Computers: A guide for the small elementary school district

Robert I. Clarke

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COMPUTERS: A GUIDE FOR THE SMALL ELEMENTARY SCHOOL DISTRICT

A Project Submitted to
The Faculty of the School of Education
In Partial Fulfillment of the Requirements of the Degree of
Master of Arts
in
Education: School Administration Option
By
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APPROVED BY:
ABSTRACT

This project documents the efforts of a small school district to bring itself into the age of computers. It takes you step by step through the early efforts, the planning, and the culmination of all the planning. Advice is given on the selection of computers and software and the best school location in which to use them. Research in the form of comparison of CTBS scores are provided to show effectiveness of the program. Several real and potential problems areas are discussed as well as possible methods to overcome them.
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INTRODUCTION

In this project the author is showing one way to approach the use of computers in a school. The project is designed to document the approach one small district made in integrating this giant technology into the curriculum and to use it in meeting requirements set forth in the California Frameworks for education. The project is not designed to provide information from classroom research, although conclusions drawn from comparisons of the California Test of Basic Skills (CTBS) are provided. Neither is it designed to show superiority of one philosophy of curriculum over another, or one theory of teaching over another. Nor is it designed to show that philosophies and theories of teaching used with computers are the only ones used by the teachers in accomplishing District directed objectives. It is an attempt, however, to help implement elements of the different teaching philosophies and theories of learning into the classroom through technology. By their very nature some subjects at the lower grade levels are best taught by one theory over another, but not to the continual exclusion of the others. By School Board policy we are directed to "teach the basics," but we are allowed a wide latitude in teaching strategies to accomplish this. The School Board, in its collective wisdom, also desires us to turn out the best educated
individual possible.

We wanted to erase the aura of mystic computers seem to hold over some people, mainly adults, and show that they, as well as other machines such as movie projectors and VCR's, are merely the means of delivery. Whatever philosophies of curriculum or teaching strategies used must come from the teacher and the program (software) used by the computer.

Although the author was one of the prime movers of this project, the success is due to the interest and cooperation of the entire Nuview Elementary School staff, and the Nuview Union School District. Input came from all directions and everyone, regardless of their initial personal involvement, was pulling for a successful outcome. Much personal time was donated. Teachers and aids attended working meetings and enrolled in courses to raise their knowledge of computers. The Principal coordinated the project and kept everyone on their toes. The Superintendent and the Board made time and money available for staff members to visit other districts and to attend meetings and workshops.

Our district is a rural, one school district with an ADA of 430 for the 1982-83 school year, when we purchased our Apple II+. Our ADA for the 1985-86 school year was 486. We are a growing district, but not a rich one. Money to purchase the hardware and software did not come at the expense of other projects, however. During this period we continued to support the curriculum, added four new classrooms, and air conditioned all remaining classrooms. We currently are undergoing a complete reconstruction of six of our older classrooms, one of which will become the new computer laboratory, workshop and storage combination. During my tenure as Mentor Teacher, 1985-86, the Superintendent and Board of
Trusties sent me to the Apple Service Certification Course at the Apple Service Center in San Jose, California, where I was certified to repair Apple computers. We now are able to repair our own equipment and purchase replacement parts at a reduced price.

At the beginning of the project we spent a lot of time in software research and developing criteria and forms to use in this research. It did not take long to realize a small staff can be spread just so far and, although software selection required much intense attention, we did not have the time and resources to do the job properly. Therefore we came to rely on the advice of other agencies in selecting our software. Of course we listened mainly to those agencies who were not involved in selling software, although the catalogs furnished by software publishers proved to be an invaluable source of software information.

We feel we can trust the software reviews and recommendations in the CUE Newsletter, published by Computer Using Educators, Inc., Family Computing, published by Scholastic, Inc., the yearly recommendations of the California State Department of Education (S.D.E.), and the Technology in the Curriculum (TIC) program developed by the S.D.E., as well as various other commercial periodicals dedicated to computing.
EXCEPTATIONS

The beginning for us was in the Autumn of 1982 when we purchased our first computer; an Apple II+. Several staff members had discussed the coming of the educational computing age and how it would have an impact on elementary education. Many teachers had very little insight on what a computer was let alone on how to use one in the classroom. Our range of experience ran from one teacher with many years of hands-on experience with main frames and collateral equipment, to most teachers who had not yet seen a computer up close, and a few teachers who were in between the two extremes. But we knew that in the interest of quality education we should get started learning how to integrate computers into the curriculum. Getting started was easy; what to do once we got started was not.

We were not entirely new to the computer age, having previously entered into an agreement with a commercial company to rent eight of their terminals and associated software located on a distant mainframe. Many of our students were receiving daily instructions on these terminals and seemed to not only enjoy the instruction but were progressing faster because of it. However, teachers were not entirely satisfied. Classes were being disrupted with only eight students being serviced at a time, not all grade levels were getting a chance to use the terminals, and a shadow of a doubt about the quality of the software was beginning to cloud
the scene. At the end of the 1982-83 school year the decision was made to increase the number of terminals to sixteen, make the terminals available to more classes, and to buy a personal computer.

The decision to buy an Apple for our first computer was not the result of a careful, well thought out plan. The District Office wanted to go into word processing and purchased an Apple III. The school got an Apple II+. Not much thought was given to software that first year. The II+ was placed in a teacher's room with one diskette of drill and practice programs. That was it. No other software was purchased. The teacher did his best to integrate the computer into the curriculum by copying public domain programs and programming on his own. By the end of the year we did not consider the experiment with the Apple II+ a success. Dedicated teachers by themselves were not going to be enough to get this program started.

Enter Apple Corporation and its far reaching decision to give schools a free computer with the program called "Kids Can't Wait." When we received our free Apple IIe, in the fall of 1983, the decision was made to place it in an upper grade room and to place the Apple II+ in a Kindergarten room. Both of these teachers were among those with previous experience. Again, no thought was given to a software budget and what new programs we got came mainly through our expanding contacts with computer using groups and through the teachers purchasing programs with their own resources. We were still using the sixteen terminals as well.

