Effect of Improved Access to Technology on Instruction in Rural East Texas as Perceived by Academic Instructors

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The No Child Left Behind Act provided unprecedented educational reform focused on reducing academic achievement disparities. It provided funding for technology and training to improve academic instruction. A literature review was conducted to determine what impact increased access to technology had on instruction. This study examined the effect access to technology had on instructional format in East Texas. An increase in access to, utilization and incorporation of technology into instructional format and setting was indicated.

Keywords: Training and development, Technology, Instructional design

Problem Statement

Educational institutions, at all levels, find themselves faced with the difficult task of preparing students to participate productively in a society that is becoming ever more complex and changing at an ever increasing pace. Whether they are students in the primary and secondary school, leaving college and entering the world of work, or participating in continuing education for their trade or profession, the educational process is preparing them for an environment that is, on many levels, increasingly competitive. The education community faces many challenges. Some of these include, limited budgets, requirements to improve performance, class sizes, time constraints, and steadily increasing demands by state and federal agencies and employers. In order to deal with these challenges and to maximize the effectiveness of instruction, every potential resource must be exploited.

The problem in this study was to determine the effects of increasing access to and availability of technology for improving instruction in academic programs.

Theoretical Framework

Access to computing/information technology in academic programs helps to build the technological acumen of our leaders of tomorrow in government, business, and industry. Therefore, it is imperative that we evaluate the implications of such resources in instructional settings and their relationship to human resource development (HRD). Swanson & Holton (2001) state "The discussion of the role of technology in HRD can be thought of in terms of strategies in the full use of technology (or high-tech) and the human need for personal connection (or high-touch)" (p. 382). Swanson & Holton (2001) additionally explain that "Technology in the twenty-first century includes technology versus touch, sources of HRD expertise, and ownership of HRD" (p. 382-383). Historically HRD has been a low-tech field of human involvement. Swanson & Holton cite Rossett & Sheldon (2001) as follows:

> The twenty-first-century challenge for HRD is to be engaged in high-tech means of developing and unleashing human expertise coming from the demand to do HRD work better, faster, and cheaper. It is easy to imagine computers, the Internet, information technology, and artificial intelligence at the center of this high-tech challenge (2001, p. 383).

Luskin (2002) emphasizes the following:

> The 2001 Web Commission of the United States Congress strongly urges greater acknowledgement of the importance of the learning continuum from kindergarten throughout our entire lives. The commission underlines the importance of early learning as fundamental to individual personal development and later life accomplishments. The lack of basic workforce education and skills plaguing employers will not be resolved in the long term unless addressed in the present. The key to competitive success and advantages for both individuals and companies in the twenty-first century is early learning.

> Kindergarten through lifelong learning is important as early learning is necessary for intellectual, emotional, and social growth. Early learning is a key to developing basic skills for the workforce of the future (2002, p. 157-160).

McLean (2004, p. 271) cites (McLean, 2001; Ruona & Roth, 2000) "A question that is widely asked within human resource development is: What is HRD?" McLean further cites his earlier work (McLean, 2001, p. 229) stating "It is a very complex issue" (McLean, 2004, p. 271). McLean cites "Weinberger (1998) explored many definitions extant in the United States, concluding that there is no common agreement as to its definition" (2004, pl 271). It appears that this citation continues to hold true today. The following paragraphs include summaries of some of the definitions which have been explored over the years.

Gilley, Eggland, and Maycunich define HRD as "a dynamic and evolving practice used to enhance organizational effectiveness" (2002, p. 2). "Human resources refer to the people employed by an organization" (Gilley, 2002, p. 5). Gilley further writes, "Development of people refers to the advancement of knowledge, skills, and competencies for the purpose of improving performance within an organization (2002, p. 5).

Swanson cites Chalofsky (1983) as writing "The discipline of HRD is the study of how individuals and groups in organizations change through learning" (Swanson, 2001, p. 5). Craig (1976) writes, "HRD focus is on the central goal of developing human potential in every aspect of livelong learning" (Swanson, 2001, p. 4). McLagan (1989, p. 7) defines HRD as "The integrated use of training and development, career development and organizational development to improve individual and organizational effectiveness."

