

EFFECTS OF TECHNOLOGY INTEGRATION IN K-12 SETTINGS

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## ABSTRACT

This review of literature assessed the use and effect of technology in the K-12 public school setting. Local, state and federal governments annually invest billions of dollars to purchase technology; yet, there is still a great deal of uncertainty and debate about the ability of technology to improve classroom teaching and learning. Several types of technologies are available to enhance student learning in the classroom. Everything from audio and video content to handheld technologies and notebook computing has been used in classrooms, and new WEB 2.0-based technology such as Wikis and Blogs are emerging. While it is impossible for any one researcher to present information for all technologies in use in public classrooms across the United States, the goal of this review is to show what is available, who is in control of the technology and how it can be used in the classroom to enhance the learning process. A primary issue of concern for administrators and policy makers in determining whether or not to implement technology is the lack of statistically significant data indicating the effectiveness of current technologies. While not measured by quantitative analyses of standardized tests, findings suggest that the positive influences of technology integration are revealed through more qualitative research.

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## DEDICATION

I would like to dedicate this thesis to my husband, Brian, whose patience, understanding and love of Golf made this possible.

## Chapter 1

### INTRODUCTION

#### Problem

Local, state and federal governments annually invest billions of dollars to purchase technology for K-12 education (Tozoglu & Varank, 2001). Yet, there is still a great deal of uncertainty and debate about the ability of technology to improve classroom teaching and learning. In addition, uncertainty exists about which technologies should be implemented in classrooms. Many have asked the question, is the money spent on technology worth the benefit to students?

Perhaps not surprisingly, Whitney (2007) states “almost every aspect of modern life is affected in some way by technology.” Most of today’s students have never lived in a technology free environment. Children today spend a great deal of their time interacting with some form of technology, be it the television, internet, or an interactive video game. For students to be successful in life, they need knowledge and skills demanded by 21<sup>st</sup> century communities and workplaces. Schools are facing the challenges of renovating their learning environments to adequately prepare students for these realities (Lento, 2005). Fortunately, society is forcing the improvement of educational technology through unparalleled investments.

While Bruce, Beranek, Michaels, and Cazen (1985) state that technology alone does nothing to enhance education, Rivero’s (2005) findings indicate that certain technologies can bring a new level of inquiry learning and leadership into the classroom. Part of the role of technology is to make the learning experience relevant for students. A large and growing knowledge base exists on the effects of technology-assisted instruction on the learning experience and academic development of students (Woodul, Vitale, & Scott, 2000). Still, the

usefulness of technology in education is fairly undefined as evidenced by the increasing number of studies seeking to identify the effects of technology usage on classroom learning (Lynch, 2006).

#### Description of the study

The purpose of this study is to analyze the use and effect of technology in the public school classroom. Specifically, this study will have three steps. First, the researcher will investigate and present types and prevalence of technologies currently used in our nation's public schools. Second, the researcher will review and present the knowledge base of research on the effects of technology use in the classrooms. Third, using data collected in the first two steps, the researcher will highlight effective technology implementation practices which benefit student learning.

The organizational structure for this thesis follows. Chapter one will set the issue in context by presenting the history, cost, and effects of technology implementation in public schools. Chapter two will present the literature on the types of technology available and what is being used in the classroom. Chapter three will synthesize the research on the classroom effects of technology. Finally, chapter four will identify effective technology implementation practices and provide direction for further research.

This research will be conducted through a review of literature using ERIC, EBSCOhost and other educational sources. Two major bodies of research will be analyzed: types and prevalence of technologies currently used and technologies effect on classroom teaching and learning. Once both areas have been studied, the researcher will identify effective technology implementation practices which benefit student learning.

## Definition

Before discussing technology and technology use in the classroom the term technology must be defined. Webster's dictionary (2003) states-*Technology: the branch of knowledge that deals with the creation and use of technical means and their interrelation with life, society, and the environment, drawing upon such subjects as industrial arts, engineering, applied science, and pure science.*

For the purpose of this study the researcher will apply the following definition of technology developed by Engstrom and Jewett (2005) and refined by Christmann (2006). The difficulty of defining technology is evident by the fact that Engstrom and Jewett's (2005) definition is truly a list of examples.

Technology: personal computers, word processors; hand held computers, Palm Pilots, graphing calculators, probe technology, Internet access, data collecting software and cognitive technology such as Wikis, Blogs and Podcasting. The next section will explore the historical data that have influenced the progress of technology usage in the classroom.

