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ABSTRACT

This evaluation report describes program implementation, computer acquisition and placement, and computer use during the second year (1991-92) of the Utah Educational Technology Initiative (ETI). In addition, it discusses the various ways computers are used in Utah schools and reports the opinions and experiences of ETI coordinators in the 12 school districts closest to Salt Lake City. The five chapters are as follows: (1) "An Overview of the Utah Educational Technology Initiative and this Evaluation" addresses Utah's financial commitments to educational improvement through educational technology, previous evaluation reports, and data sources for this report; (2) "ETI Implementation during the 1991-1992 School Year" discusses comments of ETI coordinators, influences on ETI development and implementation, teachers' use of technology for instruction, and inservice training; (3) "Computer-Assisted Instruction: A Continuum of Instructional Use" considers school reform and educational technology, the continuum of computer use, and software tools; (4) "The Impact of ETI Funding on Computer Access during the 1991-1992 School Year" describes computer access and location, student/computer ratios 1989-92, and computer type and location; and (5) "Feedback and Networking Meetings" presents a summary of participants' concerns regarding inservice, software, hardware, technical support, the ETI project office, colleges of education, legislative funding, and vendors. The appendix contains the school questionnaire and evaluation feedback data from the Alpine School District. (MES)

BERYL BUCK INSTITUTE FOR EDUCATION

"Knowledge exists to be imparted" Ralph Waldo Emerson

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January 1993

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Executive Summary - January 1993

This evaluation report was prepared by the Beryl Buck Institute for Education with funding from the Utah State Office of Education. We are indebted to the USOE Evaluation and Assessment Section for support and guidance throughout the conduct of this evaluation. The following report describes program implementation, computer acquisition and placement during the second year (1991-1992) of the Utah Educational Technology Initiative (ETI). In addition, it discusses the various ways computers are used in Utah schools and reports the opinions and experiences of ETI Coordinators in the 12 school districts closest to Salt Lake City.

The data on which this report is based include:

- telephone interviews conducted with 15 ETI Coordinators;
- comments expressed by ETI Coordinators and school administrators at the three Feedback and Networking Meetings described in Chapter 5; and
- school questionnaires (see Appendix A) returned by 295 elementary schools, 76 junior high/middle schools, and 46 high schools. These comprise approximately 75% of Utah schools receiving ETI funding.

Program Implementation

- Utah school districts continued to implement their ETI plans during the 1991-1992 school year, and reported that implementation was hampered by hardware problems and the limited expertise of teachers expected to use the hardware. New concerns arose regarding the maintenance and eventual upgrading of recently-purchased equipment and selection of software programs targeted to specific instructional needs.
- A majority of Utah elementary, junior high/middle, and high schools reported that at least 30% of their faculty were competent using drill-and-practice software and regularly used computers during instruction.
- Proportionally more elementary teachers have participated in ETI-related inservice training compared to teachers in junior high/middle schools or high schools. Elementary teachers are also more likely to use technology in their instruction than teachers at higher grade levels.

- A majority of teachers at all grade levels are competent users of word processing, record-keeping, and other types of productivity software. Considerably fewer teachers know how to use technology for instructional presentations or to access information. When this does occur, the teachers are likely to be high school teachers.

- There is broad agreement among school principals and school ETI Coordinators that teachers need further training in software selection and technology use, and that inservice programs focusing on the more sophisticated instructional uses of computers are essential.

Computer Acquisition and Placement

- Although there is wide variation from school to school, the general pattern of computer acquisition has been to use ETI funds during the 1990-1991 school year to enlarge and complete computer labs. During the 1991-1992 school year, ETI funds were generally used to purchase classroom computers and other peripheral equipment.

- Based on reports from the 212 schools returning evaluation questionnaires both this year and last year, at the beginning of the 1992-1993 school year the average elementary school computer lab(s) had 26 computers, the average junior high/middle school computer lab(s) had 44 computers, and the average high school computer lab(s) had 85 computers. There is, of course, wide variation from school to school.

- Based on reports from the 212 schools returning evaluation questionnaires both this year and last year, at the beginning of the 1992-1993 school year, the average elementary school had 16 computers in classrooms, the average junior high/middle school had 31 computers in classrooms, and the average high school had 60 computers in classrooms. There was, of course, wide variation from school to school.

- Based on reports from the 212 schools returning evaluation questionnaires both this year and last year, the average student/computer ratio at the beginning of the 1992-1993 school year was 14:1 in elementary schools, 12:1 in junior high/middle schools, and 7:1 in high schools.

- Apple computers are most frequently found in elementary schools, followed by MS DOS machines and Macintosh computers. In junior high/middle schools, MS DOS machines predominate followed by Apple and Macintosh computers.

Computer Use

- Computers can be put to a variety of instructional uses depending upon the software employed. These uses vary from that of providing a student with the opportunity to learn and practice specific facts (a "respondent" use) to that of providing students with a tool to create and represent their understanding of the world (a "representational" use). Each different way of using the computer makes assumptions about how students learn and requires students to engage in different types of learning behavior. Computers can thus be used in different ways to facilitate different types of learning. A well-designed program of computer-assisted instruction involves students in a variety of computer uses from basic respondent to sophisticated representational learning.

In Sum . . .

- Initial findings from the evaluation of the second year of the Utah Educational Technology Initiative confirms and extend the results of previous evaluations.

- *ETI has contributed significantly to Utah education by making it possible for schools to purchase educational technology. As a consequence, student/computer ratios have diminished substantially. A majority of Utah teachers are now able to use computer technology competently to enhance their own productivity and to help their students master basic skills. More sophisticated uses of educational technology are found less frequently, however, and there is widespread agreement that a significant investment in the professional development of preservice and practicing teachers will be necessary if the potential of technology purchased with ETI funds is to be realized.*

Acknowledgements

This document is the product of the work and good will of a number of different individuals, and I would like to thank them for their contributions. Special thanks go to the Utah Educational Technology Initiative staff, Dr. Vicky Dahn, Project Director, and Vali Kramer, Administrative Assistant. Their help has been invaluable. In addition, district ETI Coordinators, school administrators and classroom teachers have given of their time, invited us into their schools, and completed our questionnaires. Without the cooperation of all these individuals, the evaluation team would have little to report. We are grateful for their consistent willingness to sandwich our requests for information into already stretched and burdened schedules.

The members of the Beryl Buck Institute for Education evaluation team deserve particular recognition. Dr. Trish Stoddart, Assistant Professor of Educational Studies at the University of Utah, made major contributions to the design of this evaluation, and has been invaluable as field coordinator and liaison with Utah schools. Dr. Stoddart wrote the initial draft of Chapter 3, and participated in the Feedback and Networking Meetings described in Chapter 5. Carolyn Horan has provided guidance throughout this evaluation, participated in the Feedback and Networking Meetings, and prepared an initial draft of Chapter 5. Dale Niederhauser supervised survey distribution, prepared the data set, and conducted some of the data analyses reported herein. Without Marie Kanarr, this evaluation would be unreadable. Marie prepared graphics, tables and text, and made untold contributions to the evaluation team.

We are especially indebted to Richard Keene, Research Consultant, and the Utah State Office of Education Evaluation and Assessment Section for his support throughout this evaluation.

To all, thank you,

John R. Mergendoller, Ph.D.
Director of Research and Evaluation
Novato, California - January 1993

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Chapter 1

An Overview of the Utah Educational Technology Initiative and this Evaluation

Utah's Financial Commitment to Educational Improvement Through Educational Technology

Over the past decade, the State of Utah has made significant and substantial investments in educational technology. Beginning with the Productivity Grants in 1981, money has been made available to school districts for technology procurement and implementation, and has been used to initiate numerous technology projects. With the passage of the Utah Educational Technology Initiative (H. B. 468) in 1990, and its modification in 1991 (H. B. 344) and 1992 (H. B. 252), the Utah Legislature has increased its commitment to educational technology and the belief that such technology has the potential to increase student achievement, improve school functioning, influence curriculum change, contribute to teachers' professional growth, and help create an informed, capable, and productive work force.

Since 1990, the Utah Legislature has appropriated approximately $39.9 million to fund the Educational Technology Initiative (ETI). Of this total, approximately $35 million has been given to Utah school districts for the purchase of educational technology and the training of teachers to use this technology. The remainder of these funds are allocated to Utah's public colleges of education.[1]

The ETI legislation allocates money to individual school districts based upon a two-part formula. The first part provides all districts with a base allocation of 25% of ETI funds earmarked for K-12 schools. For the 1990-1991 school year, the base allocation was approximately $83,531 per district. In 1991-1992, the base allocation for each district decreased to $73,519. For the 1992-1993 school year, it decreased further to $60,150.

The second part of the formula allocates the remaining 75% of ETI funds earmarked for K-12 schools. In the fall of the year preceding the allocation, the total average daily membership of Utah's 40 school districts is calculated. Seventy-five percent of ETI funds earmarked for K-12 schools is then divided by the total average daily membership of Utah schools to yield a per student allocation. For the 1990-1992 school year, about $14.80 per student -- a total of $10,023,750 -- was disbursed. For the 1991-1992 school year, approximately $14.00 per student -- a total of $8,222,240 -- was allocated. For the 1992-1993 school year, roughly $12.30 per student -- a total of $7,398,850 -- was made available to the 40 Utah school districts, and for the first time, to the Utah School for the Deaf and Blind. The ETI funds each school district has received over 1990-1991, 1991-1992, and 1992-1993 school years is displayed on Table 1.1.

From the beginning, ETI Legislation has required school districts and colleges of education to match the Utah Educational Technology Initiative funds they receive on a one-to-three basis with their own locally-generated funds or through in-kind services, including the establishment of necessary infrastructure, planning services, training services, maintenance or technical assistance. Utah businesses and technology vendors have also contributed to the Utah Educational Technology Initiative through grants and by selling hardware and installation services to school districts and colleges at discounts or by providing staff training and other support services. Through June 1993, these matching funds are estimated to be $95,086,989.[2]

Taking the ETI allocation of $39,900,000, together with the estimated matching funds of $95,086,989, it can be seen that Utah's total investment in educational technology from the 1990-1991 to the 1992-1993 school year is $134,986,989 or approximately $306 per student.[2]

Evaluation of the Utah Educational Technology Initiative

The Utah Educational Technology Initiative Evaluation is built around the central concept of *portfolio analysis*, an evaluation method that incorporates the collection of diverse types of data and enables a number of types of evidence to be used to gauge accomplishments. Over the three-year course of this evaluation, we will examine the success of ETI in meeting its goals by relying upon a number of types of data -- reports from principals, analyses of student achievement scores, examples of student work, and the testimonies of those closest to the projects -- the teachers, principals, and students. After considering each type of data individually for evidence of impact, we will consider them collectively, and attempt to clarify commonalities and contradictions.

Previous Evaluation Reports and Their Findings

This document is the third in a series of evaluation reports documenting the implementation and impact of the Utah Educational Technology Initiative. The initial report, *A Portfolio-Based Evaluation of Utah's Educational Technology Initiative: 1990 - 1991 School Year* (Report # ETI-92-1) was issued in January 1992. Based on extensive site visits and a survey of all Utah schools receiving ETI funding, the report described the planning and implementation of district ETI projects and examined the impact of ETI on student performance and student access to computers during the 1990-91 school year. A second report, *Instructional Utilization, Teacher Training and Implementation of Utah's Educational Technology Initiative in School Districts and Colleges,* (Report # ETI-92-2) was issued in June 1992. Based on site visits and a survey of 1483 teachers actively involved in the Educational Technology Initiative, it described the training teachers received and their use of technology for instructional purposes. This report also portrayed how colleges of education were preparing both today's and tomorrow's teachers to use educational technology. Key findings from these two reports are summarized below.

Districts	1990-1991 Funding	1991-1992 Funding	1992-1993 Funding	Total Funding
Alpine	964,513	846,230	701,770	2,512,513
Beaver	114,609	101,445	83,547	299,601
Box Elder	331,623	293,018	243,734	868,375
Cache	364,342	323,129	266,399	953,870
Carbon	205,330	177,429	146,380	529,139
Daggett	87,664	77,370	63,363	228,397
Davis	1,312,141	1,143,665	965,219	3,421,025
Duchesne	178,808	154,330	128,725	461,863
Emery	166,606	144,824	119,016	430,446
Garfield	109,228	95,290	78,639	283,157
Grand	118,069	101,864	85,287	305,220
Granite	1,857,247	1,620,614	1,337,772	4,815,633
Iron	202,958	178,480	149,198	530,636
Jordan	1,545,897	1,367,890	1,151,921	4,065,708
Juab	119,579	104,862	86,505	310,946
Kane	116,470	102,273	84,080	302,823
Logan	207,810	186,222	153,207	547,239
Millard	170,461	148,449	123,338	442,248
Morgan	123,866	110,381	90,817	325,064
Murray	228,115	200,957	169,235	598,307
Nebo	459,716	404,527	337,160	1,201,403
N. Sanpete	135,883	119,620	97,647	353,150
N. Summit	104,183	91,902	75,693	271,778
Ogden	350,284	306,143	257,616	914,043
Park City	123,309	114,182	97,199	334,690
Piute	92,169	80,969	66,570	239,708
Provo	381,542	340,844	277,964	1,000,350
Rich	95,895	84,222	69,214	249,331
Salt Lake City	632,559	564,672	465,808	1,663,039
San Juan	162,263	142,793	114,724	419,780
Sevier	192,340	169,140	142,276	503,756
S. Sanpete	144,317	128,724	107,154	380,195
S. Summit	107,462	94,632	78,858	280,952
Tintic	88,651	78,132	64,062	230,845
Tooele	246,955	215,352	180,967	643,274
Uintah	228,545	194,636	169,168	592,349
Wasatch	151,441	132,723	111,751	395,915
Washington	375,978	345,158	290,620	1,011,756
Wayne	98,249	86,290	70,631	255,170
Weber	667,923	589,607	495,027	1,752,557
Sch Deaf & Blind	0	0	66,739	66,739
Total Across All Districts	13,365,000	11,762,990	9,865,000	34,992,990
Average Across All Districts	334,000	286,000	241,000	854,000

Table 1.1: ETI Funding of Utah School Districts - 1990-1993

ETI Impact on Student Achievement and Motivation

- Elementary schools scoring below the mathematics and reading scores predicted for them on the Utah Statewide Testing Program in 1990 were more likely to score above their predicted mathematics and reading scores in 1991 if they had ETI projects operating for at least one semester.

- School district personnel believe they have seen important changes in student learning, motivation, and performance as a result of ETI projects.

ETI Impact on Student Access to Computers

- In elementary schools receiving funding during the initial year of ETI, the average student to computer ratio has declined from 22 to 1 during the 1989-90 school year to 11 to 1 during the 1990-91 school year, although this varies widely from school to school.

- In high schools receiving funding during the initial year of ETI, the average student to computer ratio has declined from 10 to 1 during the 1989-90 school year to 7 to 1 during the 1990-91 school year, although this varies widely from school to school.

- In elementary schools receiving funding during the initial year of ETI, the average student spent approximately 60 minutes a week using a computer during the 1990-1991 school year, although this varies widely from school to school.

- In high schools receiving funding during the initial year of ETI, the average student spent approximately 135 minutes a week using a computer during the 1990-1991 school year, although this varies widely from school to school.

Teacher Computer Utilization

- In the three-year period from 1989-92, teachers actively involved in the Educational Technology Initiative doubled the amount of time they spent using technology for instructional purposes. Elementary teachers increased from an average of 1.3 hours per week to an average of 3.0 hours per week, and secondary school teachers increased their average use from 3.4 hours to 7.8 hours per week. At both levels of schooling, teachers in the higher grades reported using computers significantly more than in the lower grades.

- During the 1990-1991 school year, elementary teachers actively involved in the Educational Technology Initiative used computers considerably more to support mathematics instruction than to support reading or writing. Secondary teachers actively involved in the Educational Technology Initiative used computers significantly more to teach writing than for reading or mathematics.

- Teachers' use of computers in different subject areas is strongly correlated with their belief about computer effectiveness.

- During the 1990-1991 school year, microcomputers in labs or classroom settings were the most frequently used type of technology at both levels of schooling. Fewer than 20% of the teachers actively involved in the Educational Technology Initiative used laserdiscs, scanners, or modems.

- During the 1990-1991 school year, the majority of instructional computer use by elementary teachers actively involved in the Educational Technology Initiative was in support of the Utah Core Curriculum. Over 80 percent of these elementary teachers used computers to instill basic skills through drill and practice. Sixty percent of these same teachers used computers for stimulating creative and higher order thinking. Fewer than 15 percent used the technology as a presentation or telecommunications medium.

- During the 1990-1991 school year, over 70% of secondary school teachers actively involved in the Educational Technology Initiative reported using computers for word processing. About 60% used computers for drill and practice, for the development of basic skills in the core curriculum and for developing higher order thinking skills. About one-third of these same teachers used technology as a presentation medium. Sixteen percent utilized computers for telecommunications.

Staff Development

- During the 1990-1991 school year, approximately 45% of teachers actively involved in the Educational Technology Initiative received no inservice training to support the integration of technology with their instruction. A further 34% received less than 10 hours of inservice training.

- Although not all Utah teachers received ETI inservice training, the average teacher receiving training during the 1990-1991 school year spent almost twice as much time in writing and mathematics inservice than in reading inservice.

- The average teacher receiving ETI inservice training during the 1990-1991 school year rated that training as "effective" (3) on a scale running from "not effective" (1) to "extremely effective" (5).

- During the 1990-1991 school year, most inservice training was provided by teachers and school district personnel. About 18% of training was provided by computer vendors. Only 3% of training was provided by local universities.