During the 1983-84 school year we had begun a program to get teachers involved with their classes during their time on the terminals. The terminals were located adjacent to the library and were controlled by
a library aid. Some teachers were able to take their classes to the library during the forty minutes allotted for the terminals, teaching half the class for twenty minutes while the other half was on the terminals. By doing this we were also able to observe our students' reactions to the terminals, and the quality of instruction received by the students. We were not impressed. We started an informal analysis of the software as the students were using it to see how it related to our curriculum and our teaching strategies.

We wanted control over our curriculum decisions, in as much as this can be done at a local level. Realizing that curriculum policy is a blend of the national, state, and local level requirements, we wanted to control, or at least to influence, the subject matter, method, and order of instruction of our curriculum. In this we followed the essentialist theory of education in wanting to re-establish our authority in the classroom. Our formal curriculum was traditional and included the elementary subject matter of reading, language arts, math, social studies, science, health, as well as physical education, art, and music. We felt the perceived and operational curriculums should mesh with the formal curriculum to the extent humanly possible. The goal for our students was, and remains, that of an individual who has a foundation in the basics which enables him to enter higher education able to solve problems and to transfer learning from the known to the unknown; an outstanding citizen and possible future leader of our country. Within this framework we wanted to extend the classroom teacher's ability to provide remediation for those students at the lower end of the scale and to provide mind-expanding programs for those at the upper end. Also, we wanted to
improve our students' test scores (see Chapter XVI, Research).

Mathematics seemed to be one area computers could help, and one subject area where there was a proliferation of software. However, as noted, we were not just interested in drill and practice, or operational skills. Both the California Education Code and the California Mathematics Framework require the teaching of conceptual and operational skills, and problem solving. The Framework requires teachers to develop students who are mathematically powerful and who will use computers programs "... to perform extensive or repetitive calculations, simulate real situations, and perform experiments that aid in the understanding of mathematical concepts." At first available software seemed to stress knowledge and comprehension skills, but software companies have now developed programs for word problems, simulating real-life situations, and creating geometric displays, to name a few. These enable teachers to teach and reinforce skills at all the cognitive skill levels. With the use of data and spreadsheet programs, students are able to simulate the operations of a business by presenting an accounting of expenditures in the form of graphs or charts, showing their transfer of concepts to the application level, as well as many other applications. LOGO, a language for computers developed by Seymour Papert of Logo Computer Systems, allows teachers to teach the student to think logically, as well as to ask the question, "What if?" Students are able to make and print geometric shapes that run from the simple to the complex; products of inquisitive minds. Students learn how to integrate small procedures into larger procedures to produce, in some cases, very intricate programs. They also learn that the language of the computer is very precise and non-forgiving.
We felt we had an effective writing program in the classroom. Depending on grade level, students would engage in a five day weekly composition cycle, creating an outline from an area of student interest, or from teacher supplied background information, transferring the outline to a draft and then revising the draft to a good copy for submission to the teacher. One class period would then be spent with the teacher putting unidentified faulty and outstanding sentences on the board for the class to dissect, discuss, and correct, if needed. The last day of the cycle papers would be returned for revision, if needed. Only then would a grade be given.

How could we supplement this program while keeping it orientated towards writing as a process? The main problem we had was getting students involved in editing or revising their papers. Editing was time consuming and could result in papers being re-done completely. Our answer was to teach word processing as a way to an even more effective writing program. Word processing permitted the student to see their words on a monitor and to correct grammatical and spelling mistakes by simply pressing keys before they printed the composition or report. Editing now was made easier and students seem to overcome their fears of putting ideas on paper. Students became more fluent and enjoyed the process of writing without the tedious task of editing. Results shown in Chapter XVI, Research, tend to show this as one correct approach to take.

We looked to computers to assist us in this endeavor, but realistically we knew the computer would not fit the strategies of all our teaching staff. They would, however, fit nicely into the Technological curriculum, a concept we seemed to lean towards. Computers were to be a
tool used to assist the classroom teacher. In this concept they would be placed in the same category as the printed book, the chalkboard, and the audio/visual equipment, albeit an extremely powerful addition to this category. We could not allow computers to be perceived as taking the place of classroom teachers, only as assisting them in their teaching. As a staff we firmly believed nothing could take the place of daily interaction between teacher and student.

The more we made this informal evaluation of the commercial company's software, the more we became concerned about the lack of teacher involvement in this interaction between student and software, and the more concerned we became about the apparent irrelevances between the software and what we considered important. By the end of the year we, the teachers, had made the decision to ask the board to change directions and get rid of the terminals in favor of personal computers.

Armed with what we considered the inadequacies in the company's software, we met with the Board of Trustees and convinced them and the Superintendent to cancel the contract for the terminals and to start a program of buying personal computers for the classrooms. Our first source of money was from the approximately $12,000 annual savings from the lease agreement and telephone line rental.
WHY PERSONAL COMPUTERS?

Why the decision to switch to personal computers? What could they do for us that the terminals could not? How would we use them?

We knew the answer to the first question; we did not like the instruction and the instructional techniques used with the software provided by the contracting company. We wanted more graphics and more re-enforcement for those many elementary grade students whose level of self motivation needs stimulating. We wanted programs able to provide instruction to all of our students at his or her level, and ones which would pace the student through his or her levels of ability. Our over all program must reflect State requirements by appealing to many different types of learners and to treat the computer as another means of learning. We wanted the software to provide a tutorial when one was needed, and we did not want software which reproduced book pages as part of an assignment. We felt that any software we used should not take the place of reading from a book, rather it should enhance and encourage book reading.

The answers to the second and third questions revolved around not so much what one could do that the other could not, but how it could be done. At first we wanted our students to be "Computer Literate," but soon
discarded that term as meaningless. Computer Literacy was not part of our curriculum and it in itself would not teach the students anything we felt they should know. We wanted to become known as a staff who used computers in their teaching, not as a staff who taught computers. We wanted computer assisted instruction where the computer could act as an aid in the classroom and help us with such things as drill and practice. We wanted computer managed instruction where we could place the student at an appropriate level and have the program manage the progress of the student. We wanted computer management of our District approved objectives where a program could record a student's mastery or non-mastery. We had previously written District approved educational objectives in reading, language arts, math, social studies, and science for all grades. We now wanted software to assist us in the management of the students' mastery of these objectives. We felt that management by educational objectives would increase individual student performance because they could see their progress and would know what was expected of them. Also, parents could have reports at any time showing mastery or non-mastery of objectives, and teachers could use the reports to analyze progress. This program would have to be able to record mastery of all District objectives, not just those taught through the computer. Finally, we wanted to use computers to challenge our students and to expand their horizons. In short, we wanted the best for our students while following the dictates of the California State Board of Education.