Swanson & Holton define HRD as a "process of developing and unleashing human expertise for the purpose of improving performance" (2001, p. 385). Luskin cites Jeanne Meister, a corporate university expert, in her discussion "Changes are taking place in the American education market place. The business community recognizes that it is suffering more than ever before from the early learning inadequacies and their residual effects manifested by the limited educational proficiencies of young people and workforce training" (2003, p. 159). "The articulated link between early learning, education and workforce training presents an interesting correlation" (Luskin, 2003, p. 159).

The references cited reflect the importance of technology and how it will be a vital element in the HRD research for the twenty-first century. Therefore, implementation of technology at all instructional levels will play a major role in the integration of technology into our existing and future population. Failure of this implementation and integration of a technology driven infrastructure in educational settings across the continuum of education hinders educational proficiencies thus creates many additional challenges for workforce training in the HRD field.

Assessing computer efficacy in instructional format is difficult because researchers sometimes lack a clear focus. Past research studied outcomes in a variety of methodologies that inhibit comparisons, and the assumptions made conflict, regarding instructors' role in computer-assisted learning. The majority of studies focused on computer-managed instruction (CMI) and computer-assisted instruction (CAI) which de-emphasize instructors' roles in helping participants' learn. Computer-enhanced instruction (CEI) considers the instructor essential to the learning process but has been rarely studied (Kirkpatrick & Cuban, 1998).

Potential advantages of utilizing computing technology include: systematically planned curriculum, immediate feedback, increased personal attention, improved student engagement and motivation, and access to enormous databases, spreadsheets and graphics programs (Kirkpatrick & Cuban, 1998).

In developing curriculum materials, publishers cannot assume that sufficient numbers of computers are available. So computer activities are frequently viewed as supplemental. Therefore, HRD must address the need for professional development, training, technical support, sufficient allocation of hardware and software, instructional setting management and curriculum integration before there can be a substantial rate of return on their technological investment. Goals and best practices define how computers should be implemented in the instructional setting. Curriculum objectives are broadened by including problem solving, inquiry, project-based learning and collaborative work. Technological skills are improved through web searches, use of word processors to prepare reports and presentations, databases, graphic tools and multimedia presentation software. Computers strengthen instructors' preferred instructional methods enabling them to better incorporate visual support for lectures, add simulations, analysis and virtual experiments with software (Kleiman, 2000).

Technology–enhanced instructional settings have a different culture and expectation than traditional instructional settings. Researchers of the long-term Apple Classroom of Tomorrow (ACOT) study identified five stages of instructional evolution: entry, adoption, adaptation, appropriation, and intervention. As instructors progress through these stages significant professional development, training, and support is needed. There is a central tendency to exaggerate the potential that computer technology has to enhance teaching and learning without recognizing the complex, multifaceted task of turning that potential into reality through carefully planned, long-term administrative commitments (Kleiman, 2000).

The ACOT study indicated use of computer technology resulted in new learning experiences requiring higher level reasoning and problem solving, positively impacted participant attitudes and changed teacher methodology from lecture format to more cooperative group work (Schacter, 1999).

A ten-year study was conducted by Professor Dale Mann of the Teachers College at Columbia University and Professor Charol Shakeshaft of Hofstra University assessing the effectiveness of implementing technology in education. Of the West Virginia instructors surveyed, 48% saw technology as the key reform to achieving higher scores. The Milken Exchange study "Technology Counts 98" reported in *Education Week* (October, 1998) higher scores in problem-solving and critical thinking were directly linked to computer use when implemented by trained instructors. The two studies indicate that implementation of learning technology can improve critical and creative thinking skills (Mann & Shakeshaft, 1998).

