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ABSTRACT

This publication provides information on implementation of an integrated learning system for computer-assisted instruction (CAI) in adult learning environments. The first of the document's nine chapters is an introduction to computer-delivered instruction that addresses the appropriateness of computers in instruction and types of CAI activities. The focus of chapter II is on use of CAI in adult learning environments. It discusses characteristics particularly relevant to adult learners regarding the use of CAI and computer use with adults. Chapter III discusses differences between stand-alone and integrated learning systems. Some examples of integrated learning systems are listed. Chapter IV addresses the question of whether computers will eventually replace teachers. Strengths and weaknesses of teachers and computers are listed and an optimum scenario is described. Chapter V outlines a process for selecting an appropriate cost-effective integrated learning system. Suggested specifications for management software, curriculum software, and hardware are detailed. Chapter VI lists categories and characteristics that might be considered in addition to the specifications presented in chapter V. Chapter VII addresses some typical implementation questions that will arise as CAI is introduced. Evaluation is discussed in chapter VIII, and the final chapter offers a brief conclusion. Appendixes include the following materials: a chart showing selected integrated learning systems, software evaluation criteria, sources of computer information, and computer terminology definitions. Contains 21 references. (YLB)

LEARNING WITH COMPUTERS:

IMPLEMENTATION OF AN INTEGRATED LEARNING SYSTEM FOR COMPUTER ASSISTED INSTRUCTION (CAI)

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"Learning is a kind of natural food for the mind."

Cicero

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CHAPTER I

COMPUTER DELIVERED INSTRUCTION

INTRODUCTION

CAI is an acronym for "Computer Assisted Instruction." CAI is the delivery of an instructional program assisted by computers. Regardless of whether the delivery is through the use of a microcomputer or a mainframe system, any instance in which instructional content or activities are delivered by computer is considered CAI. Other acronyms include:

CAL = Computer Assisted Learning

CaI = Computer aided Instruction

CaL = Computer aided Learning

CMI is an acronym for "Computer Managed Instruction." Where CAI is aimed at direct instruction, practice, and enhancement, CMI is intended to make instructional management and record keeping easier and more efficient. These are teacher oriented rather than student oriented programs. They enable the teacher to individualize diagnosis, prescription and record keeping. (See Appendix E for additional computer terminology definitions.)

Research indicates that CAI has had an impact on achievement and education. In 1972, Vinsonhaler and Bass reviewed the major studies on CAI drill and practice at the secondary level and found that augmenting classroom instruction with CAI provides superior performance on the SAT. Other reviews including those of Burns and Colp (1980) and Johnson and Jongejan (1981) support the idea that supplementary instruction with CAI leads to high achievement and that

the amount of time needed to learn is significantly reduced for mathematics or language arts skills.

In studies done primarily with college students, Johnson and Jongejan (1981) found that "Instructional activities delivered by a computer have required less time for students to complete than a similar activity delivered by other means." Studies on the effect of computer delivered instruction on student attitudes concluded that "results.... have been mixed but generally show that attitude is maintained or increased" (cited in Billings, 1984).

CAI has been used to provide basic skills instruction in adult education programs. Evidence (Nickols, 1987) indicates that providing adult learners with as little as three or four weeks of intense access to CAI can yield close to three-fourths of a year of mastery achievement in basic skills. Data collected from projects conducted in a variety of school settings (including California, Kentucky, Louisiana, and Massachusetts) provide evidence of class average achievement gains of more than one year for every 25 hours of time on task computer generated drill and practice in reading and mathematics (Crumb, 1988).

Billings (1984) reports on a study by HumRRO for the Office of Technology Assessment which reviewed thirty-two studies in simulation and adaptive testing. The majority of these studies showed savings in the learner's time to complete a course of study, greater efficiency in terms of achievement per unit of time, improved skills, and the provision of instruction not previously available by conventional methods. HumRRO's review leads to the conclusion that computer based education can be an improvement over conventional methods.

The Design, Development, and Evaluation of Instructional Software by Hannafin and Peck (1988) lists the following advantages and disadvantages of CAI:

Advantages of CAI

* Increased Interaction
* Individualization
* Administrative strengths/cost effectiveness
* Motivation
* Immediate feedback
* Ease of record keeping
* Lesson integrity
* Learner control

Disadvantages of CAI

* Need for specific expensive hardware
* Difficulty in reviewing topics (e.g. reviewing lessons for tests)
* Heavy reliance on reading and visual skills
* Unrealistic graphics
* Need for additional developmental skills (authors of software need more skill in developing meaningful lessons)
* Longer developmental time than traditional lessons
* Possibility of limited incidental learning
* Perception only of programmed input (cannot sense or see what a teacher can see; the computer perceives only the correct keystrokes)

CAI is a delivery system with unique advantages and disadvantages and should not be considered the answer to all educational problems. Even when it is a viable alternative, there may be more cost effective methods for delivering instruction.

DETERMINING THE APPROPRIATENESS OF COMPUTERS IN INSTRUCTION

There are basically two issues to consider when making decisions about whether or not to use CAI. These are (1) the objectives of the instruction, and (2) cost effectiveness. According to Yarusso (1984), if you can answer "yes" to each of the following questions, then you may be in the market for a CAI program.

1. Is the subject matter/training relatively stable?

   Yes No

   (Topics requiring frequent revision are not well suited for CAI. The longer development times for CAI suggest that the content of some subject matter would change while the lesson was being developed.)

2. Is the learning of skills, concepts, or rules the primary focus of the instructional content or is imparting knowledge the focus?

   Yes No

   (Knowledge, as opposed to skills, concepts, or rules, is a secondary focus of the instructional content. According to Yarusso, when computers are employed to deliver knowledge, they are often under utilized. Unless the computer's ability to track and manage the student progress through the course is critical, there may be easier and less expensive alternatives to deliver knowledge based instruction.)

3. Will classroom interaction have a minimal impact on achieving the desired outcomes?

Yes No

(If human interaction plays a critical role in the learning process, e.g., English as a Second Language, then CAI by itself may not be the best alternative.)

4. Is the instructional content appropriate for individualization?

Yes No

(One of CAI's principle advantages is the ability to individualize. When this advantage is not important, the topic should be handled appropriately with traditional linear approaches which are easier and less expensive to develop.)

5. Is the material to be learned strictly cognitive or intellectual?

Yes No

(It is practically impossible to teach certain physical skills through CAI. Imagine trying to teach dancing or swimming by computerized instruction. Demonstration or hands on experience are more efficient to achieve such results.)

6. Is CAI a cost effective alternative?

Yes No

(Hardware costs are often considerably higher than expected, especially when they include support services. On the other hand, cost savings are also deceptive. Savings in teacher time, cost and duplication of CAI materials (as opposed to

duplication of a text based lesson), and savings on classrooms or expensive equipment simulated by inexpensive microcomputers need to be considered.)

One negative response to any of these questions does not necessarily mean that CAI is inappropriate for an instructional setting. Several negative responses may indicate that alternative instructional strategies would serve the purpose more effectively and efficiently.

TYPES OF CAI ACTIVITIES:

CAI uses many instructional activities to present information. The following examples can be delivered by computer:

* Drill and practice
* Tutorial
* Gaming
* Simulation
* Inquiry
* Dialogue
* Problem solving

Which activity is used should be based on the learning task, learner characteristics, hardware limitations and the objectives to be presented. However, a quick look at software shows that most programs deal only with cognitive information which is easily defined and used to deliver that information. That's because it's the easiest software to design! The time needed for developing an inquiry problem solving lesson on a complicated question is much longer than that for designing one on established facts.

CHAPTER II

CAI IN ADULT LEARNING ENVIRONMENTS

CHARACTERISTICS OF ADULT LEARNERS:

In an article titled "30 Things We Know For Sure About Adult Learning," (Classroom Companion, February, 1989) seven characteristics are listed which are particularly relevant to adult learners regarding the use of CAI:

1. Adults seek out learning experiences in order to cope with specific life events.
2. Adult learners seek a learning experience primarily because they have a use for the knowledge or skill being sought.
3. They prefer single theory approaches that focus heavily upon application of concepts to relevant problems.
4. Adults need to be able to integrate new ideas with what they already know.
5. Fast paced, complex or unusual learning tasks interfere with learning of the concepts or data they are intended to teach or illustrate.
6. Adults tend to take errors personally and are more likely than children to let them effect self esteem.
7. Adults prefer self directed learning projects over group learning experiences led by a professional. They select more than one medium for learning, and they desire to control pace and start/stop time.

USING COMPUTERS WITH ADULTS

Using the computer for adult literacy instruction provides the adult learner with the following:

* Privacy
* Feedback
* Individualization
* Control
* Flexibility

Most adults enrolled in basic education and literacy programs have experienced difficulty in traditional educational settings. Many of them expend a great deal of effort to hide a lack of skills and still maintain control of their lives.

Adult learning expert, Terilyn C. Turner, explains how important privacy is to the adult learner:

> "In our society, difficulty with reading and math is synonymous with stupidity. Illiterate adults have experienced years of discrimination that children do not have. The computer affords privacy.... When observing a computer literacy lab in operation it is virtually impossible to tell the reading level of the students from a cursory glance around the room. This is the privacy afforded by technology. Adult learners do not want others to know about their reading problems."

In traditional educational settings, students often wait days, or in some cases weeks, for feedback on their work. Computerized instruction gives immediate feedback on results and reinforces successful instructional behaviors.

Retention of learning is increased when the adult learner can control the pace, direction, and extent of learning. Computers allow the student to progress at a learner defined pace, as well as to determine the direction of the learning experience. An individual course of study can be tailored for each student based on individual needs and goals. The computer allows the adult learner flexibility and independence to include learning in his/her busy schedule.

Adults benefit from learning experiences primarily when these two elements are present:

* Relevance
* Success

Adults bring a wealth of experiences and relationships to the learning process. They need to focus on topics of adult concern and interest and should be able to tap the thinking and reasoning skills they have brought with them to the educational setting. Computer courseware designed for successful adult learning shows the learner how to apply previous knowledge to relevant problems.

Adults who fail to experience success in an educational program rarely persevere towards achievement of their goals. The immediate feedback afforded by computerized instruction provides the learner reinforcement for success and a motivating, esteem building learning experience. With each success, the learner is encouraged to continue.

CHAPTER III

STAND ALONE VS. INTEGRATED LEARNING SYSTEMS

Ariella Lehrer describes the difference between a floppy disk approach and an integrated learning system in the article "A Network Primer: How They're Used... And How They Could Be Used," in the April, 1988, issue of Classroom Computer Learning:

> "Educational software on a floppy disk is to ILS as Sesame Street is to Instructional Television. While entertaining and certainly educational, Sesame Street is not necessarily a part of a well thought out sequence of objectives and activities; an instructional television series, on the other hand, represents a broader approach to learning. Similarly, a single program on a floppy disk, however well designed, does not offer the kind of sequenced learning activities available on most ILS's."

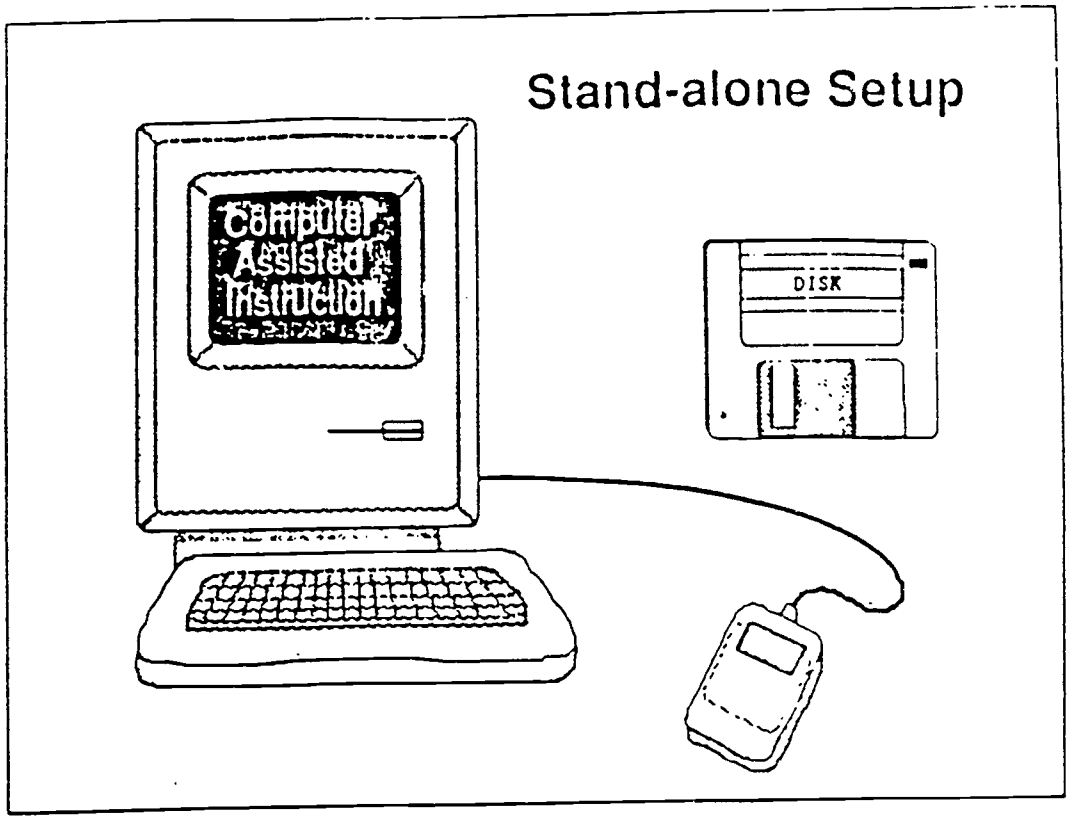
For example, different ILS's offer anywhere from 1,500 math and reading lessons to 15,000 hours of lesson material in over 200 subject areas. A few systems claim to have developed software that encompasses the entire K-12 curriculum.