In explaining Teaching and Technology, Kneller (Kneller, George L., ed., Foundations of Education, John Wiley and Sons, Inc., (1971), 337-356) concluded that the computer had a greater potential than any medium since
the textbook to provide for a means of basic instruction. Although he
sees computers as only suitable for drill and practice because no real
teaching is done at that time, we felt that computers had passed that
plateau and were now suitable for computer assisted instruction.

With drill and practice we felt we could break complex subjects into
small pieces of information which could then be learned step by step, and
which could reward the student by positive reinforcement for each small
step learned. Called linear programing by B.F. Skinner, this method would
help to insure that learning was taking place. However, linear programing
was not the only method we wanted to use. As pointed out in Chapter I,
Introduction, we did not want to use one teaching method to the exclusion
of others. Drill and practice by itself would soon prove to be boring for
most students. Drill and practice would have to be expanded upon to allow
some room for wrong answers and to provide tutoring in the program to aid
instruction.
HOW DO WE START?

Now that we had the right questions, and the desire to go ahead and get on with it, just how was that to be done? How were we to get started? We knew the administration and the board seemed to be behind us and expected us to do something, but just what was another matter.

We wanted all the input from all the sources we could get, but to start with we decided to lay the groundwork with teachers only. Following this plan, we loosely organized a Computer Users Group composed of those teachers interested in learning more about using computers in education. We met during our lunch periods and gradually developed a plan of action. We knew the futility of trying to re-invent the wheel, so we decided to visit as many school sites as possible and to write to other school districts to obtain copies of their master plans. As luck would have it, Bellflower USD was hosting a conference on educators and computers, and we were able to send one of our members. From this conference we gained volumes of insight, both printed and hands-on, on how other school districts, the State, and the National Government viewed the use of computers in the classroom.
CRITERIA FOR CHOOSING HARDWARE/SOFTWARE

What type of computer to get? You would think a decision such as this would be easy, after all it is the software that does all the work. However we again went back to our Computer Using Group to set up a procedure making this choice as easy, and logical, as possible. We first asked the question of how the computers would be used. We decided we wanted to use them for drill and practice, tutorial, demonstration, simulation, instructional games, word processing, programming, and management. We then looked around to see what choices we had in the software for our uses. The software had to come from reliable sources, the cost must be affordable, the publisher must offer up to a 30 day preview, back-up diskettes must be made available, and documentation must be in clear and concise English. Above all, we wanted continuity. We wanted affordable computers we could count on to be supported by both manufacturer and third party software companies. Considering the volatility of this market we did not want to spend our money on computers made by companies who would not be able to stay in the market and compete. We also wanted computers that would not be obsolete the day after we bought them. Since the last requirement was beyond our ability to control, we looked for computers we could expand to keep up with the fast changing technology.

After putting all of our requirements together, we decided the Apple
IIe came closest to meeting our requirements.

How many computers would we need and what kinds of ancillary equipment should we buy? No good answers were available for that question. For the first phase, our short range goal, we felt each classroom should have at least one computer. However that classroom first had to have a teacher who was willing to make a commitment to learning how to use the computer. Once a teacher showed a willingness to take classes or learn from another teacher, he or she was placed on the list for a computer. We had decided to purchase monochrome monitors, until we realized the full potential of the color programs on both primary and elementary students, so we purchased low resolution color monitors. Since the monitors were low resolution, we knew we would be limited to 40 columns for word processing. This was no problem for the students, but some teachers were already used to software providing 80 columns for word processing, so we also purchased 3 monochrome monitors. Of course, this meant we also had to purchase the 80 column card, but since the Apple IIe had 7 expansion slots plus an auxiliary slot, there was no difficulty in upgrading to 80 columns. Since word processing and management software was on our purchase list, we also decided to place a printer in each room with the computer.

Our second phase, or long range goal, was to have upwards of three computers in each classroom. The classroom computers would be augmented with a computer laboratory of at least thirty-two computers. This laboratory would have sufficient furniture to handle two full classes with two students per computer, although in almost all circumstances only one class would be using the laboratory at a given time. The laboratory and
classroom computers would be connected through a networking device, allowing all teachers access to all software considered important to the curriculum. Initially, this laboratory would be a participatory one and each teacher would bring his or her own class to the laboratory at a given time. Later, a full time laboratory teacher would be hired.
DIALY LEVEL MASTER PLAN

At this point we felt we needed more guidance, so we went back to the District Administration and discussed the need for a Board Policy. By now we knew the direction in which we wanted to go, but an approved Board Policy would set these goals and priorities for all to see and follow.

In this policy we wanted to set the need for continuity in our purchases of both hardware and software. Also, we needed a Board commitment to arrange for yearly funding of what we thought we needed. Without a secure source of funding, we knew we would be at the mercy of whatever whims or priorities would crop up to place a claim on the budget. As it turned out, finding funds to purchase and expand our computer plan was not a big problem. The District was very generous with its funds, we were able to get an AB890 grant from the State, and, later, we were able to use the lottery funds.

Another area we felt we had to cover in the policy was the need for maintenance on the equipment. Hopefully this would not be a problem for several years, but as the equipment got older we knew we would have downtime because of breakdowns. We felt a member of the staff trained in the repair of computers would be a better investment than having to send all problem equipment to a vendor for fixing.
WORKING THE PLAN

Now that we had a plan, we started to work that plan. Just what were our expectations? Did we expect students to raise their scores on the standardized tests? If so, how many grade levels would we consider the norm? Or, did we just hope that by being exposed to computers and computer assisted instructions the students would gain enough? What expectations did the teachers expect from this venture - initially very time consuming? Could we expect support from the community and what did they expect?