- Teachers receiving inservice during the 1990-1991 school year were more likely to use computer technology more than teachers not receiving inservice. They were also more likely to use computers to stimulate higher order thinking and creativity.

- Universities do not appear to be providing the inservice support envisioned in the ETI legislation.

Data Source for This Report

This evaluation report is based on a survey distributed during October 1992 to every elementary, junior high, middle and high school in Utah. Principals (or the school's ETI Coordinator) were asked to complete and return the survey if their school had received any ETI funding. If no ETI funding had been received by the school, the principal was instructed to discard the survey and return a statement enclosed indicating that no ETI funds had been received. The original mailing was supplemented by a follow-up mailing to schools that did not return their surveys. In addition, the statewide ETI Project Director reminded school district ETI Coordinators to encourage principals to return the surveys. We also telephoned individual schools to remind them that the ETI evaluation survey had not been received.

Statewide response to the school ETI Evaluation Survey is displayed on Table 1.2. In all, a total of 680 surveys were distributed to Utah schools. Five hundred thirteen schools responded; of these, 435 schools indicated they had received ETI funding. Although the school response rate ranged from a low of 9% in one district to a high of 100% in five districts, the response rate on a statewide basis was 75%.[3] A copy of the Utah Educational Technology Initiative (ETI) Evaluation 1992-1993 School Questionnaire appears in Appendix A.

In addition to the school ETI evaluation, structured telephone interviews were conducted with district ETI Coordinators. These interviews included questions about districts' accomplishments and problems with ETI projects during the 1991-1992 school year, the impact ETI has had on students and teachers, and any changes that have occurred as districts implemented their ETI plans.

Site visits were also conducted at four schools in the greater Salt Lake City area, and meetings were held with school and district personnel from Salt Lake City, Davis, Granite, Jordan, Tooele, Murray, Cache, Box Elder, Weber, Alpine, Nebo, and Provo.

Districts	# of School Surveys Distributed	# of All Schools Responding	Response Rate for All Schools	# of ETI Schools Responding
Alpine	41	29	71%	16
Beaver	6	3	50%	3
Box Elder	26	19	73%	19
Cache	18	11	61%	10
Carbon	12	8	67%	7
Daggett	3	3	100%	3
Davis	66	56	85%	52
Duchesne	13	9	69%	6
Emery	10	8	80%	7
Garfield	9	7	78%	3
Grand	4	3	75%	3
Granite	91	83	91%	81
Iron	11	9	82%	9
Jordan	67	55	82%	50
Juab	4	2	50%	2
Kane	9	5	56%	4
Logan	9	9	100%	8
Millard	9	6	67%	6
Morgan	3	3	100%	3
Murray	10	8	80%	8
Nebo	25	18	72%	16
N. Sanpete	7	7	100%	7
N. Summit	3	2	67%	2
Ogden	22	2	9%	1
Park City	4	3	75%	3
Piute	3	2	67%	2
Provo	16	12	75%	10
Rich	4	4	100%	2
Salt Lake City	37	36	97%	17
San Juan	13	6	46%	4
Sevier	12	8	67%	5
S. Sanpete	6	3	50%	3
S. Summit	3	1	33%	1
Tintic	4	2	50%	2
Tooele	15	10	67%	10
Uintah	13	8	62%	8
Wasatch	7	6	86%	6
Washington	23	18	78%	11
Wayne	4	3	75%	3
Weber	38	26	68%	22
All Districts	680	513	75%	435

Table 1.2: School Response Rates for 1992-1993 ETI Evaluation Survey

The Organization of This Report

The following evaluation report contains five chapters. The first chapter presents an overview of the Educational Technology Initiative and previous evaluation findings. It also discusses the data on which the following chapters are based. Chapter two describes the implementation of school and district ETI project during the 1991-1992 school year, focusing especially on the training teachers have received and still require. Chapter three provides a series of examples of different types of educational software in order to give the reader a sense of the possibilities educational technology makes available to teachers and students. Chapter four discusses the impact ETI has had on the hardware available in schools and surveys the types and locations of computers generally found in schools. Finally, chapter five presents the comments of the administrators, teachers and district staff members who attended three Feedback and Networking Meetings held in October 1992. The purpose of these meetings was to communicate findings from the first year's ETI evaluation, provide those attending with personalized reports on ETI implementation in their own district, and establish a forum for networking and professional sharing.

We emphasize descriptive findings in this report to ensure the results of this evaluation are understandable by the average reader. Readers interested in more sophisticated statistical analyses of these data will find more information in the forthcoming evaluation report to be available in June of 1993.

Endnotes

1. Further discussions of the influence of the Educational Technology Initiative on Utah's public colleges of education can be found in Mergendoller, J.R.; Stoddart, Trish; Horan, Carolyn; Niederhauser, Dale; and Bradshaw, Dean, *Instructional Utilization, Teacher Training and Implementation of Utah's Educational Technology Initiative in School Districts and Colleges*, Report # ETI-92-2.

2. Through June 1992, ETI matching funds are reported by the ETI Project Office to be $63,391,326. The figure of $95,086,989 matching funds reported in the text assumes that matching funds for the 1991-1992 school year will equal the average amount received during each of the first two years, or $31,695,663.

3. The response rate of 75% includes all schools responding and includes schools that had and had <u>not</u> received ETI funding. Since there is no reason to assume ETI schools would be more or less likely than non ETI schools to return the evaluation survey, this also represents our best estimate of the response rate of schools receiving ETI funding. If one were to estimate the response rate on a "worst case" basis and assume that all schools who did not respond to the survey were ETI schools, this lowers the statewide response rate three points to 72%.

Chapter 2

ETI Implementation During the 1991-1992 School Year

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ETI Implementation During the 1991-1992 School Year

The Utah Educational Technology Initiative (ETI) was conceived as a three-year program subject to legislative allocation each year. Legislation authorizing The Educational Technology Initiative was passed in March 1990, and first-year funding was available to Utah school districts the following July. As described in our initial evaluation report, *A Portfolio-Based Evaluation of Utah's Educational Technology Initiative: 1990-1991 School Year*, school districts planned to implement a variety of projects. These included creating or upgrading computer labs, placing computers in teachers' classrooms, purchasing multimedia and other presentation tools, and establishing or enhancing distance learning capabilities.

The current report focuses on the implementation of ETI projects during the 1991-1992 school year, the second full year of the Educational Technology Initiative. We discuss information collected from district ETI Coordinators in two ways:

1) In October 1992, regional debriefing meetings were held with district ETI Coordinators from around the State. At this meeting Coordinators completed a questionnaire which focused on their concerns relating to the ETI implementation;

2) In January 1993, researchers telephoned a random sample of 15 ETI coordinators and interviewed them about the implementation process. The analysis presented below draws on both these data sources.

Comments and Concerns of District ETI Coordinators

By the end of the 1992-1993 school year the majority of the public schools in Utah will have received educational technology equipment as a result of ETI. The majority of ETI Coordinators report that this technology has been installed and is being used. The type of technology selected, however, varies considerably across districts. Some districts have concentrated on putting a computer on every teacher's desk and installing an instructional management program such as trACE. Other districts have chosen to install the equivalent number for computers (15-25) in a computer lab for students' instructional use. As each year's ETI funding becomes available, districts expand and improve their systems. For example, one ETI Coordinator said:

> "We have finished putting (computer) labs in place. Now we want to network into every classroom."

There is a consensus that both students and teachers have developed enthusiasm for and expertise in using educational technology. Parents are also said to be very supportive of the increased access to educational technology made possible as a result of ETI. ETI Coordinators commented:

> "The teachers have bought it in. Every teacher wants to have computers in the classroom."
>
> "We've had great support from parents. They feel a real need for technology. This is important. Kids are getting parents to buy them computers at home."
>
> "Teacher attitudes have changed from fear, to willingness, to excitement."
>
> "The teachers who are using the equipment installed in the first year have become comfortable in using it."

The general consensus is that ETI is up and running and that educators, students, and the community are enthusiastic about it. As they progress through the implementation process, however, ETI coordinators are identifying three primary issues which they feel need to be addressed:

1) installation and maintenance of hardware;
2) identification of appropriate software programs; and
3) training teachers in the use of educational technology.

Specific concerns have been raised relating to hardware and software. Many coordinators had experienced problems in the installation of equipment. For example, one ETI Coordinator commented:

> "It changed the network topology. We went from arcnet to twisted pairs and had problems working out the wiring problems."

Most coordinators are concerned about the maintenance of the technology equipment they have installed. They report that typically districts do not have funds to assign or hire expert personnel for maintenance. In many districts troubleshooting and maintenance are done by ETI Coordinators and teachers on top of their regular activities. Some schools have volunteers and parents who help out and supervise the computer lab. Many coordinators agreed with the following comment by one of their colleagues:

> "Equipment issues are going to create obsolescence and repair problems that have not been thought about."

Problems have also arisen as a result of the rapid development of new hardware and software. Hardware and software upgrades are expensive, and districts frequently lack the funds to keep up to date. Schools are often left with equipment purchased just a few years ago but which is now outdated. One ETI Coordinator commented; "The new software won't run on the old computers." Another pointed out:

> "We need frequent inservice for upgrades. We also need hardware and software upgrade dollars."

There was a general consensus that ETI Coordinators, teachers and administrators need to receive more information about different types of instructional software. Coordinators suggested that there should be an analysis of how specific software programs meet specific types of instructional situations -- particularly with regards to the content in the Core Curriculum and the needs of students at different grade levels. There was concern that some software vendors market their products as a universal answer to all student learning needs. One ETI Coordinator commented:

> "We need to address the question of one size fits all software. We should address the values and limitations of using software that is trying to address all student or teacher needs. Just because it's on the market [doesn't mean it does what the vendor says it does]."

One ETI Coordinator raised the issue of making the software used in schools compatible with the software used in business and industry; noting "We need an overall focus for the software used."

Once software is identified, teachers and administrators need to learn how to integrate it with instructional programs targeted to the Utah Core Curriculum. Such training is inevitably expensive in time and money. Finally, the issues of upgrading and repairing installed hardware need to be addressed. Since new generations of computers, noticeably more powerful than their predecessors appear every one or two years, ETI Coordinators were concerned that attention be given to maintaining and upgrading hardware already purchased.

For example, from the standpoint of preparing students to enter the world of business, should we use "industry standard" software even if it's complex and hard to master, or should we use easier "user friendly" programs that aren't industry standard? Several Coordinators raised the issues of standardizing software use across the state and the purchase of site licenses for software.

> "We have need for help in solving problems around software and hardware needs such as the need for multiple copies of programs, license for LAN's or decisions on upgrading equipment and/or software," and "There should be coordination of software purchases and upgrades so there is compatibility across the school/district."

All the ETI Coordinators were concerned about teacher training. They pointed out that most teachers are still novices at using educational technology. The primary issues were those of time for training and paying teachers for the time they spend learning to use the new technology. ETI Coordinators stressed that teachers need time outside of the classroom to upgrade their computer skills:

> "Time is the biggest problem -- we need time for instruction, time to practice and time to teach technology."

> "We need uninterrupted time for training and practice. Can't purchase computers without purchasing TIME."

> "We need time to learn the new programs before we have to teach using them."

The Coordinators stressed that teachers need to be compensated for time spent in technology training with release time, financial reimbursement or even their own personal computer. Many Coordinators also argued for stronger technology training for pre-service teachers in university teacher education programs. We heard many variants of the following comment:

> "[New] Teachers should graduate with experience with a variety of [computer] platforms. They should be able to do word processing, use grading programs and be familiar with software in their subject area."

To summarize the perspectives of ETI Coordinators, there was consistent agreement that the first stage of Utah's Educational Technology Initiative has been successfully implemented -- new technology has been placed in classrooms and teachers and students are enthusiastic about using it. ETI Coordinators are now struggling with the complexities of the second stage of implementation: fully integrating the use of technology into the instructional process. According to the ETI Coordinators, successful integration requires knowledge, training and practice. Teachers and administrators need to become more aware of available educational software in order to select software compatible with their hardware which will serve specific instructional purposes.

Influences on ETI Project Development

Although the legislation authorizing the Educational Technology Initiative required that each district submit an ETI Plan describing proposed activities, it did not specify who was responsible for preparing the ETI plan or who would be responsible for providing guidance during the plan's implementation. To gain a better sense of how schools had created and carried out their ETI plans we asked principals to name the individual or group who has been most influential in developing the ETI project at each school. Their answers to this question appear on Figure 2.1.

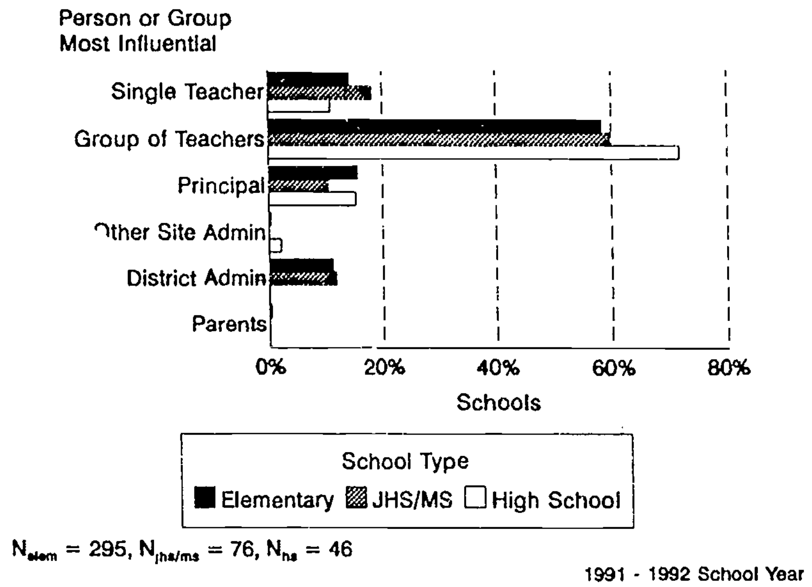

Figure 2.1: Person or Group Most Influential in the Development of ETI Projects by School Type

On Figure 2.1, the dark bars represent responses received from elementary schools, the gray, patterned bars represent junior high/middle school responses, and the white bars represent responses received from high schools. As can be seen, it was most common for a group of teachers to take leadership in the development and implementation of ETI projects in all types of schools. Fifty-eight percent of the elementary schools, 60 percent of the junior high/middle schools, and 72 percent of the high schools responded that this pattern was followed. Conversely, it was extremely rare for parents or site school administrators other than the principal to exert influence over ETI projects, no matter what the school type. A minority of schools -- approximately 10% to 20%, depending on the school type -- reported that either a single teacher or the principal had the most influence in developing the school's ETI project. Although roughly 11% of the elementary and junior high/middle schools stated that district administrators had played the key role in creating the ETI project, this occurred at none of the high schools.

Previous studies of educational change demonstrate that the longevity and utilization of an educational innovation is related to the roles and allegiances of those responsible for the innovation. When innovations are imposed from the outside -- as in a district-mandated change -- or when they are not considered to facilitate the goals of the school, they are often not supported by the teachers expected to implement the innovation. As a consequence, they fail. On the other hand, when innovations are conceived and carried out by groups of teachers at individual school sites, they have a better chance of being sustained. An innovation planned by those who will implement it can be tailored to the unique concerns of the school, and by including several teachers on the planning committee, can recognize and respond to the multiple concerns of different multiple constituents in the school community.

Although it is impossible to ensure the success of an innovation, it is a hopeful sign that in a majority of schools groups of teachers were most influential in the planning and implementation of ETI projects. This maximizes the possibility that the ETI project will be seen as "the school's project," and should encourage school staff to take advantage of the opportunities it provides.

Impediments to ETI Implementation

The Utah Educational Technology Initiative seeks to use educational technology to make fundamental changes and improvements in the way schools operate, teachers teach, and students learn. As anyone who has been involved in changing organizations can attest, this is a significant challenge. There are a number of obstacles that must be overcome before people and organizations can function in new ways.

To better understand the problems schools faced as they sought to realize their ETI plan, we asked schools to identify the impediments they had experienced over the past two years. Their answers to this query appear on Figure 2.2.

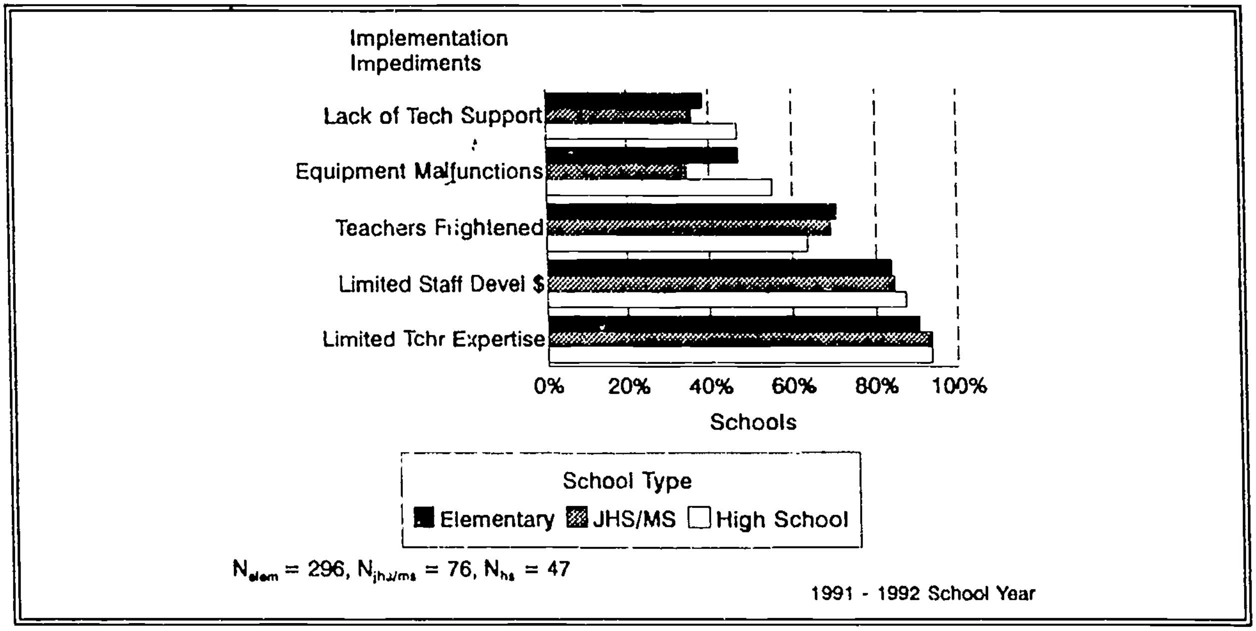

Figure 2.2: Impediments to ETI Project Implementation by School Type

On Figure 2.2, the dark bars represent responses received from elementary schools, the gray, patterned bars represent junior high/middle school responses, and the white bars represent responses received from high schools. Although the responses from schools varied slightly by type, they were generally quite consistent and fell into two major categories: equipment problems and training problems. Of the two, a greater number of schools cited training problems than cited equipment problems.