## History

Initially, technology in the classroom meant radios and or televisions used as a substitute for teachers' lectures (Tozoglu & Varank, 2001). In the 1980's a push to introduce computer technology into the classroom setting was initiated; from there a culture of computer usage in the classroom was cultivated (Bruce et al., 1985). In 1981, approximately eighteen percent of public schools had one computer for instructional use and the ratio of students to computers was 125:1. As the drive for technology integration continued, approximately 2 years later in 1991, the estimate of public schools having at least one computer for instructional use increased by eighty



percent from 1981 and the ratio of students to computers decreased to 20:1 (Hamaz & Alhalabi, 1999).

By the late 1980's the prevalence of computers in schools gave rise to technology standards for teachers. In 1989 the International Society for technology in Education (ISTE) was formed. Its mission - to facilitate K-12 classroom teachers and administrators communicate effective techniques for enhancing student learning with innovative classroom technologies. In 1993, the ISTE introduced the first edition of "Technology Standards for Teachers," with 13 indicators (Shelly, Cashman, Gunter & Gunter, 2004). In 1994, seventeen percent of the country's classrooms had Internet connections and the number of computers connected to networks in schools climbed to 28 percent (Hamaz & Alhalabi, 1999).

During the State of the Union address in 1996, President Clinton challenged Congress and the general public to dedicate to the resources essential to guarantee all students access to high-quality technology and the information superhighway. Reflecting the significance of the dedication to reach his goal, the President's budget provides \$2 billion over five years for the Technology Literacy Challenge Fund to help states put into practice their educational plans for incorporating technology. This program was designed to catalyze and influence state, local and private sector efforts to allow public schools to provide students with skills to succeed in the 21<sup>st</sup> century. After a study of eight schools immersed in the Technology Literacy Challenge, the RAND Corporation found that countrywide implementation of comparable models would cost between \$8 billion and \$20 billion per year over five years (U.S. Department of Education, 1997).

By 1997, fifty million users connected to the World Wide Web and the ISTE released the second edition of "Technology Standards for Teachers" including 18 indicators structured into

three major categories. The National Council for the Accreditation of Teacher Education (NCATE) adopted these teacher standards for accrediting teacher education programs by the end of 1998. Shortly after, the U.S. Department of Education starts a multiyear \$125 million grant program called Preparing Tomorrow's Teachers to Use Technology (PT3). This program was initiated to generate technology- proficient teachers at all levels. In the year 2000, the ISTE formalizes the "Technology Standards for Teachers," naming them National Educational Technology Standards (NETS). In the year 2003, 48 states assumed, personalized or aligned with the NETS to meet the requirements of the No Child Left Behind Act that was signed into law by President Bush in 2002 (Shelly, Cashman, Gunter & Gunter, 2004).

In 2004, the federal Education Rate program invests more than \$14 billion to connect K-12 classrooms to the Internet. By the year 2005, 82,480 public schools in the United States had access to Internet based technology. Greene (2007) found as of the year 2005, that public schools have an average of 154 computers per school and 97 percent of those computers have Internet access; this figure demonstrates that only 3 percent of public schools in the United States were without any Internet access.

The information presented has established the chronological course of technology as introduced into education. This path has led to a nationally recognized set of standards for incorporating technology into the classroom. The U.S. Department of Education has adopted four national technology goals; financial backing is being supplied from an assortment of sources to aide schools in installing the essential infrastructure and to prepare teachers with training in the use of technology to meet those goals (Forcier & Descy, 2002). According to Forcier and Descy (2002) the four goals are as follows:

1. All teachers and students will have modern computers in their classrooms.

2. Every classroom will be connected to the information superhighway.
3. Effective and engaging software and on-line resources will be an integral part of every school curriculum
4. All teachers will have the training and support they need to help all students learn through computers and through the information superhighway.

The next section will focus on types of technology available and technologies used in the K-12 classroom.

## CHAPTER 2

### TECHNOLOGY, TECHNOLOGY USE IN THE CLASSROOM AND LOCUS OF CONTROL

Current thought on effective school learning environments suggest that today's students are digitally enabled when they enter the classroom (Woodul et al., 2000). Skamp and Logan's (2005) work indicates that most students are not interested in reading textbooks because many students have more technology in their bedrooms than some schools have in their classrooms. While print textbooks provide the necessary material to cover the content standards, they no longer captivate and hold students' interest. Students come into the classroom expecting to use technology rather than traditional pen and paper materials for learning. Technology provides a brand new look at content learning which Frontline (2008) states takes a digital student and provides them with an environment they are used to interacting with.