The No Child Left Behind Act (NCLB) of 2001 gives historic educational reform opportunities based on four pillars: stronger accountability for results, more freedom for states and communities, proven education methods, and more choices for parents. States are held accountable to close the achievement gap ensuring all students, regardless of socioeconomic status or other disadvantages, achieve academic proficiency. Progress is monitored and if deficient, the school is required to implement corrective measures. An unprecedented flexibility is given states and schools in the use of federal funds to fulfill their specific needs. Grant funds can be utilized for acquisition of technology to improve academic instruction, teacher training and development. Rigorous scientific research is the basis for determining which educational programs and practices have been proven effective. Federal funding is provided to support programs and instructional methods that work to improve learning and achievement. The NCLB Act increased education funding for Texas to over 7.6 billion dollars, increased Title 1 funding to 1.2 billion dollars, and provided 273.7 million dollars for reading grants for the 2005 budget year (No Child Left Behind Act of 2001).

The purpose of the grant in this study was to increase the availability of and access to computing resources and infrastructure. This was to be accomplished through the placement of mobile computer labs in the classrooms where core academic subjects were taught. If the technology was in fact, made available through the grant, did the teachers in these core academic areas in fact utilize it? And, if so, to what degree was the technology utilized? All too often, when new technology is introduced into an environment, resistance is encountered. Such resistance may, or may not be overt. But, it frequently prevents a project from realizing its full potential. Did the availability of and access to increased levels of technology in the classroom have an impact on the instructional format utilized by the teachers? If so, in what way and to what extent was the technology utilized?

The research questions were derived from the goals dictated as evaluation criteria for the grant. These research questions were deemed necessary to adequately assess whether the goals of the grant were accomplished sufficient to support continued grant funding for the following years of the grant. The research questions posed are as follows:

Research Question

1. Did instructor access to technology increase due to resources provided through the grant?

2. Did instructors utilize technology when it was made available?

3. What effect did technology have on instructional format in the core areas?

Methods and Procedures

The methodology was dictated by assessment of success goals delineated in the grant through the Texas Education Agency for Technology Applications Readiness Grants for Empowering Texas (TARGET) implemented to improve student academic achievement. Assumption No. 1: Access to technology will increase due to the resources provided through the grant. Assumption No. 2: Instructors will utilize technology when it is made available. Assumption No. 3: Technology will have a positive or improved effect on instructional format in the core subject areas. Assumption No. 4: Instructors responded candidly and without bias. This research covers the first year of a three-year grant study. The grant provided funding for purchases of infrastructure technology to provide instructors and participants with access to technology that could be used in a variety of locations to meet academic achievement needs and help instructors integrate technology into curriculum and instruction. Included in this purchase was infrastructure technology notebook computers, computer projectors, and printers. Scanners were funded to provide instructors with the ability to scan, score and disaggregate participant performance data and plan for the individual's and subpopulations' needs. These scanners will be used to identify shortfalls in instruction. Nine mobile notebook computer storage cabinets and wireless Internet connectivity hardware were funded to provide portability.

The purchased equipment was configured into nine mobile computer labs. The portable labs were equipped with twelve notebook style computers with wireless Internet capability. The computers utilized Microsoft Windows® operating system and other standard connectivity software. A notebook from the above purchases was provided to each trainer and the project coordinator.

The grant additionally funded general supplies, such as paper, photocopying, pens, notebooks, CD-ROM disks, and diskettes, various software for the computers labs, and books for staff development. (TARGET grant, 2002-2003)

The study examined the effects of introducing the additional technical/computing resources into the instructional setting including resulting changes to instructional processes and infrastructure. To this end, several instruments and data sources were utilized. The study employed both quantitative and qualitative techniques, included surveys, open ended questions and curriculum units. The open ended questions were evaluated as positive or negative.

Participants

The school districts chosen to participate in the grant were randomly selected from area school districts that fell within the guidelines specified in TARGET grant for community population size and student body size in potential participating schools. Within each selected school district, a stratified sample of instructors was selected by administrators and grant mentors. The population from which the sample was selected included instructors whose primary responsibilities involved teaching in the core subject areas specified in the grant. The sample for the study consisted of forty instructors.