STAND-ALONE SYSTEM

Regardless of its advantages, an ILS may not be the best choice for some districts.

A stand-alone set-up (see Figure 1) is less expensive to purchase and offers more flexibility in the selection of courseware, but does not include built-in instructional management software designed to monitor student progress.

FIGURE 1



Since management software is not a part of a stand-alone set-up the demands and limitations on the teacher are many. The teacher must:

* Diagnose what each student needs.
* Know detailed contents of each disk.
* Know the instructions on each disk.
* Manage the disk-loading, who has which disk, student A needs the disk student B is using.
* Track progress of each student.

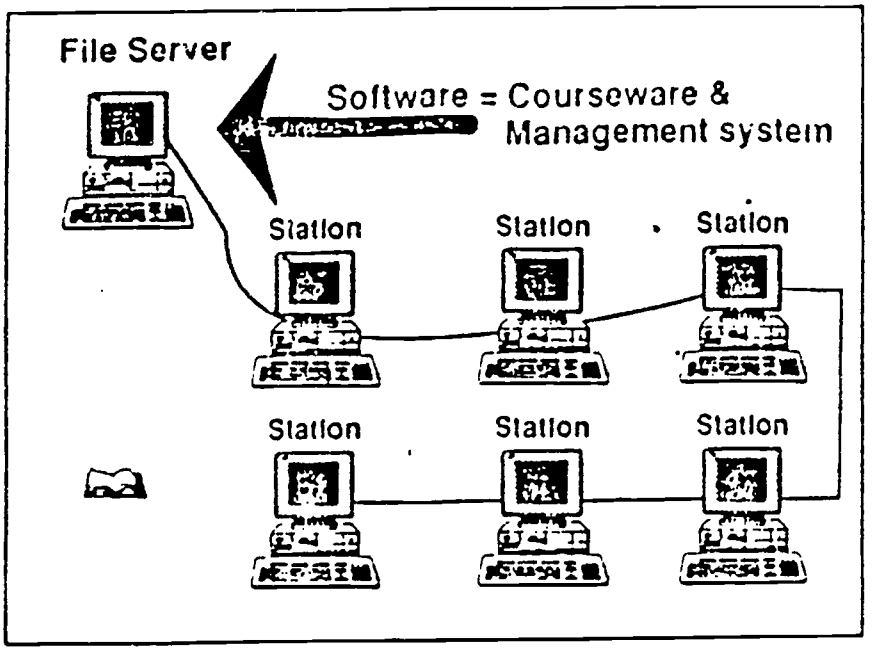
Students must be able to do the following:

* Know the instructions on each disk.
* Handle unfamiliar materials.
* Wait because the teacher is busy loading someone's disk onto the computer, explaining instructions to someone, etc.

ILS: INTEGRATED LEARNING SYSTEMS

An integrated learning system is one that includes both courseware and management software running on networked hardware (see Figure 2).

FIGURE 2



A management system on a file server system offers:

* Diagnosis on the computer that can lead directly into placement.
* The teacher ready access to a particular student's performance record.
* The teacher ready access to all student records and can collect class information.
* The student easy access and exit.

The fileserver component of an ILS delivers the courseware/ curriculum to all students. A student is able to move backwards or forwards in the curriculum based on mastery of competence. This feature can be either good or bad depending on how well courseware matches the goals and objectives of your program. Because the courseware is loaded onto the fileserver, flexibility in the selection of software is sacrificed when a complete curriculum package is purchased. However, many ILS's have the capability of easily removing individual workstations from the system so that third party (floppy) software can be used on the workstations as if they were stand-alones. An ILS is only as useful as the courseware installed on it, so make that selection very carefully.

Summarizing, one must weigh the complete curriculum package and recordkeeping capabilities afforded by an ILS against the lower cost and flexibility in courseware selection afforded by a stand-alone set-up. Which is best depends upon the individual program's goals and the needs of the student population being served.

PROCEED WITH CARE

Depending on their complexity and comprehensiveness, ILS's cost from $25,000 - $250,000. Invest the time and effort to carefully study ILS's, as these systems can easily become either the most expensive white elephants that you will ever have or the best investment you could possibly make. Some examples of Integrated Learning Systems:

* CCC (Computer Curriculum Corporation)
* CCP (Comprehensive Competencies Program)
* CNS (Computer Networking Specialists)
* EDL (Educational Development Lab)
* Ideal Learning
* Jostens
* PLATO (Programmed Learning for Automated Teaching Operations)
* Wasatch
* WICAT (World Institute for Computer Assisted Teaching)

(This chapter is an adaptation of a presentation, "Computer Technology: Teaching in the Future", by Evelyn Yap Curtis, Educational Specialist, Division of Adult and Community Education, Texas Education Agency. For additional information on integrated learning systems see Appendix A.)

CHAPTER IV

WILL COMPUTERS EVENTUALLY REPLACE TEACHERS?

A computer will never replace an effective teacher. On the other hand, a teacher will never replace an effectively used computer. Each possesses abilities that the other does not; each performs some tasks better than the other. Used together they are a dynamic team in the instructional process.

Chapter 3 of The Design, Development, and Evaluation of Instructional Software lists the following strengths and weaknesses of teachers and computers:

THE STRENGTHS OF TEACHERS

* Planning
* Developing
* Bonding with students
* Ability to Synthesize (identify and use information from several sources)
* Answer student questions
* Powerful role model (behaviors and values)
* Empathize with students
* Ability to work with large groups
* Motivate students
* Adaptability

THE TEACHER'S WEAKNESSES:

* Unable to spend adequate time with individual students.
* Unable to spend adequate time planning and developing instruction for individuals.

* Unable to grade and track student performance efficiently.

* Unable to evaluate students objectively.

* Experience frustration.

* Become bored.

THE COMPUTER'S STRENGTHS:

* Performs at high speed

* Performs accurately

* Collects and manages information

* Motivates

* Performs repetitive tasks without boredom

* Does not become frustrated

* Is able to individualize cost effectively

THE COMPUTER'S WEAKNESSES:

* Does not react spontaneously.

* Ineffective with large groups.

* Unable to model certain types of behaviors and values.

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AN OPTIMUM SCENARIO: When the teacher and computer are combined in a way that capitalizes on the strengths of each, a powerful instructional system results. The optimum scenario may be one where a teacher presents a particular concept in the classroom and then takes his/her class to the computer lab for practice and reinforcement of that same concept. In the classroom, the teacher presents material in the traditional way. In the lab, however, he/she assumes a new role, monitoring student progress in much the same way that an art, music or physical education teacher performs in many schools. If the teacher

remains uninvolved and uninformed about the curriculum delivered and the student progress made in the computer lab, it is unlikely that learning will generalize to any other medium or situation.

CHAPTER V

INTEGRATED LEARNING SYSTEM SELECTION PROCESS

The ability to read and write has become more important than ever. Preparing students for a rapidly changing and technological world poses a real challenge to any education system. That challenge is compounded by the fact that in the adult education environment, the student must meet his/her educational goals in months, not years. The adult education program needs to provide its students with effective and efficient academic and life skills preparation to become functionally literate. Technology can help address the literacy problem through the use of computers.

Instructional computer technology is well suited to the needs of an adult program because of its focus on diagnosis and remediation and its capacity for repetition and immediate reinforcement. Advances in technology make computers practical for assisting non-readers in learning to read. Voiced software enables the non-reader to use computer assisted instruction. Skill specific software can provide the illiterate student with guided practice activities and the reinforcement necessary for progress.

An additional benefit from the expanded use of computer technology in the classroom is an increased ability of the teacher to manage classroom instruction. The rapid turnover of students produces massive paperwork and record keeping problems for teachers who are required to provide individualized instruction. The computer management system can assist the teacher in diagnosing, prescribing and evaluating students. The computer is able to free the teacher

from these recordkeeping chores and allow more time for direct monitoring of the student's classroom work.

With all of the obvious benefits that come from use of computers in the classroom, a large price tag comes along as well. Care must be taken in the selection process to ensure that sound decisions are being made. Once it has been determined that monies are going to be committed to CAI, the next step is to develop a process for making an appropriate cost effective selection.

A PROCESS FOR SELECTING A SYSTEM

The following steps may be included in the decision making process when attempting to decide what product(s) to purchase.

SELECTION PROCESS

* Draft specifications
* Invite vendors to present their products for review and consideration
* Participate in vendor presentations and demonstrations of products
* Document "fit" of product to stated specifications after each vendor presentation
* Narrow list of vendors to manageable number based on degree of "fit" (only necessary if there are many initial vendors under consideration)
* Make site visits, if possible and appropriate, to see product in actual use

FIGURE 3

DIRECTIONS FOR

COMPUTER EVALUATION WORKSHEET

On the tally sheet below, assign an IMPORTANCE FACTOR of 1 to 3 for each category, depending on how important you think each category is to your decision. (1 = NOT IMPORTANT; 2 = IMPORTANT; 3 = VERY IMPORTANT)

As you compare each system, give each one a rating of 1 to 3 in each category (1 = POOR; 2 = AVERAGE; 3 = GOOD). For example, if license fee information is not available, give it a 1 under the corresponding category; if the fee is relatively low, gage accordingly and give a 2 or 3.

When all the categories have been rated, multiply them by the importance factor you originally assigned. The end results are then added together. The highest total will indicate the system best suited for your needs.

SAMPLE:

BRAND _____

CATEGORY	IMPORTANCE FACTOR (1 to 3)	RATING (1 TO 3)	TOTAL
1. Network vs. standalone (network vs. floppy disk)			
2. Computer flexibility			
3. Operating flexibility (DOS, Unix, etc.)			

FIGURE 3 (cont'd.)

BRAND _____

	CATEGORY	IMPORTANCE FACTOR (1 TO 3)	RATING (1 TO 3)	TOTAL
SYSTEM CONCERNS	1. Network vs. Standalone (network vs. floppy disk)			
	2. Computer Flexibility			
	3. Operating System (DOS, Unix, etc.)			
	4. Vendor Support (training into. access)			
	5. Cost			
	6. License Fee			
CURRICULUM CONCERNS	7. Reading Curriculum (Adult Literacy Concerns)			
	8. Language Arts (writing)			
	9. Science Curriculum			
	10. Social Studies Curriculum			
	11. Math Curriculum			
	12. Job/Life/Pre-Release			
	13. GED Curriculum			
	14. ESL Curriculum			
	15. Vocational Curriculum			
	16. Management Software			
EXTRAS	17. Voiced Software			
	18. Graphics Software			
	19. On Line Help (glossary, calculator, notebook			
	20. Off Line Instructional Materials			

TOTAL _____

* Analyze final list of vendors by assigning importance to each criteria (specification or category of specification) and then rating each vendor as to degree to which vendor satisfies the specification/criteria (see Figure 3)
* Assuming that a number of reviewers are involved in the review process, compile results of previous step to get numerical average rating for each vendor (see Figure 4)
* Identify top ranking vendor (or vendors)
* Make recommendation to decision making body such as Board, Superintendent, Private Industry Council, etc.

DETERMINING NEEDED SPECIFICATIONS

Establishing the list of specifications involves making decisions about software (curriculum, management, and format), hardware, and technical support provided by the vendor. Instructional issues should be determined first. Hardware is irrelevant if appropriate software to meet your learners' needs is not available for the particular hardware platform that you are considering.

