slower than others to automate their offices, and some of the Alphamicro computers have been put to use in the classroom rather than the office -- not always the most efficient way to use these powerful machines. Nevertheless, with the one exception, the machines are being used, and in each of the districts visited, staff are experimenting with ways to use them better.

County planners readily acknowledged that they made mistakes and have yet to solve problems that limit more effective computing. Thus, within the county office, there is a dual, wholly independent computing system for business purposes, relying on a Hewlett-Packard mini-computer with separate terminals in each of the district offices. This system is not compatible with the Alphas, limiting somewhat the advantages that might have existed with a fully integrated system. However, county staff maintain that internal organizational problems -- one senses that this means interdepartmental rivalries and turf battles -- made it virtually impossible to seek a fully integrated system and that had they pursued that aim, they would

still be haggling over system specifications. As it is, there is an administrative system in place, with certain limitations but functioning and generally well accepted by local staff.

There is an important lesson here: pursuing the "perfect system" is an elusive, never-ending quest that will leave the user with nothing rather than the ideal system that meets all one's present and future needs. The technology of hardware and software is changing so rapidly that it is impossible to buy a system that is fully up to date; waiting for the best possible system is to wait indefinitely, because the technology is constantly getting better. "At some point, you simply have to take the plunge, accepting that you haven't gotten it completely right," said one county administrator. Planning, therefore, must concentrate on finding ways to maintain options (especially for expansion) rather than defining a detailed final course of action that, with some practical experience using computers and with changes in technology, may make little sense in one or two year's time.

To give them as much flexbility as possible, the Mendocino County planners chose hardware with interchangeable parts and boards. The county has the equivalent of an entire machine that it uses for spare parts when a computer goes down. Rather than try to repair a computer on site, the malfunctioning part is

simply replaced and then sent to the manufacturer for service. Similarly, the county has paid careful attention to using structured modular software and insisting on complete documentation and ease of use from its own programmers so that the county's computer operations do not become dependent on any one programmer.

At the local level, planning has mirrored this incremental, iterative approach. Two characteristics stood out in those districts having the greatest success with computers. First, in the districts and schools with the strongest programs, there was a very strong commitment to computing on the part of the administration -- either the superintendent or the principal. While much has been made of the enthusiastic teacher (and we met many of them) as a way to initiate computer education in the classroom, we repeatedly observed that little happened outside their own classrooms unless the principal took an active interest in promoting computing throughout the school. Moreover, without such support, those few teachers using computers quickly become isolated, and in some cases grow bitter, as resentment and misunderstanding grow among the rest of the teaching staff that, for one reason or another, are unable to use computers in their own classes. Similar, although less pronounced, problems existed in districts where superintendents were unenthusiastic about

computing.

It is worth noting that this administrative support for computing in many cases was nothing more than a kind of simple faith that "computers are here to stay in education, and we need to learn how to use them effectively." In a few instances, some more general educational objectives underlay this outlook -- for example, "making every child comfortable with computers as a tool," or "taking advantage of the computer's power to teach logic and problem solving." Nowhere, however, did it require a well articulated plan for how computers should be used in education. Indeed, the second characteristic of the more successful efforts was a clear understanding that there is no single "right way" to use computers, either in the classroom or administratively, and that a great deal of trial and error is required to use computers effectively.

This willingness to experiment and make mistakes with computing struck us as especially important, if for no other reason than these days it takes courage. If schools fail "to get it right" with computers, their mistakes open the door to one more attack on the competence of educators and their ability to teach and manage effectively. Two factors feed this intolerance for error. First, in the computer euphoria that has swept the country, it is difficult for the general public to believe that

there could be all of this activity if business did not know exactly what it was doing with office automation and other aspects of the computer "revolution." The schools, therefore, ought to be able to follow suit. Yet the proliferation of self-help guides, as well as the rapid growth in firms consulting on business computer uses, should be ample evidence that the private sector is struggling with computerization as much as the schools.