Instrumentation

An existing survey instrument was utilized. The instrument was used with permission of the Texas Center for Educational Research. The instrument was developed by the Texas Center for Educational Research and was utilized in their Technology Integration in Education Initiative (TIE) statewide survey report (Texas Center for Educational Research, 2003). “In the TIE statewide survey report the survey instrument requested comprehensive information around the four areas of the state’s long-range plan for technology” (Technology Integration in Education Initiative, 2002, p. 3).

The instrument was utilized for pre and post instructor evaluation of the integration of technology into the curriculum.

Surveys contained 85 items, including demographic information, quantities of specific resources available, four- and six-point Likert scale questions as well as open-ended interview questions. Of the 85 items on the survey, 18 Likert scale questions were identified as providing specific measures of the use/effect of technology in the instructional setting. Responses to these questions are summarized in Tables 1 and 3 in the Results section. The surveys were administered in the fall of the year (n = 36) and again in the spring of the next year (n = 36). The results were compared to determine whether there had been a change in the use and/or effects of technology during the year.

Surveys included open-ended questions to measure utilization of technology in the instructional process and barriers to such utilization. The questions addressed (1) improvement in the use of technology in developing lesson plans; (2) integration of technology into the curriculum; and (3) utilization of technology in lessons.

Instructors were provided with an instructional unit template. This template served as a guide for the creation of instructional unit plans. The instructors were expected to submit instructional unit periodically for units one through eight by January of the evaluation year. The purpose of the instructional unit plans was to document utilization of technology in the curriculum. This provided a vehicle by which increases in such utilization could be quantified and measured.

Procedures/Treatment

Pre surveys were delivered to participants during the Fall 2003. The surveys were completed and interview data collected, compiled, and evaluated. Post surveys were conducted in the same manner during the Spring 2004.

The pre and post surveys were hand scored and the data entered into a spreadsheet for convenience of processing since spreadsheet software is readily available. Following the entry of the data into spreadsheets, they were transferred to SPSS for analysis.

All responses to open-ended survey questions were reviewed by the researchers and grouped into five categories. The responses were then evaluated as either positive or negative. The results were entered into an Excel® spreadsheet for sorting and summarization. See Table 2 for categories and results.

Measures of central tendencies, including mean, standard deviation, and variance, were computed for pre- and post counts reflecting instructor access to resources in twelve resource categories (see table 1). These same measures were performed on six items related to instructor use of available resources (see table 3). In addition, t-tests, at .05 level were performed on all eighteen of the previous data items.

Limitations

The study was limited to thirty-six instructors in nine rural East Texas schools. These limitations were dictated by the guidelines set forth in the grant.

Results

Within the framework of the three research questions, the results of the study showed that measurable improvements were realized from increasing access to and availability of technology in the instructional setting. As a matter of candor, the researchers acknowledge that self report data may be open to bias if there is a perceived benefit, such as continued availability of the technology resources in the classroom. In the absence of evidence to indicate such bias, it must be assumed that the instructors participating in the study provided honest and well considered answers.

In response to **Research Question 1,**

Did instructor perception of access to technology increase, due to resources provided through the grant?

The results showed that instructor access to technology showed increases that were significant ($p<.05$) in 10 of the 12 categories measured, due to resources provided through the grant. Increases in 2 resource categories, Computer Labs and Distributed Learning, were not significant. (See Table 1 below)