Two types of equipment problems were named most frequently. First, roughly 40% of all schools reported that they lacked the technical support necessary to install the computers and set up the project. Second, nearly one-half of all schools reported experiencing equipment malfunctions that delayed the implementation of their ETI project. (One could hypothesize that if more technical support had been available to install the technology, then equipment malfunctions resulting from faulty installations would have been avoided.)

These two equipment problems -- lack of technical support and equipment malfunctions -- were not as prevalent, however, as the training problems schools experienced. More than 60% of the elementary, junior high/middle, and high schools noted that their teachers were frightened of the new technology. More than 80% of the schools reported that they had limited staff development funds and this hindered the planned ETI projects. Finally, more than 90% of the schools cited their faculty's limited expertise with educational technology as an obstacle to the implementation of their ETI projects.

Although equipment problems were responsible for delaying the implementation of ETI projects in almost one-half of the schools, it was the training problems that were more prevalent and most troublesome. When asked to name the two problems that "posed the most difficulties for your school," the two most frequent responses in all types of schools were that they had limited funds for staff development and that their faculty lacked technological skills and expertise. About 1 out of 7 of the junior high/middle and high schools mentioned that they lacked the physical space necessary for their ETI project.

This finding that staff training is the pre-eminent implementation problem identified by Utah's principals reinforces a number of results and recommendations regarding staff training reported in the second evaluation report, *Instructional Utilization, Teacher Training and Implementation of Utah's Educational Technology Initiative in School Districts and Colleges* (Report # ETI-92-1). If one is to change the way schools operate, one must change the way teachers operate, and this generally requires extensive training and support. Without attention to the human factors in an educational intervention, it has little chance of achieving its potential.

Teachers' Use of Technology for Instruction

Although the state of Utah has made a major financial investment to place educational technology in school buildings, this investment will not pay educational dividends until it is fully utilized. The second evaluation report, *Instructional Utilization, Teacher Training and Implementation of Utah's Educational Technology Initiative in School Districts and Colleges* (Report # ETI-92-1), reported on the usage patterns of Utah teachers selected by their principals as being "involved with the Educational Technology Initiative." We assumed that these teachers would use technology more extensively than their fellows, and provide examples of the best uses of educational technology. In the current school survey, we sought to compile a more typical portrait of teachers' instructional use of educational technology. We asked what percentage of teachers in their school regularly use educational technology in their instruction. Responses were recorded in one of five pre-established categories: 1) less than 10% of the teachers; 2) 10 to 29% of the teachers; 3) 30 to 49% of the teachers; 4) 50 to 69% of the teachers; and 5) over 70% of the teachers.

To simplify reporting these data, we have placed schools into two categories: 1) "minimal user schools" -- those in which at least 30% of the faculty are regular technology users; and 2) "maximal user schools" -- those in which at least 70% of the faculty are regular technology users. The results of this analysis are displayed on Figure 2.3.

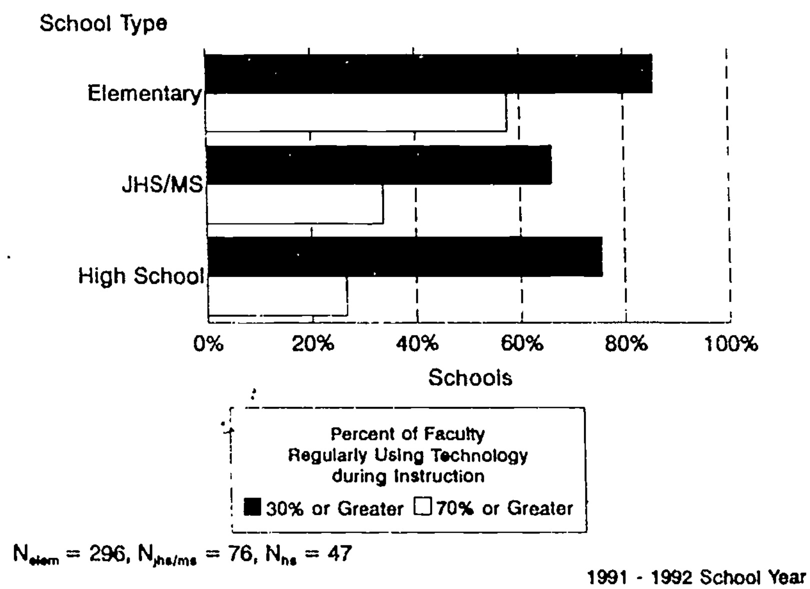

Figure 2.3: Percent of Schools Where Faculty Regularly Use Technology During Instruction by School Type

The dark bars display the percent of elementary, junior high/middle, and high schools that are "minimal user schools." The white bars indicate the number of schools considered to be "maximal user schools." As noted on Figure 2.3, at least 30% of the faculty regularly use technology in 86% of the elementary schools, 66% of the junior high schools and 76% of the high schools. Put another way, in these "minimal user" schools, a student has about a 1 in 3 chance of taking a course from a teacher who uses educational technology regularly in instruction.

The more interesting part of Figure 2.3, however, is the white bars, for they represent the "maximal user" schools where a clear majority of the faculty uses technology in their instruction. As one would expect, the proportion of schools falling into this category are much lower. Fifty-eight percent of the elementary schools noted that at least 70% of their teachers were technology users, compared with 34% of the junior high/middle schools and 27% of the high schools. It thus appears that proportionally more elementary schools qualify as "maximal user" schools. This contrasts sharply with high schools where just over one-quarter of the schools reported that technology was used for instruction by at least 70% of their faculty.

This finding must give pause, since it is in high school that the developmental level and prior learning of students enable them to undertake projects that exploit the full potential of educational technology. Many of the sophisticated uses of educational technology, such as the creation of multimedia presentations or the completion of independent projects built upon communication with remote databases, require the advanced knowledge and autonomy of high school students to maximize their potential. If significant numbers of high school teachers do not introduce these opportunities to their students, it is the students who lose.

Figures 2.4 and 2.5 categorize schools according to the proportion of their faculty who are competent in using three different types of educational software: 1) drill and practice software providing repetitive exercises designed to develop students' basic skills; 2) open ended/tool-based software designed to enable students to explore and create knowledge; and 3) professional tools such as word processing, record-keeping or grading programs. Figure 2.4 displays the percent of elementary (dark bar), junior high/middle schools (gray, patterned bar), and high schools (white bar) where 30% of the faculty are competent using the different types of software. Using the logic discussed earlier, one might consider these schools to have a minimal number of faculty competent in the use of educational software. Figure 2.5 displays the same information for schools where 70% of the faculty are competent in using the same three types of software programs. These schools might be considered to have more optimal numbers of faculty competent with different types of educational software. When comparing Figures 2.4 and 2.5, several findings are worth noting.

First, at least 30% of the faculty in a majority of elementary, junior high/middle, and high schools are competent in the use of both drill and practice and productivity software (Figure 2.4). A lesser proportion of schools of all types have 30% of their faculty competent in using open-ended/tool-based software with their students. A slight majority of high schools (53%) report that 30% of their staff are competent using open-ended/tool-based software, but less than 35% of the elementary and junior high/middle schools made the same statement.

Turning to Figure 2.5, there are a smaller proportion of schools where 70% of the faculty are competent with the three different types of software. This is especially apparent when one considers open-ended/tool-based software. Less than 15% of Utah's elementary, junior high/middle, or high schools report that 70% of the faculty is competent using open-ended, tool-based software. On the other hand, roughly one-half of each type of schools reported that 70% of their faculty were competent using personal productivity software, and 53% of the elementary principals noted that 70% of their faculty were competent using drill and practice software.

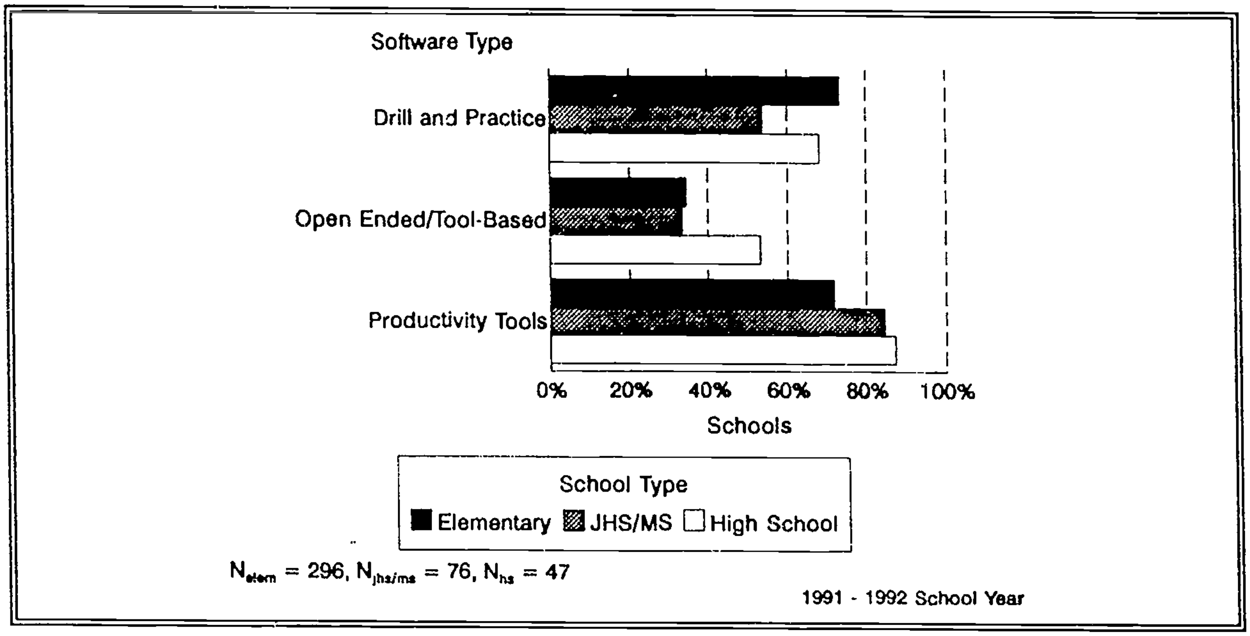

Figure 2.4: Percent of Schools Where at Least 30% of the Faculty is Competent Using Different Types of Software by School Type

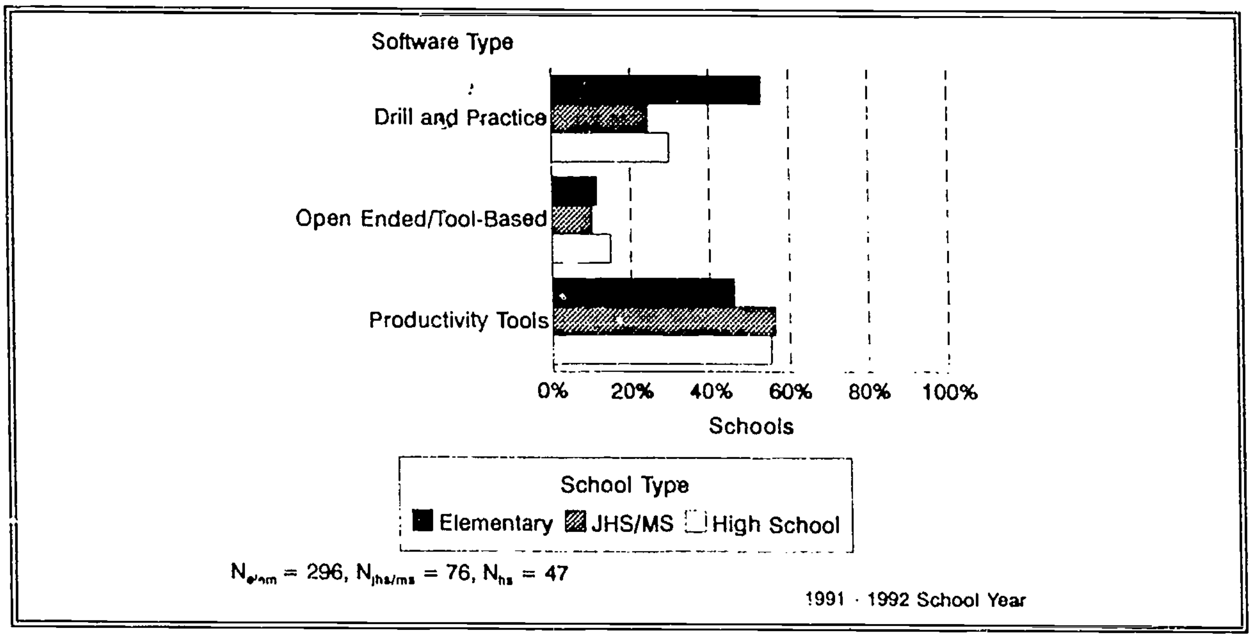

Figure 2.5: Percent of Schools Where at Least 70% of the Faculty is Competent Using Different Types of Software by School Type

These findings point to the prevalent use of drill and practice and personal productivity software in K-12 education. Whether a school contains a minimal or optimal percentage of computer competent teachers, their competence will probably be found in these two areas. It is rare to find a substantial proportion of faculty competent to use more sophisticated instructional software programs like LOGO, Geometric Supposer, or Personal Science Lab. This points again to the crucial importance of staff training to maximize the investment Utah has made in educational technology.

Educational technology can be used to create instructional presentations and to access computerized information systems and databases. Indeed, it is these capabilities that have inspired many of the reformers who believe education can be fundamentally changed through the application of educational technology. The percentage of elementary, junior high/middle, and high schools in which 30% of the faculty are competent to use educational technology in this fashion appears on Figure 2.6.

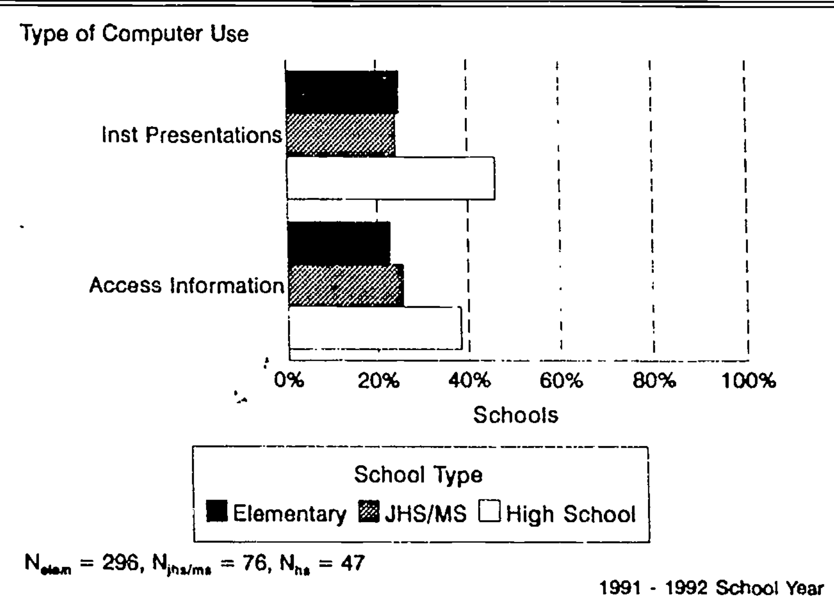

Figure 2.6: Percent of Schools Where at Least 30% of the Faculty are Competent Using Technology for Instructional Presentations or to Access Information by School Type

As before, the dark bars on Figure 2.6 represent elementary schools, the gray patterned bars represent junior high/middle schools, and the white bars represent the high schools. It is immediately apparent that even given the "minimal" criterion of 30% of the faculty, these skills are represented in a minority of Utah schools. Approximately 26% of the elementary schools reported that 30% of their staff could use technology for instructional presentations, a statement also made roughly the same number of junior high/middle schools and 45% of the high schools. With regards to using educational technology to communicate with others and access information, approximately 24% of the elementary schools, 26% of junior high/middle schools, and 38% of the high schools indicated that 30% of their faculty could do this.

These responses confirm, once again, that educational technology is not being used in complex, sophisticated ways by the majority of Utah's teachers. This is not surprising, given that most Utah citizens do not use technology in complex ways, and since specialized training is generally necessary to do so. Once again, it is apparent that the challenge of the Educational Technology Initiative is not the technology, but the requisite training that is necessary if teachers are to take full advantages of the capabilities technology offers.