A second factor inhibiting schools' effective use of computers has been created by the education profession itself, or at least by its community of thinkers and researchers. All too often, in the rush to promote their own view of how computers can best be used in education, they find it necessary to denigrate all other uses. There is no better example of this second phenomenon than the current derision of "drill and practice," which for its milder critics is simply mindless, uncreative use of computers but for its more vehement attackers is a pedagogical disaster that will turn our children into unthinking regurgitators of Pavlovian-induced facts. Similar attacks have been leveled at computer gaming and strategies that use computers as rewards. Amidst such claims and counterclaims, it is easy for educators to become paralyzed and eschew computing altogether.

A more appropriate response is to recognize that different

uses are appropriate under different circumstances. Thus, drill and practice have proven helpful for slow learners who have problems mastering subjects that require memorization -- vocabulary, math, symbols, punctuation, capitalization rules, and so forth -- and whose motivation may suffer as a result. For these students, the computer provides immediate feedback, is infinitely patient, does not get angry or judgmental, and can generally hold the attention of these students longer than the typical classroom teacher. Similarly, games have proven very effective ways to introduce both children and adults to computers, and there is good evidence that even games like PAC-MAN provide an excellent means for improving eye-hand coordination. Games also can be used to simulate various social, political, or economic behavior and involve students in solving complex problems. Recall that the Defense Department takes computer gaming very seriously.

The key, then, is the ability to experiment and a willingness to make mistakes. In several districts in Mendocino County, we found both factors at work, with an extraordinary openness to outside criticism and advice.

COMPUTER USES

On the average in 1982-83, there was one computer or

computer terminal for every forty students in Mendocino County, and in some schools the ratio was much greater. Compared to national figures indicating that in 1982 there was one computer for every 400 students, this ratio of computers to students is quite remarkable.[3] How are they being used?

Of the four districts we visited, Mendocino Unified School District had been using microcomputers the longest. There, in 1978, two middle school teachers organized a magazine sale to finance the purchase of two TRS-80s. The sale produced about $3,500 and has become an annual event. The first two TRS-80s formed the beginning of a computer lab that four years later had grown to about 10 machines for the school's 205 students. In addition to being used for introductory courses in computer literacy and advanced courses in programming, the computers are also used to produce the school's newspaper and to provide other opportunities to become familiar with word processing.

In the elementary school of about 400 students, 9 computers are being used to teach BASIC programming. The school has experimented with a number of approaches to making these

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3. National Center for Education Statistics, "Instructional Use of Computers in Public Schools," Washington, D.C.: National Center for Education Statistics Fast Response Survey System, September 7, 1982.

accessible to teachers and students. Initial attempts at placing one in each classroom proved unsatisfactory. The ability of teachers to use the equipment varied greatly, and one computer for 25 or so students failed to give students sufficiently concentrated time on the machine. The school also rejected creating a computer lab and instead settled on an approach that places a cluster of 7 machines in one classroom for six to eight weeks and then moves the cluster to another classroom for a new six to eight week period. The school employs a local computer enthusiast as a teacher's aid, who moves with the machines and instructs both teachers and students in basic computing.

In the classroom we visited, the machines were arranged in one corner of the room and set off with a moveable partition. The teacher's aid worked with groups of seven students in thirty minute sessions, while the teacher carried on other activities with the rest of the class. Such an approach requires considerable flexibility on the part of both students and teachers, but in this classroom, which was only on its third day of its eight week program, both the computing and the regular classroom activity went forth with extraordinary ease that belied the considerable thought and organization that had gone into planning the day's activities.

The decision to teach BASIC to elementary school students

was made quite carefully and consciously. The school harbors no illusions that it is training future programmers or that BASIC per se will be a particularly useful tool throughout these students' educational and professional careers. Rather, teaching BASIC provides a means to teach students logic and systematic thinking in a way they find exciting. Programming is problem solving, a skill that will last a lifetime even though programming languages and techniques change.

It is worth noting that the emphasis on programming greatly simplified this school's needs for hardware and software. All the major machines on the market -- TRS-80, Atari, Apple, Commodore, and so forth -- provide BASIC for their simplest systems. For introductory programming, cassette tapes provide inexpensive (if sometimes tedious) storage. Therefore, investment in disk drives and color monitors, which would be necessary for running more sophisticated software, can be avoided or postponed.