Table 1. *Instructor Access to Technology Resources*

	Pre Survey			Post Survey					
	Mean	N	Std. Deviation	Mean	N	Std. Deviation	Change	t	Sig.
Desktop Computers	3.92	36	10.391	4.94	35	10.57	1.03	3.578	p<.05
Laptop Computers	0.42	31	0.720	1.25	32	2.05	0.83	4.204	p<.05
Printers	0.80	35	0.677	0.85	33	0.71	0.05	9.845	p<.05
Internet Drops	4.26	35	10.481	4.71	34	10.41	0.45	3.587	p<.05
Laptop Carts	0.48	33	1.938	1.63	32	3.36	1.14	3.046	p<.05
Projector	0.76	33	0.614	1.03	33	0.92	0.27	9.228	p<.05
Scanner	0.32	31	0.832	0.44	32	0.88	0.11	3.555	p<.05
Digital Camera	0.16	31	0.374	0.32	31	0.65	0.16	3.570	p<.05
Graphing Calculator	1.31	29	4.607	6.81	31	13.30	5.50	3.098	p<.05
Smart Board	0.10	30	0.305	0.13	31	0.34	0.03	2.789	p<.05
Computer Lab	0.50	14	0.855	2.36	11	7.51	1.86	1.325	ns *
Distributed Learning	0.21	14	0.426	1.20	10	3.79	0.99	1.252	ns *

* - not significant at .05

Furthermore, as indicated in Table 2 below, there was significant reduction in instructors' perception of barriers to the use of technology in the instructional setting. Prior to the grant's provision of laptop computers and technological training, more than half the instructors perceived the need for more computers and a third perceived the need for more technological training. The additional computers and training provided by the grant reduced the instructors' perception of need for more computers by more than half and for more training by almost two-thirds. Barriers to incorporating technology into instructional format and setting were reduced, resulting in increased satisfaction of 37 percent with integration of technology into curriculum and instructors' personal proficiency. The instructors' perception of the grant's positive impact on the integration of technology into curriculum and personal proficiency increased 27 percent.

Table 2. *Comparison of Pre and Post Instructors' Perception of Barriers to use of Technology*

Comment Category	Pre Survey Interview	Post Survey Interview
Need more computers	56%	20%
Need more training	32%	10%
Need more time	12%	6%
Satisfied with integration of technology into curriculum and personal proficiency	0%	37%
The grant has positively impacted integration of technology into curriculum and personal proficiency	0%	27%

In response to **Research Question 2,**

Will instructors utilize technology when it is made available?

As shown in the following table, the researchers found that instructors did utilize technology when made available. As mentioned in the previous section, additional training for utilization of the technology was funded in the grant thus increasing the potential for improved utilization of technology. Table 3 indicates noteworthy improvement in the six areas related to the use of technology resources.

Table 3. *Instructor Utilization of Technology Resources*

	Pre Survey			Post Survey					
	Mean	N	Std. Deviation	Mean	N	Std. Deviation	Change	t	Sig.
Lesson Plans	3.66	35	1.589	3.97	35	1.52	0.31	20.538	p<.05
Instructional Materials	5.31	36	0.525	5.53	36	0.51	0.22	87.702	p<.05
Internet	4.61	36	1.076	4.72	36	0.91	0.11	39.880	p<.05
Model Lessons	3.75	36	1.156	4.14	36	1.10	0.39	29.438	p<.05
Multimedia Presentations	3.00	36	1.373	3.86	36	1.33	0.86	20.609	p<.05
PowerPoint Presentations	2.75	36	1.204	3.39	36	1.36	0.64	19.816	p<.05

In response to **Research Question 3,**

What effect did technology have on instructional format?

Instructional unit plans showed an overall increase in the use of technology with the exception of the utilization of Zip Drives as demonstrated by Table 4 below. (One reasonable explanation for the reduction in the use of Zip drives is the availability of newer storage technology such as flash drives.)

Table 4. *Comparison of Instructional unit plans 1-8*

Use of Technology by Instructors	Instructional unit plans 1-4	Instructional unit plans 5-8
Microsoft Word® (word processing)	100%	100%
Microsoft Word® (instructional unit plans)	100%	100%
Microsoft Word® (student handouts)	33%	100%
Microsoft Word® (student Homework)	33%	100%
Microsoft Word® (student Exams)	33%	100%
Microsoft PowerPoint®	32%	63%
Microsoft Excel®	0%	34%
Internet Search (student homework)	21%	67%
Zip Drive	46%	33%

Instructional unit plans were collected from the instructor participants periodically throughout the 2003-2004 grant year. The instructional unit plans collected were reviewed for references to, or examples of, technology integration. The percentages reflect the number of instructors who utilized that particular technology per number of instructional unit plans submitted. The n value varied per instructional unit plan. Therefore, they were grouped 1-4 and 5-8 for comparison. The technology proficiency of the grant project instructors varied and appeared to be content dependent. Technology proficiency and integration into classroom curriculum improved throughout the year as evidenced by the instructional unit plans and by instructor comments on the post survey.