Some common software considerations follow:

Management software must:

* Provide a management tool for networking computer aided instruction software.
* Automatically record student performance data in on-line curriculum to management system
* Diagnose learner placement in the core curriculum
* Generate individual educational prescriptions for off-line material

FIGURE 4

NUMBERICAL RANKING OF COMPUTER INSTRUCTIONAL SYSTEMS/PROGRAMS

COMPANY NAME	HARDWARE VERSATILITY	LICENSE FEE	READING (ADULT. LIT.)	LANG. ARTS/WRITING	SCIENCE	SOCIAL STUDIES	MATH	JOB/LIFE SKILLS PRE-RELEASE	GED	ESL	VOCATIONAL	MANAGEMENT SOFTWARE	VOICED SOFTWARE	ON LINE HELP (glossary, calculator, notebook)	OFF LINE HELP (class materials, texts, etc.)	THIRD PARTY SOFTWARE	TOTAL
1.																	
2.																	
3.																	
4.																	
5.																	
6.																	
7.																	
8.																	
9.																	

Ratings

4 - Excellent 3 - Good 2 - Fair 1 - Poor 0 - Not Available/Unacceptable

* Provide for teacher adjustment of mastery levels for on-line curriculum
* Include security checks/blocks to prevent tampering with records or program
* Be user friendly
* Generate individual student performance records
* Generate group student performance records for program evaluation

Curriculum Software must:

* Integrate program curriculum objectives into the management system of the file server
* Include majority (set appropriate percentage) of local program curriculum objectives at each level in language arts and mathematics
* Be capable of integrating third party software into the management system to augment core curriculum on file server
* Include voiced software for the low level language arts and ESL student
* Have digitized speech capability
* Allow for site ownership of on-line curriculum
* Allow 90 day approval of core curriculum
* Include instruction for occupational knowledge/awareness on file server
* Include GED preparation instruction on-line
* Include process writing instruction
* Provide free updates to file server during term of contract

* Allow for customization of sequence of objectives on file server to accommodate local program arrangement of curriculum objectives

* Include materials appropriate for the slow learner

Hardware considerations might include all or some of the following:

* Utilizes color system, 128K, 5-1/4 inch single disc computer terminals that are compatible with chosen software. (Whatever specs are identified here, the key is software compatibility.)

* Utilizes _X_ (size appropriate for software package) MB hard disc file server with networking capability for a minimum of _X_ (how many you will want to attach) workstations

* Includes file server that can be networked to remote terminals/labs

* Is capable of managing _X_ (number of students in program) student records plus core curriculum

* Experiences no noticeable degradation in time of operation for student user or system's manager when a minimum of _X_ student terminals are networked

* Provides for rapid backup of management system taking no more than _X_ minutes per day for _X_ student records

* Allows for use of third party software

* Can transfer student information electronically between learning sites

No system is going to serve your needs if your staff does not know how to operate it or if you cannot get it repaired in a timely

manner when it breaks down. The following are considerations regarding technical support:

* Provides _X_ (whatever number of days that you think your staff will need) days of initial staff training to users and support staff
* Trains in-house staff to serve as technical trouble shooters as well as in-house trainers
* Provides education consultant for at least _X_ day(s) per month per lab for term of contract, if needed
* Provides for installation, replacement, repair of hardware and software to be free for first year
* Rearranges and moves lab or lab parts as necessary
* Warranties on all products for term of contract
* Plans delivery and installation within _X_ (how quickly do you need to set up) days after award of contract
* Assures compatibility of services between vendors if more than one is involved in purchase of lab

The final selection of a computerized learning system is not a decision arrived at quickly or easily. Reviewing available products is time consuming and often confusing. You may not feel that you alone have the technical or curricular expertise to make such a momentous decision. It is wise to involve as many people in your organization in the decision making process as is possible and workable. Aside from assuring the quality of the decision, involvement of other staff will ensure the commitment of all staff to the final selection. Implementation will be much more effective if the staff is in support of the decision made.

CHAPTER VI

CHARACTERISTICS TO CONSIDER IN EVALUATING EDUCATIONAL SOFTWARE

In Chapter V, a process for selecting a total integrated learning system was outlined. Suggested specifications were detailed to serve as "thinker starters" for someone new to such a process. The process outlined was suggested as a model. The specifications suggested were not intended to serve as a model but rather to simply illustrate the point. What follows is a list of categories and characteristics within categories that might be considered in addition to those examples in Chapter V.

BREADTH AND SCOPE

* Provides an adequate number of lessons per objective.
* Provides for easy installation and use of third party software.

COVERAGE

* Develops thinking skills such as making inferences, finding patterns, and solving problems.
* Intersperses review lessons with new topics.
* Provides "mixed practice," e.g., student may get a few exercises in decimals, followed by a few in division, then some in geometry).
* Integrates content areas across disciplines
* Provides opportunities for student exploration through varied lesson types such as tutorials and practice exercises (learner control).

QUESTIONING STRATEGIES

* Varies types of questions (multiple choice, fill in the blank, open ended).
* Allows student to go back and forth between lesson and questions.
* Repeats questions incorrectly answered later in the lesson/exercise.
* Provides reasonable and appropriate number of trials.
* Provides for on-screen calculation when appropriate.

RESPONSE JUDGING

* Allows for certain degree of error/variation in response (e.g., will accept + sign for addition, upper or lower case, misspellings, etc.).
* Prompts.
* Gives clues and hints (if yes, what is quality?).

FEEDBACK

* Gives positive feedback.
* Prompts student who does not respond for a period of time rather than counting non-response as an error.
* Allows control over timing of tutorial/hints on the screen and response time.
* Provides helpful hints.
* Goes from hints to on-screen tutorials.
* Provides error specific feedback.
* Allows student to see own performance record.
* Uses branching to automatically adjust difficulty levels or sequence according to student performance.

CLARITY

* Gives clear procedural prompts (e.g., "press enter to continue").
* Screens are easy to read.
* Instructions are clear.
* Provides variety of on-line tools (e.g., glossary, thesaurus, calculator).

APPROPRIATENESS

* Matches curriculum objectives.
* Application is well suited to computer use.
* Presents sufficient information for intended learning to occur.
* Uses readability level that is appropriate for the intended student population.
* Uses highlight and animation appropriately.

LEARNER CONTROL

* Pull down calculator available for math.
* Pull down glossary for clarification of terms.
* Student can go forward as well as backward in lesson.
* Student has access to the right answer.
* Graphing capability available.
* Help available; quality of available help.
* Pull down tools like protractor/ruler.

GRAPHICS AND AUDIO

* Has high quality graphics (clear, colorful, integrated into the instruction).
* Uses animation appropriate to learner level/needs.

* Uses graphics and audio to motivate.

* Focuses attention on appropriate content with graphics.

* Avoids distracting graphics.

CREATIVITY

* Challenges and stimulates creativity.

* Uses innovative pedagogy/andragogy.

* Allows for student exploration (the computer is used as a learning/research tool).

TECHNICAL QUALITY

* Downloads smoothly while on-line.

* Responds rapidly to text input and/or commands.

TESTS

* Places students into the curriculum.

* Adjusts initial placement to appropriate student placement as student progresses.

* Provides multiple versions of tests.

* Allows for adjustment of the pass/cutoff score.

DOCUMENTATION AND SUPPORT MATERIALS

* Provides designed, easy to use, and informative reports that the teacher needs.

* Instructions are contained in a single document and are well indexed.

(For additional software evaluation information and other sources of computer information see Appendices B and C.)

CHAPTER VII

PROGRAM IMPLEMENTATION

The actual implementation of a computerized learning system in an adult education environment is going to be impacted by the number of teachers, the number of students, amount of available space, hours of operation, and many other variables. There is no "ideal instructional or organizational arrangement that has been identified. This chapter attempts to address some of the typical implementation questions that will arise as CAI is introduced:

* For which adult students does CAI work best?
* What are the optimum number of hours of lab participation for an adult learner?
* What organizational arrangement will facilitate implementation?
* What teacher characteristics should be considered in assigning teachers to the lab?
* How much training will the staff need?

WHICH STUDENTS RECEIVE THE GREATEST BENEFIT?

Teachers generally agree that students at the polar extremes (advanced GED or college prep students and the most needy students) benefit the most. Perhaps low level students respond well to the computer because many of them are kinesthetic. The computer is visual, tactile, and auditory; it appeals to all the senses. Several teachers believe that CAI is equally beneficial to both high and low achieving students once they overcome their fear of the computer.

Conversely, what students receive less benefit from computerized instruction? Teachers are in agreement on this question and

invariably say the non-readers and ESL students. In addition, those students who are not independent learners have difficulty with CAI. These individuals need constant external reinforcement from the teacher. However, once they understand that they are in control of their learning, they can go forward very quickly.

OPTIMUM HOURS OF STUDENT PARTICIPATION

There is little hard data that establishes some "magic" number of productive learning hours in a computer lab for an adult student. Common sense dictates that there is some high number after which participation becomes counter productive and some minimal amount at which participation is not worth the time or effort. Somewhere in between those two extremes is a reasonable amount of time "on-line" for most students.

The Windham School System in the Texas Department of Criminal Justice implemented an integrated learning system computer lab on the majority of its campuses in 1990-91. Given the number of campuses and the differing number of adult students in need of service at each campus, the differing number of student workstations at each site, and the differing school schedules that had to be accommodated, several lab schedules were implemented. The experiences of Windham with implementation of CAI will be drawn upon here to illustrate how effective various implementation approaches might be.

Students in Windham participate in computer lab from a minimum of 45 minutes per week to a maximum of three hours per day. The most common schedule arrangements are as follows:

* Once a week for 3 hours

* Twice a week for 1 1/2 hours

* Every day from 45 minutes to 1 1/2 hours

Experience indicates that students often become bored during 3 hour sessions but that anything less than 45 minutes is unproductive.

ORGANIZATIONAL ARRANGEMENTS

There may be as many different ways to organize the computer lab as there are people to think those ways up. For the administrator who doesn't want to "reinvent the wheel," the following three arrangements might be considered typical:

* A lab instructor is designated and students are rotated through the lab as appropriate.

* All teachers are designated as lab instructors and take their classes to the lab at a designated time.

* A lab instructor is designated and whole classes are accompanied by their "regular" teachers to the lab.

In settings where there are designated lab instructors, classes are either sent as a whole group from their regularly assigned class or four or five students from each of several academic classes are sent into the lab. Sending whole classes at a time to lab can provide a "free" period for the sending classroom teacher. In a fairly large school, that can be an important administrative benefit. Another benefit is that a few students being sent from each of several classes to the lab can effectively reduce the student/teacher ratio in all classes and allow for more individual attention.

When students go to the lab without their classroom teacher, the lab instructor and classroom teacher should conference regularly. At

least once a week is necessary but even daily is appropriate so that each teacher can stay abreast of the progress of students. Lab instructors who do not work closely with the regular classroom teachers are at a disadvantage and may not be as successful as possible.

Printouts from the management system indicating student progress can be sent to the classroom teacher by the lab instructor on a regular schedule (e.g. daily, weekly, monthly). Additional notes can be written on the printouts that are sent to the regular teachers as a means of fostering communication. Supplementary workbook materials that are a part of the computerized instruction can be distributed to the classroom teachers for use in regular classes. This sharing of materials fosters a sense of collaboration among teachers who share students.

In situations where all classroom teachers are trained as lab instructors, the lab becomes everyone's area of expertise. From the standpoint of integrating lab instruction with traditional classroom instruction, this method is excellent, and it may be the most cost effective in terms of staff use. However, many teachers feel inadequate in their knowledge of the lab operation and prefer that a designated lab instructor or an instructional aide be provided for assistance. In addition, some teachers' skills are better used in a classroom that focuses on high student/teacher interaction. Teacher characteristics should be given serious consideration when determining whether this arrangement is best.

Another limitation to sending whole classes to a lab is that there may not be enough student workstations to accommodate all students. Off-line activities must be provided and supervised by the

teacher. Some computer software packages come with supplementary workbooks and other media intended to be used to augment the curriculum that is computer driven. For those that do not, staff need to be prepared to provide appropriate adult materials that range from workbook formats to multi-media materials. Teachers may use peer tutoring effectively to ensure that all students are actively engaged in learning activities while in the lab whether each student is working at a computer station or not.

The third arrangement is to designate a lab teacher but to send whole classes to the lab accompanied by their "regular" instructor. In effect, this amounts to a "team teaching" arrangement. The experiences of Windham School in implementing this approach indicate that staff prefer this model. Their feeling is that students get more direct teaching assistance while in the lab; the "regular" teacher can better reinforce what is learned in the lab and vice versa; the necessary time spend on technical, mechanical activities during lab impacts less on student time on task; and students make more achievement gains. The down side to this arrangement is that it is the most expensive to implement given staff salaries. Two teachers in a classroom serving the same number of students who would be served by only one of those teachers is often seen by administrators as unacceptable. Instructionally, of course, the question is, "Would each of those students learn as much if only one teacher were there to assist?"