At the high school level, Mendocino operates two schools, a traditional high school and an alternative school, the Mendocino Community School, that is immediately adjacent. The Community School is a private corporation with which the district contracts to work with students who have great difficulty making it in the traditional classroom. Many have dropped out and would not

otherwise be in school were it not for the school's efforts to seek them out and encourage them to give school a chance in a radically different environment. A number are very gifted but are tempermentally unable to sustain any interest in regular school activities. Classes in both schools are open to all students, although during our brief visit, it was impossible to determine how much movement back and forth actually occurs.

The alternative school makes heavy use of technology to interest and motivate students, and the school is very well equipped. In addition to computing equipment, the school has its own recording studio and a wide array of video equipment. The school emphasizes advanced programming, as well as graphics and musical applications. With this emphasis on creative computer applications, the school is well ahead of most other high schools.

These gains, however, have some costs. Among the few students and staff we talked to, there was a kind of specialized intensity that was at once intellectually stimulating but also somewhat withdrawn. Just as these students do not feel comfortable in the conventional classroom, most students at home in the more traditional setting would probably not be comfortable here. Thus, the school exhibits an educational style that is somewhat threatening to other teachers and parents. Among

several of the teachers we talked to in the traditional program, there was jealousy over the alternative school's success at obtaining computing equipment, as well as some distrust about its ability to use it effectively.

In the regular high school, the district's Alphamicro computer does double duty as an administrative machine and as the classroom workhorse for the school's business department, where it is used to teach wordprocessing. In addition, the school operates a Resource Center that relies heavily on microcomputers for teaching and administration. The Center is responsible for competency testing in reading and math and placement of students in remedial, regular, or advanced programs. The Center maintains a number of software programs for individualized, self-directed skill development in reading and math and uses an Osborne computer to keep track of students' progress on math and language competencies.

The high school and the small district office both rely heavily on computers for administrative purposes. Staff at the Community School have developed a School Information System that maintains student registration, class schedules, class directories, grading, and report cards. It provides routines that print class lists, standard mailing labels, and student transcripts. It also computes student grade point averages. An

attendance package keeps track of daily attendance, processes excused absences, and prints attendance reports. In the district office, staff rely on the computer for virtually all word processing (the IBM Selectric, once the mainstay of the office, sits covered on a table far across the room from the secretary's desk) and have also developed a spreadsheet program for preparing the district's budget, using an Osborne.

Osborne portable computers have proven very popular throughout the district. Teachers and administrative staff are encouraged to take the computers home, and one administrator who has no electricity in his home carries a battery pack that permits him to use the computer at home. This relaxed approach to letting staff become comfortable with computers in their own way and at their own pace has worked well in Mendocino. While the district enjoys the talents of some very skilled computer aficionados, most of the teachers and staff now using the computers had no prior computing experience. That so many are now enthusiastic users is a tribute to very effective management throughout the system.

The three other districts we visited were not as far along as Mendocino, especially in classroom computing. In Ukiah, the high school's offices are fully automated, using the district's Alpha minicomputer donated by the county. Under the auspices of

the Regional Occupational Program (ROP), the high school offers an introductory computer science program to about 135 students. The program acquaints students with computer hardware and then moves quickly into getting students to use the computer. The course covers disk and storage organization, disk operating systems, word processing, some light programming, spread sheets, data base management, and data communications.

Ukiah's school board recently established standards that beginning in the 1983-84 school year, will require all students to take a semester of typing and a semester of computer science. With 100 classroom terminals already installed in the district's new high school and 50 more slated for installation by fall 1983, the school will have one terminal for every ten students.