Conclusions and Recommendations

The study found that the introduction of computing/information technologies into the instructional setting had a significant impact on the ability of the instructors to integrate a broad spectrum of techniques into their content delivery. In addition, the authors believe that the educational experience in those teachers' classrooms was enriched and became more challenging for the students. This is indicated by the fact that instructors integrated the use of the technology into their curriculum when it was made available, when adequate teacher technology support training was provided and that teachers modified their instructional format to take advantage of the diverse opportunities afforded them through the availability of these technologies.

Recommendations include continued support for teacher training in utilization and set up of the technology infrastructure. Utilization improvement was noted in the curriculum development as additional teacher technology training was provided.

Instructors at all levels and in all educational settings face many of the same challenges and constraints including budgets, class sizes, time, and a desire to constantly improve the quality and effectiveness of content delivery. They also have at their disposal many of the same methods and techniques. By making technological tools available, along with appropriate training in their use, instructors will use them to enrich their delivery and adopt new and diverse teaching methods. The availability of technology provides options for instructors at any level and in any environment.

The historic educational reforms, derived from the NCLB of 2001 funding opportunities, support the development of instructors in relationship to improvements in technology integration. HRD, through these technology-funding programs, provides many opportunities for increased access and availability of technology for teachers in the instructional development.

Implications for HRD

Data in this study have implications for HRD in the following areas. As referenced in the theoretical framework, Swanson & Holton define HRD as a "process of developing and unleashing human expertise for the purpose of improving performance" (2001, p. 385). Faced with the need to compete on a global scale, such human expertise must be unleashed and performance improved using all the tools at our disposal. This research implies that technology integration improves teachers' instructional performance. Increased access to, along with the availability of, technology creates a positive perception of technology usage. It appears that integration of technology in instructional settings is paramount to the creation of the most productive instructional environment for the twenty-first century.

It is hoped that this study will stimulate further research to determine the effect of improved access to technology on instruction as perceived by students. A comparison of the two studies could provide an enlightened awareness of the effect of improved access to technology on instructional design and the correlation between the perception of the teachers and students. Since the students' performance in future workplace learning and performance is enhanced by technology and instruction received throughout the continuum of education, it would be worthy to acknowledge the student's perception. The students are our HRD audience in the future corporate workforce. Teacher utilization of technology throughout the continuum of education is vital to the inroads that technology has made in our lives today. In this technology age, we must create a technology driven environment throughout the education continuum leading to improved corporate workforce training and performance in this technology driven age. Teacher proficiency and utilization of this technology is critical to HRD corporate workforce development.

As cited in Gilley's writing, "Development of people refers to the advancement of knowledge, skills, and competencies for the purpose of improving performance within an organization" (2002, p. 5). Therefore, technology integration in instructional settings has the potential to improve upon the acquisition of knowledge, skills and competencies of the participants in the instructional design.

As previously referenced, Luskin citation of Jeanne Meister, a corporate university expert, implies a crucial relationship between education and workplace learning. "The business community recognizes that it is suffering more than ever before from the early learning inadequacies and their residual effects manifested by the limited educational proficiencies of young people and workforce training" (2003, p. 159). Luskin cites "The articulated link between early learning, education and workforce training presents an interesting correlation" (Luskin, 2003, p. 159). Thus this relationship or correlation between early learning and corporate workforce training creates a need for further exploration of methods to bridge and improve the early education and training to assist with the transition into corporate workplace training and development.

As Craig (1976) was cited by Swanson "HRD focus is on the central goal of developing human potential in every aspect of livelong learning" (Swanson, 2001, p. 4); therefore, it appears that implementation of technology into livelong learning will increase the human potential.

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