Inservice Training Topics

Since the results of last year's evaluation of the Educational Technology Initiative made explicit the need to provide inservice training to Utah teachers, we asked schools to rate the importance of the following inservice topics: 1) understanding how computers work; 2) using instructional software; 3) using productivity software; 4) teaching programming; and 5) evaluating educational software. Respondents were asked to make their judgments using a five-point rating scale running from "Not Important at All" (1) to "Essential" (5).

The responses from elementary, junior high/middle, and high schools are displayed separately on Figure 2.7. Responses from elementary schools are indicated by a small dot, those from junior high/middle schools by a star, and those from high schools by a cross. The consistency of opinions received from elementary, junior high/middle, and high schools is remarkable.

As Figure 2.7 indicates, all types of schools ranked the use of instructional and productivity software as the top priority for inservice, followed by learning skills necessary for evaluating educational software. The average rating of all three of these topics varied between "Very Important" (4) and "Essential" (5). Inservice programs focusing on how computers worked were ranked as next in importance, and believed that teaching teachers to do computer programming was considered of least importance among the above topics.

Staff Inservice

We asked schools to report the number of staff during the 1991-1992 school year who had either attended a technology inservice program or who had been given a reduced teaching load or paid a summer stipend to develop curricula integrating technology into regular instruction. We then calculated the percent of faculty at each school participating in each type of staff development, and categorized schools into five groups: 1) those schools where 0 - 20% of the faculty participated; 2) those schools where 21 - 40% of the faculty participated; 3) those schools where 41 - 60% of the faculty participated; 4) those schools where 61 - 80% of the faculty participated; and 5) those schools where 81 - 100% of the faculty participated.

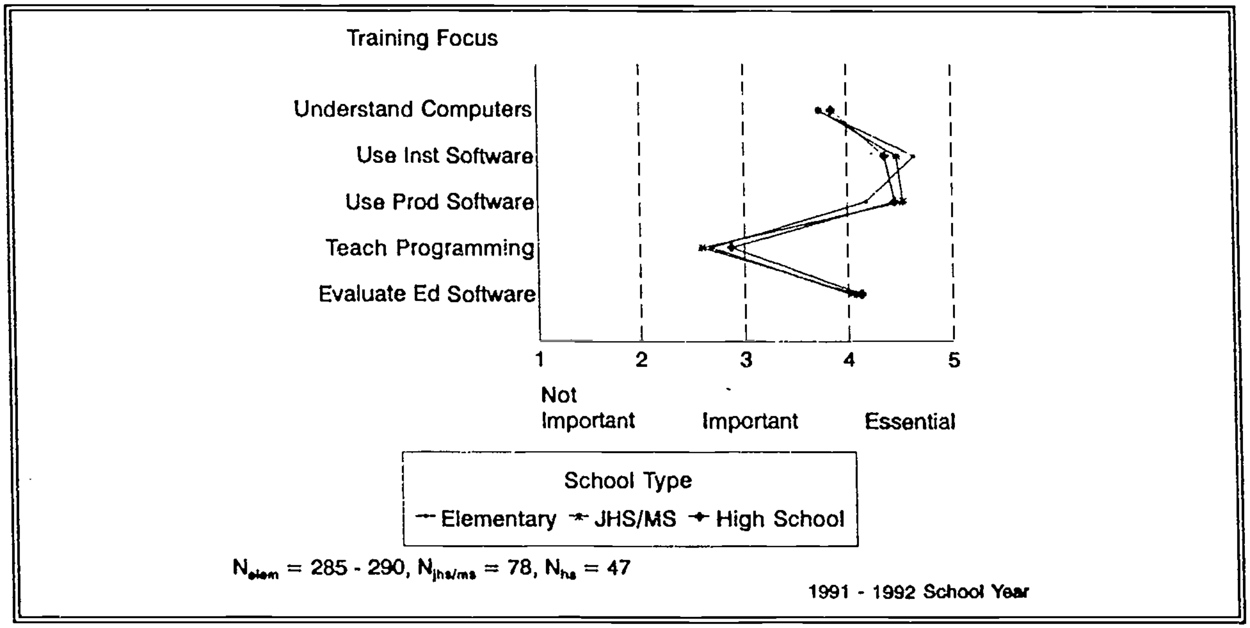

Figure 2.7: Schools' Rating of the Importance of Different Types of Technology Inservice

Figures 2.8 and 2.9 display our analysis of these data. As before, the color of the bar indicates the type of school responding. Elementary schools are represented by dark bars, junior high/middle schools by gray, patterned bars, and high schools by white bars. The percentage of schools in each category is indicated by the length of the bars.

Although there are a number of variations according to school type, several general trends are worth noting. First, it appears that in a majority (67%) of elementary schools, at least 81% of the faculty participated in inservice training during the 1991-1992 school year. In contrast, only 24% of the high school principals reported that at least 81% of their faculty participated in inservice programs focusing on the use educational technology. The percent of junior high/middle schools in the 0-20%, 41-60%, and 81-100% faculty participation groups is relatively constant, ranging from 24 - 30% of all junior high middle schools.

These results suggest that substantial proportions of the staff at all of the schools responding to the survey attended inservice programs, and this is especially apparent in elementary schools. This finding is interesting since the results reported earlier on Figure 2.2 suggest that the lack of inservice funding is a significant obstacle to the implementation of ETI projects. It thus appears that although inservice is indeed occurring, more in-depth training is needed.

Another reason why staff expertise remains a roadblock to ETI project success can be found on Figure 2.9. This figure, arranged in the same format as Figure 2.8, displays the percent of elementary, junior high/middle, and high schools where faculty have been given a reduced

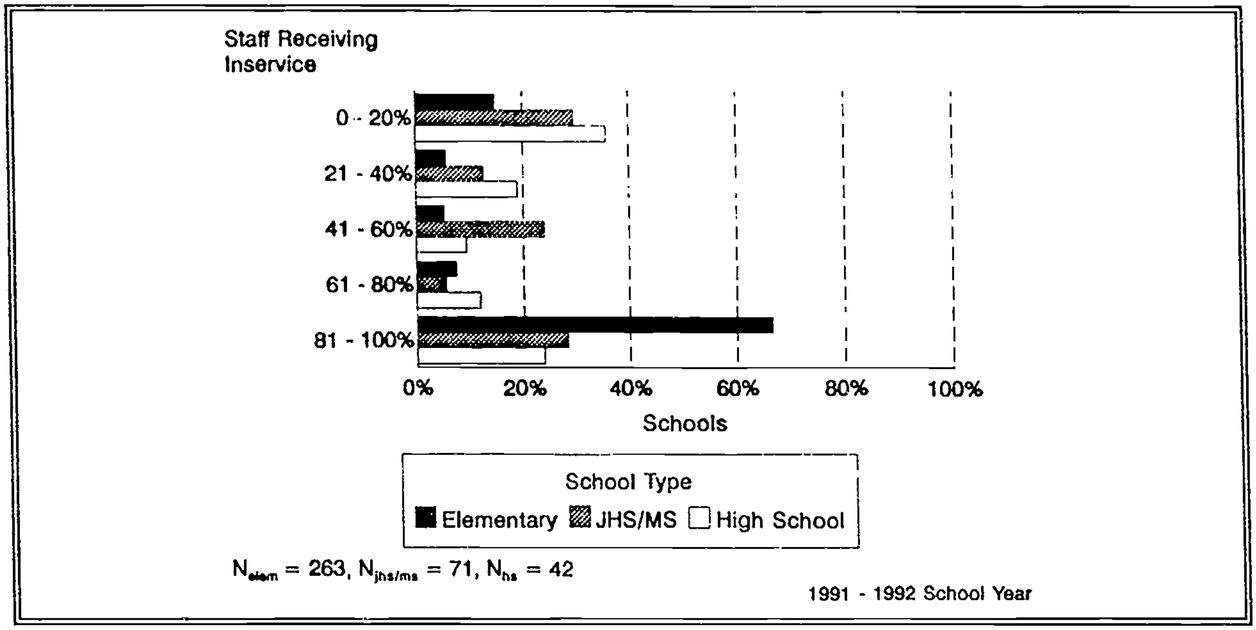

Figure 2.8: Percent of Schools Where Staff Received ETI Inservice Training

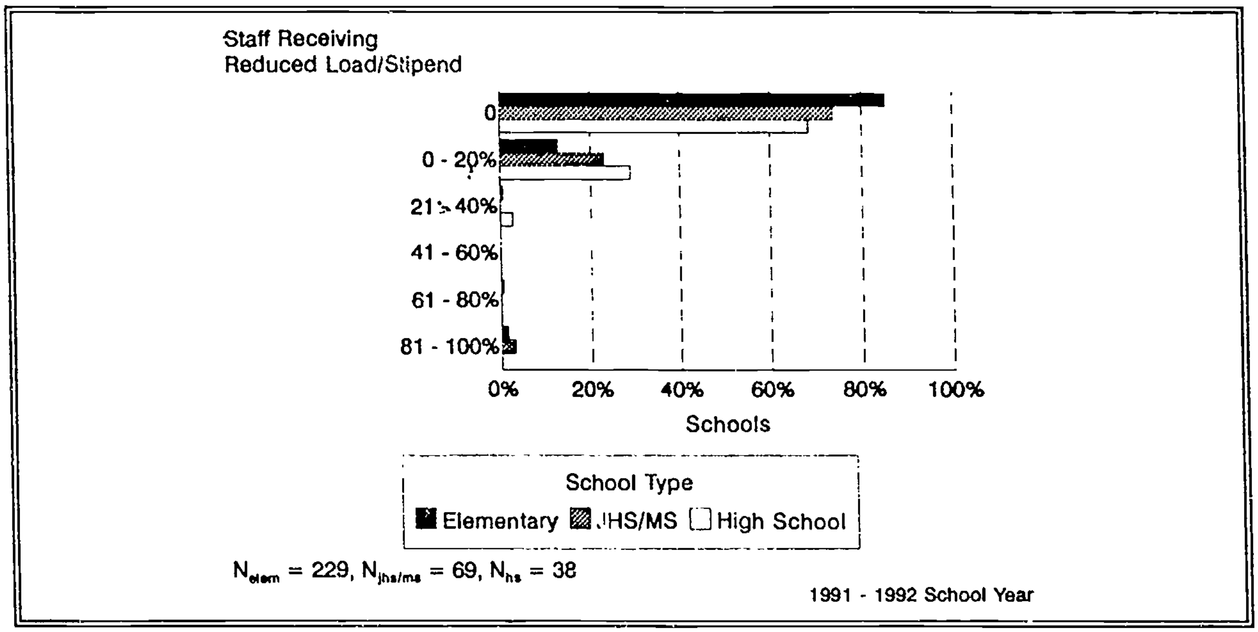

Figure 2.9: Percent of Schools Where Staff Received a Reduced Load or Summer Stipend by School Type

course load or a summer stipend to develop a technology curriculum or materials for their school. As can be seen, the vast majority of schools, no matter what type, have not given this opportunity to their faculty. Approximately 13% of the elementary schools provided these opportunities to 20% or less of their faculty, as was the case with 23% of the junior high/middle schools and 28% of the high schools.

When learning something new, training is essential. But it is also essential to have time to consolidate and incorporate the training into daily activities. Reports from all types of schools indicate that the vast majority of teachers and administrators are being asked to incorporate educational technology into their instruction *on their own, uncompensated* time. If the goal of the Educational Technology Initiative is to infuse Utah's schools with sophisticated, learning activities that employ technology as a tool for learning, we suggest that the opportunities teachers and administrators have to use and to incorporate technology in their daily instructional lives should be reconsidered. Some portion of funds currently spent for new technology purchases might be better spent to give teachers the time necessary to consolidate and incorporate what they have already learned.

Summary

During the second year (1991-1992) of the Utah Educational Technology Initiative, Utah school districts continued to implement their ETI plans as expected. New concerns regarding the maintenance and upgrading of already purchased hardware arose and the attention of ETI Coordinators moved from hardware purchase and installation to software selection and teacher training. Schools consistently reported that the implementation of their ETI projects -- almost universally planned by a group of teachers at an individual school -- were hampered by hardware problems and the limited expertise of teachers expected to use the new technology. Despite these obstacles, a majority of schools reported that at least 30% of their teachers regularly used technology during instruction and were competent using drill and practice and productivity software. Elementary teachers were more likely to use technology during instruction than junior high/middle or high school teachers. Not surprisingly, it appears that proportionally more elementary teachers have participated in inservice training compared to junior high/middle and high schools.

A majority of teachers at all grade levels are competent users of word processing, record-keeping and other types of productivity software. There are many fewer schools in which faculty are competent to use technology for instructional presentations or to access information. Where this does occur, the schools are more likely to be high schools. There is broad agreement that technology training needs to focus on software use and the selection of appropriate educational software for classroom use, and although many teachers have been trained to use the new technology, considerably more training -- especially in the use of the more sophisticated capabilities of educational technology -- is still needed.

Chapter 3

Computer-Assisted Instruction: A Continuum of Instructional Use

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Introduction

Educational technology is viewed by many policy makers and educators as a tool for instructional reform (Collins, 1991; David, 1991; Sheingold, 1991). Large amounts of public money are being invested in an effort to computerize education in the belief that installing technology in the public schools will promote the school restructuring effort and improve teaching and learning (The Office of Technology Assessment, 1988). Introducing technology into the public schools, however, will not in itself bring about school reform; the key to reform lies in how the technology is used (Stoddart & Niederhauser, 1992).

Computer-assisted instruction (CAI) does not embody a single instructional paradigm. It includes a whole spectrum of approaches to teaching and learning based on a variety of instructional theories. Different types of software promote very different kinds of learning outcome. If education policymakers and teachers are to make effective decisions in selecting and using CAI in the public schools they must understand the philosophy and goals on which the software programs are based.

Recently, scholars in the field of educational technology have begun to examine the assumptions about teaching and learning inherent in different approaches to CAI (Maddux and Willis, 1992; Stoddart and Niederhauser, 1992). This chapter builds on and extends this work by identifying a continuum of CAI use based on the role of the computer and the role of the learner. Five categories of use are identified: respondent, interactive, general multipurpose, exploration and representation. Each approach is discussed in relation to the implications for student learning and school reform.

School Reform and Educational Technology

Nationally and locally, curriculum and instruction are in a period of transition (Stoddart, 1993). Over the past ten years the "cognitive revolution" has radically changed educators' views of the teaching and learning process (Case and Bereiter, 1984; Putnam, Lambert and Peterson, 1990; Resnick, 1986; Shuell, 1986). A shift from behaviorism to constructivism has been accompanied by an emerging view of individuals as active participants in the learning process who construct meaning through experience and develop personal theories about the physical and social world. Educational reformers advocate a shift in the focus of instruction from mechanical drill and practice towards teaching for understanding with an emphasis on "hands on" inquiry oriented instruction. This new vision of teaching and learning radically alters the role of the learner from the replicator of facts inherent in behaviorist theories to the constructor of knowledge--a problem poser and solver--inherent in constructivist theories. This new view of learning has been the basis for recent reform efforts in language arts, mathematics, science and social studies (AAAS, 1989; NCTE, 1988; NCISE, 1989, NCTM, 1989; NRC, 1989, NSTA, 1989). Both behaviorist and constructivist views of teaching and learning can be found in instructional software programs (Maddux & Willis, 1992; Stoddart & Niederhauser, 1992).

For the past thirty years behaviorist theory has been enormously influential in the design of instruction technology and computer software (Dick, 1991; Merrill, 1991). Behaviorism is based on the objectivist view that learning should involve students in mastering and replicating the knowledge and skills transmitted to them in school (Lakoff, 1987; Duffy and Jonassen, 1991). The cornerstone of behaviorist theory is the idea that behaviors are learned (become habitual) as the result of reinforcement (Gagne, 1963, 1968; Skinner, 1968). In using an a behaviorally-oriented computer program, students work through computer activities in a sequential fashion with early activities laying the foundation for later activities. The information to be presented is broken down into small discreet bits which are presented in a linear or hierarchical structure. The computer displays a problem for the student (stimulus) who, in turn, responds with an answer (response). The computer then provides feedback to the student regarding whether he or she has provided the "right" answer (reinforcement). This process continues until the student has demonstrated an ability to consistently provide the right answer at a certain criterion level (shaping). The student then moves on to the next set of activities.

In the last ten years, however, the design of instructional technology has begun to be influenced by cognitive and constructivist theories (Papert, 1980, diSessa, 1986; Schwartz & Yerushalmy, 1990). Computer software programs based on constructivist principles provide students with the experiences that allow them to discover or re-invent concepts. Students are given access to a variety of open-ended applications which they use to help them construct their understandings. In this model, the computer is a tool which the students use to enhance their learning. Papert (1980), for example, describes his LOGO "Turtle" as a computational "object to think with." Children learn to construct understandings by "teaching" the Turtle (making it do what they want it to do), which involves planning and trouble-shooting as an ongoing process. The computer is typically used as a tool to collect, organize data and represent the students' understanding. The learner is an active seeker of information who revises and updates his or her understanding through the process of gathering new information. The focus is not on getting the "right" answer, rather it is on developing ever more complex and thorough understandings. Thus, knowledge is seen as a sophisticated interrelated set of concepts and ideas which the learner is continuously developing.

Continuum of Computer Use

These different views of what it means to learn and to understand are apparent in the design of instructional software. In software based in behaviorist principles the source of knowledge is external to the learner (Merrill. 1991). Knowledge resides within the computer program and it is the student's task to memorize the information and provide it to the computer when requested. The computer is the transmitter of knowledge and questioner as it guides students learning. In the constructivist approach, the learner is in control and the computer is a tool for inquiry. This differentiation between computer-directed and student-directed instruction can be viewed as a continuum. Figure 3.1 shows a continuum of computer use which moves from completely computer directed to wholly student directed use. The continuum includes 5 categories of use: two types of behaviorally-oriented computer directed use: (1) respondent software; (2) interactive software, and three types of constructivist, tool-based use; (3) general multipurpose; (4) exploration; and (5) representation. Each of these categories of use will be discussed below with examples of representative instructional software programs.