In Fort Bragg, the high school operates an ROP similar to that in Ukiah. Begun in midyear in January 1982, the program got off to a poor start when the teacher left after only one semester, citing frustration with discipline problems and a long commute. For the 1982-83 school year, the school hired a new teacher who moved up from the San Francisco Bay Area. Using the Alphamicro supplied by the county, he organized a course in computer technology emphasizing basic computer literacy, word processing, programming, and data base management. In addition, the course required every student to complete some job searching

competencies, including preparing a resume on the word processor, completing a job application, and participating in a mock job interview. With no prior teaching experience, this teacher readily acknowledged that he was barely staying ahead of his six sections and 108 students. He expects things to go more smoothly next year, when he will have the benefit of a year's experience and a complete set of lesson plans.

The principal of Fort Bragg High School noted that while the ROP program has filled an important gap in the school's curriculum, it has also created some difficulties. The courses are popular and drain students from other electives. In a schoo where enrollments are stable or declining, this creates problems with what to do with tenured teachers in other electives. Decisions can lead to morale problems and turf battles, and indeed in Fort Bragg High School, there is some evidence of this. The regular vocational business program competes with the ROP program for students and offers its own computer instruction. With only two Apples for over 100 students, however, it is less well equipped, and one senses some envy of the ROP with its eleven terminals and two independent microcomputers. Under these conditions, a principal must maintain good communication with staff and develop sound rationales for allocating very scarce resources.

The Fort Bragg High School also uses computers in it special education program for 30 mainstreamed students. Computerizing special education has been given high priority by the Mendocino County Office. It has provided one Atari 800 with a disk drive to every special education teacher in the county, and most districts have supplemented these with one or more additional units. Fort Bragg's two Ataris are used constantly during four periods of special education for spelling practice, drilling in math, capitalization, typing, word games, logic and deductive reasoning exercises, hand/eye coordination, and entertainment. The special education teacher reported that the computerized spelling bee was one of the few approaches that worked when all else had failed.

Meanwhile, the County Office has nearly completed a twelve month effort to develop software that will enable special education teachers to prepare Individual Education Programs (IEP) on the computer. This program allows teachers, with the student and parent present, to develop an IEP by selecting relevant objectives from a detailed computerized inventory organized by subject (mathematics, reading, spelling, and so forth). For example, objective number 77 in the mathematics area states that the student "will recongize that a fractional number greater than 1 may be expressed as a mixed numeral." Number 82 states that the student "will add unlike fractions where one of the

denominators is a multiple of the other." The program permits the teacher to set a date by which an objective is to be achieved and establishes the criterion for determining success (for example, a score of 80 percent of better on a worksheet testing the particular objective).

In developing the IEP with the student and parent, the teacher simply informs the computer (by number) what objectives have been selected. The computer then produces a printout that lists for each area of the curriculum the annual goal, short term objectives, achievement criterion, and the date by which success is sought. A copy is produced for the parent, and the entire IEP is stored on the computer so that the status of each objective can be monitored. The program eliminates the tedium from the preparation of the plan, allowing the teacher, the student, and the parent to concentrate on developing very specific program objectives. Within a year, the county hopes to have refined the program so that it will also identify resource materials associated with particular objectives.

The county office provides a similar kind of support to local districts through its Instructional Materials Center, which has been building a library of computer software. Additionally, the Center has established a system for evaluating software. In return for free software, teachers are asked to evaluate new

programs purchased by the county. These evaluations are then made available to other teachers interested in a particular software package. Because it is difficult to obtain trial copies of software programs, this centralized system of evaluation eliminates much of the duplication that would occur if districts had to purchase and test software on their own.

The importance of this kind of support from the county office was reflected once again in Point Arena, the smallest of the districts we visited. There, the schools are organized as two districts, an elementary and a high school, with two boards and a single superintendent. The elementary district consists of four schools, two of which have fewer than 30 students. The high school has only 150 students. A district this small would have a difficult time developing computer applications without outside help.

The county has supplied an Alphamicro with four terminals that are used for both administration and teaching. It has also provided two TRS-80s for the continuation high school (a special school for 22 students who have dropped out of the regular high school), and the ROP has provided 8 microcomputers to supplement the Alpha Micro in the district's computer science program. Next year, the district has budgeted for the purchase of four more micro computers and a smaller Alphamicro that will free the

larger machine for administrative use only.