Regardless of the manner in which a computer lab is overseen, computerized instruction is not be be viewed as a means to an end. In order to receive optimum benefits from CAI/CMI, instruction must be

integrated with that of the regular academic classroom. This cannot occur without appropriate communication between all persons involved.

CHARACTERISTICS OF EFFECTIVE COMPUTER LAB INSTRUCTORS

What type teacher makes a good lab instructor? The following characteristics should be considered:

* Must exhibit an interest in the computer
* Must be easy-going; not the place for a person who is easily upset
* Must be someone not afraid to ask questions
* Must be someone not afraid to make mistakes
* Must be an energetic person (moves around all the time)
* Must be motivated
* Must be an established teacher, not one new to the system
* Must be able to coordinate well with other teachers
* Must be self-directed
* Must be aggressive
* Must be a good disciplinarian
* Must be a "top of the line" classroom teacher

STAFF TRAINING

The most cost effective, learner friendly, instructionally sound computer learning system will not be effectively and efficiently implemented without adequate staff training. Recall that this was one of the evaluation criteria considered before the purchase was made.

The amount of training needed will vary depending on the technical sophistication of your staff and on the sophistication of the system being implemented. The adult teaching environment creates some special problems for training. Many community based adult

education programs experience significant staff turn-over. Most vendors will commit to a certain number of hours or days of initial training up front, but that does not include coming out repeatedly to train new staff members as the experienced ones move on. It is important to identify some staff person who can be relied upon to be fairly stable in the program who can be trained to be a "trainer" for new staff. That person may be you, the administrator.

If the vendor from whom you purchase offers some level of on-site support after the initial training, buy all that you can possibly afford. You will need it! Much information is covered in an initial inservice on the use of the lab. A great deal of it may go over many people's heads. These staff members will need individualized assistance in a "hands-on" setting to become really proficient in the operation of the lab. This should be nothing new to you as an adult educator. We are, after all, just like our students in that respect. Even after all technical questions have been answered to everyone's satisfaction, on-going support will help your teachers to integrate the lab instruction into the regular school program. Training consultants will enable your staff to create innovative and effective ways to use computer delivered instruction for your student population.

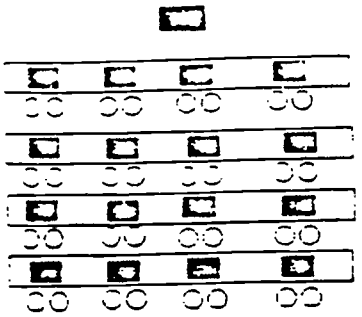
SUGGESTED PHYSICAL ARRANGEMENT

The actual number of workstations in the classroom will be dictated, in part, by the physical limitations of the room. Any of the following arrangements will work successfully (see Figure 5).

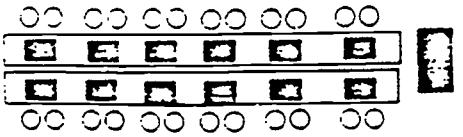
Be certain to plan for the physical space required by and for work tables, carrels, chairs, teacher desks, file cabinets, file

ARRANGEMENTS

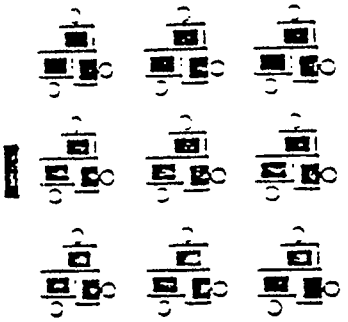
Rows - Crosswise



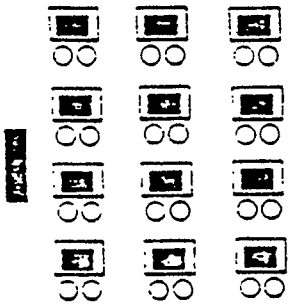
Center Rows



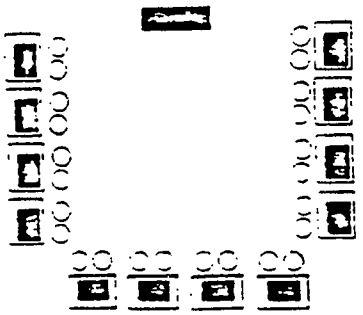
Clusters



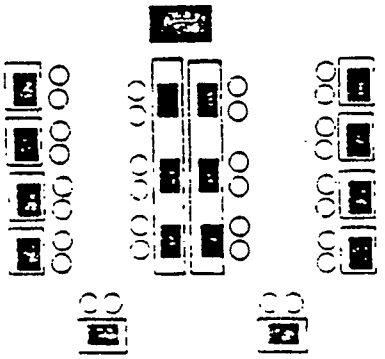
Rows - Lengthwise



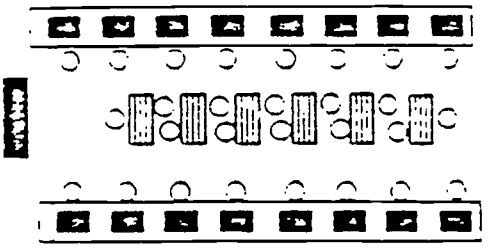
U-Shaped



Modified U-Shaped



Rows with Workspace



Source: Computer Lab Guidebook, Minnesota Educational Computing Consortium, 1985

server, printer(s), and any other furniture and fixtures that will be in the classroom.

Check the electrical requirements of the lab that you are considering before the computers are unpacked. Generally, allow 20 amps for every 20 workstations. Ensure a dedicated line for the fileserver and surge protectors for every outlet.

TIPS FOR IMPLEMENTATION

Teachers in the Windham School System who were involved in the implementation of the integrated learning computer labs were surveyed for suggestions that could help other staff as they attempted to implement CAI. The following is a list of suggestions:

* Assign terminals (make students accountable for computers).
* Post rules at each computer station and on walls in lab.
* Provide sign-in and sign-out sheet at each computer station.
* Have contracts for students before working in the lab.
* Do not overload classes to the extent that computers are not available to all students.
* Have a set of written directions for substitute teachers.
* Make all computer terminals visible from the teacher's station.
* Leave enough space between terminals for the teacher to move freely.
* Dismiss students one at a time so that the lab instructor can check station.

There is little difference in managing a computer lab and a regular classroom; organization is the key. When everyone knows

exactly what he/she is responsible for, an efficiently run computer lab is the result.

Many teachers also described organizational or instructional strategies that worked well for them:

* Team teaching (lab instructor and classroom teacher)
* Peer tutoring (at least, pair new students with "stars" of class for initial orientation)
* Teach keyboarding lessons using a typing manual.
* Correlate local objectives to software objectives.
* Assign free time on the word processor as a motivator.
* Encourage writing on the word processor.
* Allow students to view their progress on the print outs (pin point weak areas and brag on successfully mastered lessons).
* Give students a feeling of success and a sense of direction.

There will be frustrations as a computer lab is implemented. Some staff will feel overwhelmed by what they are being asked to learn and provide. Lab teachers must maintain security, give student directions, monitor off-line student activity, run the management station, and more while in the lab environment. These staff must provide student reports for other teaches and administrators. They must figure out how to communicate effectively with other staff about student progress without creating some unmanageable "paper monster." They will deal with toc many students and too few workstations, with students who aren't turned on by computer driven learning (and there are some), and with too little time before and after class to plan, make assignments, maintain the system and evaluate student successes.

In spite of those very real frustrations, the staff will very likely view CAI as an effective teaching strategy. Their feelings will likely be reflected by these two statements from teachers who have gone through the experience and survived:

"Even with the problems, it's worth it!"

and

"We can't say enough good things about it!"

CHAPTER VIII

EVALUATION

To assess the effectiveness of a computerized learning system once installed and implemented, you will want to examine student data, both achievement oriented and attitudinal.

Achievement gains are traditionally measured by comparing pre and post test results for students who received a common number of hours of instruction in the computer lab. A standardized achievement test such as the Test of Adult Basic Education (TABE) or Adult Basic Learning Examination (ABLE) is used to assess student performance in reading, language and mathematics. A comparison of grade equivalents expressed as gains or losses provides a measure of achievement.

Mastery of curriculum objectives is another measure. In a competency-based program, this evaluation is perhaps more appropriate than a measure of grade gains. Some programs categorize objectives by grade level and base growth on grade equivalents spanned by objectives. This is another means of discussing achievement, albeit a somewhat biased measure (see Figure 6, also Appendix G).

Student demographic data can be tracked by the management system to enable program administrators to analyze performance trends in terms of selected student variables. Such variables might include the following:

* I.Q. scores
* Identified learning disability

FIGURE 6

LANGUAGE ARTS

Table 1

Student	Student Mastery Level	Months in Lab	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	70%	4	0.0	5.1	5.1
2	85%	4	8.0	9.0	5.0
3	90%	6	1.2	9.0	7.8
4	85%	2	3.5	8.0	4.5
5	70%	8	3.5	9.0	5.5
6	85%	6	3.5	9.0	5.5
7	85%	2	7.4	9.0	1.6
8	85%	6	3.0	9.0	6.0
9	85%	2	3.5	9.0	5.5
10	85%	6	1.9	8.0	6.1
11	85%	2	0.5	8.0	7.5
12	88%	12	0.5	9.0	8.5
13	85%	7	3.5	9.0	5.5
14	85%	17	3.5	9.0	5.5

Average growth by grade level: 5.7

Average number of months in lab: 6

MATHEMATICS

Table 2

Student	Student Mastery Level	Months in Lab	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	85%	5	4.0	9.0	5.0
2	85%	1	2.0	4.0	2.0
3	85%	4	9.0	9.0	0.0
4	85%	6	4.0	9.0	5.0
5	85%	7	2.5	9.0	6.5
6	85%	6	4.0	9.0	5.0
7	85%	2	4.0	9.0	5.0
8	85%	2	4.0	9.0	5.0
9	70%	8	4.0	9.0	5.0
10	85%	13	2.0	4.0	2.0
11	85%	2	4.0	9.0	5.0
12	90%	5	4.0	9.0	5.0
13	85%	2	9.0	9.0	0.0

Average growth by grade level: 3.0

Average number of months in lab: 4.8

* Identified handicapping condition such as

  a. mental retardation

  b. emotional disturbance

  c. visual handicap (not corrected by glasses)

  d. hearing impairment (not corrected by hearing aid)

* Limited English Proficiency (LEP)

* Learning style strengths

* Last year of school completion

* Last date of school enrollment

* Date of birth

* Race/ethnicity

* Sex

* Socio-economic status

The capability of tracking student gains by demographics enables program evaluators to disaggregate data to determine what students gain most/least from CAI participation.

Student attitudes towards computer delivered instruction are equally important. One inmate student, after participating in the lab environment for several sessions, said that he wished that CAI had been available to him when he was a kid in school because he didn't think that he would be in prison if he had been able to be successful in school. Admittedly, this is a perception and one that may oversimplify the relationship between "schooling" and criminality, but it expresses the very positive way that one adult student feels about the benefits of CAI. Other students were polled and penned the following statements:

* I enjoyed the computer room and wish we could go everyday.
* I thank the people who thought about this computer lab because it is very helpful to me and others in TDC.
* It gives me feedback.
* If only my mind would observe like computers I would be smart.
* I believe this class will help out a lot of people because these computers are great!
* I enjoy the computer lab most of all my classes, because I get the individual help I need.
* I feel that the computer class has helped me in spelling, reading, and math. I'll like very much to own one or two of them.
* I like the computer class because it helps me learn how to do work that I don't understand. The class has helped me a lot.

The following letter from an inmate in TDCJ expresses the feelings of many adult students.

Well I think it's better than classroom learning.
Because everything is explained much better than in class.
Plus, one can see, and reread instructions if necessary.
Which can be an awful lot of help to people with poor learning abilities.

That is how I see it.

Thank you

(See Appendix D for additional inmate letters.)

CHAPTER IX

CONCLUSION

Many states are accelerating use of technology to meet the instructional needs of adult learners. It is a phenomenon that may eventually transform adult education in America. Studies show that using CAI is effective for many adult learners. Adults in literacy programs usually increase their test scores and/or grade level equivalency when CAI is used. However, along with the ability to expand the educational vista comes the challenge of sorting through a host of hardware and software options in order to find a combination that is instructionally effective and affordable.

In using technology as a significant tool in adult education, we should get rid of the idea that technology can "do it all." Technology is not a panacea, but it does have the ability to provide a multi-sensory, bias-free alternative to traditional instructional approaches. It can easily be controlled for quality and equity of access, and it can afford students privacy and individualization as well as control over their own learning.