We discussed the advisability of administering special tests to the students in order to establish a benchmark, but discarded this as impractical for several reasons: one was due to cost and time involved; another was due to some students having already been exposed to computers in the classroom and working with the now departed terminals. Further, we had come to the conclusion that computers would be a means to the end, an educated student, and as such were just another tool for teachers to use. Therefore their effectiveness should be measured as part of the whole effort, and not as a single entity.

Teacher support was growing. Most seemed to see advantages in having a computer in the room for students to use, although some were
skeptical about how they would use it. A few, for whatever the reason, did not want to get involved with computers. The latter teachers fell into two loose categories; in the first were those who did not feel at ease around the machines, and in the second were those who seemed to have a bias against computer technology. To counter arguments against computer use we held informal meetings to discuss and to show what could be done with them. We invited teachers into our rooms (with the Principal taking over their class) to watch student skills and responses and we had workshops to train teachers and aids on the machines. One of the more effective means to interest those who were holding back was to invite them into our rooms after school and work with them on a one-to-one basis. Another effective way to get these teachers interested was to assign them students who had a computer in the classroom the previous year. Whichever method worked, we soon had all teachers, to varying degrees, behind the project and wanting computers in their rooms.

Community support was mixed at first. We consider ourselves a school that is open to ideas which enable us to serve the entire community. We knew we needed the support of the community to make this plan work. To help sell the idea of using computers school wide, we invited interested parents to observe what their children were already doing with computers. We met with the community through the School Site Council and the Booster Club to enlist their support. We invited community members to the School Board meetings when the computer program was to be discussed, and at Back to School nights we made sure parents could see our existing computer set up and how their children could use them. On these nights many parents touched a computer for the first time,
guided by their children. We sent a survey letter home with the students asking for parental input and the results showed the majority were for computers in education. In another letter we told parents we would be providing adult education classes to acquaint the school community members with computers and asked if they wanted to participate. The results of this letter showed the extent parents wanted computer training for themselves; we had more potential students than we could handle. Support for the computer program was in the community.

Generating interest was a problem that had to be done on a continual basis. Teachers who showed interest during one workshop might lose that interest if follow up action was not taken. Students might find many ways to be busy with something else when their turn at the computers came up, or they would sit and stare at the monitor hoping their lack of activity would not be noticed. Generating and keeping a high level of interest was due, in part, to the hard work by the teachers in the Computer Users Group. Again, a lot of the interest was due to students being motivated to work on computers. Integration of the software into the curriculum seemed to be a key. If students knew some of their English and reading assignments were to be done on the computer, then working with the typing software and learning word processing became something necessary. When they saw the designs, patterns, and games made by fellow students using the Logo software they became excited and motivated to do the same. A presentation to the Board of Trustees at a very key time was successful, in part, because students' Logo programs were shown on a TV screen.
FUNDING

Of major importance to us was the problem of funding. As much as the Superintendent and the Board of Trustees wanted to help us on this, we knew the budget was not bottomless and had other priorities. However, by taking a realistic approach to purchasing our equipment and in the planning that went into it, the Board felt they could and must support our efforts.

We did not really do anything extraordinary for funding and only wrote two grants which were approved for hardware and software. These were the AB803 grant previously mentioned which allowed us to buy eight computers and printers, and a CTIIP grant which allowed us to purchase the Mastery Management Program from the Hopkins (Minnesota) School District. In the early part of our acquisition we ordered prudently. Later, when the programs were going well, we were able to purchase in larger amounts. The ability to purchase more hardware and software seemed to be tied to how well and how much we utilized what we already had. Nobody wanted the computers to be relegated to the same closet as the unused audio/visual equipment. So "Prudence" was our given name and "Pragmatic" our family name. The Board and Superintendent could see this program was not a flash in the pan, and they tried to fund us as much as they could. Now with the Lottery money coming in, we were able to lay claim to a large share of it for the computer program.
Once again the question of where best to place the computers came up. A study in which we were involved (Becker, HOW SCHOOLS USE MICROCOMPUTERS, The John Hopkins University, [March, 1985]:23-24) indicated that the classroom was probably a less desirable place than the computer laboratory. However, we decided to disregard this good advice and placed all the computers into the classroom. Our reason was a simple one for us; more teachers would become involved if the computers were in their rooms than if they only had access to them in the lab. A laboratory was still in our plans, but for now it was not desirable. We wanted to get all teachers interested, excited, and burning to use this new medium for education; we wanted all the new ideas on ways to integrate the computer into the curriculum we could get. What better place to get this information than from the classroom teacher?

As previously mentioned, the training was paramount to interest being aroused and maintained. We contacted the Riverside County Schools TEC Center and arranged for their mobile laboratory to pay us a visit for a workshop. Although the workshop was for the teachers, it was so successful we arranged for another for the classified staff.

With all the different forms of training going on, self-help, TEC Center, community help, and formal training, we felt we had a good bit of computer interest established. To keep this interest going and to help
teachers and staff develop and maintain skills on the Apple IIe and software, we worked out a plan allowing staff to take hardware and software home for use over vacations. The only stipulation was that the equipment and software had to be back in the classroom during student contact time and that any and all avoidable damages would have to be covered by the person taking the equipment. This has worked to the advantage of all concerned. Besides the obvious advantage to the staff, the district did not have the worry of storing hardware on campus during extended vacation periods. This was not an idle worry. During the time we had the commercial company's terminals, vandals broke into the library, trashed it, and used hammers to destroy the computer terminals and ancillary equipment.
SOFTWARE

Now we began to search for software in earnest. Following our earlier stated guidelines we began to search through catalogues, the TEC Center's inventory, and check on leads from courses teachers were taking and leads from colleagues in other districts. We soon found that two of our requirements could not always be met; not all publishers would offer a free preview of their programs, and not all documentation was in clear and concise English. We joined the Minnesota Education Computing Consortium (MECC) and found them to be a good source of inexpensive software. Since we were a direct support school of the county it only cost $300.00 to join MECC for one year. That membership gave us the right to use a MECC copier to copy their software as needed. However, after one year's membership we gave it up, figuring we could buy other software with the $300.00. Later on we gained membership in the California Computing Consortium (CCC) through the TEC Center at no cost to us. CCC membership made it possible again to purchase MECC software at a reduced price.