Like other districts we visited, Point Arena has not been satisfied with dividing use of the Alpha between administration and the classroom. Not only does the practice raise potential security problems, but also students are prone to crash the system, disrupting daily office functions. In some cases, this is accidental, but for many students, crashing the system is great sport, a challenge to their computing skills. While a systems crash also disrupts classroom routines, getting the system back up and devising ways to prevent future crashes have some instructional value that make the disruption more tolerable if it is not affecting other school activities. Therefore, each of the districts we visited is moving as quickly as possible to separate classroom and administrative systems.

As in the other districts we visited, most of Point Arena's experience with computing is very recent. It began in 1978-79 when two high school teachers, one in math the other in social science, became interested in computers and enrolled in a correspondence course with the University of California Extension. When the Alphamicro arrived in 1980-81, they began offering two courses, one concentrating on programming and the other on word processing and accounting. The county has since provided additional training, and the district continues to

expend considerable effort and money on in-service training.

Obtaining good training in Point Arena is especially difficult because the closest state college is about two hours away in Santa Rosa. The district successfully sought state grant money to reimburse teachers for expenses incurred in driving to Santa Rosa for computer education classes, but this is small compensation for a round trip drive of four hours, usually at night over roads that are often foggy and treacherous. To relieve such problems the county is developing training programs on video tape that can circulate among the districts. Each district has at least one video tape machine, because these are used to back up the Alpha Micro computers -- another small but important detail in the county's computer planning.

This kind of "seat of the pants" approach to learning about computers and computer education will no doubt horrify steadfast proponents of credentialing, but Point Arena's superintendent, Clarence DePew warns that "state requirements on computer credentials could ruin rural districts." With relatively small total resources and limited staff, they need as much flexibility as possible in staffing for effective education. Point Arena's elementary school is an excellent case in point. There much of the responsibility for introducing students to computers rests with two people hired as teacher's aides, one taught by her own

daughter who learned programming in the high school's ROP course. In addition, the school organized a workshop for parents in which the school offered to teach parents how to use the school's Atari computers in return for the parents agreeing to come into the school and teach children. Six parents stuck with the program in the first year.

We witnessed this kind of innovative problem solving time and again throughout our visits. None of these districts is particularly wealthy, and some, such as Ukiah, are among the lowest spending in the state in terms of expenditures per pupil. The reader will be wondering, therefore, how all this activity has been financed. To that topic we now turn.

FINANCING COMPUTING

Since the passage of Proposition 13 in June of 1978, California's schools have been subjected to intense fiscal pressures. In 1968-69, California ranked 13th in the nation in current expenditures per pupil; by 1981-82, the state had slipped to 35th. In terms of education revenues as a percent of personal income, California ranked 9th from the top in 1973-74; by 1982-83, the state had slipped to 50th. From 1974-75 to 1981-82, during which the California Consumer Price Index rose more than 90 percent, revenues for the general elementary and secondary education program rose only 72 percent. To restore the purchasing power enjoyed by California's public schools in 1974-75 for support of the general education program (excluding categoricals) would have required $2.1 billion in 1982-83, 25 percent more than the $8.4 billion actually spent. Schools in Mendocino County have not been exempt from the effects of this fiscal squeeze. How, then, have they managed to undertake such a substantial program in administrative and classroom computing?

No other aspect of financing computing in Mendocino County is more important than the existence of federal and state categorical aid. With a few exceptions, almost every computer in the county has been purchased with funds available through state

and federal special education programs, the federal Vocational Education Act (VEA), the state's Regional Occupational Program, or some other source of special purpose revenue. Similarly, grants have been the major source of funds used to support in-service training and software development. According to one high school principal, "Many districts don't trust the claim that automation will save money. Introducing computers isn't an easy thing to do. Consequently, most boards are unwilling to commit general purpose funds to initiate computing." The availability of discretionary, categorical funds, therefore, has provided the necessary wherewithal for Mendocino's schools to develop their computing programs.