Swift transformations in computer technology have resulted in significantly enhanced and expanded functions in education. Schwartz (2008) reports most public schools today use technology to support and implement the standard course of study. At the same time as technology influences what happens in the public school system, technology, with its continuing advances and influence, drive the public's perception of education forward from the static perception based on what education was like to the reality of what education could be (Forcier & Descy, 2002). This chapter will present relevant research on two aspects of technology in America's public schools. First, the availability and prevalence of technology will be addressed. Second, research on the use of technology will be explored.

#### Technology

For many, educational technology is synonymous with the term computer. According to Shelly, Cashman, Gunter and Gunter (2008) a computer comprises an assortment of hardware

components that work in conjunction with software to organize data, carry out calculations and communicate with other computers. Computers can offer several valuable opportunities for teaching and learning, some of which include “skill-building practice, real-world problem solving, interactive learning and discovery learning.” When thinking about computers in education, typically, one would think of the personal computers (PC), laptop computers and mobile devices such as a personal digital assistant (PDA)/Palm Pilot (Shelly et al., 2008). Educational software applications consists of programs designed to perform specific tasks for users; which refers to computer software products used to support teaching and learning of subject related content. Teachers can use different technology applications available to enhance student learning and students use different applications available to build knowledge. There are several applications however, that are used congruently by teachers and students to enhance the total educational process. The most prevalent types of software applications that can be found in classrooms across the nation are productivity software (Thorsen, 2009).

Productivity software defined by Shelly at el. (2008) is software that is “designed to make people more effective and efficient while performing daily activities.” Productivity software includes such applications as word processing, spreadsheets, database, presentation graphics, and personal information management. However, with advances in technology occurring on continuing bases, the norm of what type and how technology is being used in the classroom is rapidly changing.

Several types of technologies are available to enhance student learning in the classroom. Everything from audio and video content to handheld technologies and notebook computing has been used in classrooms, and new uses of technology such as blogging are frequently emerging (Marshall, 2002). These technologies allow students and teachers to engage in written, two-way

communication (Colombo & Colombo, 2007). According to Levine (2002) however, in order for instructors to use technology as part of their instruction, their classroom must first contain the most basic technology. At the very minimum, each classroom setting should include a computer with productivity software, a network connection and a projection system. The following sections will discuss technologic applications from the most basic to the most innovative that are student driven, teacher driven or driven by both teacher and student. While it is impossible for any one researcher to present information for all technologies in use in public classrooms across the United States, the goal is to show what is available, who is in control of the technology and how it can be used in the classroom to enhance the learning process.

#### Locus of Control-Student

Technology supports a transformation from teacher-centered to student-centered learning environments by offering advanced, all-digital technology that promotes authentic exploration through discovery, and by directly assisting educators in implementing 21<sup>st</sup> century learning environments (Lento, 2005). Eighty-eight percent of teachers surveyed with computers available in their schools reported that their students used computers in the classroom (National Center for Education Statistics (NCES), 2000). Lento (2005) found that students using technology are motivated and attain higher test scores. Providing students with technological tools helps ensure the accuracy and thoroughness of student work. The instant response reinforces content as well as enhances interest in learning (Lento, 2005). One finds that there are many computer applications available for the classroom that when used by the student, supports an increased level of self efficacy. This self efficacy is apparent in the quality of the outcome of the product or products produced by the application when the student interacts with it (Woodul et al., 2000).

As reported in many research studies, the most common use of technology in schools is through the use of Computer-Assisted Instruction (CAI). CAI software is designed to assist in teaching facts, information and skills aligned with subject-related materials (Shelly et al., 2008). CAI is an instructional application that uses a computer to enhance student learning. There are three kinds of instructional software involved in CAI; tutorials, drill and practice and simulations and modeling (Thorsen, 2009).

Tutorial software develops concepts through the usage of questions, written explanations, pictures and descriptions (Bitter & Pierson, 2005). Tutorials are specific to individual concepts that explain a topic. Tutorials are used by the student to discover the information, practice what they have explored, and then apply what was learned by taking a test (Thorsen, 2009). According Forcier and Descy (2002) working on a tutorial program at a computer in the classroom can provide interest and motivation.

This software application is designed to be used as a standalone and does not require other instructional efforts prior to usage. In a busy classroom with various learning styles and levels, tutorials can be used to supplement instruction (Bitter & Pierson, 2005). Mavis Beacon Teaches Typing!® and the Super Tutor® math series are two examples of tutorial software. Both programs allow for students to interact with the programs as they practice new information moving at their own pace; providing feedback and remediation when needed. Tutorial programs are to be used by the student to supplement learning. They can also be used as an independent study for students exhibiting difficulty with specific skills and concepts (Forcier & Descy, 2002).