The challenge confronting education is not to produce more electronic technology but rather to creatively develop the education potential that the new technologies offer. Administrators are faced with the challenge of how to best deliver the benefits of instructional technology to the adult population. Training instructors in the effective and creative use of technology and identifying and assessing which materials and systems are the most appropriate for adult learners are significant challenges. (See

Appendix G). Even with the challenges, computers and CAI have a promising future in education. There is still a long way to go, for computers have not yet had the impact that might have been expected, but CAI has the potential to "enhance significantly the quality and delivery capability of adult literacy and basic skills instruction" (U.S. Department of Education, 1991).

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APPENDIX A

A Selection of Integrated Learning Systems

A Selection of Integrated Learning Systems

Company	Host network	Computer model(s)	Maximum number of computer connections	Curriculum areas	Teacher training/ technical support	Cost	Annual software license fee (per computer)
Computer Curriculum Corporation, (CCC) Box 10080 Palo Alto, CA 94303 (800) 227-8324 (800) 982-5851 (in CA)	CCC MICROHOST Computer with graphic server or Multiplexer	Atari 1040ST or IBM PC or Apple IIe and IIGS (with emulators available from CCC)	128	K-12+ math, reading, language arts, programming, ESL, adult education	• $200 per day • hotline number available • field representatives	$100,000 includes • host network • 30 Atari STs • all courseware	$200
Computer Networking Specialists (CNS) Rt. 1, Box 286-C Walla Walla, WA 99362 (800) 372-3277 (509) 529-3070 (in WA)	Corvus Omninet III (45 mg recommended)	Apple IIe and IIGS	63	• third-party software modified for system • CNS "Class-Works Management System"	• 1 day • hotline number available • modem support	$17,517 includes: • Corvus network (not including Apple computers) $10,000 includes: • basic software package	none
Dolphin-Houghton-Mifflin Box 683 Hanover, NH 03755 (603) 448-3838	DEC PDP-11	DEC PDP-11	14	• 1-8 math computation • 3-8 math problem solving, language arts, reading	1 day per curriculum area	$30,000 includes • host network • 14 workstations $9,480 licenses • all courseware for 8 computers	$6,000 (for 8 computers)
Education Systems Corporation (ESC) 6170 Cornerstone Court East San Diego, CA 92121 (800) 548-8372	Tandy 3000 with 3COM or Mac SE with Local Talk or IBM PS/2 Model 30 with Baseband	Tandy 1000 (640K) or Apple IIGS (1mg) or IBM PS/2 Model 25	40	K-12 reading, math, language arts, writing processor	• trained lab attendant or teacher training • hotline number available • local field representatives • continuous in-service	$100,000 includes • host network • 30 computers • CD-ROM player • all courseware	2 options • perpetual license or • 3-year rent-to-buy software
Ideal Learning, Inc. 5005 Royal Ln. Irving, TX 75063 (214) 929-4201	Lan Tech or Corvus Omninet III or Digicard	Apple Plus, IIe, and IIGS	63	• K-12+ math, language arts, foreign language, science • management system	• 2 days • hotline number available • field representatives	$28,000-$30,000 includes • host network for 25 computers (not including Apple computers) • courseware for 10 courses	none
PLATO Educational Services Box 1305 Minneapolis, MN 55440 (800) 328-1109	Local PLATO delivery system	IBM PC or compatible (640K)	30	• 4-8 (remedial) reading, math • high school reading, math, writing, science, social studies, computer awareness	• 5 days of lab attendant training or teacher training • hotline number available • field representatives	$100,000 (approx.) includes: • host network • 30 computers • 1st year courseware license fee for all courses	$600
Prescription Learning Corporation 6150 N. 16th St. Phoenix, AZ 85016 (800) 422-4339	MS-DOS SC-NET	Apple IIe or IIGS, or IBM PC or compatible (any two can be networked together in same lab)	30	K-12+ math, language arts, ESL, reading, adult literacy, writing	• 3.5 days teacher training plus 2 times per-month visit by consultant and technician • workshops twice a year • hotline number available	not available	not available
Wasatch Educational Systems 5250 S. 300 West Salt Lake City, UT 84107 (800) 288-2838	Novell	IBM PC or compatible	30	K-12+ science, math language arts, reading, literature, word processing, adult education	• 13 days in the first year • hotline number available • field representatives	$112,500 includes • host network • 30 computers • all courseware	$400
Wicat 1875 South State St. Orem, UT 84058 (800) 453-1145	Wicat System 1250 or System 1255 or System 300	Wicat workstations or Apple IIe or IIGS, or IBM PC	8 32 64	• K-12 language arts, math ESL • special programs Chapter 1 at risk mainstream online testing	• 5 days for director • 2 days for teachers	$110,000 includes • host network • 32 computers • 1st year courseware license fee for 6 courses • 15 month maintenance	$300

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APPENDIX B

Software Evaluation Criteria

SOFTWARE EVALUATION CRITERIA

The following are some questions which Adult Basic Education and Literacy administrators may want to consider when thinking about purchasing a instructional computer software for their program. This is not an inclusive list. It is offered in the hope that it will stimulate adult education and literacy administrators and teachers to ask additional questions about the software they are thinking about buying.

Hardware

1. Are the computer and the related peripheral equipment being offered current state-of-the art or is it an obsolete system the company wants to sell quickly at a reduced price?

2. Does the computer's central processing unit have standard interfaces?

3. Does the system use color monitors? Some adults with learning disabilities learn more readily with color, so consider your student population and the extent to which the use of color in the text and/or graphics might be important to them.

4. Does the system have and audio component? What is the quality of the audio component? Is it easy to use? Does it work reliably? Is the audio built into the computer or are additional items such as a cassette player, tapes, and headphones necessary? Are headphones used? If so, are they comfortable for the students? Are there individual volume controls for the audio? Can the audio portion of the equipment be used with hearing impaired students? Are any modifications to the audio equipment necessary before it can be used by hearing impaired adults?

5. Can the monitor and keyboard accommodate the visually impaired? Are any appropriate modifications available from the company for these students?

Software

1. Is the instructional purpose(s) of the software clearly stated by the developer? Are the instructional purposes of the software compatible with the instructional purposes of your Adult Basic Education or Literacy program?

U.S. Department of Education. Division of Adult Education and Literacy.

2. What is the educational level for which the curriculum was developed? Was it initially intended for adults? It is appropriate for use with adult learners? If not, can it be adapted by your classroom instructors or your literacy volunteers for use with adult learners?

3. What is the quality of the software? Is it uniformly high or are there weak areas in the instructional content?

4. What was the basis upon which the curriculum was developed? Were standard adult basic education or literacy materials used?

5. How was the curriculum field tested? How was effectiveness determined? How large was the test group? What were the field test results? How did the company change the curriculum as a result of the field tests? How extensively is the system being used now? Will the company give you references for both satisfied and unsatisfied users?

6. Does the curriculum contain graphics? If so, are they of high quality? Are they presented in a style and manner which is likely to hold the students' attention? Are the graphics free of offensive gender, racial or ethnic stereotypes?

7. Was the curriculum developed in a linear, sequential manner or is branching used? Branching enables the student to go back to use remedial material as needed.

8. What sort of feedback is given to the student? Is it immediate, appropriate and helpful?

9. Is remedial material built into the curriculum? Is it new material presented in an interesting and effective manner or is it more of the same material the student initially did not understand?

10. Can the student run off a print copy of his or her work?

11. What sort of individual and collective student feedback is available to the teacher from the system? Is there a student management system built into the system? Can the teacher use the diagnostic feedback to identify the areas where individual students need additional help?

12. Is an English as a Second Language software available? Is the instructional approach in the software compatible with your program's philosophy concerning Adult Basic Education and Literacy programs for ESL students?

13. Does the software company have curriculum available for Adult Basic Education students who have learning disabilities? If so, is the material appropriate for your adult students?

14. Can the software be used on a standard computer or does it require purchasing the software company's computer?

Teacher Assistance

1. How much time is usually required by teachers to become competent to use software?

2. Does the software company provide a representative who comes on-site to provide technical assistance to the teachers who will be using the software? For what length of time will the software company provide follow-up assistance to your teachers?

3. Are curriculum-specific teacher manuals available? Are any print materials available for teachers which offer suggestions concerning supplementary learning activities?

4. If the curriculum software is to be used in a learning lab situation, what is the required skill level of the lab supervisor? Can an aide ran the lab and assist students or is a teacher necessary?

5. Does the curriculum have a student management system? If so, what sort of student accountability data will it provide? How much, if any, teacher input is required? To what degree will the student management system help you with your local, State, and/or Federally mandated accountability requirements?

6. Will your teachers need to learn X instructional strategies in order to integrate the software effectively into the rest of their classroom instruction?

7. Do you anticipate that your teachers will need inservice training beyond what the software company will? In what ways, if any, do you anticipate the role of your teachers changing? Will the teachers need any inservice to help adjust to their anticipated changed roles?

Considerations for Administrators

1. How will the computerized curriculum system fit into the overall educational plan for your State or local adult basic education program? What, if any, curriculum or program modifications do you anticipate needing to make in order for the system to be most effective for your Adult Basic Education and Literacy program?

2. What are the total initial costs of the system? What are the estimated annual ongoing costs? What are the estimated annual per student costs?

3. What are the educational, administrative, and cost benefits you expect to derive from the software? How will you determine these benefits?

4. How is your Adult Basic Education and Literacy program and adult learners similar to or different from the user sites you spoke with about the software? What, if any, curriculum or program modifications do you anticipate needing to make in order for the software to be used most effectively in your program?

5. Concerning your teachers, do you anticipate needing to provide inservice training beyond what the computer company will provide? In what ways, if any, do you anticipate the role of your teachers changing? Are any additional educational or administrative adjustments you anticipate needing to make?

Appendix B

Characteristics Considered in Evaluating Educational Software[1]

Instructional Quality

General

- Program is useful in a school-based, instructional setting (i.e., in a classroom, computer laboratory, media center, or school library).
- Program avoids potentially controversial, nonstandard teaching methodologies.
- Program allows completion of a lesson in one class period (approximately 30 minutes).
- Instruction is integrated with previous student experience.
- Program is likely to save time for the student when compared to other means of presenting this topic.
- Program is likely to save time for the teacher when compared to other means of presenting this topic.
- An on-disk tutorial concerning the program's command structure is provided when appropriate (e.g., for a word processing program).

Content

- Content is appropriate for intended student population.
- Content is accurate.
- Content is current.
- Content breadth is reasonable (does not focus on too few or too many different concepts or content topics within one session).
- The processes and information learned are useful in domains other than the subject area of the program.
- Content is free of grammar, spelling, punctuation, and usage errors.
- Content is free of any bias or stereotyping.
- Content supports the school curriculum.
- Content is relevant to the subject field.
- Definitions are provided when necessary.
- There is continuity between the information presented and prerequisite skills required.
- Content avoids taking a side on potentially controversial moral or social issues.
- There is a need for better than the standard treatment of this topic in the curriculum.

Appropriateness

- Application is well suited to computer use.
- The pedagogic approach used is superior to what is available elsewhere.
- Readability level is appropriate for the intended student population.
- Tone of address is appropriate for the intended student population.
- The means of response (e.g., single keystroke, manipulating graphics) is appropriate to the intended student population.
- Prerequisite skills required are appropriate for the intended student population.
- Time required for use by a typical student does not exceed the attention span of that student.
- Multiple levels of instruction are available.
- Difficulty levels are based on discernible logic (e.g., reading ability, complexity of problems).
- Sufficient exposure and practice are provided to master skills.
- Sufficient information is presented for intended learning to occur.

Questioning Techniques

- Questions are appropriate to the content and effectively measure student mastery of the content.
- Questions incorrectly answered can be repeated later in the lesson/exercise.
- The number of trials are reasonable and appropriate (e.g., student receives the correct answer after no more than three or four trials, and after at least two trials).
- Calculation can be accomplished easily on-screen when appropriate.

Approach/Motivation

- Approach is appropriate for the intended student population.
- Format is varied.

[1] Based on items used by 36 public, private, and governmental software evaluation agencies, and additional items considered important by selected teachers, software publishers, university professors, and private consultants. Many of the educational software experts consulted in the compiling of this list felt that subject-specific and population-specific characteristics would have to be considered for a thorough evaluation. See Ellen Bialo and Jay Sivin, "An Analysis of the Scope and Quality of the Current Supply of Educational Software and of the Available Sources of Information on Educational Software," OTA contract report, Sept. 30, 1987.

From: Power On! New Tools for Teaching and Learning. Congress of the United States, Office of Technology Assessment, 1988.

- Overall tenor of interaction is helpful.
- Student is an active participant in the learning process.