From 1980-81 through 1982-83, the County Office spent approximately $1 million to purchase the hardware and software used to automate special education and other administrative functions. The office is currently spending about $175,000 annually to maintain its computer operations. With a total annual budget of about $7 million, these amounts represent a substantial commitment. Although precise figures were unavailable, county officials estimated that about 75 percent of the funds used for equipment purchases came from special education revenues. Revenue from the county's general apportionment funded the remainder and now also support operating

expenses.

Federal VEA funds and the stat -funded ROP have been the major sources of funds for purchasing computers used in the classroom, especially in the high schools. Technically, this means that the equipment must be used in programs that have a clear occupational orientation, limiting somewhat the schools' abilities to introduce computers into other parts of the curriculum, such as English and math.

In Ukiah, the high school has been able to achieve a much broader coverage throughout the curriculum mainly because a portion of the bonds used to finance construction of the high schools was reserved for equipment purchase, including microcomputers. This bond money that has enabled Ukiah to purchase the bulk of its microcomputers and terminals. Proposition 13 has virtually eliminated this financing option for other districts in California; Ukiah's school bonds were the last public school issue in the state. With bond financing eliminated for additional computer purchases, the district has pursued other means. Thus, it has entered into a number of lease/purchase agreements to obtain computers. By leasing, the costs of computer acquisition can be spread over three to five years, improving the district's cash flow.

Because VEA and ROP funds cannot be used at the elementary level, finding funds for computer purchases has been somewhat more difficult. Special education has been one source, but generally these machines cannot be used in the regular classroom. Therefore, elementary school computers must be purchased out of general purpose funds or through special grants to foundations or state and federal sources. Money available through the state's School Improvement Program has been one source of special purpose funds that elementary districts have used to lease computing equipment. In some districts, such as Mendocino Unified, teachers and parents have organized special fund raising efforts to purchase computers. As noted above, an annual magazine sale raises between $3,000 and $4,000 in Mendocino's middle school. There were several other examples of this "catch as catch can" approach to obtaining a sufficient number of computers. In one elementary classroom we visited, the teacher had brought in her own home computer to supplement the others the students were using.

In short, even in fiscally tight times, money can be found for purchasing a substantial amount of computer equipment. The essential requirement is strong agreement on the part of teachers, administrators, and parents that computing is a top priority and the appropriate use for discretionary funds.

Are the benefits of computing worth the costs? Neither the county nor the district offices have yet undertaken a systematic study, and indeed in the classroom, it will no doubt be some time before the full benefits of computing can be assessed. Administratively, it should be possible soon to make some useful assessments. From our brief visits, we got the impression that administrative computing has resulted in very tangible gains in productivity. As best we could tell, these gains have not resulted in people being replaced by computers -- a common fear -- but rather that the same people are doing more than they did before and doing it much more accurately.[4] Thus, there has been a dramatic improvement in recordkeeping on attendance, and word processing has made all kinds of routine reporting easier -- to parents, to the county, to the state, and to the federal government. Computing has improved the schools' abilities to identify, serve, and monitor students with special needs, increasing their income from state and federal special education programs. Whether these and other benefits outweigh the costs of computing in Mendocino County could not be determined from our

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4. In some cases, districts have reduced the number of administrative personnel but through attrition rather than layoffs. Ukiah, for example, has cut 74 full-time positions since 1978 without a single layoff. How much of this reduction can be attributed to office automation and how much to reduced workload because of declining enrollments or to other administrative efficiencies is difficult to determine.

limited study, but given the degree of enthusiasm that exists among most of the schools we visited, all the signs are that they do.

PLANS FOR THE FUTURE

Probably the biggest challenge for schools with computers in Mendocino County will be keeping up with the momentum they have already generated. In a very short time, not more than two years in some of the schools we visited, every student will have had some exposure to computers. Most will know some basic programming and be familiar with the computer's facility for word processing and data management. If these students interests and skills are to be sustained, advanced courses will have to be available, and sufficient equipment will also have to be available for students to use computers as tools in their every day academic work. Introductory courses at the high school level will be come less and less necessary, as students come up from the lower grades already prepared. This will require some major changes in the high school curriculum, not only in the computer science programs but throughout if the schools are to take full advantage of the students' computer abilities. One would hope that word processing would become a routine part of students' writing assignments and that the data processing capabilities of the computer will be used much more regularly in science and math

to allow students to tackle more complex problems.