Computer Directed ... Student Directed

<-->

Respondent	Interactive	General Multipurpose	Exploration	Representation

<-->

Behaviorist ... Constructivist

Figure 3.1: Continuum of Instructional Computer Use

Respondent Software

Respondent software is based on the behaviorist principle of the stimulus-response-reinforcement feedback loop. The computer poses problem for the student (stimulus), who in turn inputs an answer (response). The computer then provides feedback to the student regarding whether he or she has provided the "right" answer (reinforcement). The emphasis is on getting the students to produce the right answer not reason through the problem. It is a closed end process with the computer in control. Many of the respondent software programs closely resemble computerized worksheets.

Students work through computer activities in a sequential fashion with early activities laying the foundation for later activities. Instruction consists of the computer presenting problems (in a tutorial or drill and practice format) which students work through, receive feedback on their answers, and are presented with further problems based on their performance. This form of computer usage fits well with the traditional public school curriculum in which teachers and workbooks pose problems to students. Most of the respondent programs have a record-keeping system which tracks student progress. This feature enables teachers to monitor student progress and easily produce progress reports to send home to parents.

The Waterford Mental Math program is a respondent type program. The program is primarily a drill and practice program--students complete computerized work sheet--with reinforcement provided through competitive game playing activities. Students can compete against the computer or each other. Students are graded by the computer on accuracy (number of problems they get correct) and speed (how quickly they do them). When two students, or groups of students, are competing the one who gets the most problems correct in the shortest time wins. Students scores are integrated into a computer game. One involves a tug of war. The student or group of students who get the highest score are the strongest and win the tug of war. This is represented on the screen by two teams of cartoon characters pulling at both ends of a rope.

For example, in using the Waterford Mental Math program second grade students sit at individual computers in a computer lab and work alone. They are completing an electronic mathematics work sheet containing basic addition problems (such as 14 + 9 =). They fill in the answers in a blank space in the problem on the screen. Students work as fast as they can because they know they are being scored on speed as well as accuracy. When they have completed the worksheet the computer gives them their score. It is represented in two bar graphs--one for accuracy and one for speed. If they meet the computer criterion set by the teacher a cartoon appears. In this case a fairground scene with a carton character testing his strength by hitting a block with a hammer to ring a bell. If the student does not meet the criterion, s/he is given another work sheet to complete. If s/he fails again there is another worksheet to complete. A student is allowed three attempts. Those who fail are rerouted by the computer to a simpler exercise. The computer program records students scores for the teacher. The students do not receive a printout of their work. Teachers say the kids are highly motivated by the program, "they love to go beat the computer".

In language arts respondent type programs often include exercises on such things as combining sentences, parts of speech, punctuation, spelling and vocabulary. Students respond to the questions which the computer presents in a matching, multiple choice or fill in the blank format. These activities are remarkably similar to the workbook or ditto sheet activities which have dominated instruction since the 1960's.

Respondent Software	Students respond to computer-posed questions and are given feedback and reinforcement. Answers are right or wrong. Students progress through program in a linear fashion. Computer monitors/tests student performance and places student at the appropriate level.
Examples:	Waterford Mental Math, Math Practice, Math Blasters, Math Munchers, Bouncy Bee, Combining Sentences, Word Attack.
Interactive Software	Computer poses problem, students are given a variety of options or ways to respond. Assumption is there are several ways to solve a problem. Computer provides options to guide the learning process. Computer gives feedback but does not necessarily determine correctness of answer.
Examples:	Writing to Read, Story Board Plus, Measurement Time & Money, Carmen San Diego, Oregon Trail.
General Multipurpose Tools	Basic general purpose computer tools for information processing, data analysis, text manipulation, etc. The learner uses the computer program to process and present data that they have gathered. Tasks, issues, questions, etc. are determined by the learner. "Right answers" are not in the computer, rather they lie with the individual's ability to use the program and interpret the results.
Examples:	SuperCalc (spreadsheet), Ace File (database), WordPerfect (word processor), E-Mail and Electronic Bulletin Boards (telecommunications), Corel Draw (graphics package).
Exploration Tools	The learner uses the computer to develop understandings by exploring representations of complex systems and concepts. The kinds of topics that can be explored are determined by the program but there is a great deal of flexibility in terms of how the learner uses the tool. Determining correctness of answers is not the responsibility of the computer. This is essentially guided exploration or "hands-on learning" through computer simulation.
Examples:	Math Exploration Toolkit, Personal Science Lab, Geometric Supposer, Logo.
Representation Tools	Authoring programs which allow students to develop models which represent their understanding of a concept. The learner uses simple programming languages to control the computer. Learners develop multimedia displays, graphic representations and models to represent their knowledge. They teach the computer to solve problems.
Examples:	ToolBook, HyperCard, Linkway.

Table 3.1: Expanded Continuum of Instructional Computer Use

First Words is designed to teach young children to associate a written word with a picture of an object. The computer displays a picture of a train on the screen and the child must select the appropriate written word to go with the picture. If the child selects the correct word an animated blob on the screen turns a somersault. If the child is incorrect, the picture of the train flashes and the program waits for the child to try again. If the second response is incorrect, the picture is shown alone in the middle of the screen and the child is instructed, "See the train." The program continues to present the ten pictures in the transportation category until the criterion level (preset by an adult) is reached.

Interactive Software

In the category of interactive software there is more interaction between the student and the computer. The computer still poses a problem but the students are given a choice of responses. The emphasis is on learning the content presented by the computer but the instructional program includes a number of ways to solve the problem and a variety of answers. The computer poses a problem, students are given a variety of options or ways to respond.

In using a program called Storymaker children construct stories by selecting which path of several should be followed. They can choose from several stories. For example, LeMar chose the "Haunted House" Story. He read the first phrase, "Lace opened the front door and ...." He then was presented with three possible ways to complete the sentence. The options from which he could choose are contained in the boxes at the second level of a "story tree"- -a branching story design. LeMar chose the second option. The computer then completed the sentence on the screen: "Lace opened the front door and slipped into what looked like a bowl of spaghetti." It then offered LeMar [the next set of options]. The whole story was constructed like this, with LeMar choosing the paths he preferred from each level of the "story tree." Each choice branched him to another set of choices, and so on. When the story was finished, he instructed the computer to make a copy of it on the printer.

Carmen San Diego (Broderbund Software Inc, 1985, 1989) is an interactive computer game program that can be used to teach students history and geography. In Where in the World is San Diego? students conduct a world wide search for a thief. The computer program provides clues and information. Students take notes and use a world almanac to conduct research. They must use a logical reasoning process to follow the thief's track and identify him or her and his or her location. For example, Julie logs onto the computer and finds herself in Acme Detective Agency. A teletype printout informs her "National treasure has been stolen from Lima. The treasure has been identified as Pizarro's sword. Female suspect reported in the scam". A message from the agency Chief tells her "Your job is to trail the thief from Lima to her hideout and arrest her. You must arrest her by Monday 12 pm. Good luck Julie, The Chief". The program gives her information about Lima Peru, "Peru is slightly smaller than Alaska and is bordered by Ecuador, Columbia, Brazil, Bolivia and Chile". Julie must find out who the thief is and where she has gone. She can chose from several options to receive more information: See connections (which tells her the plane connections from

Peru to other destinations); Investigate (which gives her clues about the suspect); Depart by plane which allows her to follow the thief to the destination she believes the thief has gone to and continue to investigate) and Visit Interpol (which allows her to check her information with Interpol files. Julie chooses to investigate in Lima, Peru. The computer program gives her a choice of location---MarketPlace, Library, Airport. She chooses Market Place. She is given the clue "She brought black market kinas. She wore an attractive ring". Julie thinks kinas are form of currency. She accesses Connections to see which places the thief may have gone to. She is told San Marino, Bamako, Port Moresby, and Baghdad. She looks on the map and to find which countries these cities are in. She then uses her World Almanac to find out which of thee countries has kina as a currency. She discovers this is Port Moresby in Papua New Guinea. She accesses the Depart by Plane function and goes to Port Moresby to continue the search. The game continues until Julie finds out the identity of the thief. In the process it is possible to learn a great deal about world geography.

Exploring Measurement, Time and Money (IBM, 1989) is interactive mathematics education program. Students are given a variety of ways to interact with math problems For example Measure It contains five types of activity: (1) Explore in which students use different types of measuring tools--a string of paper clips, an inch ruler, a half inch ruler-to measure different objects--crayon, comb, hammer, spoon etc; (2) In measure students complete measuring problems, (3) Follow the clue students compare the sizes of objects; (4) In read the graph the computer creates simple bar graphs of objects sizes; and (5) in using the Graphmaker function student create simple spreadsheets. Students interacts with the program by can moving objects around on the screen e.g. moving the spoon next to the measuring tape to see how long it is. They can create their own graphs.

In Storymaker, Carmen San Diego, and Exploring Measurement, Time and Money the computer guides the interaction and there is a structured learning process. The focus is still on learning specific facts and procedures--the computer is a primary source of knowledge and gives feedback on accuracy. The student, however, is allowed to make choices and those choices influence the learning path. These programs give students more influence in the learning process than the respondent programs.

General Multipurpose Software

The third category includes general multipurpose tools which students use for information processing, data analysis, text manipulation, etc. In these programs the interaction between the computer and students is more equally balanced. The computer provides a structure or framework for collecting, analyzing or representing information. The student determines the tasks, issues or question, inputs data and receives information. The response generated by the computer will be determined by the accuracy and structure of the student's input. "Right answers" are not in the computer, rather they lie with the individuals ability to use the program and interpret the results.

For example students can use a spreadsheet to organize, analyze and present data from a science experiment on the freezing points of different liquids. Students conduct a series of experiments and collect data on the temperature at which each liquid freezes. They then type data into the cells presented on the computer screen by the spreadsheet program. The student then uses the computer to produce a graphic representation of the data--selecting from a variety of options such as a bar graph, line graph etc. Students can use a telephone modem to access a variety of national and international data bases to do research for class projects and reports.

Telephone modems can also be used to access satellite networks which allow students to listen to communications between NASA and astronauts on the space shuttle or to access weather reports from any place in the globe. Students now routinely use word processing programs to prepare class work. Many schools are installing dedicated phone lines and modems so that students can log onto the school computer network to receive information, complete homework, etc.

These multipurpose tools allow students to develop and represent their ideas in sophisticated ways as well as providing them with skills that will be useful to them in higher education and the work place.

Exploration Tools

In using exploration tools the learner uses the computer to develop understandings by exploring representations of complex systems and concepts. The kinds of topics that can be explored are determined by the program but there is a great deal of flexibility in terms of how the learner uses the tool. The computer program provides experiences which allow students to construct their own understanding of a concept. The range of experiences are determined by the program. The responsibility for constructing meaning, however, resides with the student. The computer program does not determine the correctness of the students' work. This is essentially guided exploration or "hands on learning" through computer simulation.

Seymour Papert (1980), developed an exploration tool--a "Turtle" which is the basis for the LOGO program. He describes his LOGO "Turtle" as a computational "object to think with. The Turtle is a computer-controlled cybernetic animal. Students learn the LOGO language to communicate with the Turtle and control it. Papert calls this TURTLE TALK To start working with the Turtle students type in SHOWTURTLE and the Turtle appears. Students can move the Turtle by typing in commands. By typing in FORWARD 100 the student moves the Turtle forward 100 units. The Turtle can be moved forward and backwards and can turn right or left in response to the simple commands FD, BK, LT, RT. Using the following simple commands, the learner can make the turtle draw a square:

FD 100 RT 90 FD 100 RT 90 FD 100 RT 90 FD 100 RT 90.

In figuring out how to construct a square the student discovers that the angles of a square are 90 degrees. Having discovered that the angle of a square is 90 degrees students may then be given the assignment to figure out the angles of an equilateral triangle.

In using TURTLE TALK students begin to understand what it means to program a computer and teach it what to do. Using the Turtle students can begin to explore the properties of shapes--squares, rectangles, triangles--and begin to discover basic geometry concepts. Through learning to interact with the Turtle, "the child is learning how to exercise control over an exceptionally rich and sophisticated 'micro-world.'" In Papert's view, children learn to construct understandings by "teaching" the Turtle (making it do what they want it to do), which involves planning and trouble-shooting as an ongoing process. Papert claims programming with the Turtle helps students develop thinking skills which lay the foundation for their understandings of science and mathematics.

In mathematics instruction, Schwartz and Yerushalmy (1987) have developed a series of microcomputer-based programs, called Geometric Supposers, that were designed to "help students and teachers become makers of mathematics." The Geometric Supposer is a computer tool which constructs and manipulates geometrical objects in order to explore the relationships that do or do not hold among these objects. The program can be effectively used at the junior high school and high school levels. Using the Geometric Supposer students do geometry on the computer.

For example, using the circle program they can construct circles and draw segments, tangents parallels, perpendicular bisectors, angle bisectors, and inscribed and circumscribed circles. In addition, the user can measure lengths, angles, and areas as well as arithmetic combinations of these two measures, such as the sum of two angles, the product of two lengths, or the ratio of two areas, and the square of a segment length. The program gives students an extremely flexible computer workspace in which to explore the geometric properties of objects. A beginning student using the program could: (1) draw two concentric circles, (2) draw a line through center A to intersect the outer circle (a diameter), (3) draw a second circle through center A to intersect the outer circle (another diameter). (4) Label the points where the lines intersect the inner circle, and (5) Use the measuring tools to investigate the relationships among the segments, angles and arcs.

The power of the Geometric Supposer lies in its ability to remember and repeat problem constructions developed by students and apply them to new objects. This allows students to discover properties that are only true in particular circles and properties that seem to be true when repeated on circles of all types and sizes. Through this exploration students begin to understand how to develop a mathematical proof.

With programs such as LOGO and the Geometric Supposer, students use the computer as a tool to construct and develop their understandings. The computer allows students to easily create geometric shapes and test relationships between and within shapes. Right and wrong answers have nothing to do with the information in the computer, rather, that judgment is made by the people who use them.

Representation Tools

Representation tools are completely under the students' control. The students use a simple programming language to direct the computer to create a representation of their concepts or ideas. They may use this to create a multimedia display for a history project or program the computer to solve a mathematics problem. Representation programs allow full use of students' creativity. In this situation it is quite possible for a student to develop a completely personal and unique representation of an idea.

For example, students can use the program Hypercard to develop a multi- media Hypercard Stack to complete a social studies project, write a science fiction story, describe the life cycle of a plant etc. The Hypercard program gives students four computer 'objects' they can use to create their project: (1) Picture elements can be included in their stack. These pictures can be still, full motion or animated. Students can use drawings, paintings, photographs or videotape; (2) Sound elements can also be included--voice over, music, train noises, footsteps etc; (3) Text fields present the written component of the project. This element is in essence the word processing component of Hypercard. Students can include text in a variety of sizes, colors and fonts. Computer objects 1, 2 and 3 can be used together.

A picture or sound element can be inserted anywhere in a text and a text element any place in a picture or video. And (4) Link elements are the functions students use to create their Stack. They include scriptable button and hot word functions. To develop their Hypercard Stack students must write a script of all the elements they will include in their project. They use a simple programming language to program the computer. These same objects and techniques are also present and applicable to systems such as Guide and Toolbook. Students preparing a history project on the American Constitution could include drawings or animated cartoons of the critical events leading up to the revolutionary war (such as the Boston Tea Party) accompanied by voice over descriptions, a recording of a dramatic reading of the bill of rights over a photograph of the original document, and pictures and brief biographies of the founding fathers. These components are linked together in a Hypercard Stack and can be viewed by teachers and other students on their computers.

Dr. Mike Connell and Dr. Don Peck at the University of Utah have used the scripting languages of Toolbook and Hypercard to develop a Hypermath project (Connell & Peck, 1992). In this project students use a simple scripting language to teach the computer how to solve math problems. This project integrates hands on learning in mathematics using concrete objects and graphic materials with computer representations. For example, in the first stage 6th and 7th grade students solve problems involving addition, subtraction, multiplication and division of fractions using concrete objects such as rods, blocks and egg cartons. Students then develop explanations and come up with a general rule for solving this type of problem. The students then write a script to teach the computer to solve the problem. The correctness of their solution is judged on the basis of the computer program's efficiency in solving the problem. When the program does not work students have to figure out the flaw in their logic. The students are in effect constructing their own algorithms to solve problems. These personally constructed algorithms are directly related to students' experiences with concrete objects and represent a deep level of conceptual understanding.

Representation tools allow students to develop models which represent their understanding of a concept. The learner develops understanding through off-line experiences then uses the computer as a tool to demonstrate his understanding. The computer helps the learner to formalize his understanding by making it explicit, as well as allowing for others to examine the representation. If the model does not accurately reflect the learners understanding, the learner must make changes to the model until he is satisfied (self-correcting).

Discussion

All these types of computer software provide useful learning experiences for students. There is a place of drill and practice in the curriculum along with guided exploration and representation. A problem arises, however, when there is an over-reliance on one type of use. National and international studies of the uses of educational technology indicate that the dominant use of technology in the public schools is for drill and practice--the behaviorally driven programs Respondent programs described in category one. There is very little used of the conceptual tool-based programs described in categories four and five--the Exploratory and Representation tools (Becker, 1986; 1992). This is also true in Utah. The most frequent uses of technology in Utah elementary schools is for drill and practice in mathematics and in secondary schools it is mainly used for word processing and writing (Mergendoller, Stoddart, Horan & Niederhauser, 1992). This represents a very restricted use of technology.