The 1999 Fast Response Survey System (FRSS) Survey focused on the availability of technology reports 50 percent of teachers who had access to CAI, assigned students to use drill-and practice applications (NCES, 2000). Drill-and-practice software initially provides factual

information and then during repetitive drills permits the learner to continue to work on specific materials, which promote memorization of information (Shelly et al., 2008). This software is effective for learning fundamental skills and remediation by providing the repetition necessary to move acquired skills and concepts into long-term memory (Bitter & Pierson, 2005). The program then prompts the student to answer some questions or solve problems and then provides the student with immediate feedback (Thorsen, 2009). This feedback determines if the student is ready to move on to higher-order conceptual thinking. It is this instant feedback coupled with sequential learning tasks that establishes the stimulus-response connection required for memorization which leads to mastery of a skills (Forcier & Descy, 2002).

Drill-and-practice programs focus on students mastering basic skills needed in content areas (Bitter & Pierson, 2005). These programs are primarily used to reinforce math concepts because of the unambiguous nature of basic math facts. Some examples of drill-and-practice programs that provide practice of higher-level thinking skills are Number Munchers® and Math Blasters® (Forcier & Descy, 2002). Drill-and Practice programs can also be effective in areas that take advantage of “game like formats, contextual clues, rhymes, and riddles, such as vocabulary, historical dates, and scientific definitions” (Bitter & Pierson, 2005).

The third instructional software associated with CAI is simulations and modeling. Educational simulations allow students to understand events that they are not observable personally because it would be too complex and/or unsafe to reproduce in the classroom setting (Forcier & Descy, 2002). Simulations present the student’s with opportunities to manipulate variables that affect the outcome of the event (Shelly et al., 2008). These programs typically have graphics that help students visualize what is being simulated and can offer genuine practice at solving real problems (Forcier & Descy, 2002). Students using simulations will be forced to



reaffirm and enhance their understanding about a given topic. The 1999 FRSS survey indicates 39 percent of public school students use simulations in school (NCES, 2000).

According to Forcier and Descy (2002) advanced levels of cognitive skills are involved when blending facts, rules, and concepts used in problem solving. Simulations should not be used as a standalone unit rather to reinforce concepts and skills that have already been explored (Bitter & Pierson, 2005). Thorsen (2009) states three examples of simulation software programs are, Oregon Trail®, Geometer's Sketchpad® and SimCity®. These simulations provide “what if” questions for students to ponder and explore real-world concepts based upon prior knowledge. The award winning Carmen Sandiego® series of programs (Where in the World.....) is a program that one is likely to see in just about every public school in grades K-12 across the nation (Forcier & Descy, 2002).

#### Locus of Control-Teacher

The tendency for teachers to use technology from a long-established teacher-centered point of view stems from the lack of awareness about the technology itself. Once the teachers become familiar and at ease with the technology, they can begin to integrate the technology into the curriculum and use that technology as an incentive to experiment with innovative instructional practices (Shelly et al., 2008). Teachers must appreciate the profound impact technology is having on society as a whole. Technology has changed the nature of work, of communications, and our perception of the development of knowledge (Wise, 1997). One finds that technology enhances the teachers' role by providing multiple applications that support teacher productivity (i.e. record keeping and classroom management tools).

Spreadsheet productivity software enables the user to organize numeric data in rows and columns from other numeric information. Spreadsheets are highly specialized databases, they

can generate graphs from the numerical data entered (Forcier & Descy, 2002). Prevalent spreadsheet software that can be found in public schools across the nation is Microsoft Excel, Microsoft Works and AppleWorks (Shelly et al., 2008). Sixty one percent of teachers use spreadsheets (NCES, 2000); several use them as a substitute for grade book programs to maintain student and class grades. Spreadsheets are often used to predict results, promote accuracy of calculations of whole numbers and fractions, to calculate sums and averages, to generate graphs and to convert time and speed measurements (Bitter & Pierson, 2005). There are however, effective grading programs available that eliminates the time consuming chore of sorting and performing statistical analysis of grades. Some well-liked examples of grading programs include Grade Machine®, MicroGrade®, Gradebook Plus® and GradeQuick®. Through the use of these programs teachers can easily maintain grades, generate class rosters and statistical reports within a matter of minutes (Forcier & Descy, 2002).