Accountability of the software was another area we felt we had to resolve before it became a problem. Where was it to be kept, whose was it, and how was it to be used? We decided that no matter who ordered it, as long as it was from district funds it belonged to every teacher. All district software was to be kept in the library to be checked out on a two week loan, renewable for as long as no other teacher was waiting to use
it. For the first phase we decided to let each individual teacher use the software where they felt it best fit with the curriculum.

We concentrated our purchases in the areas of math, typing skills, word processing, and Logo programming. In addition, some teachers bought programs with their own money to be used by their own students. For word processing we purchased the Bank Street Writer for the elementary grades and the Milliken Writer for the primary grades. We purchased Apple Logo for all grades with the addition of E-Z Logo from MECC for the Kindergarten. For our math, we purchased a program from the San Diego Unified School District called Basic Skills in Mathematics. This program was designed to work as a traditional Computer Assisted Instructional (CAI) model and incorporated student interaction, tutorials, problem sets, motivational games, and automatic record keeping. The San Diego math program was our first step in providing a program which could be used at all grade levels and which provided computer generated record keeping and reports for teachers, parents, and students. It remains, in modified form, as our base for CAI in math.

To further our use of automatic record keeping we investigated and purchased through a C.T.I.I.P. Grant the Mastery Management System (MMS) from the Hopkins School District, Minnesota. MMS is a goal referenced, competency based system that would offer us useful information for classroom decision making. MMS stores information necessary to score and evaluate tests, records student mastery of defined instructional objectives or basic skills, reports individual and group mastery of these objectives, groups students for instruction, and prescribes appropriate study helps. With this program we could monitor a student's mastery of
school identified objectives, identify problem areas, provide for individually tailored student study helps, check on our curriculum effectiveness, and furnish a variety of reports on mastery of prescribed skills. We also purchased a card reader to make this program more automatic. Now, when a student takes a test the program automatically scores the test, by use of the card reader, and upgrades his or her records to show mastery or non-mastery of specific objectives. While we find this program very helpful it is not one to be taken lightly. The program requires a lot of time for setting it up (entering teachers, students, objectives, etc.) and requires development of multiple choice or true/false questions to check on the school's objectives. However, as with most programs, once something is set up and running smoothly teacher time is reduced for that particular task, giving opportunities for more teacher/student involvement.
ARE WE ON TARGET?

It now was time to take a look at what we had done and where we were heading. Were the students learning more because of computer use? How were the teachers using their computers in the classrooms? Were we on Target?

Because we did not use a benchmark test it was not possible to give a definitive answer to the question about the students' learning. If we were looking for a quantity rather than a quality answer, then we would have to say that students were learning more. They were becoming quite adept at using computers and software. They felt at ease using the computers for curriculum enhancement, they were able to word process on the computers using spelling checking software and print formatting, and they were able to program in Logo using some very intricate geometric designs. So by looking at the quantity of learning we felt the quality of learning had also gone up. Not that we felt more equals better. Teachers were also reporting more enthusiasm in learning math using the San Diego Math Program. Students were able to work with a partner (if about on the same level) and help each other out. Students who had already mastered fractions, decimals, or percents were volunteering to help those still struggling with two digit multiplication or division. Competition was
very keen with the publishing of daily objectives mastered, not only within a class but with other classes at the same grade level. And, through the automatic record keeping, teachers were better able to spot trouble areas and concentrate on those areas. When students saw how their book reports looked after being printed out they did not want to go back to handwriting them. Of course, as previously noted, handwritten assignments were still required. Even those students who felt they could not write a good book report became excited when they saw their works "published" and strived to do better. Students in a second grade class were printing out letters to pen pals in another school and "mailing" these letters to these pals by use of a modem. All in all we felt good about the progress shown and the learning gained.

The answer to the question on how teachers were using the computers was not so encouraging. Most teachers in the Computer Users Group were able to integrate the computers into the curriculum and set up classroom schedules for their use. Some teachers found this hard to do and were using the computers as part of their reward system. As a group we felt using the computers only as a reward for good behavior was defeating the purpose for which they were purchased. While this use would certainly help the students who qualified, some of the very students we wanted to reach might never gain enough credits or points to get on the computers. We felt a system for computer usage must give proper weight so that all students would have an equal opportunity to use them and that games for rewards must not take precedence over using the computers for curriculum enhancement.

Something had to be done before we lost the momentum we had worked
for. It was time for a mid-course evaluation and correction.
We now looked again at where we should place the computers. Was our plan of classroom placement a good one? Or, were we short changing some students by keeping computers only in the classrooms?

A computer lab was in our plans, but if we took the computers out of the classrooms and placed them into the labs we felt we would be short changing those students whose teacher had already worked the computer into the curriculum. Yet, current studies (Becker, *HOW SCHOOLS USE MICROCOMPUTERS*) did show a rise in the number of regular teachers using computers and the number of hours per week of student use when the computers were located in a computer laboratory versus the classroom only. We did not want to become a school where interest in the use of computers was allowed to decline. On a second visit to a larger school district to the West, we had observed a computer laboratory that obviously had not been used very much lately, a fact verified by the teacher showing us around. Teachers were finding reasons not to bring their classes to the laboratory for lessons, and since the classrooms did not have computers the students were doing without for long stretches of time.

We came to the conclusion that our original plan to have a mix of computers in the classrooms and the laboratory was still the best route
for us to take. Rather than take the computers out of the classrooms we went back to the Board of Trustees in the Summer of 1985 with a plan to purchase additional computers and set up a computer laboratory. The Board approved our plan for sixteen Apple IIe's with color monitors and disk drives, two were to have two disk drives, two Imagewriter printers, and a 1200 baud modem with private telephone line.
The only building available to us for the laboratory was currently being used as a staff lounge and work center. This would only cause a problem if we didn't have full support of the staff in making a change, as we did have another area, smaller and less desirable, where the staff lounge could be moved to. By telephone and letter we contacted all staff members who overwhelmingly gave us the support we needed to make the change.