To make the investment of scarce resources in educational technology worthwhile educators and policy makers must support the elaborated use of technology to include tool-based systems. The constructivist ideas that tool-based systems are based on, however, are not widely accepted in the public schools. Behaviorist traditions are pervasive throughout the institution of schooling. Over 70% of the current teaching force, who were trained in the 1960's, '70's and early '80's, went through behavioral competency-based professional training programs (Stoddart, Losk & Benson, 1984). Teachers tend to teach as they were taught (Lortie, 1975) and as the Rand studies demonstrated often resist innovation (McLaughlin, 1990).

In addition, the current emphasis on accountability in education which has led to the development of "teacher-proof" curricula, and a reliance on student achievement data, has been heavily influenced by behaviorist theory. Many states and districts are adopting some form of "core" curriculum which ensures, at least theoretically, that all teachers are teaching the same content at the same grade level. These curricula typically consist of a series of goals and objectives which students are tested on at the end of the year. This system encourages teachers to embrace transmission teaching styles because of the sheer amount of content which must be covered. Additionally, teachers' performance is often evaluated in terms of their use of behaviorist lesson planning models such as the one developed by Madeline Hunter. Integrated Learning Systems, with their emphasis on discrete objectives closely linked to assessment, seems to fit well with most state and school district curriculum and evaluation procedures.

Another problem is the lack of effective for teacher training both preservice and inservice. In the 1992 evaluation of the Utah Educational Technology Initiative 46% of all teachers surveyed reported that they had received no inservice training to support the integration of technology with their instruction. A further 20%-25% received less than 10 hours of inservice training (Mergendoller, Stoddart, Horan & Niederhauser, 1992). Teachers who did receive inservice technology training used all types of computer technology more frequently than teachers not receiving inservice. They were also more likely to use computer technology to stimulate students' creativity and higher order thinking skills.

To effectively use computers in a constructivist manner, the teacher must have an extensive amount of knowledge in the specific content area, knowledge about the various software packages in terms of what is an appropriate tool for their students and how to use that tool, and constructivist pedagogical knowledge to be able to design activities which helps students incorporate technology naturally into their learning. According to David (1991):

> "The presence of technology complicates teachers' jobs enormously. They are learning not only how to use the technology but also how to teach differently, how to relate in new ways to their students, and how to assume new roles as learners, researchers, and equipment technicians."

In fact, incorporating technology into the schools makes significant demands on teachers in terms of time and effort, rather than serving as a time-saving aid (Niederhauser & Stoddart, 1992).

Finally, in many cases, the money that is allocated for providing technology in the schools often goes directly to purchasing hardware and software rather than for providing inservice training. Sheingold (1991) describes the need for pedagogical as well as technical support: "Technology demands much more than hardware, software, and technical support in schools and districts. It needs people who can help teachers integrate the technology into their practice." Technology funds must be spent by those who know what they need. If a school needs extensive inservice training to be able to use the technology effectively, that should be an option.

Summary

Computers can be put to a variety of instructional uses depending upon the software employed. These uses vary from that of providing a student with the opportunity to learn and practice specific facts (a "respondent" use) to that of providing students with a tool to create and represent their understanding of the world (a "representational" use). Each different way of using the computer makes assumptions about how students learn and requires students to engage in different types of learning behavior. Computers can thus be used in different ways to facilitate different types of learning. A well-designed program of computer-assisted instruction involves students in a variety of computer uses from basic respondent to sophisticated representational learning.

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Chapter 4

The Impact of ETI Funding on Computer Access During the 1991-1992 School Year

Chapter 4

The Impact of ETI Funding on Computer Access During the 1991-1992 School Year

As we noted in our initial evaluation report, *A Portfolio-Based Evaluation of Utah's Educational Technology Initiative: 1990-1991 School Year*, ETI has had a tremendous impact on the availability of computers in Utah schools. In this chapter, we illustrate how ETI has had an impact on the number of computers in the average elementary, junior high/middle, and high school. In addition, we discuss the types and locations of computers found in Utah's elementary, junior high/middle and high schools.

Computer Access and Location

The data reported regarding computer access is based on a subset of 150 elementary schools, 37 junior high/middle schools, and 25 high schools. These schools represent roughly 38% of Utah's elementary schools, 23% of the junior high/middle schools, and 26% of the high schools. These schools were chosen because they completed the relevant questions and returned the ETI School Evaluation Questionnaire in both 1991 and 1992. By restricting analyses to this subset of schools, we are able to draw a more accurate picture of changes in computer allocations across time since there are no missing data to consider. Because this subset of schools represents in total only about 35% of Utah's schools, it does not make sense to consider the absolute number of computers reported by these schools. Instead, we will discuss the average number of computers found in these schools in the hope that this will give a more representative portrait of computer availability and location in the typical Utah school.

The average number of computers found in a "typical" elementary school before and after the Educational Technology Initiative began can be seen on Figure 4.1.[1] The dark bars represent the average number of computers in the 1989-1990 school year. The gray, patterned bars represent the average number of computers in the 1990-1991 school year, and the white bars represent the average number of computers in the 1991-1992 school year. In the 1989-1990 school year, before ETI was launched, the average elementary school had approximately 5 computers in classrooms, 14 computers in a computer lab, and one computer in a media center. The number of computers increased substantially during the 1990-1991 school year -- the first year of ETI funding.

If one again visited the same "typical" elementary school, 12 computers would be found in the classrooms, while the computer lab would contain 27 machines. The media center might

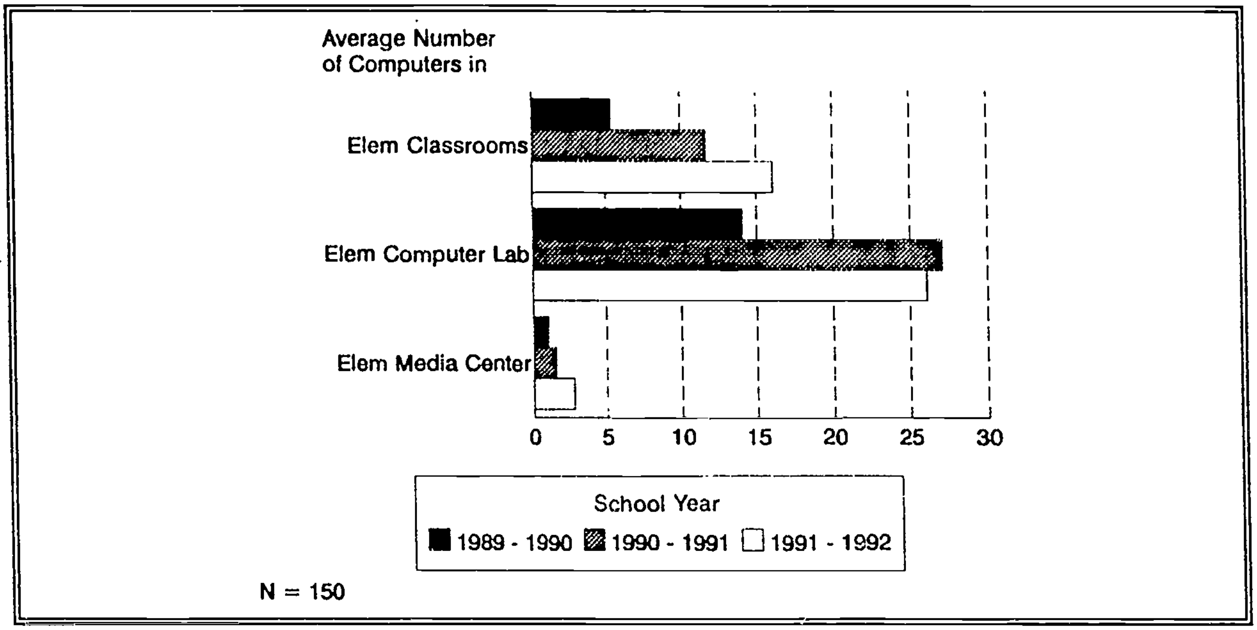


Figure 4.1: Average Number of Computers in a "Typical" Elementary School by School Year

now contain two computers. During the 1991-1992 school year, the number of computers available to teachers and students would again increase, and the pattern of computer placement would change as well. This year, instead of increasing substantially the number of computers found in the computer lab, the typical elementary school put its new computers in teachers' classrooms. As a result, the number of computer stations in the lab stayed about the same. At the same time, the number of computers in the classrooms increased by about 50% from 11 to 17. An additional computer was also placed in the media center, bringing the total to 3.

The same information for junior high/middle schools is portrayed on Figure 4.2, and the pattern of increases in computer use and placement is quite similar. Once again, the dark bars represent the average number of computers in the 1989-1990 school year. The gray, patterned bars represent the average number of computers in the 1990-1991 school year, and the white bars represent the average number of computers in the 1991-1992 school year. During the 1989-1990 school year (before ETI), an average junior high/middle school would have 14 computers in the classrooms, 28 in the computer lab, and 1 or 2 in the media center. Next year, after the commencement of ETI funding, the number of computers in junior high/middle schools classrooms climbed to 23, and an additional 21 computers were placed in the computer lab to bring the total to 48. An additional computer was also placed in the media center. During the 1991-1992 school year, the number of computers placed in the classrooms of a typical junior high/middle school increased by 9 to 31, the number of computers in the computer lab decreased to 44, and the number of computers found in a typical junior high/middle school media center increased by 1 to 4.

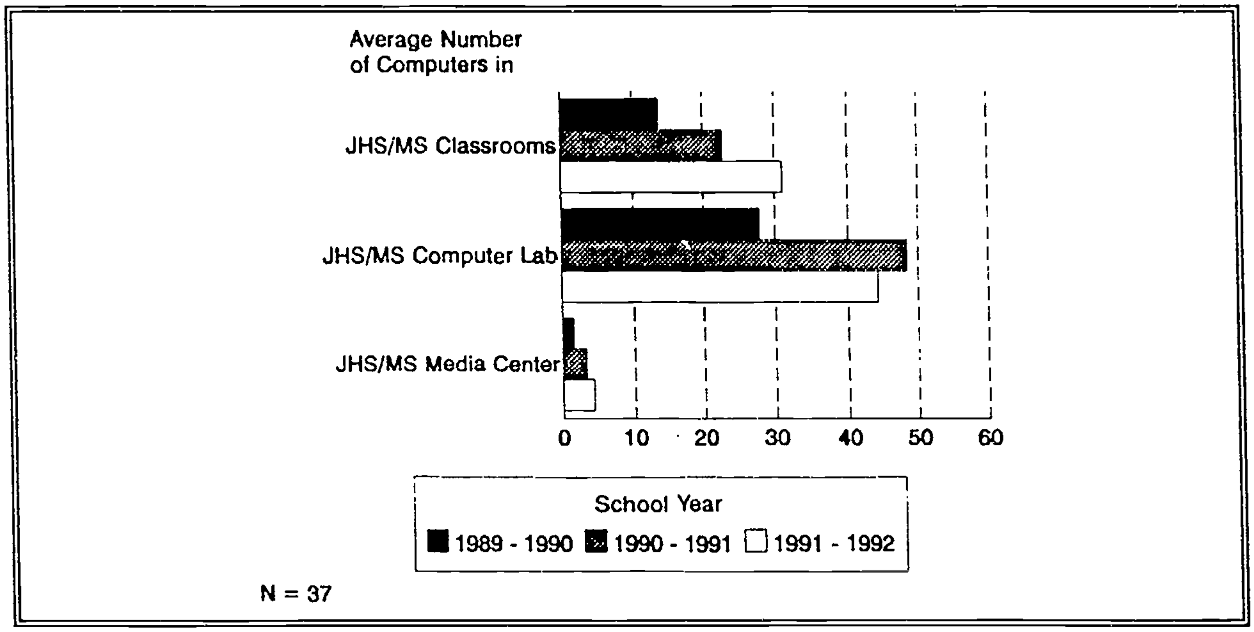


Figure 4.2: Average Number of Computers in a "Typical" Junior High or Middle School by School Year

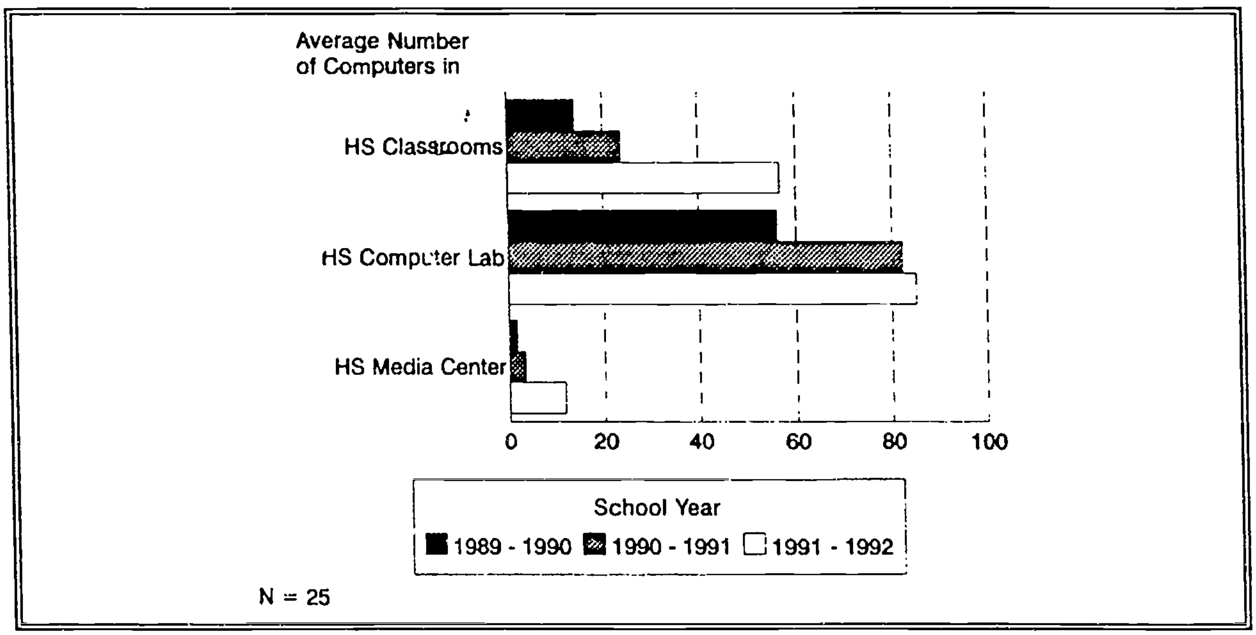


Figure 4.3: Average Number of Computers in a "Typical" High School by School Year

The same graphic convention is used on Figure 4.3, to represent the average number of high school computers in 1989-1990 (dark bars), 1990-1991 (gray, patterned bars), and 1991-1992 (white bars). Before the start of the Educational Technology Initiative, the average high school had 14 computers in classrooms and 60 computers in a computer lab. An additional two computers would be found in the media center. With the beginning of ETI funds, the number of computers in the classrooms of a typical high school increased by 9 to 23, while the number of computers in the computer lab increased by 26 to 86. Two additional computers were placed in the media center that year, bringing the total to 4. During the 1991-1992 school year, the typical high school more than doubled the number of computers available in classrooms from 23 to 60, but kept the number of computers in the computer lab about the same. Again we see the emphasis on increasing the availability of computers in the classroom -- rather than the computer laboratory. The number of computers available in the media center was increased from 4 to 7.

Student/Computer Ratios 1989-1992

Using the same subset of 212 schools returning the ETI School Evaluation Questionnaire in 1991 and 1992, it is possible to calculate student/computer ratios by summing the students enrolled in each type of school and dividing by the total number of instructional computers available in classrooms, computer labs and media centers. The results of this calculation are displayed on Figure 4.4.[2]

The dark, patterned bars represent student/computer ratios at the end of the 1989-1990 school year. The gray, patterned bars represent student/computer ratios at the end of the 1990-1991 school year, and the white bars represent student/computer ratios at the end of the 1991-1992 school year. As can be seen, the largest decreases in student/computer ratios at all types of schools occurred between the 1989-1990 and 1990-1991 school years. This is not surprising since the 1990-1991 school year was the start of the Educational Technology Initiative. Although student/computer ratios continued to decline following the 1990-1991 school year, the difference is not nearly as dramatic as it was the previous year. Following the 1989-1990 school year, student/instructional computer ratios declined by 48% in elementary schools, 41% in junior high/middle schools and 32% in high schools. The following year student/instructional computer ratios declined again by 10% in elementary schools, 5% in junior high/middle schools, and 22% in high schools.

Although these data do not describe whether schools spent their ETI funds on other types of technology besides computers, they would seem to suggest that since ETI allocations to schools were not substantially reduced following the 1990-1991 academic year, schools spent these funds in other ways than by acquiring microcomputers. These could include the purchase of computer peripherals such as printers, modems, or projection devices as well as providing staff training or installing network wiring.