Shelly et al. (2008) state games can be an effective method of teaching content through repetition and practice. Instructional games can have an added increased incentive because of the rules, the engaging environment and competition (Bitter & Pierson, 2005). Some examples of instructional games software is Stickybear Word Scramble®, Super Solvers®: Gizmos & Gadgets® and Dragon in a Wagon®.

There are several computer applications that teachers can use as productivity tools. Productivity tools save teachers time which allows teachers to devote more energy to planning and preparing lessons. Teachers use productivity tools to generate supplementary materials and test. According to Forcier and Descy (2002) timesaving software programs help teachers prepare for class more efficiently. Teacher utility tools are user-friendly and can be customized to the needs of the individual classroom. Some of the more popular programs come from the

Companion® series to include Math Companion®, Crossword Companion™ and Teacher Resource Companion®.

More advanced technologies that are used by teachers includes interactive white boards and digital projectors. Interactive white boards are boards which connect a large touch screen to a computer and digital projector (Kopf, 2007). Instructors manage and exhibit software and multimedia to classes and can write over applications using digital ink. Teachers can then teach lessons or take notes and then save or post them for future collaboration. According to Starkman (2006) interactive whiteboards allow the instructor to write in digital ink over applications, Web sites, and videos.

A user-friendly software application for teachers to use to become familiar and with Website technology is Contribute®. Contribute® is primarily used by non-programmers with little or no programming experience to keep websites and blogs edited and updated with content. By creating a technologically rich environment that use instructional websites, teachers offer the learner the opportunity to discover how to look up valid information, compare that to the information they already have, and produce original thoughts about the information learned (Besnoy, 2006).

According to Stanton (2008) Instructional Management Systems (IMS) such as Blackboard Learning System™ allows teachers to apply prevailing learning content, using an assortment of web-based tools. The IMS is the strategic tool that teachers can use on a routine basis to manage instruction and observe development. Teachers use this to look student performance throughout the year. The Blackboard Learning System™ lets an instructor teach using any model for teaching. This is because the Blackboard Learning System™ is open, flexible, and focused on enhancing student achievement and the learning process. Through IMS

teachers can access data from various reports to include reports are Baseline reports, Multiple Measure reports, At-Risk reports and longitudinal reports. Once accessed and analyzed teachers can then use this information to construct an effective instructional program. Blackboard Learning System™ permits the teachers to connect with Internet enabled-technology to improve the educational process (Stanton, 2008).

Another Instructional Management System (IMS) is Desire2Learn™. This web-based management system provides teaching and learning tools that facilitate course development, course delivery and classroom management (Nagel, 2007). The tools available in Desire2Learn™ allow the instructor the flexibility to match their instructional approach to one that best meets the needs of their learners. According to Nagel (2007) this type of IMS can also promote smooth communication and collaboration by providing tools that facilitate an engaging web-based learning environment.

#### Locus of Control-Shared

Research has shown that technology is changing both teacher and student roles in the classroom. As the students acquire a knowledge base about the technology, the teacher's role becomes more facilitative (Matzen & Edmunds, 2007). Incorporating technology provides educators and students the opportunity to investigate and understand their surroundings quantitatively. Several computer applications available facilitate a constructivist or shared learning environment by providing a platform for both teachers and students to interact in a technology driven environment.

The FRRS data (1999) indicate that 61 percent of 4<sup>th</sup> grade students and 62 percent of 8<sup>th</sup> grade students used computers for writing drafts (NCES,2000) Word processing software is used to create, edit and format text documents. Word processing programs typically have two basic,

cooperative parts; a text editor to maneuver text and a print formatter to send the text file to the printer (Forcier & Descy, 2002). More sophisticated word processing programs however, usually have additional features such as spell/grammar checker, dictionary and thesaurus. Word processing can be used for any word document from creating written reports to newsletters to mailing labels (Shelly et al., 2008).

Prevalent word processing applications that can be found installed on computers in schools today are Microsoft Word, WordPerfect, AppleWorks and Microsoft Works (Shelly et al., 2008). The 1999 FRSS survey focused on availability of technology, word processing applications is the most used; 61 percent of teachers who had access to word processing applications in the classroom assigned students to use it (NCES, 2000). Teachers use word processing programs to create text, visual, and Web-based materials for the classroom such as lesson plans, study guides, rubrics, tests and quizzes (Tomei, Balmert, 2000).