Teacher training, then, will need to figure prominently in the county's future plans, but the nature of this training can be expected to change. To date the emphasis has been on training teachers to teach computer science -- basic introductions to computer hardware and software. Increasingly, teachers will need to be trained to find creative uses for computers in their own areas of specialization -- English, math, science, art, music, and so forth. No doubt, there will remain an important occupational emphasis on computing, but ideally, computing will expand beyond the current ROP courses into the rest of the schools' activities.

This suggests that the computer's capability as a simulator may come to play a more important role in some aspects of the curriculum. Thus, for example, students' understanding of economics may be improved by using the computer to develop and play games involving complex market transactions in industries of particular interest to them. Similarly, they might play games simulating important historical events -- battles, elections, legal decisions, types of industrial development, diplomatic negotiations, and so on.

Such possibilities will become more likely as the

integration of the computer with other technology advances. Mendocino County planners recognize this and have established a High Technology Committee charged with integrating the county's computer activities with its other technological systems. Among the projects they are pursuing is the development of microwave communications that will facilitate electronic mail and improve the access of students, teachers, and administrators to data bases maintained by the county. Presently, there are insufficient telephone lines to permit efficient linking of the various computing systems. Additionally, the county is pursuing ways of combining computers with video to improve computer assisted instruction and teacher training. To take advantage of the skills developed in its own vocational courses in computer technology and repair, the county office is also hoping soon to have in-house repair capabilities to cut down on the cost of maintaining its growing inventory of electronic equipment. Whether all this will come to pass remains to be seen, but on the basis of the county's record to date, one must expect more good things to come.

SOME CONCLUDING OBSERVATIONS

When we began this study of computing in rural schools, one

of the questions that intrigued us was whether we would find anything uniquely rural about the use of computer technology in Mendocino County's schools. Were these schools simply doing what everyone else was doing except on a smaller scale, or were there uses and problems peculiar to a rural area? We come away from the study realizing that we may have been asking the wrong question. Struck by the successes and the overall high competence of the people we met throughout the county, we must ask instead whether there is anything uniquely rural that accounts for their accomplishments?

Perhaps so. In the areas of Mendocino County we visited, we were very much impressed by the impact of geographical isolation on people's desire for information. People in urban areas take information for granted. There is at least one major newspaper, and anyone desiring more can usually find them at a local news agency. There are a half dozen or more television stations and dozens of movie theaters. Book stores are everywhere, and a library is always close by. There is hardly anything one cannot find out with a local, toll-free telephone call.

Not so in the little towns of Gualala, Booneville, Hopland, Manchester, and others sprinkled over Mendocino County. There, seeing a good movie, finding an offbeat magazine, reading a specialized journal, obtaining current financial information, and

even finding out last night's baseball scores involve frustrating delays. The micro computer holds out an enticing promise to residents of rural areas: it offers not only instant access to information hundreds of miles distant but also the ability to process it quickly and cheaply. For the urban dweller, the additional access afforded by the microcomputer is but a small convenience; for the rural resident, it can quickly become a necessity. Ironically, in their drive to overcome their isolation, rural folk may come to find that they are not only better informed than their urban brethren but also more adept at using the information they are getting.

All this, of course, is mere speculation. It can be argued that Mendocino County is atypical of most rural areas, that it enjoys the benefits of more than its fair share of people with computer expertise and other talents. But the county may also be a bellwether, for as technology continues to overcome many of the information barriers that exist in rural America, rural regions will attract more and more newcomers from the nation's urban areas. If they resemble those who have come to Mendocino County, they will be bringing with them new expectations, values, and ideas that will challenge rural education. In Mendocino County, the schools are up to it.