Evaluator's Field Test Results

- Student understands the on-screen presentation, and can proceed without confusion or frustration.
- Student enjoys using the program.
- Student retains a positive attitude about using the program.
- Student retains the desire to use the program again, or to pursue the topic in other ways.
- Program involves students in competition in a positive way.
- Program fosters cooperation among students.

Creativity

- Program challenges and stimulates creativity.
- Pedagogy is innovative.
- Program allows the student as many decisions as possible.
- Program provides opportunities to answer open-ended questions and provides evaluative criteria to assess responses.
- Program demonstrates a creative way of using knowledge.
- Program challenges the student to alter an underlying model, or design an alternative model.

Learner Control

- Learner can alter program sequence and pace.
- Learner can review instructions and previous frames.
- Learner can end activity any time and return to main menu.
- Learner can enter program at different points.
- Learner can stop in the midst of an activity, and at a later session begin at that stopping point with the previous record of progress intact.
- Help is available at likely points of need.

Learning Objectives, Goals, and Outcomes

- Learner objectives are stated and purpose is well defined.
- Steps are taken to make learning generalizable to other situations.
- For programs requiring use over several days, learning outcomes are worth the time invested.

Feedback

- Feedback is positive.
- Feedback is appropriate to the intended student population and does not threaten or inadvertently reward incorrect responses.
- Feedback is relevant to student responses.
- Feedback is timely.
- Feedback is informative.
- Feedback is corrective when appropriate.
- Feedback remediates and/or explains when appropriate.
- Feedback employs a variety of responses to student input, and avoids being boring or unnecessarily detailed.
- Feedback remains on the screen for an appropriate amount of time.
- Branching is used effectively to remediate.
- Program uses branching to automatically adjust difficulty levels or sequence according to student performance.

Simulations

- Simulation model is valid and neither too complex nor too simple for intended student population.
- Variables used in the simulation are the most relevant.
- Variables in the simulation interact and produce results approximately as they would in real life.
- Assumptions are adequately identified.
- Program simulates activities that can be too difficult, dangerous, or expensive to demonstrate in reality.
- The time needed to complete both a step and the entire simulation is reasonable and effective.
- Encourages decisionmaking or calculation rather than guessing.

Teacher Modifiability

- Teacher can easily change or add content.
- Teacher can easily regulate parameters (e.g., number of problems, rate of presentation, percentage correct needed for mastery) for each class using the program.
- Teacher can easily regulate parameters (e.g., number of problems, rate of presentation, percentage correct needed for mastery) for each student.
- Parameter set-ups can be bypassed (e.g., default settings are available).

Evaluation and Recordkeeping

- Program provides an adequate means of evaluating student mastery of the content.
- If tests are included, criteria for success are appropriate for the ability/skills of the intended student population.
- If tests are included, content accurately reflects the material presented.
- Scorekeeping and performance reports are provided for the student when appropriate (e.g., summary of problems correct/number attempted, running point totals).
- Useful information about student performance is stored for future retrieval.
- Useful diagnostic pre-test or placement test is provided, where appropriate.
- Useful diagnostic or prescriptive analysis of student performance is available to the teacher, when appropriate.
- Student performance information is easily accessible to the teacher.
- Management system includes adequate security.
- Program allows printout and screen display of student records.
- Program can hold multiple performance records of a single class (e.g., 35 to 50 students).
- Program can hold multiple performance records of several classes (e.g., up to 5 classes) arranged by class.

Documentation and Support Materials

- Quality of packaging is durable and appropriate for student use (e.g., not too large to be used at a computer station).
- Student, parent, or teacher guides and materials are clearly identified as such.
- Technical and operational explanations for implementation are clear and complete.
- If appropriate, "quick start-up" section is included.
- Useful reproducible student worksheets are provided.
- Other valuable support materials are provided (e.g., wall charts).
- Sample screen-by-screen printouts of the program are provided.
- Teacher support materials can be separated from student materials.
- Useful suggestions are provided for introductory classroom activities.
- Useful suggestions are provided for classroom activities during the use of the program, where necessary or helpful.
- Useful suggestions are provided for followup activities.
- Useful suggestions are given for classroom logistics in a variety of hardware situations (e.g., single or multiple machines) and student groupings.
- Useful suggestions are provided on how to integrate program with the regular curriculum.
- If the program is open-ended, subject-specific suggestions are included.
- Clear explanations of the differences between the various difficulty levels are provided.
- Prerequisite skills are clearly stated.
- Accurate and clear description of instructional activities are provided.
- Accurate and clear descriptions of content topics are provided.
- Where appropriate, a description of how material correlates to standard textbook series is provided.
- Necessary information can be found quickly and easily (e.g., contains index, table of contents).
- Quick reference card for program use is included, where appropriate.
- Printed text is clear and readable.
- Printed graphics are clear and readable.
- Printed text is free of errors in spelling, grammar, punctuation, and usage.

Technical Quality

General

- Audio can be adjusted (i.e., turned down or off).
- Audio is clear and used effectively.
- Character sets used in text display are clear, appropriate, and visually interesting.
- Graphics are acceptable on a monochrome monitor.
- Graphics are clear and can be easily interpreted.
- Program is "crash-proof."
- Program runs consistently under all normal conditions and is "bug-free."
- Program runs without undue delays (e.g., graphics fill in a timely manner, does not excessively access disc drive).
- The transitions between screen displays are effective (e.g., text changes).
- Program guards against multiple key presses advancing the student past the next screen (e.g., leaning on return key and thereby missing several screens as they flash by).
- Program avoids unnecessary or inappropriate moving back and forth between screens (e.g., from page to feedback or data pages).
- Special features (e.g., flash, inverse, scrolling, split screen) are used appropriately and effectively.
- Program requires a minimal amount of typing (except typing programs).

- Random generation or selection is used when appropriate (e.g., to allow repeated use by varying the problems or data presented).
- Program judges responses accurately and accounts for minor variations in the format of the input (e.g., accepts either the correct word or letter choice in a multiple choice item).
- Program allows user to correct answer before being accepted by the program.
- Program accepts partial answers as correct whenever appropriate.
- Where students must input responses, inappropriate keys are disabled.
- Control keys are used consistently.
- Students require a minimum amount of teacher supervision while using the program, when appropriate.
- Computer (and peripherals) operation does not interfere with concentration on activity.
- Program makes effective use of peripheral devices (e.g., joysticks) for alternate input modes while still allowing keyboard input.
- Program considers a previously unexplored potential of the computer or greatly expands an existing capability (e.g., new animation techniques, digitized speech).
- Program uses other technologies (e.g., audio cassette, videodisc, videotape) to enhance learning, when appropriate.
- Printing is easy and simple to accomplish with a variety of popular printers.

Clarity

- Procedural and instructional statements are clear.
- On-screen prompts clearly indicate where user should focus attention.
- Frame formatting is clear, uncluttered, and consistent from screen to screen (e.g., screen input is restricted to a consistent location).
- Presentation of each discrete content topic is logical.
- Sequence of content topics and instruction is logical and in appropriate steps.
- Sequence of menu items is logical.
- Prompts and cues are clear and consistently and logically applied.
- Hints are clear and not misleading (e.g., length of spaces in fill-in blanks matches number of letters needed).
- Demonstrations and examples are clear and available when appropriate.
- Interface is simple enough to be used with little or no reading of the documentation.
- Program makes clear where the user is in the program (e.g., question number, page headings).
- User-computer communication is consistent and logical.
- Prompts to save work are given when appropriate.

Start-up and Implementation

Teacher:
- Software code modifications or unusual manipulations of discs are not required to use program effectively.
- Start-up time for teacher implementation is not excessive.
- Teacher needs a minimum of computer competencies to operate program (e.g., does not require installing add-on boards).

Student:
- Start-up time for student implementation is brief enough to permit completion of a lesson.
- Students need a minimum of computer competencies to operate program (e.g., does not require use of control-key combinations).

Graphics and Audio

- Graphics and audio are used to motivate.
- Graphics and audio are appropriate for the intended student population.
- Graphics, audio, and color enhance the instructional process.
- Graphics help focus attention to appropriate content and are not distracting.

Probeware and Peripherals Included in the Software Package

- Probes or peripherals are durable.
- Probes or peripherals are sensitive.
- Audio and/or graphic quality are effective.
- Probes or peripherals are easy to install.
- Calibration is accurate and easy.
- Data displays are flexible (e.g., can be scaled, redrawn).
- Data analysis is useful.

Hardware and Marketing Issues

- Potential usefulness of the program justifies its price in comparison to other similar products.
- Peripherals (not included in the package) that are difficult to acquire or inappropriately expensive are not required.
- Producer field test data are available.

- Field test data indicate that students learned more or better, or had a better attitude toward the subject matter, as a result of using the program.
- Preview copies are available.
- Back-up copies are provided.
- Adequate warranty is provided.
- Telephone support is available.
- If allowable, multiple loading is possible.
- Site license is available.
- Network versions are available.
- Multiple copies discount available.

APPENDIX C

Sources of Computer Information

Educational Computing Journals

AEDS Monitor
Association for Educational Data Systems
1201 Sixteenth St., N.W.
Washington, DC

Classroom Computer Learning
2451 E. River Rd.
Dayton, OH 45439

Computers, Reading, and Language Arts
P.O. Box 13247
Oakland, CA 94661

Computers in the Schools
The Haworth Press, Inc.
28 E. 22nd St.
New York, NY 10010

The Computing Teacher
University of Oregon
Eugene, OR 97403

Educational Technology
140 Sylvan Ave.
Englewood Cliffs, NJ 07632

Electronic Education
Suite 220
1311 Executive Center Drive
Tallahassee, FL 32301

Journal of Computers in Mathematics and Science Teaching
Box 4455
Austin, TX 78745

Mathematics and Computer Education
Old Bethpage Rd.
Long Island, NY 11894

Teaching and Computers
902 Sylvan Avenue
Englewood Cliffs, NJ 07632

Reference: Miller, Samuel K. Selecting and Implementing Educational Software. Boston: Allyn and Bacon, Inc., 1987.

Review Journals

The Apple Journal of Courseware Review
Apple Computer, Inc.
20525 Mariani Avenue
Cupertino, CA 95014

Digest of Software Reviews
301 West Mesa
Fresno, California 93704

Evaluations: Microware
7351 Elmbridge Way
Richmond, B.C., Canada V6x 1B8

Hively's Choice
520 E. Bainbridge St.
Elizabethtown, PA 17022)9989

Library Software Review
520 Riverside Ave.
Westport, CT 06880

MicroSIFT Reviews
Northwest Regional Educational Laboratory
300 S.W. Sixth Avenue
Portland, OR 97204

SECTOR PROJECT
(Special Education Computer Technology Online Resources)
Exceptional Child Center, UMC-68
Utah State University
Logan, UT 84322

Software Reports
2191 Las Palmas Dr.
Carlsbad, CA 92008

Reference: Miller, Samuel K. Selecting and Implementing Educational Software. Boston: Allyn and Bacon, Inc., 1987.

Educational Computing Newsletters

CHIME (Clearinghouse of Information on Microcomputers in Education)
108 Gunderson, Oklahoma State University
Stillwater, OK 74078

Closing the Gap
P.O. Box 68
Henderson, MN 56044

CUE (Computer-Using Educators)
127 O'Connor St.
Menlo Park, CA 94025

Microcomputers in Education
5 Chapel Hill Dr.
Fairfield, CT 06432

Users: The MECC Instructional Computing Newsletter
3490 Lexington North
St. Paul, MN 55112

Other Sources of Information

PRO/FILES
EPIE Institute
P.O. Box 839
Water Mill, NY 11976

The Educational Software Selector
EPIE Institute
P.O. Box 839 Water Mill, NY 11976

Reference: Miller, Samuel K. Selecting and Implementing Educational Software. Boston: Allyn and Bacon, Inc., 1987.

SOURCES OF SOFTWARE EVALUATION FORMS

Guidelines For Evaluating Computerized Instructional Materials
National Council of Teachers of Mathematics
1906 Association Drive
Reston, VA 22091

The Evaluator's Guide For Microcomputer-Based Instructional Packages
The Computing Teacher
University of Oregon
1787 Agate St.
Eugene, Oregon 97403)1923

Microcomputer Courseware Evaluation Form
EPIE & Consumers Union
P.O. Box 620
Stony Brook, NY 11790

Computer Courseware Review Forms
Student Evaluation of Microcomputer Materials
The Microcomputer Educational Materials Evaluation
Minnesota Educational Computing Corporation
2520 Broadway Drive
St. Paul, MN 55113-5199

Reference: Miller, Samuel K. Selecting and Implementing Educational Software. Boston: Allyn and Bacon, Inc., 1987.