Fifty two percent of 4<sup>th</sup> grade students and 41 percent of 8<sup>th</sup> grade students use word processing applications to read stories (NCES 2000). According to Forcier and Descy (2002) there are numerous word processing programs for students to use to improve reading and writing skills. Programs from emergent through mature students such as Read, Write & Type® for grades 1-2, Type to Learn® for grades 3-5 and Student Writing Centers® for grades 4-12. Standard word processing software, such as Microsoft Word, offers a fundamental tool for students (Plough, 2008). Students must first learn to use these basic programs in order to receive the most benefit from the newer more innovative programs.

Shelly et al. (2008) states multimedia applications combine the use of text, audio and visuals to deliver classroom instruction that adds to student learning. Multimedia applications are effective tools to help teach difficult concepts. The interactive programming allows teachers to

pretest the learner's knowledge before they enter a given level of instruction. This application can also pre-teach basic concepts to students allowing them to focus on what is being taught in class. The 1999 FRSS survey focused on availability of technology, states 45 percent of teachers assign students to use multimedia applications (NCES, 2000). This can focus the teacher's attention to the concepts that need to be re-taught or can help with the pacing of a lesson giving indicators of when to move on to the next concept. According to Plough (2008) students have easy access to multimedia equipment such as video cameras. Many student and teachers have recording capabilities on their cell phones and often make movies for their own entertainment. They can use this easy access and interest to create projects using multimedia applications.

The PowerPoint presentation is one of the most common presentation tools used in the classroom (Shelly et al., 2008). PowerPoint applications allow users to promptly generate vibrant graphical presentations, while incorporating workflow and ways to easily share information. According to NCES (2000) at least 43 % of all students will use a presentation application during their K-12 education. According to Plough (2008) both students and teachers must have a solid understanding of how to use the prevailing PowerPoint application in order to incorporate its use into the more innovative applications such as WEB 2.0 tools. WEB 2.0 presentation applications, such as Zoho Show or Slideshare enables students to construct presentations and share them with the world. In order to use these programs one must first put together their project in the PowerPoint application before it can be uploaded; but knowing that they are uploading it for the world to see, adds a little extra incentive for creativeness during the whole process.

WEB 2.0 tools are a combination of social networking systems such as Wikis and Blogs with the development of tag based delivered media (Brooks, 2008). WEB 2.0 creates a more organized and categorized content for learners by providing a more sophisticated interactive

architecture for the user. These new web-based technologies move away from simply using static websites and the independent use of search engines to a more dynamic interactive World Wide Web (WWW) (Plough, 2008). WEB 2.0 consists of innovative Read/Write technologies facilitates students moving away from the more traditional pen and paper environment to one that promotes student self expression, interaction with peers and provides an opportunity for authentic learning experiences (Brooks, 2008).

Guhlin (2007) reports one of the most exciting Read/Write technologies available for educator use includes Wikis. A Wiki is a piece of server software that allows users to freely create and edit Web page content using any Web browser (Cunningham, 2002). One must have fundamental knowledge of the more basic applications in order to become proficient in using Wiki's (Guhlin, 2007). Wiki's can be used as an editable database, processor documents, multimedia hosts and any number of additional functions (Plough 2008).

Wikis allow students to work collaboratively and create a series of Web-based information pages. The ease of operation makes a Wikis an effective tool for mass collaboration (Engstrom & Jewett, 2005). The idea behind Wikis is that students can constantly transform information on a page through real time collaboration. It is the instant feedback from their peers and the ease of bouncing ideas back and forth that cultivates and enhances their cooperative learning experience.

Besnoy (2006) asserts that cognitive technologies and instructionally appropriate Websites can be an equally effective way of motivating students to learn content. Examples of instructional cognitive technologies being used in the classroom are blogs, vodcasting and podcasting, all in the hopes of creatively designing learning activities that maximize technology and non-technology resources. Dolt (2007) asserts that generating podcasts would inspire

students to learn content, and viewing these designs on a blog would prompt them to write comments to their peers.

A blog is a Website journal about some topic or issue. Blogging is a fairly recent trend. Kirby and Kaillio (2007) state, blogging is a broadly used way of communicating for millions of Internet users around the globe. Blogs entries may be posted regularly and serve as online journals or commentaries. Within the blogs, text, images and links to other sources can be found. The impact of blogging is noteworthy in that of the 21 million teens online, 19% keep a blog (about 4 million), and 38% read blogs (Kirby & Kaillio, 2007).

It was reported by Jakes (2006) that Blogs, Wikis, and Podcasting can be utilized to create 21<sup>st</sup> Century school information environments. Calling such technologies social software tools, Jakes describes how these technology tools can serve as platforms for dynamic classroom instruction. Jakes supports the position that including such technologies into the curriculum creates a value-added learning experience for students.