The building that was to become the new laboratory had been built to be used as a classroom, although it was only about half the size of our regular classrooms. It had its own air conditioning system, four free standing walls, small high windows that could be bolted from the inside, and one entrance that could be viewed from much of the campus. All of these were attributes we considered important for security of the computers. Tables and chairs were available for use and although not the style considered ideal for a computer laboratory they got us started. The Superintendent ordered new furniture which arrived several months after we opened the laboratory.

This laboratory was still to be a participatory one because we just were not able to justify the expense, at this time, of a full time
certificated computer teacher. That was, and still is, yet to come. We set up a daily schedule which allowed teachers of grades four through six to take their classes to the laboratory forty-five minutes a day, Monday through Thursday, for instruction. Friday was a minimum day, so the time for each upper grade class was cut to thirty minutes, but then we were able to let each of the third grades come in for 20 minutes of instruction. We realized this was not an ideal situation and did not like the idea of some grades being shut out of the laboratory, but it was something we had to live with. We had come a long ways in just a very short time.

To further expand student use, the laboratory was opened for one hour after school ended, Monday through Thursday, and staffed by volunteer teachers. Students who had written permission were allowed to stay and receive instruction with the computers. In addition, we set up a course of study and received approval to operate adult classes two nights a week for two hours each. The classes were a success and the waiting list long. The teachers for this project were paid.
The laboratory was up and running and all seemed to be just as we thought it would be. For the first few months of the school year all seemed to be going fine. But hints of trouble started to surface. Some students started complaining to other students that they were not getting their computer time everyday. When they did get on the computers, their San Diego Math Program was not up to date. The program had not given them credit for objectives passed, or had actually dropped them back several objectives. Others complained they were not learning anything, just playing computer games.

We checked into the complaints and discovered that in fact some teachers were not using the laboratory all of the time. We talked things over and discovered what appeared to be the reason behind their partial usage of the laboratory; lack of understanding on how the software worked and lack of time to update the management program each day. The San Diego Math had worked fine in the classroom with one student at a time and with updating the management system once a week, but in a laboratory situation the daily updating required by the program management was overwhelming. As a result updating was put off and subsequently student results were lost. Also, these teachers were among most who only had one disk drive
attached to their room computer, and those who have used the San Diego Math management realize that two disk drives are almost a must. This problem was solved in part by training sixth grade students on how to consolidate the diskettes and daily update the masters on computers with two disk drives for all teachers wishing it. We also made the decision to purchase additional disk drives so each room would have one machine with two drives attached. Additionally, one on one training was given to the teachers requiring it.

While looking for a solution to this problem, we came across another. Setting up and loading one computer in the classroom was nothing compared to the time required to do the same thing for sixteen computers in a laboratory. Too much teacher and instructional time was being wasted in this task. As a stop gap help, the title of Computer Aid was created and sixth grade students trained to set up the laboratory and software before a teacher and class arrived. This helped some, but the problem of non-productive time cemented our resolve to network our system just as soon as possible. These problems were not completely unexpected, but we just did not count on them being so disruptive.

Another problem that did not surprise us, but did annoy us, was the problem of vandalism while a class was in the laboratory with its teacher. Such vandalism was not major, although several diskettes disappeared, and consisted mainly of marking equipment with pencils and hiding diskettes and envelopes. For the most part this was solved by the teachers talking to their classes and instilling in them the pride of ownership of the computers and laboratory.
Networking

At this time we felt we had no alternative but to explore the possibility of networking, a Local Area Network, or LAN. The LAN would conserve our resources by tying our computers together and allowing all to use the same software. We had done some research on the systems available in the fall of 1985 when we applied for a CORVUS award (CORVUS is the name of a networking device or system). CORVUS at this time was offering ten free systems in a nation-wide competition. We did not win one, but the effort brought us into contact with CORVUS and their support people, and we liked what we saw.

In the CORVUS network we saw the advantage of saving teacher time. The management of the diskettes had become just about impossible to handle, information was being lost and the subsequent recopying was becoming too much. We had to have a way to provide multiple access to our software without taking valuable time away from teachers teaching. In our research on networking we had run across claims of saving money in software costs and how it could improve test scores, as well as managing the curriculum and provide for master and individual scheduling. As much as we hoped to save money and improve test scores, realistically we decided we would settle for saving teacher time and improving the quality of education. We felt networking would do this for us.

The CORVUS system with its hard disk drive would manage the network
for us, but we also wanted something which would manage the software on the hard disk drive. We wanted a manager that would manage software in at least the areas of math, language, and reading, and could handle software from several different publishers. Ideally this manager would provide full record keeping on all students assigned software objectives by their teachers, moving them through the objective sequence from one objective to the next at their own pace as they passed each objective. It would further provide teachers with a means of identifying students in trouble and provide print-outs in several formats to facilitate trouble spot identification. It seemed we were asking for an awful lot, but we were determined this need could be fulfilled.

We already had a management system, previously mentioned, called the Mastery Management System, but this system was to monitor students through the entire curriculum showing mastery or non-mastery of our locally produced and District approved curricular objectives by teacher prepared tests and observations. A hard disk network software manager would supplement the system we already had. We looked at two managers, the Master Curriculum Manager (MCM) from Computer Networking Specialists (CNS), a company started by a former local area teacher, and Ideal Learning’s Integrated Classroom Learning System (ICLS). We settled on the MCM from CNS because it appeared to be better suited to the elementary curriculum, and because we were able to check its reliability with local references.

As rosy as the prospect seemed, we knew that there would be problems and disadvantages. This would be another piece of hardware and software for teachers to learn and on which to become proficient. Because of
security problems not too many publishing houses were producing software for hard disk drives, but this problem seemed to be in the process of being overcome. Publishers who were producing copies of programs to run on hard disk drives were charging three to four times the basic price for their product. Although this would be more expensive, just having that program available for use on all our computers seemed to justify the additional cost. Finally, the cost of purchasing the equipment and installing it was going to be expensive.