APPENDIX D

"How The Computer Helped Me"

"How Computers have helped me in School"

Computers hold a greater attention Span with me. the lessons are interesting as well as Educational and since my assistance is required to keep the lesson in motion, my interrest is held better than Standard Text book lessons.

I feel that since my Attention and Interrest is at a Higher level due to the Computers, I will learn more, Faster and usually this is exactly what happens.

I also like to monitor my results of my work so I can see the areas I'm lacking in. Tests done on Paper take longer to get results back and with the computer, this is not a problem. My results are right there after each lesson and I can see how well or how poorly I had done.

Over-all Computers Simply make things easier and more Efficient for me and I do better.

My Appreciation To Yall

Since I have used the computer it has thought me a lot about programming in and out of the computer. When I first started using the computer I did not like it. The reason was because I did not know how to program in or out much less do my reading, writting or math, but Mrs Pursewell showed me how easy it is to work the computer; punching in and out and working my reading, writting and Math. Today I enjoy each and every minute I get to spend in the computer room working as much as I can on my School work. Thanks to the School Staff I will walk out of T.D.C. with my GED and have a better chance to connect with Society. My thanks to the school staff.

New Computer
New School Me

Computers have benefited me in several ways, learning how to operate them, following the programs, improving my reading skills, and with my studies in math. The codes needed to enter and exit a computer are one of the first things I learned.

The programs on the soft-ware are fairly easy to follow. They can be boring because the altering of one program to the other is time consuming. The programs leave no margin for error, for if you push the wrong key the computer will not function, and you have to start over with the program.

The wording in the programs has helped me improve my reading skills. I like the way the computer talks to me on the reading part of the programs. This makes it easy to learn the things that I need to work on. The math program is fun to work with because I enjoy using numbers, and solving difficult problems.

The only other time I have used computers was like the work/invoicing and shipping of items with a computer system. At that time, I learned to look up the items I needed, and delete them as I pulled the items for a packing list.

that was not to hard to do at the time.

In using computers, I have learned how to operate them. The programs that I worked with need to be updated to make the learning process faster. The time I have spent working with the computer has been very useful in my goal, to get the G.E.D. It is also fun working with the computer because it is a challenge.

I feel that the computer lab will help me more and more as I go on each week cause I have just worked with the computer only for my third time up to now. As far as I can express myself as to how it has helped me up to now I think that it has help me on my spelling, reading, and right now I just started on my math and it is working just fine for me. As to my spelling I'm also learning how to type just by spelling the words out and over a of each time that the computer prints the word its missing a letter to the word, and the computer prints it out about as many time as to how many letter to the word. Then at the very last it prints out a sentance and I get to type the word for my last time in the sentance So by the last time I type the word up I all ready know where the keys to the word are with out looking at the key board.
So as for me I give thanks to who ever came up with the idea to have a computer lab in the psion system and also for giving me the oporiunity to work with the computers.

Thank You

The Teacher is very nice.
The COMPUTER Room is a very nice Thing TO Comic UP WITH.
d Learn QUICKER and Think BETTER When not disTurb.
Yes d Love The COMPUTER Room and EnJoy every minTUre
of iT. dim TrYing my best To Take advanTage of every Thing
That is offered To me. d Thank The Teacher and every Body
Eles For This opportuniTY.

April 4, 1991

Computers are a major asset in today's society. They maybe used in many areas of life such in the Homes, Offices, Businesses, schools, and etc. Computers Have Helped me tremendously in school. These machines Has a very unique way of making what seems complicated, simple. They also enable us to save alot of valuable time. Sometimes I wonder just ^ How advanced I would be if I learned How To use it years ago.

"How Computers have helped me."

Computers have helped me in various ways. They have helped me with my math, and also, with spelling.
I think that Computers help you one on one, more as a Teacher has more than one person to deal with..
Computers are very helpful, they like your on private Tutor.
I think that any one thinking about going into Computers in my book they are making a positive move.

APPENDIX E

Computer Terminology Definitions

Adaptive Firmware Card

The Adaptive Firmware Card is a multi-purpose peripheral card which enables the user to operate most commercial software with a single switch. Many programs which require paddles may also be set up for switch use via the Adaptive Firmware Card. In addition, it allows the user to choose from 14 different modes of input including scanning, Morse code and adaptive keyboards.

Adaptive Keyboard

Often used with children who are physically impaired, adaptive keyboards are generally attached to the computer with firmware cards. Their advantage over computer keyboards is that they are usually programmable and enable the user to set up the keyboard to send information to the computers in many different forms. For instance, different areas of the keyboard could be set up to send a certain letter or word to the computer for use with a specific program.

Backup

A backup is a second copy of a disk, a program or a piece of hardware used for insurance purposes. If your first unit (e.g., drive or diskette) quits working, all you need to do is use your backup. It is highly recommended to have backups, particularly for heavily-used or favorite programs and file the original. Many companies provide backup disks free or for a reduced fee. Should the original disk quit running, send it back to the company for another disk at reduced cost.

Boot

Booting a disk or program means you should be able to load a program into memory and run it. The term originates from the definition of loading a very large program into memory a section at a time, in which case the program 'pulls itself up by its bootstraps'.

Bug

This is a mistake or an incompetently written section which keeps a computer program from working correctly.

Cassette

A cassette and cassette recorder can be used by many small microcomputers to store and retrieve computer programs and data. Cassette systems are slow and somewhat unreliable. It is usually worth the extra money to purchase the faster and more reliable disk drive.

Central Processing Unit (CPU)

A CPU is the main "brain" of the computer. It is usually one or two chips (the thin black 'boxes' with little silver connector legs plugged into the mother board of the computer).

Character

A character, for a computer, is any letter, punctuation mark, space bar, or digit.

Chip

A chip is an integrated circuit which makes the computer a computer. It holds information either permanently or temporarily. Chips are normally thin black rectangular boxes with spike-like connectors coming out the bottom, and are plugged or soldered into the circuit boards of the computer.

Computer Assisted Instruction (CAI)

CAI is instruction which is conducted or augmented by a computer. CAI types include drill and practice, tutorials, simulations, problem solving, and educational games.

Computer Managed Instruction (CMI)

Where CAI is aimed at direct instruction, practice, and enhancement, CMI is intended to make instructional management and record-keeping easier and more efficient. These are teacher-oriented rather than student-oriented programs. They enable the teacher to individualize diagnosis, prescription and record-keeping.

Crash

This is what happens when a program quits working, a disk goes bad, or the computer becomes unreasonably stubborn—it crashed, or quit working.

Cursor
A cursor is a small box which appears on the monitor which indicates that the computer is waiting to receive a command.

Debugging
Debugging is the process of removing the bugs, errors, from a computer program. It involves trouble shooting and problem solving.

Disk
A disk, also known as a diskette or floppy disk, is a piece of magnetic storage material like recording tape enclosed in a plastic envelope and used to store computer programs or date. Disks need to be handled with some care: do not bend, spill on, put your fingers on, or dirty a disk and do not place them close to a monitor, TV, electric motor, or phone.

Documentation
Documentation refers to the instructions (the manual) which accompanies commercial programs. Do check the documentation before purchasing software if possible.

DOS
DOS is the DISK OPERATING SYSTEM. This is the information or program that tells the computer how to use a diskette. The computer has to know how to distribute information on the disk, how to read information from the disk, and which commands (like "SAVE" and "CATALOG") use the disk and what they are supposed to do. This is one of the main reasons that the disks from one computer cannot be used on another brand.

Dot Matrix
There are a number of different ways that printers make their impression on paper. Dot matrix refers to one of the two most popular methods (see LETTER QUALITY). In this method, letters are formed when a set of pins are pushed out from the print head to strike the ribbon and paper. Dot matrix printers can approach typewriter quality and have the advantages of being very fast (100 or more characters per second is common), relatively inexpensive, and quite flexible. These printers can be set to strike everything twice (double strike, useful for darker print and for making dittos), print is many different sizes and styles, and many can also print graphic displays or pictures.

Drive
A drive is a machine which spins, records onto, and reads from disks. Disk drives should be cleaned regularly and should be periodically checked for adjustment—see your dealer.

Expanded Memory
Memory in excess of the addressable 64K. Usually expanded memory is a firmware card which gives more RAM storage to the computer. (See MEMORY).

Firmware
Firmware are green cards with chips on them which insert into one of seven slots on the inside of a //e, II+ computer that enable it to perform different functions. Some firmware cards must be inserted in specific slots (slot dependent). Many peripherals have firmware cards (speech synthesis, printers, disk drives).

Graphics or Touch Tablet
These increasingly popular input devices look something like a flattish tracing pad with a stylus of some sort attached. They provide a quick way to enter graphic images into the computer, usually by tracing or drawing. Some touch tablets have programs which enable them to be used as instructional software such as the Power Pad and the Koala Pad.

Hard Copy
A hard copy is the printout of what appears on the monitor. You are currently reading a hard copy of a text file stored on disk.

Hardware
Hardware refers to computer equipment, devices, which are or can be part of a computer system. This can include printers, the computers themselves, disk drives, monitors, etc, but does not include diskettes or programs.

Initialize
When you buy a blank diskette, it will, for many computers, not function in any manner until you initialize it. This process electronically divides the disk into sectors and tracks which the computer uses for areas of data storage. Initialization also puts the disk operating system on the disk with many systems.

Input Device
An alternative input device is any type of peripheral equipment which inputs or operates a computer besides the actual keyboard. (Disk drive, cassette recorder, switches, touch tablet, adaptive keyboard, light pen). (See OUTPUT). It is any piece of hardware which can send information to a computer in a form which is usable.

Joystick
This is a mechanical device for controlling some aspect of the computer or inputting data. Normally, a joystick is used for games. A joystick varies from paddles (see PADDLES) in that there is one stick control which can move in a 360 degree plane rather than a dial which only turns.

K
K stands for Kilo, or 1000. Unsurprisingly, computers consider one kilo or K to be 1024, generally in reference to memory space and counted in bytes. The number 1024 comes from two to the tenth power which is the closest number to the decimal number 100 in binary.

Languages
Not unlike human verbal language, a computer language is a means of communicating your instruction to a computer in such a way that the computer can understand them and carry them out. However, computer languages are more structured, non-ambiguous, and precise. This makes them somewhat unfamiliar and difficult for the novice to use.

Letter Quality
This refers to a classification of print quality. Basically, letter quality is any print quality which can be considered adequate for professional purposes. Most letter quality printers are "full formed", meaning that the characters are produced by a print wheel or ball (like on an IBM typewriter). Some of the most expensive dot matrix printers can print letter quality, or nearly letter quality.

Light Pen
Believe it or not, this input device (like a stylus, but light sensitive) allows one to input instructions, usually menu selections, from the SCREEN by touching the appropriate spot with the light pen.

Medium or Media
Any material which can store date and/or programs can be called a medium, e.g., disks, punched cards, cassettes.

Memory
This is what makes a computer a computer. Not unlike human memory, computer memory stores and manipulates information or data. The computer memory tends to be more precise than human's which makes computers so valuable. Computer memory is stored in RAM, ROM, and on media such as diskettes.

Microprocessor
The central processing unit (see CPU) is often referred to as the microprocessor. This does not refer to the computer itself, but to the central processing unit.

Modem
The modem is a device which allows a computer to communicate with another computer over the phone lines. The word "modem" is derived from the words MOdulate/DEModulate.

Mother Board or Logic Board
The main circuit board in a computer is often called the mother board. It typically contains the central processing unit (CPU), RAM, and ROM.

Operating System
A computer's operating system is the program(s) built into the computer which control the computer's functioning. Use with DOS.

Output Device
An output device is any type of peripheral equipment which is operated by the computer (printer, robots, speech synthesizer).

Paddle
A paddle is a device for controlling input into the computer, usually for games. They normally have a dial and a button on each of the pair. One dial can control vertical movement and the other horizontal.

Peripheral Device
A hardware device which is outside of but connected to the computer is often called a peripheral device. These include printers, disk drives, modems, robots, etc.

Printer
Printers are the most popular output devices next to monitors. See DOT MATRIX and LETTER QUALITY.

Program
This is what makes the computer perform a function. Without a program, a computer will just sit there. A program is a list of instructions for the computer written in one of the many programming languages.

Random Access Memory (RAM)
RAM is the internal user accessible memory of the computer. It is memory space where programs and data reside. Its primary characteristic is that it goes away when the power is turned off. For this reason, programs and data are stored permanently on disk or cassette before the machine is turned off. When you load a program from a disk, you are placing it in RAM where the computer can use it. RAM is usually measured in Ks (seeK).

Read Only Memory (ROM)
Unlike RAM, ROM information does not go away when the power is turned off. Information in ROM is usually the resident language of the computer, the operating system, etc.