This chapter described technologies being used in public schools across the nation. Research presented demonstrates the use by the public school teacher as well as the student. This chapter reveals many of the current trends to use computer based technology to enhance student performance and learning. As reported, the use of technology has had an impact on the teaching and learning process in public school classrooms. Chapter three will focus on technologies effect on classroom teaching and learning.



## Chapter 3

### CLASSROOM EFFECTS OF TECHNOLOGY

This chapter will provide an overview of research on the effects of technology implementation in American public schools. As with most educational research, the effects of technology implementation are mixed. The following sections present information about interventions that have been found to positively affect student learning, engagement, and motivation and interventions that have had no effect.

The need for effective instructional-based technology tools is great. “Approximately eight million young people between fourth and twelfth grade struggle to read at grade level. Some 70 percent of older readers require some form of remediation” (Carnegie Corporation, 2004). Students that lack proficient reading and writing skills will have difficulty functioning in today’s working world (Graham & Perin, 2007). The need for educators to address and solve this problem is vital for struggling readers.

Researchers found that with the aid of technology, speech sounds can be altered, duplicated and ultimately differentiated. Findings from a study of Fast ForWord®, a CD-ROM and Internet-based reading program, indicate the program helps at-risk children quickly construct verbal communication understanding and other significant proficiencies essential to the reading process (Overbay & Baenen, 2003). Fast ForWord® has been implemented in more than 400 school districts. Researchers discovered that students can widen critical language skills by using this technology in a rigorous adaptive training program (Borman & Benson, 2006).

Researchers employed by Scientific Learning performed initial controlled studies to quantify the effectiveness of the CD-ROM and Internet-based reading program (Schacter, 1999). The clinical results of the study, which lasted for one year, 1994 through 1995, demonstrated fast

improved verbal communication skills, general language comprehension and other receptive and expressive language skills.

In fall 1997, Scientific Learning carried out the School Pilot Study in cooperation with nine school districts in Texas, Nebraska, California, Indiana and Illinois (Borman & Benson, 2006). The objective of this study was to establish if Fast ForWord® training would have a positive effect on students at-risk for failure in reading and language arts.

Students were evaluated using the Test of Auditory Comprehension of Language. The results were decidedly positive. According to Borman and Benson (2006) the findings before Fast ForWord® implementation indicate that student performance was below average at approximately the 12.5 percentile. After implementation of Fast ForWord®, the study group improved to the 49th percentile compared to the control-group performance which improved to the 21st percentile. For the language comprehension component, subjects in the study group moved from a percentile of 11.3% to 39.3%. The control group demonstrated less of a percentile gain, 11.9% to 14.8%. According to Schacter (1999) the technology was extremely successful in enhancing a series of pre-requisite reading skills in at-risk students.

Research has shown that technology implementation based on a gaming approach has been effective for reading improvement as well. One such program, DaisyQuest®, is a pre-reading curriculum that teaches the vital skill of phonological awareness through the use of technology to pre-K and kindergarten students. Schacter (1999) reports DaisyQuest® software was designed to teach seven phonological awareness skills to include rhyming, beginning sounds, middle sounds, ending sounds, blending phonemes, and segmenting. These skills have been revealed through inquiry to calculate future reading achievement (U.S. Department of

Education, 2006). DaisyQuest® requires students to play games that involve all of the phonological awareness skills for a minimum of 15 minutes per session.

Two studies have been conducted on DaisyQuest®. In the first study, 70 second semester kindergarten students participated from four kindergarten classrooms (Foster, Erickson, Foster, Brinkman & Torgesen, 1994). Initially, students were tested on the Peabody Picture Vocabulary Test. Using this data, students were paired according to ability, and then randomly assigned to either DaisyQuest® or the control group (Schacter, 1999). To assess different aspects of phonological awareness, four pre-tests were given. While control students participated in their regular classroom curriculum, DaisyQuest® students used the software during 16 sessions, averaging a total of five hours per student (Foster, et al, 1994). Schacter's (1999) reports students in DaisyQuest® performed significantly better than the control group on three of the four tests of phonological awareness. The findings were decidedly significant with the average effect size obtained across measures at 1.05.