In March of this year we went back to the Board of Trustees with another proposal. And once again, based on our track record, they approved it. We purchased a 45 Megabyte hard disk drive and enough computer cards to connect all classroom and laboratory computers into the CORVUS network. We also let a contract for running conduit and wire to all the rooms in the school to handle the network. We had decided on a unique system. We would not be satisfied with connecting just the laboratory computers into the network, but all classroom computers as well had to be able to use the CORVUS. It was not just enough to have the students in the laboratory able to use whatever software we had on the CORVUS, but a teacher had to have access to the software at all times, from the classroom or the laboratory. If all else failed we felt, at least we would not be accused of not having the proper attitude of open experimentation with computers in education.
To provide some relevant statistical data for this project, the author correlated the results of the California Test of Basic Skills (CTBS) for the 1986 sixth grade class and the 1985 fifth grade class in three areas; Reading, Mathematics, and Language. The test population was drawn from those students (49) taking the test both years on the same Form - S, Level - 2 with the results expressed in grade equivalences. The test for 1985 was given in May and the test for 1986 was given in June. The following was noted:

**DESCRIPTIVE STATISTICS**

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<tr>
<th></th>
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<th>READING (1986)</th>
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Making the assumptions that all variables remained the same and that a student should show one year of growth each school year, the statistical results are interesting. The subject we thought would show the strongest gains was math. Our San Diego Math Program was a good one, strong in both drill and practice, and in tutorials. While the results were below our expectations, they were not too disappointing. Keeping in mind the one month difference in the test dates, the median showed the assumed 1.0 year
growth, while the mean recorded a 1.3 year growth. The maximum remained the same with the number of students at that level increasing by one. The minimum showed growth of 0.7 years. Reading showed somewhat the same as math, although we were not using a specific program for reading.

The surprise was in the subject of language. As sixth graders the class received a heavy dose of training in word processing, using the Bank Street Writer and the Bank Street Speller. Four students received the maximum of 11.9 years while the minimum showed a growth of 0.9 years. The mean increased by 1.8 years and the median by 2.0 years. From this we can conclude that not only do students enjoy but are motivated to excel by the process of typing and printing book reports and compositions with the use of a computer. By the use of this medium they are encouraged to do something they detest under other circumstances: proofread and rewrite.

By using the t-Test for Related Measures, we were able to show all gains to be significant.
Now that we can look back upon our first phase, what did we do that we would not do now with the vision of hindsight? Did we waste time and money by doing everything piecemeal? Would we have been better off by first setting up a small lab and then adding to it as money became available? Was our decision to move into the computer age a good one? Was the money well spent, or, could support of the curriculum in another manner have been more beneficial to the students?

By doing everything piecemeal we certainly did waste some time and money, but considering the problem in finding qualified answers to questions, even from the experts, we did not feel this to be a significant problem. Had we been able to get some straight answers we might not have purchased our four Apple IIc's. It was not until some time after we purchased them that we found out they could not be networked with the Apple IIe's. However, the four IIc's have not been wasted and are getting a daily workout by support staff members very happy to have the ability to word process and print, maintain cafeteria inventories, and keep the library inventory up to date. Had we gone to a CORVUS networking system at first we would have saved money on software purchases by eliminating duplicates, but then the software for the CORVUS costs more than individual programs.

One inescapable conclusion to this entire project has emerged; plan
your work and then work your plan. Before a project of this magnitude is started, you must plan on where you are going and how to get there. Have staff meetings, formal and informal. Meet with administrative and board members, and call on community members for input and support. Brainstorm! Set your goals and plan on how to get there. Plan your computer set-up as far as you can see into the future. Do not worry about it being something that seems out of reach. Remember, all great journeys begin with a single step. The plan must have the support of all involved, so build flexibility into it that mid-course changes can be made without destroying what you have already accomplished. Try to provide for a funding source in your plan, and lay the groundwork to hire a full time teacher as the computer coordinator. Pick one member of the staff to coordinate and implement the plan.

First, decide on what software and what software companies best support the curriculum you want to enhance. Do not just rely on third party evaluations. You are spending a sizeable amount of money and some software companies will send a representative to show what their product will do. At the very least, they should allow you to preview the software. Use the invaluable resources and expertise of your TEC Center. Their resources should include copies of the software you are considering. The software you choose must provide for grade level, remedial, and advanced learning.

Next, decide what hardware best supports the software you want to purchase. Beware of companies that offer software and hardware packages for a single program. Both hardware and software might be excellent and the program something you really need, but you might be tying up a large
sum of money to support one small part of your curriculum. Look for hardware that is expandable and supported by an aggressive company. Ask company representatives to show their computer's capabilities to your staff. Again, arrange for your staff to view and use the different computers available at your TEC Center. Stay away from the companies advertising compatible computers (compatible with the IBM PC, Apple, etc.). These clones might be excellent computers, and the price will certainly be right, but your software might not be 100% compatible with the clones, and you will not know this until after you have made the computer purchase. Also, the technical and the maintenance support for the clones might be far less than adequate. Remember, you are spending public money to assist you in reaching your educational goals and you want to spend that money wisely; an inexpensive product that might not fit your needs does not necessarily equate with spending wisely. Stick with your plan even though it means buying fewer computers than you would like to start with.

Train your Staff! Ask your TEC Center for assistance. They will have some of the computers you expect to purchase and the experts to assist you training your staff to use them. When you are sure your staff knows everything about the hardware and software — train some more! Have workshops and provide for one on one training. Most on site training can be done by your computer coordinator, if he or she has adequate release time. Do not expect to operate a computer system on the "cheap." By this time you have made a sizable commitment to integrate computers into your curriculum and sooner or later you will recognize the need to hire a full time teacher for this part of your curriculum. The sooner this is done
the better it will be for all concerned.