Scanning
Scanning is a term used frequently with augmented communication systems Generally words or items are presented on a screen. A cursor or a scanning box highlights or surrounds each item presented on the screen in a categorical manner. When the user wishes to select an item, he waits until the cursor or box highlights his choice and presses a switch or controller button to make his selection.

Software
The programs which make the computer do what you want are often referred to as software

Speech Synthesis
Speech synthesis is a type of output device which enables the computer to "speak". As with all peripheral devices, the software which operates the speech synthesizer must be specifically designed to do so In other words, software must be designed to use speech synthesis in order to take advantage of the equipment.

Word Processing
Computers with the appropriate software are capable of being used as advanced memory typewriters. They allow easy insertion, deletion, and movement of text which permits full revisions and perfect printouts in little time.

Write
Recording or saving information on a disk, cassette, tape drive, or other storage device involves writing on that medium.

APPENDIX F

Long Range Plans For Technology - Texas

LONG-RANGE PLAN FOR TECHNOLOGY OF THE TEXAS STATE BOARD OF EDUCATION 1988 - 2000

The State Board of Education Equipment Targets, established in the Action Plan that follows, phases in these technology configurations at the following rates:

	Phase 1 1988-92	Phase 2 1992-96	Phase 3* 1996-2000
Student Workstations			
Access Time	1.3 hours/week	5 hours/week	7.5 hours/week
Ratios	23:1	6:1	4:1
Teacher Workstations			
Access Time	2 hours/week	15 hours/week	30 hours/week
Ratios	20:1	2.6:1	1.3:1
Portable Workstations			
Access Time	1.3 hours/week	10 hours/week	
Ratios	30:1	4.1	
Administrator Workstations			
Access Time	2.7 hours/week	15 hours/week	30 hours/week
Ratios	15:1	2.6:1	1.3:1
Districts with:			
Wide-area Network (TEA-NET)	100%		
Local-area Network	100%		
Open-access Learning Centers	20%	80%	90%
Telecommunications Centers	75%	80%	100%

* Ratios in Phase 3 will depend on the results of research on optimal ratios

1. Student Workstations

Objectives	Requirements
Students can receive and interact with instruction and information	In order to meet the educational objectives, the workstations need to incorporate the following capabilities, standards for which will be established as appropriate: • computing ability • input devices • audio, video, color, and graphics capability • expandability beyond the requirements of applications software • upgradability
Individual and group mastery of essential elements can be continually monitored and remediated	• tracking of mastery of essential elements • access to teacher workstation modules
Students' and teachers' stations can interact for teacher-directed and peer learning	• electronic mail • local-area network (LAN)
Students can search and retrieve bibliographic and other information	• access to selected databases
Districts can control access to student and teacher records	• security of and access to external information
Students can interact with much of the information and develop some skills that are linked to and exceed the essential elements	• delivery of interactive courseware keyed to and exceeding the essential elements
Students can prepare and print reports, graphics, etc.	• word processing and graphics production • printer output devices

2. Teacher Workstation Modules

Objectives	Requirements
Teachers can conduct large group instruction, demonstrating simulations, preparing graphics and sound enhanced lectures, and illustrating trends and concepts.	In order to meet the educational objectives, the workstations need to incorporate the following capabilities, standards for which will be established as appropriate: • large screen • optical media, such as CD ROM and video disc • audio output • instructional television • recording and playback
Teachers can prepare and print reports, graphics, etc	• word processing and graphics production • expandability beyond the requirements of applications software
Teachers can use stations to conduct routine instructional and administrative "paper" work	• recording of attendance, program placement, disciplinary actions
Teachers can send pre instruction and post instruction tests to students electronically.	• storage of and access to validated pre- and post test item bank
Teachers can use station to grade tests, display results for student and teacher, aggregate results, and send report to appropriate location.	• local area network (LAN) • recording and aggregating of test results by specified factors (e.g., classroom and program) • transmission of results to campus and district offices
Teachers can monitor individual and group mastery of essential elements and progress through the curriculum and adjust instruction accordingly	• tracking of learning, including the essential elements and the curriculum

Objectives	Requirements
Teachers can analyze learning styles, diagnose learning problems, and adjust instruction accordingly	• diagnostic and prescriptive software
Teachers can notify staff and parents of students' at-risk status.	• "early warning" indicators of at-risk students
Teachers can search banks of pre designed or teacher made lesson plans for instructional suggestions.	• storage of and access to commercially available and teacher-generated lesson plans
Teachers can download existing software written for dedicated machines.	• universal standard for various operating systems • video, color, and graphics capability • telecommunications reception
Teachers can send messages and assignments, etc., to students, staff, and parents	• electronic mail • routing of audio, data, and video signals through the same channel • interactivity
Teachers can prepare lessons, check student achievement, and obtain information at home as well as at school	• portable central processing unit (CPU), modem, and display screen for battery or plug-in use • retrieval of bibliographic and instructional information from databases
Teachers can send attendance, grade, and other reports to distnct and regional offices.	• wide-area network (WAN)
Teachers can send paper reports to students, parents, and administrative offices and can create materials	• printer/output devices
Teachers can receive training on use of workstation modules	• training software

3. Administrator Workstations

Objectives	Requirements
	In order to meet the educational objectives, the workstations need to incorporate the following capabilities, standards for which will be established as appropriate:
Administrators' time to manage instruction can increase	• local-area network (LAN) • aggregation of data on test results and student achievement, attendance, financial statements, inventories
Administrators can retrieve and review data on achievement, course and bus schedules, inventories, budget, and other instructional and administrative factors	
Administrators can write and send memoranda, etc., and record contacts with students and parents.	• word processing • electronic mail • printer/output devices
Administrators can access electronic, optical, and other data bases.	• CD ROM and other mass data retrieval systems
Administrators can send information to and receive information from TEA, other districts, regional education service centers, and buildings in the district	• wide-area network (WAN) • electronic mail
Administrators can record teacher assessment processes and results	• software for teacher assessment

4. Open-access Learning Centers

Note Open access Learning Centers, possibly located in campus libraries, will contain more sophisticated workstations and other technologies than those available to students, teachers, and administrators and will access a wider variety of databases. They will be available for training of and use by parents and other community members as well as students, teachers, and staff.

Objectives

Students, teachers, staff, and community members can receive training in technology use and application.

Students, teachers, staff, and community members can investigate subjects in depth.

Students can obtain nearly total course content and evaluation in subjects for which courseware is prepared, using public broadcasting and interactive video and audio computer-based stations.

Students, teachers, staff, and community members can produce high quality materials.

Parents and other community members can receive and interact with literacy training, job-related training, and technology training and course work in a wide variety of fields.

Open access Learning Centers provide entertainment as well as didactic and research materials

Requirements

In order to meet the educational objectives, the centers need to incorporate the following capabilities, standards for which will be established as appropriate:

- training software
- access to bibliographic and other information from a variety of databases
- instructional television
- video, color, and graphics capabilities
- interactive videodisc capability
- knowledge-based courseware
- audio capability
- evaluation capability
- compatibility with student and teacher stations
- printer/output devices
- electronic mail
- local-area networks
- input devices
- computing ability
- expandability beyond the requirements of application software
- upgradability
- diverse courseware and instructional materials

5. Telecommunications Centers

Note The Telecommunications Center will be the focus for distance learning. Distance learning refers in general to instruction and inservice that are delivered over a distance via telecommunications or other means or on site via technology and is comprised of at least one of the following characteristics: (1) the instruction supplements or comprises entire course content and/or (2) the instruction is available from an instructor in real time and/or (3) the instruction is interactive with the instructor and/or with courseware and data available on student workstations.

Telecommunications Centers will be configured differently depending on local need and decisions. In some cases, the Centers will consist of self contained facilities dedicated to distance learning; in others, they will be portable units; in others, various functions will occur in different locations, including Open access Learning Centers. For instance, all relevant classrooms should have the capability to receive instructional television.

Objectives	Requirements
	In order to meet the educational objectives, the centers need to incorporate the following capabilities, standards for which will be established as appropriate. Other standards and processes will also be set.
Students can receive the course work they need regardless of location or teacher availability	• mechanism for state approval of course content, materials, and delivery, and of teacher certification
Teachers can receive on site inservice in technology training and other areas	• audio interactivity • data transmission capability • video capability
Teachers and administrators can confer from school based sites	
Classroom instruction can be enriched with master teacher presentations, video presentations, and interactive data communications.	• video and audio capability through receipt of distance instruction • instructional television
Communications among students and teachers at multiple sites can be interactive and live	

APPENDIX G

Student Gains

LANGUAGE ARTS

Clemens Unit (3R Students)

Student	Total Hours In Lab	Mastery Level	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	29 hrs.,38 min.	70%	1.0	7.0	6.0
2	10 hrs.,14 min.	70%	5.0	7.4	2.4
3	1 hr., 19 min.	70%	1.5	4.0	2.5
4	2 hrs.,15 min.	70%	3.5	7.4	3.9
5	9 hrs.,57 min.	70%	3.5	3.5	0.0
6	14 hrs.,14 min.	70%	0.0	7.4	7.4
7	1 hr., 43 min.	70%	3.5	7.6	4.1
8	53 hrs.,22 min.	70%	3.5	11.5	8.0
9	13 hrs.,54 min.	70%	3.5	7.6	4.1
10	2 hrs.,34 min.	70%	3.5	9.0	5.5

Average number of hours in lab = 13.9

Average growth by grade level = 4.39

MATHEMATICS

Clemens Unit (3R Students)

Student	Total Hours In Lab	Mastery Level	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	29 hrs.,38 min.	70%	9.0	9.0	0.0
2	10 hrs.,14 min.	70%	4.0	5.0	1.0
3	1 hr., 19 min.	70%	4.0	5.0	1.0
4	2 hrs.,15 min.	70%	4.0	8.0	4.0
5	9 hrs.,57 min.	70%	6.0	8.0	2.0
6	14 hrs.,14 min.	70%	4.0	4.0	0.0
7	1 hr., 43 min.	70%	4.0	4.0	0.0
8	53 hrs.,22 min.	70%	5.0	9.0	4.0
9	13 hrs.,54 min.	70%	5.0	6.0	1.0
10	2 hrs.,34 min.	70%	5.0	9.0	4.0

Average number of hours in lab = 13.9

Average growth by grade level = 1.7

LANGUAGE ARTS

Eastham Unit

Student	Total Hours In Lab	Mastery Level	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	25 hrs., 7 min.	80%	1.0	3.5	2.5
2	53 hrs.,18 min.	85%	3.5	5.0	1.5
3	57 hrs.,35 min.	85%	3.5	6.2	2.7
4	63 hrs.,45 min.	85%	1.0	4.0	3.0
5	18 hrs.,46 min.	85%	1.0	5.0	4.0

Average number of hours in lab = 43.66

Average growth by grade level = 2.74

MATHEMATICS

Eastham Unit

Student	Total Hours In Lab	Mastery Level	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	25 hrs., 7 min.	80%	2.5	5.0	2.5
2	53 hrs.,18 min.	85%	1.0	9.0	8.0
3	57 hr., 35 min.	85%	2.0	5.0	3.0
4	63 hrs.,45 min.	85%	2.0	4.0	2.0
5	18 hrs.,46 min.	85%	4.0	5.0	1.0

Average number of hours in lab = 43.66

Average growth by grade level = 3.3

LANGUAGE ARTS

Huntsville Unit

Student	Total Hours In Lab	Mastery Level	Lowest Level Objective Completed	Highest Level Objective Completed	Growth
1	2 hrs.,10 min.	85%	1.0	4.0	3.0
2	3 hrs., 1 min.	85%	3.0	3.0	0.0
3	34 hrs.,27 min.	85%	4.0	5.4	1.4
4	10 hrs., 8 min.	85%	4.0	4.0	0.0
5	25 hrs.,54 min.	85%	8.0	9.0	1.0
6	7 hrs.,53 min.	85%	1.5	2.2	0.7
7	29 hrs.,59 min.	85%	3.5	8.0	4.5
8	8 hrs., 2 min.	85%	3.5	5.0	1.5
9	38 hrs.,22 min.	85%	4.4	4.5	0.1
10	9 hrs., 5 min.	85%	1.2	1.7	0.5
11	2 hrs.,28 min.	85%	4.0	4.0	0.0
12	0 hrs.,23 min.	85%	1.5	1.5	0.0
13	22 hrs.,49 min.	85%	3.5	7.0	3.5
14	1 hr., 40 min.	85%	4.0	4.5	0.5
15	6 hrs.,53 min.	85%	3.5	7.6	4.1

Average number of hours in lab = 13.45 hrs.

Average growth by grade level = 1.6