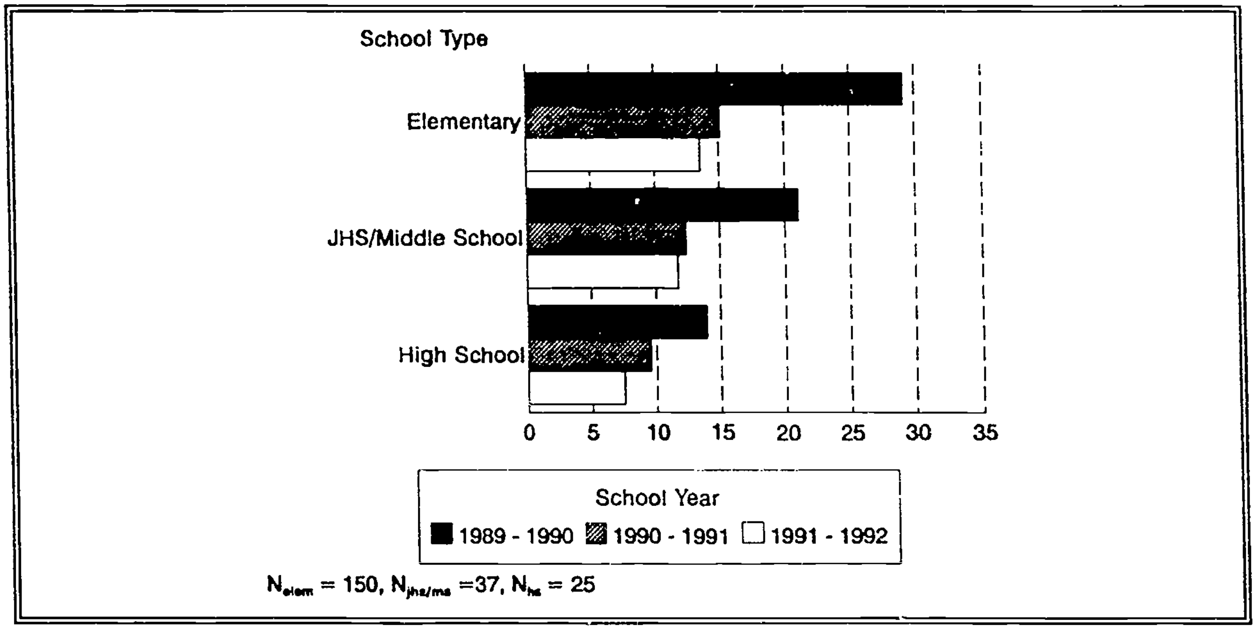


Figure 4.4: Student/Instructional Computer Ratios 1989-1992 by School Type

Computer Type and Location

The following results are based on a survey of 297 elementary schools, 78 junior high/middle school, and 47 high schools. These schools returned the 1992 ETI School Evaluation Questionnaire in 1992 and represent roughly 75% of Utah's elementary schools, 72% of the junior high/middle schools, and 48% of the high schools. Together, this sample comprises 64% of Utah schools. As a consequence were we to report raw numbers of computers found in schools underrepresent the actual number of existing computers. On the other hand, the relative proportions of different types of computers should be more accurate, as long as we can assume that these 522 schools are representative of the remaining Utah schools. This seems a reasonable assumption, and in the discussion that follows, we wish to focus attention on the relative proportion of different types of computers found at different locations in the school.[3]

The relative distribution of different types of computers in elementary schools during the 1991-1992 school year is found on Figure 4.5. MS DOS (IBM compatible) computers are represented by a dark, patterned bar. Apple computers (including the Apple II, Apple Iie, and Apple Iigs) are represented by a gray, patterned bar. Macintosh computers are represented by a white bar, and other types of computers are displayed as a black bar.

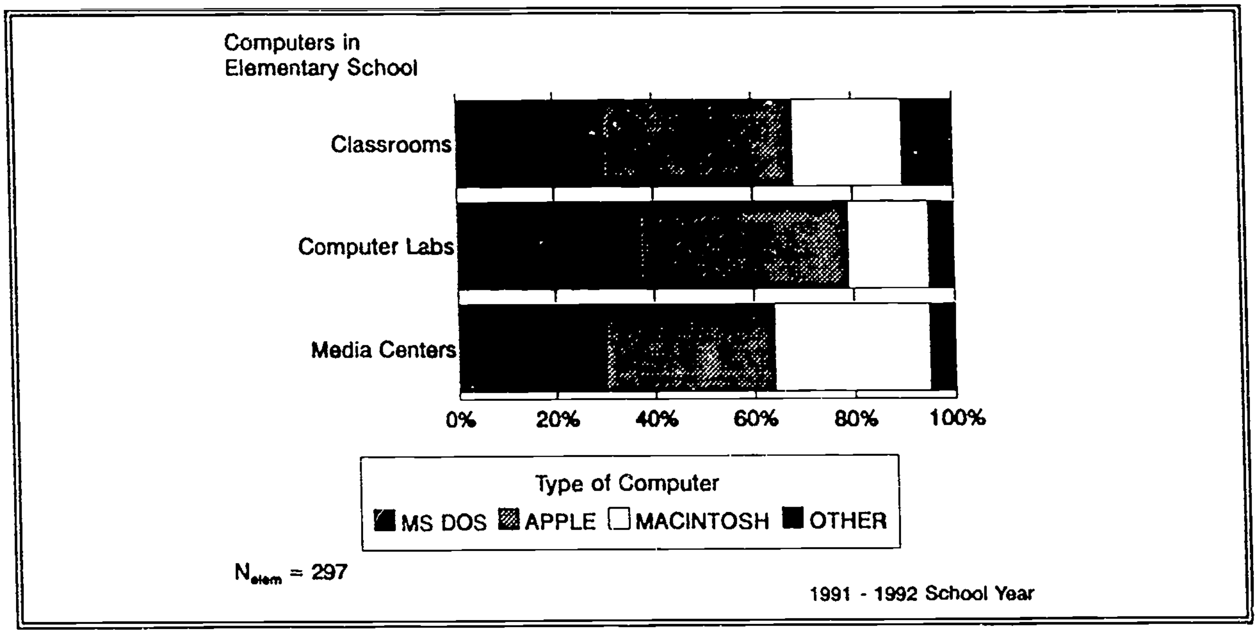
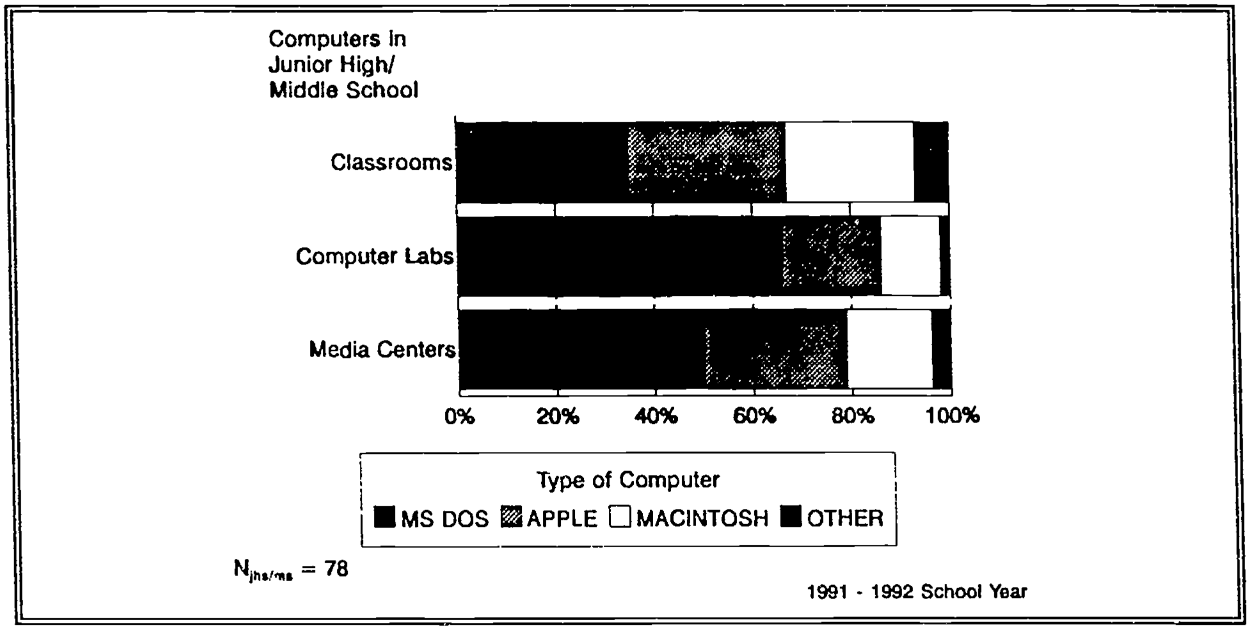


Figure 4.5: Percent of Different Types of Computers in Elementary Schools

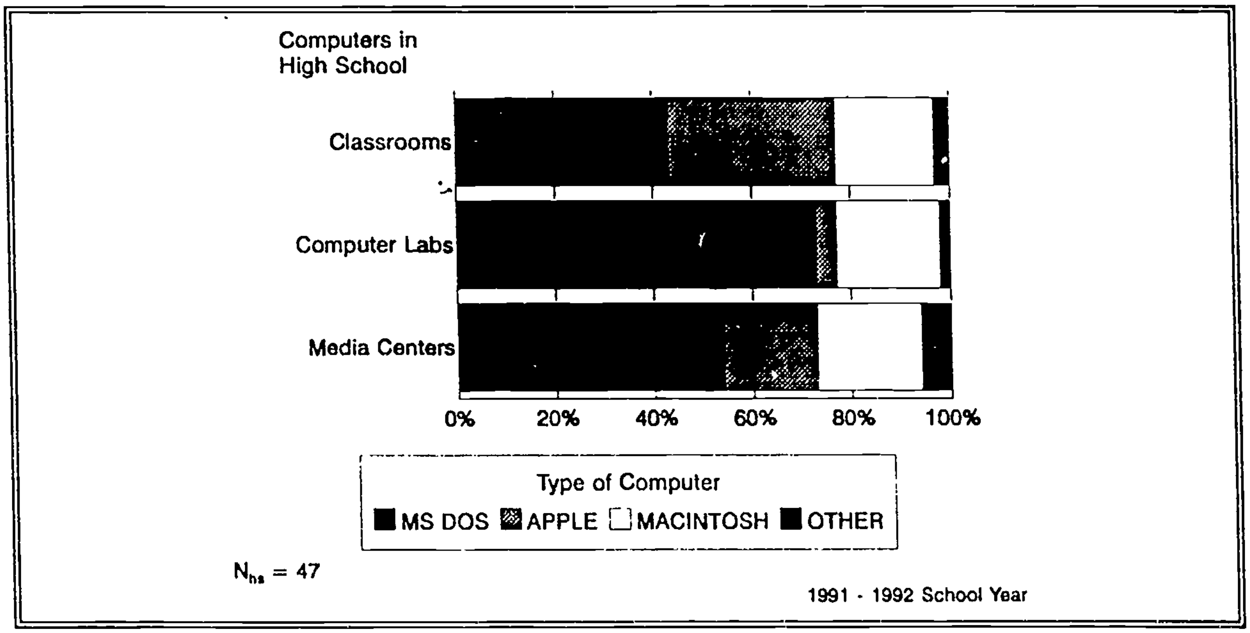
In elementary schools, Apple computers are the most common type of computer found in classrooms, computer labs, and media centers. In fact, over one-third of all computers in the elementary schools in our sample were reported to be Apples. IBM compatible, or "MS DOS" machines are the next most common type of machine in both classrooms and computer labs. Macintosh machines are next most common in both the classroom and the computer lab and have roughly equal popularity with Apple and MS DOS computers in media centers. Machines made by other manufacturers (Commodore, Amiga, Franklin, etc.) are seen the least, and make up less than 8 percent of the computers found in elementary schools.

A different pattern of computer usage is found in junior high/middle schools and displayed on Figure 4.6. Once again, we use the convention of a dark, patterned bar for MS DOS machines, a gray, patterned bar for Apples, a white bar for Macintosh computers, and a black bar for computers made by other manufacturers. In junior high/middle schools, MS DOS machines are slightly predominant in the classroom when compared to both Apple and Macintosh computers. In the computer lab, however, it is a different story. There are nearly four times as many MS DOS computers as Apple computers, and over 5 times as many MS DOS machines as Macintosh computers in high school computer labs. In the media center, MS DOS machines are also in the majority, making up 50% of all computers.



$N_{jhs/ms} = 78$

Figure 4.6: Percent of Different Types of Computers in Junior High/Middle Schools



$N_{hs} = 47$

Figure 4.7: Percent of Different Types of Computers in High Schools

In high schools, a pattern of computer use similar to that found in junior high/middle schools is found. This is displayed on figure 4.7 using the same graphical conventions. There are slightly more MS DOS computers than Apple computers in high school classrooms, while Macintosh computers make up roughly 25% of the computers found in these classrooms. In high school computer labs, we find very few Apple computers. In contrast, MS DOS machines are extremely common, representing over 70% of the installed computers. Macintosh computers represent less than 20% of the machines currently found in high school computer labs. MS DOS machines are also more frequently found in media centers, with about twice as many MS DOS computers as Apple or Macintosh machines.

Summary

During the 1990-91 and the 1991-92 school years, the typical Utah school used ETI funds to add computers to classrooms, computer labs and the media center. Although there was wide variation from school to school, the general pattern was to enlarge the average elementary computer lab to 26 stations, the average junior high/middle school computer lab to 44 stations, and the average high school computer lab to 85 stations. Additional computers were also placed in teachers' classrooms, most notably during the 1991-92 school year. At the beginning of the 1992-1993 school year, the typical elementary school had 16 classroom computers, the typical junior high/middle school had 31 classroom computers, and the typical high school had 60 classroom computers. As a result of the increasing availability of instructional computers in Utah schools, the average student/computer ratio has declined markedly in all school types. During the 1989-90 school year, 29 elementary students shared each computer as did 21 junior high/middle school students, and 14 high school students. At the beginning of the 1992-93 school year, those ratios had dropped to 14 elementary students, 12 junior high/middle school students, and 7 high school students sharing a single computer. In elementary schools, Apple computers were found most frequently, followed by MS DOS machines and Macintosh computers. In both junior high/middle and high schools MS DOS machines were predominant followed by Apple and Macintosh computers.

Endnotes

1 We are aware the "typical" school does not exist, and rural schools are often vastly different than urban schools. Two qualifications should be made regarding our portrait of the computers available at an typical school. First, there is clearly a great deal of variation among schools. This is shown by the large standard deviations relative to the means in the table below. Second, since the majority of Utah students attend schools in urban and suburban areas, the average school we portray will look more like an urban or suburban school than a rural school.

	Classroom Computers		Computer Lab Computers		Media Center Computers	
	M	*SD*	*M*	*SD*	*M*	*SD*
Elementary Schools (N=150)						
1989-1990	5.39	6.75	14.05	11.10	1.04	1.82
1990-1991	11.66	18.11	27.12	15.51	1.52	2.35
1991-1992	16.07	18.81	26.11	13.26	2.76	5.30
Junior High/ Middle Schools (N=37)						
1989-1990	13.76	17.07	27.93	17.03	1.51	1.61
1990-1991	22.76	25.94	48.41	26.69	3.35	6.66
1991-1992	31.16	19.79	44.24	24.56	4.41	3.70
High Schools (N=25)						
1989-1990	14.40	13.96	60.04	37.40	1.80	2.89
1990-1991	22.96	17.95	86.68	58.98	3.68	4.23
1991-1992	59.84	32.42	85.08	53.60	6.72	5.20

2 The actual student/instructional computer ratios represented on Figure 4.4 appears below.

	N	Student/Instructional Computer Ratio		
		1989-1990	1990-1991	1991-1992
Elementary Schools	150	29.18	15.08	13.55
Junior High/ Middle Schools	37	21.01	12.40	11.78
High Schools	25	13.97	9.56	7.49

3 Actual numbers and percentages of computers found at different locations in our sample of 522 schools can be found in the following table.

	Classroom		Computer Lab		Media Center		
	N	%	*N*	%	*N*	%	Total *N*
Elementary Schools (N=297)							
MS DOS	1,495	30	3,083	37	280	30	4,858
Apple	1,888	38	3,523	42	312	34	5,723
Macintosh	1,079	22	1,375	16	283	31	2,737
Other	530	10	451	5	53	5	1,034
Total	4,992		8,432		928		14,352
Junior High/Middle Schools (N=78)							
MS DOS	876	35	1,958	66	208	50	3,042
Apple	800	32	590	20	121	29	1,511
Macintosh	655	26	356	12	73	17	1,084
Other	159	7	80	2	18	4	257
Total	2,490		2,984		420		5,894
High Schools (N=32)							
MS DOS	1,240	43	3,233	73	171	54	4,664
Apple	987	34	195	4	59	19	1,241
Macintosh	575	20	913	21	66	21	1,554
Other	88	3	90	2	23	7	201
Total	2,890		4,431		319		7,640
Grand Total	10,372		15,847		1,667		27,886

Note: Percents may not sum to 100 because of rounding errors.

Chapter 5

Feedback and Networking Meetings

Chapter 5

Feedback and Networking Meetings

Introduction

To maximize the usefulness of the ETI Evaluation to the administrators and ETI Coordinators in Utah school district, three Feedback and Networking Meetings were held during the final week of October, 1992. The first meeting was held on October 26 at the Box Elder School District Office, and was attended by representatives from Box Elder, Cache, and Weber school districts. Another meeting was held on October 27 at the Alpine School District Office, and brought together teachers and administrators from Alpine, Nebo, and Provo school districts. The final meeting was held on October 29 at the Hila B. Jones Center, and was attended by representatives from Davis, Granite, Jordan, Murray, Tooele, and Salt Lake City School Districts.

The importance of these meetings cannot be over emphasized. Often large-scale evaluations commissioned by a legislature and which focus on statewide concerns do not include issuers identified as priorities by practitioners in the field. Yet it is these individuals who are in a position to fine-tune program operations. The comments in this chapter represent the views of teachers, administrators and support staff from thirteen school districts in Utah regarding the problems they have faced and the solutions they envision as they work to implement Utah's Educational Technology Initiative in their own schools and districts.