Monitor the use of the computers! Are all students receiving equal instructional time? Are teachers integrating the software into their curriculum or using computer time as a reward? Is your software serving the needs of all students? To assist in this it is necessary to purchase a good management software program to monitor the progress of your students. A good management program is not inexpensive and you should expect to pay anywhere in the $500 to $3,000 range for it. A good program should handle students as individuals and yet group them with the rest of the class and their teacher. It should provide for pretests to automatically place the student at the proper level, yet allow for teacher over-ride to skip lessons or objectives. It should allow the school to set the passing or mastery percentage and it should allow for teacher intervention by locking the student out of the next lesson after a set number of tries for mastery. The teachers would then reteach that objective before allowing the student to go on. The program should manage the school or district curriculum objectives, not just those supplied by the software publishers. A good program must provide for reporting on the progress of individual students and classes. At a minimum it must record the progress of each student through the objectives and lessons, the passing percent of each objective/lesson, and the number of times or dates the student has used the system. Some programs provide reports which can be used as report cards. Finally, the program must provide an easy means for student transfer between teachers and classes without the loss of his or her records.

Network all of your computers just as soon as possible! The
management of individual programs on floppy disks will present an insurmountable task for some teachers. Teacher productivity will increase and frustration will decrease by networking your program from a hard disk drive.

Problems still crop up and answers are not always reliable. When we went out to bid on the wiring for the networking system we were told we would have to run a separate system of Schedule 40 PVC conduit and use twisted pair wire (similar to telephone wire). The first contractor tried to use inferior conduit and would not upgrade until we insisted. Before the job started we decided to also run television coaxial cable to each room as well, so all teachers could have the use of television for instructional purposes—with VCR’s to be added later. We contacted the office installing the CORVUS and after much discussion, they decided the TV signal in a shielded cable would not cause radio frequency interference (RFI) with the computer signal. Before the job was actually started the author met with the new contractor and a representative from the CORVUS installing company and discussed this and other problems again. This time there was some question of running the two cables together and the CORVUS company was contacted. After lengthy and careful consideration, CORVUS decided that TV cable could not be run with the computer cable, and that the TV signal could indeed cause stray bits of information to cross over and join the computer data stream. You could imagine the problems we might have had with our computer programs had we gone ahead with the installation based on our first answer. This is presented merely as an example to show that in so far as computers are concerned, the mode of operation must be, "buyer beware!" Even an experienced staff can get
burned!

Would a small lab been sufficient for us to get started? Studies show (Becker, *HOW SCHOOLS USE MICROCOMPUTERS*, 24-25) in an elementary classroom computers were used more for drill and practice than for programming instruction with fewer teachers using computers in their teaching and a narrower range of uses being made of the computers. An elementary computer laboratory would generate more regular use of the computers by a larger number of teachers with a higher proportion of students using the computers at all. Also, elementary schools with computer labs reported much greater student enthusiasm for school. We did take part in this study, so these conclusions were drawn on, in some small part, from our input. Even so we felt we had taken the right path in installing the computers in the classrooms before the lab. We did have the twin problems of unequal use and of narrower range of uses, but felt this was a necessary trade off in our drive to get all teachers motivated to computer use.

The decision to move into the computer age was the right decision and a necessary one. How else could we prepare our students to become adults able to live and work in an advanced technological society? The money was and is continuing to be well spent. The key is to integrate computer technology across the curriculum and not to make it a part of the curriculum by itself.

Hidden costs do appear. Money must be set aside for unexpected maintenance problems which can not be resolved at the site. With new equipment and with the reliability we have experienced, it is easy to be lulled into expecting the equipment would function correctly each and
every time it was called on to do so. The amount to be budgeted will at first be an educated guess, but after a schedule of maintenance costs can be collected a district will have an idea of how much to budget. With the maintenance costs in mind, the standardization of equipment must be stressed once again. It is far easier to train personnel into maintaining one particular type of computer than many. It is far easier to deal with one vendor for repair work than with several. Operation costs must also be taken into consideration in the budget. It is not reasonable to assume that a printer ribbon will last a teacher all school year. A ribbon, once it is taken out of its sealed container, will have a life of about three months, used or not. No matter how new the ribbon was in the Spring, it will need replacing at the beginning of the new year. A box of good computer paper will last some teachers all year, while others will start or finish the second box. For a school year figure on two ribbons and one 2,000 sheet box of 20lb. paper for each printer.

The one area we could and should have done more was in-servicing for the teachers and staff. Much of our inertia and motivational problems could have been solved with teachers having better training in both the software and hardware. Hiring substitutes and conducting training sessions during the school day is very hard to do. Getting teachers to come in on their own time is equally as hard. Hiring outside consultants to come in is just too expensive for a small district. Our thrust for future training is to use what contractual in-service time we can, work one on one with teachers between pupil release and the time when teachers can leave, and to explore incentives such as college units for column advancement or to offer a stipend for training on their own time.
By hard work and cooperation we have come a long way; there is much left to be done.
UPDATE

There is still much work to be done. Because of construction delays, the new computer laboratory was not opened until just before the 1986 Christmas break. Because of problems involving construction dust and the moving of the computers several times, the equipment failure rate has been higher than we expected. There were several delays in getting the computer networking and electrical wiring done, but most of the construction problems are now behind us.

The computer laboratory is being used Monday through Friday by grades four through six. Each class is scheduled for forty-five minutes, however, with sixteen computers only one half of the class is on the computers at one time. The other half of the class receives teacher instruction when not on the computers. All the laboratory and all the classroom computers are networked off of our hard disk drive, giving each and every computer access to all the programs on the drive.

The District has hired a full time Computer Coordinator who is responsible for all phases of the computer program. An order for twenty Apple II GS computers has recently arrived and we are in the process of placing them into the classrooms replacing the Apple IIe's. The Apple IIe's will be placed in the computer laboratory giving it a compliment of
thirty-six computers. Each student will then have a computer to work with while in the laboratory.

A new schedule for the computer laboratory is in the final stages of approval. With it, all of our approximately 600 students will have some laboratory time during the week. Grades four, five, and six will have forty minutes, and grades one, two, and three will have thirty minutes every other day. Kindergarten classes will have thirty minutes each Friday. One forty-five minute period is set aside Monday through Thursday to instruct teacher chosen bright sixth grade students in advanced math concepts and in writing skills. After school classes, from 3:00 to 4:00 PM, have been started for teacher chosen students for drill and practice, or advanced applications.

Plans are advancing to once again start evening adult education classes. Currently, the plans are to teach the adults specific programs in word processing, data base management, spreadsheet applications, and financial management. Skills which can be transferred to personal or to business use.


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