Summary of the Meetings

The agenda of each meeting was divided into four parts. During the first part, Dr. Trish Stoddart, Co-Director of the Educational Technology Initiative Evaluation, presented an overview of statewide results from the initial year of the ETI evaluation. She discussed the following topics:

- Student computer use during the 1989 - 1990, 1990 - 1991, and 1991 - 1992 school years;
- Computer use by elementary and secondary teachers for writing, reading, and mathematics instruction;
- Computer use by teachers in classroom vs laboratory settings;

- Percent of elementary and secondary teachers using computers for different instructional goals and purposes;

- Amount of ETI inservice received by elementary and secondary teachers.

To make these statewide findings more meaningful, we provided each school district with a set of tables displaying results for their district. (An example of these tables appears in Appendix B.)

In the second part of the meetings, Dr. Carolyn Horan, Executive Director of the Beryl Buck Institute for Education, led a brainstorm and discussion of the problems school districts had experienced while implementing ETI projects.

Summary of Participants' Concerns

To give a flavor of individuals' concerns, we have summarized their comments by topic below.

Inservice

— We need an overall vision to create teacher awareness and get teacher "Buy in." We are trying to play one tune and we're using 100 different sheets of music.

— Time is the biggest problem -- we need time for instruction, time to practice and time to teach technology. You can't purchase computers without purchasing **TIME**. Time not available during contract hours, and teachers do not want to put in extra time.

— Money is an issue: Do we pay teachers for time spent training or for results/products they produce, or do we pay them to learn at all?

— Where we don't have access to adequate numbers of computers we have a training problem and an attitude problem -- people don't want to go to inservice if they can't practice or have easy access to the equipment.

— We need to identify legitimate curriculum needs.

— Inservice, hardware/software upgrades should not be made without an overall review of school needs. Inservice needs to be customized. We need to identify teacher needs and plan inservice around those needs so teachers will "buy in" to training and use of technology.

— We need to question the value of "one size fits all" type software. We should question the value and limitations of using software that is trying to address student or teacher needs just because it's on the market. We should analyze needs for teachers and students first and then direct inservice to legitimate curriculum needs. For example, inservice should emphasize specific grades or focus on student grade level needs.

— We need to look at differences between new staff (who bring vitality and have computer skills) and old staff (who don't want to change). We should weigh the effort against the return in training senior teachers who don't want to learn. We need to motivate people to become aware of training opportunities and want to learn new things.

— We need to increase communication between classroom teacher/lab teacher.

Software, Hardware, and Technical Support

— We need inservice on classroom management software such as attendance records and student tracking.

— We need to examine software programs and develop expertise in their use. Should we use "industry standard" software even if it's complex and hard to master or should we use easier "user friendly" programs that aren't "industry standard."

— We need frequent (sometimes on-going) inservice to upgrade hardware/software. We need help in solving problems around software and hardware needs, such as the need for multiple copies of program, license for LAN'S, or decisions on upgrading equipment and/or software. There should be coordination of software purchases and upgrades so there is compatibility across the school.

— We also need hardware and software upgrade dollars. This requires reviewing the needs of the overall school/district. Equipment issues are going to create obsoletion and repair problems.

— We need to analyze "overall costs" of software - i.e., cost of original program, preparation to use new software, training teachers, etc. before teaching students.

— Repair and replacement costs both money and time. What do you do with 30 students in a lab that doesn't work?

State Office of Education or ETI Project Office

— We are moving toward mastery learning -- State SIS system doesn't allow for flexibility away from letter grades. We need to interface with State mainframe to put data directly on State system electronically instead of "filling in bubbles."

- Reporting processes -- many reports need to be completed for State use that have data located at sites that is not readily available to districts where the reports are generated.

- We must avoid the sense that ETI is "completed" as it leads to a loss of administrative priority/support.

- ETI funds should be attached to an inservice plan; if there is no plan then funds should be withheld.

- Yearly shift in state office expectations for how ETI is used is a problem.

Colleges of Education

- There should be more emphasis on pre-service preparation. Teachers should graduate with experience with a variety of platforms. They should be able to do word processing, use grading programs and be familiar with software in their subject area.

Legislative Funding

- Legislative inservice is needed. Legislature gets us started and then bails out complaining that we were not productive. They need to stay the course. They have unrealistic expectations.

- Get special funding from legislature dedicated for inservice training.

- Some schools have not received funding yet -- so continued funding in some districts is a major issue. The full 60 million expected from ETI needs to be funded. Reduction of funding requires changing strategies and plans. The shortfall -- depending on size of the school -- could destroy the plan.

- Legislature needs to see real kids. How can we coordinate and get visits at schools from legislators?

- There should be equity in funding -- putting everybody on line versus having some super stars.

- ETI dollars should be used for curriculum leadership. For example, standardize textbooks, add software to curriculum. This is the ETI Director's responsibility.

- There should be flexibility in equalization of capital at legislative level (include technology in maintenance and operation costs.)

Vendors

— Need vendor support and pricing that give schools a break. Some districts get business industry support -- no pricing breaks for ETI - The vendors gave standard educators' price.

Once problems were aired, the discussion turned to their solution, and a variety of ideas were generated and considered during the third part of the Feedback and Networking meeting. Solutions included:

— Career ladder performance bonus -- technology could be a requirement.

— Plan inservice to meet individual needs and offer different training to create specialists. Determine competencies for classroom teachers, school specialists, media specialists, and district specialists.

— Conduct needs assessment on teacher needs for training preferences for learning (keep in mind teachers may want to learn in a way that best suits their style, i.e., read manual vs. have tutor).

  - Use building specialists for training.
  - Identify and apply uses of technology to get beyond drill and practice.
  - Have ongoing training in buildings.
  - Mandated participation.

— School specialists should be trained and available at each site:

  - Free up one-half day each week for training.
  - Trouble shooters trained and well versed in all technology used in the building.
  - Assist in curriculum integration.

— Reschedule so teachers who have skills have enough time to help others.

— Leadership (Principal) -- Administrators need to use technology well to be role models.

— Incentives: Offered by district -- (Lane change credit; as opposed to pay) Ideas to "sweeten the pot".

  - Offer teachers opportunity to take computers home.
  - Offer teachers computers as their own after so many hours inservice.
  - Cart set up to take the computer and other equipment to move into teacher's room for a period.
  - District provides inservice and instead of paying teachers they get equivalent in computer equipment.
  - Teachers that don't use the equipment, lose it. Getting new equipment would be the same story. If they don't demonstrate use, they don't demonstrate need.
  - Inservice provides each teacher with usable curriculum unit that they have completed by the time they leave the inservice.

— At elementary -- reschedule to allow for preparation time schemes that could be put in place.

— Increase communication (Lab manager <-> teacher)

— Break away from traditional ways of inservice.

— Train the trainers adequately for a broad base of knowledge.

— Provide inservice credit. Pay teachers to learn.

— Tie $ from ETI to inservice plans to be carried out by the districts.

— Get ETI $ to create curriculum.

— Change contract year. Add days for training or more flexibility.

— Develop and implement new assessment systems to show increased student learning.

— Plan inservice at various times: After school (1-1/2 hr.); Saturday 10 - 4; Summer - best.

— Funds for substitutes so teachers can break away to participate in networks.

— Have inservice that shows teachers how the technology aids their own instruction.

— Use contract/career ladder days for training.

— Have teachers visit each other by request for training.

Finally, during the fourth part of the meeting, participants were given the opportunity to give a word of written advice to Vicky Dahn as she began her job as ETI Project Director. A summary of these comments appear below.

— Help legislature understand the importance of continuing funding. Great inequities exist between schools and districts.

— Please take a look at the library media specialist as a pivotal person for inservice and developing strategies to implement technology in enhancing curriculum in all areas. You cannot have technology without human resources to strategize and implement and train -- the LMS is a logical place to start.

— Good luck -- Don't hesitate to ask ETI Coordinators for assistance.

— Implement technology (training) outside contract school hours.

— Funds directed to districts should go to individual schools and schools should have more to say on how those funds are utilized.

— Business needs to be more involved in technology and education.

— We need teacher inservice.

— Provide vision -- a plan to follow for hardware, software, inservice, etc.

— Get out and talk to teachers in school.

— We need access to much more software for student use.

— Software needs to be used by teachers **without** hours and hours of pre-teaching preparation.

— Get firm commitment from legislators - long term funding.

— Availability of hardware and software only half of important access issue re: teacher capability, the other half is time for meaningful sustained learning.

— Work on plan to get on-going maintenance and replacement.

- Help us move away from standardized scores as primary measures of technology achievement.

- Teacher inservice needs to be connected directly with teacher needs and goals - immediately -- and not taught in isolation.

- Help us develop a better infrastructure which coordinates on-site technology to state technology. Example: interfacing micro-based grading programs to SIS.

- Teachers need an incentive of earning a computer for "x" amount of inservice hours and demonstrated competency.

- Help legislators understand we need ongoing funding.

Appendices

Appendix A

Utah Educational Technology Initiative (ETI) Evaluation 1992-1993 School Questionnaire

Utah Educational Technology Initiative (ETI) Evaluation

1992-1993 School Questionnaire

Evaluation Funded by the Utah State Office of Education

Purpose: The purpose of this questionnaire is to gather information about the implementation of the ETI Project at your school. Please have the person most knowledgeable about ETI complete it.

I. Introductory Information

School Name ______________________ District ______________ ______ - ______

Number of teachers and administrators ____________________ Phone ________________

1. Check the most appropriate description of your school:

a. Elementary . . . . ______

b. Junior High or Middle School . . . . ______

d. High School . . . . ______

e. Other (describe):______________________ . . . . ______

2. School enrollment on October 1, 1992 . . . . ______

3. Your position (check one)

Principal . . . . ______

Assistant Principal . . . . ______

Department Chair . . . . ______

ETI Coordinator . . . . ______

Teacher . . . . ______

Other (describe):______________________ . . . . ______

4. The ETI program has been developed through the influence of different people. Who has been the most influential in developing the ETI project at your school? Please circle one number at right.

a. A single teacher, department chair or computer coordinator 1

b. A group of teachers and other staff members 2

c. The school principal 3

d. Other administrators at the school 4

e. School district administrators 5

f. Parents 6

II. Software and Computers at Your school

5. Please list below in column #1 the 4 software programs most often used at your school. In column #2 please circle the subject(s) in which each program is used.

	Column # 1: Name of Software Program	Column # 2: Subject(s) Used In
a.	______________	Reading ● Writing ● Math ● Science ● Other
b.	______________	Reading ● Writing ● Math ● Science ● Other
c.	______________	Reading ● Writing ● Math ● Science ● Other
d.	______________	Reading ● Writing ● Math ● Science ● Other

6. In October 1992, how many of the following types of computers did you have in your school? (All computers must be functional.) Where were they located? Please use the columns labeled "Classroom," "Lab," and "Media Center/Library" to record the appropriate number of each type of computer.

		Classroom		Lab		Media Center/ Library		Total
a.	MS DOS (PC compatible)	______	+	______	+	______	=	______
b.	Apple II	______	+	______	+	______	=	______
c.	Macintosh	______	+	______	+	______	=	______
d.	Other:______________	______	+	______	+	______	=	______
	Grand Total:	______	+	______	+	______	=	______

7. In October 1992, how many of the technology types listed below did you have in your school? Please write the number of units available in each of the following locations in the appropriate columns below.

		Classroom		Lab		Media Center/ Library		Total
a.	Modems	______	+	______	+	______	=	______
b.	LCD Plates	______	+	______	+	______	=	______
c.	Videodisc players	______	+	______	+	______	=	______
d.	VCR's	______	+	______	+	______	=	______
e.	Calculators	______	+	______	+	______	=	______
f.	Graphing calculators	______	+	______	+	______	=	______
g.	Laser printers	______	+	______	+	______	=	______
h.	Dot matrix printers	______	+	______	+	______	=	______
i.	Science lab probes/sensors	______	+	______	+	______	=	______
j.	Scanners	______	+	______	+	______	=	______

III. Staff Capability and Development

8. How important do you think it is for teachers in your school to have the following types of technology training? Please use the scale below. Write your answers on the lines at the right.

1 Not Important at All	2 Somewhat Important	3 Important	4 Very Important	5 Essential

a. Understanding how computers work .... ________

b. Using instructional software with their students .... ________

c. Developing instructional software with their students .... ________

d. Using the computer as a professional tool (to make handouts and tests, for grading, etc.) .... ________

e. Teaching students how to do simple programming .... ________

f. Evaluating software so they can make decisions about instructional use .... ________

9. What percentage of teachers in the school regularly use technology in their instruction? Please circle one response.

Less than 10%   10-29%   30-49%   50-59%   Over 70%

10. What percentage of teachers and administrators in your school, including yourseif, are novice computer users, competent users or expert users in the following areas? (Novice users are still mastering the basics. Competent users rarely make mistakes. Expert users can teach others.)

	Novice		Competent		Expert		
a. Using drill and practice programs with students	____ %	+	____ %	+	____ %	=	100%
b. Using open-ended, tool-based exploration programs with students	____ %	+	____ %	+	____ %	=	100%
c. Using one or two instructional programs with at least one type of computer.	____ %	+	____ %	+	____ %	=	100%
d. Knowing about a wide variety of instructional computer programs useful to teaching	____ %	+	____ %	+	____ %	=	100%
e. Using word-processing, record-keeping or similar professional tools	____ %	+	____ %	+	____ %	=	100%
f. Writing instructional programs in a computer-programming language	____ %	+	____ %	+	____ %	=	100%
g. Using technology (LCD plates, laserdiscs, etc.) for instructional presentations	____ %	+	____ %	+	____ %	=	100%
h. Using computerized information systems and communication networks	____ %	+	____ %	+	____ %	=	100%

11. How many teachers and administrators at your school participated in technology inservice during the 1991-1992 school year . . . . ________

12. How many teachers or administrators have been given a reduced teaching load or summer salary to develop curricula or course materials related to using technology . . . . ________

13. The problems listed below have been mentioned by administrators and teachers as difficulties experienced during the implementation of ETI projects. Please check all of the problems that occurred at your school.

a. Limited funds for staff development . . . . ________

b. Teachers' lack of skill/expertise in technology . . . . ________

c. Limited physical space . . . . ________

d. Lack of technical support for installation and setup . . . . ________

e. Software did not cover the content in the Core Curriculum . . . . ________

f. Software was difficult for students to learn to use . . . . ________

g. Teachers were frightened of the technology . . . . ________

h. Vendors did not provide adequate support . . . . ________

i. Equipment malfunctions . . . . ________

14. Using the letters to the left of the above list of problems, please write the letters of the two problems that posed the most difficulties for your school on the lines at right.

Constraint # 1 . . . . ________

Constraint # 2 . . . . ________

Thank you for your help!

Appendix B

Alpine School District
1991-1992 ETI Evaluation Feedback

Alpine School District
1991-1992 ETI Evaluation Feedback

Introduction: The following pages report information received from elementary and secondary teachers in your district who were actively involved in the Educational Technology Initiative. The following tables display computer use by students and teachers as well as the ETI inservice Alpine teachers received.

Grade Level	Academic Year		
	1989-1990	1990-1991	1991-1992
Elementary	1.15	1.58	2.05
Secondary	3.78	5.70	7.45

(Data from 28 Elementary Teachers and 25 Secondary Teachers.)

Table 1: Hours Per Week of Computer Use by Elementary and Secondary Students in Alpine School District from 1989-1992.

Grade Level	Subject Area		
	Writing	Reading	Math
Elementary	57%	43%	46%
Secondary	48%	4%	32%

(Data from 10 Elementary Teachers and 25 Secondary Teachers.)

Table 2: Percent of Alpine Elementary and Secondary Teachers Using Computers for Instruction in Different Subject Areas During the 1991-1992 School year

Grade Level	Percent of Teachers Using Computers in: Labs	Classrooms
Elementary		
K-2	57%	71%
3-4	100%	75%
5-6	92%	62%
Secondary		
7-8	ND%	ND%
9-10	85%	77%
11-12	67%	67%

(Data from 36 K-2 Teachers, 36 3-4 Teachers, 36 5-6 Teachers, ND 7-8 Teachers, 13 9-10 Teachers, and 9 11-12 Teachers)

Table 3: Percent of Alpine Elementary and Secondary Teachers Using Computers in Laboratory and Classroom Settings During the 1991-1992 School Year

Instructional Purpose	Grade Level	
	Elementary	Secondary
Teacher Curriculum	54%	68%
Games	61%	32%
Word Processing	75%	80%
Grading	79%	76%
Reward	50%	24%
Testing	39%	52%
Simulations	36%	24%
Visual Presentations	18%	36%
Telecommunications	14%	32%

(Data from 28 Elementary Teachers and 25 Secondary Teachers.)

Table 4: Percent of Alpine Elementary and Secondary Teachers Using Computers for Different Instructional Purposes During the 1991-1992 School Year.

Instructional Goal	Grade Level	
	Elementary	Secondary
Drill and Practice	57%	60%
Enrichment	68%	64%
Review and Remediation	57%	36%
Higher Order Thinking	64%	48%
Creativity Enhancement	61%	60%
Concept Introduction	32%	56%

(Data from 28 Elementary Teachers and 25 Secondary Teachers.)

Table 5: Percent of Alpine Elementary and Secondary Teachers Using Computers for Different Instructional Goals During the 1991-1992 School Year

Amount of Inservice	Grade Level	
	Elementary	Secondary
None	15%	44%
3 hours or less	39%	8%
3 to 10 hours	19%	40%
More than 10 hours	23%	8%

(Data provided by 26 Elementary Teachers and 25 Secondary Teachers.)

Table 6: Percent of Alpine Elementary and Secondary Teachers
Receiving Different Amounts of ETI Inservice
During the 1990-1991 School year