In a second study of DaisyQuest®, Barker and Torgesen (1995) selected 54 first grade students who were falling behind their peers in reading skills. These students were randomly assigned to one of three groups. One group received the DaisyQuest® intervention, a second group for control, was the Hint and Hunt® group, which received training on a reading program that did not use technology and a third control group, was composed of students that focused on math skills. All groups took four tests of phonological awareness that consisted of segmenting, blending, word attack, and the phoneme elision task. According to Schacter (1999) the DaisyQuest® group performed significantly better than the control groups on all tasks except the phoneme-blending task. The average effect size for DaisyQuest® compared to the other two groups was .91. Barker and Torgesen (1995) reported that the considerable growth on the word

identification sub-test confirmed that the DaisyQuest® intervention resulted in students making significant gains in their ability to use phonological skills in reading real words.

Based on a tutorial approach SuccessMaker® is an integrated educational program that teaches K-8 students reading and writing skills through literature-based activities (Schacter, 2001). The Reading Readiness component is targeted to Kindergarten, the Discover English component is for grades K-2 and the Reading Adventures components are for grades 3-6. This multimedia program develops reading skills through the use of audio and video recordings and playback of children's classic literature, poems, and folktales. This interactive multimedia program focuses on reading comprehension and reading for information by providing the user opportunities for practice combined with reinforcement (Donnelly, 2004). SuccessMaker® adapts to each student's learning style and continuously assesses user performance to adjust the level of reading difficulty to the student's skill level. Reports generated by the program track student achievement and indicate when teacher intervention is necessary.

Several studies have been conducted that demonstrate the impact of SuccessMaker® on student achievement. A study by Kulik (1994) indicated that students who utilized the SuccessMaker® software scored considerably higher on standardized reading tests, with an effect size of .40, than those who did not use the program. Specifically, Kulik (1994) reported that student's reading comprehension and vocabulary skills were enhanced by the individualized instruction given by SuccessMaker®.

A study performed by Donnelly (2004) assessed whether SuccessMaker® implementation was linked to improved student performance on the Palmetto Achievement Challenge Test (PACT). As reported by Donnelly (2004) the participants in the study group included 395 students in grades three through eight and were identified as being largely of a

lower socio-economic status by their inclusion in a free/reduced lunch program. The gender of the participants was fairly equal, with 52% percent reported as being female. Across race the study group was identified as being 92% African American, 6% White, and 3% of “other” ethnicity. The grade levels of the study group consisted of 43% from grade 3, 21% from grade 4, 8% from grade 5, 17% from grade 6, 5% from grade 7 and 6% form grade 8.

According to Donnelly’s (2004) findings, SuccessMaker® students scored higher on the PACT ELA than those students not receiving the intervention. Students considered at the Below Basic Level that participated in SucessMaker® achieved the most gains in reading comprehension with an increase of 36 %. This same group of students also achieved higher gains on the PACT mathematics category with increase of 51% when compared to the group of students that did not receive the intervention.

Another positive impact of technology on reading has been attributed to the implementation of Academy of Reading®. The Academy of Reading® is designed to supplement an existing reading curriculum for K-12 students and adults. It is a program used as an intervention for those who are critically behind in their basic reading and acquisition skills which aims to help these readers attain the skills they need to become proficient readers (Rissman, 2004). A key component of the Academy of Reading® program is diagnostic tests of a student's reading aptitude. The results of the diagnostic tests are then used to generate an individualized lesson plan which then uses a comprehensive management system to observe and evaluate each student's learning processes (Schacter, 1999).

A study conducted by Fiedorowicz and Trites (1987) assessed 115 students who were of average intellectual ability but reading below grade level. These students were randomly placed with Academy of Reading®, an alternative reading technology group, or a control group with no

treatment. All groups took pre- and post- assessments on a series of reading and comprehension tests to include oral reading, word recognition, fluency, G-E Phonetic Knowledge and WRAT-R reading tests, (Schacter, 1999).

All students in each group performed the same on the pre-tests. Fiedorowicz and Trites (1987) study of post-test results show that Academy of Reading® trained group considerably outperformed the control group on several measures. Additionally, the Academy of Reading® students showed a noteworthy decline of reading errors. In a follow up study Fiedorowicz and Trites (1990) reports Academy of Reading® students' word recognition reading skills were improved by 1.2 grade levels, while the control group with not treatment improved by a mere .3 grade levels.

READ 180 Enterprise Edition® (READ 180 EE) is an intensive reading intervention program that is scientifically based for students in upper elementary through high school (Scholastic, 2004). READ 180 EE has been proven to considerably increase the reading scores of older, struggling readers (Pearson & White, 2004). The gains achieved by students from this program are due to the individualized “intelligent software”. This “intelligent software” is used to determine the individual needs of each student by collecting data based on individual responses and then adjusts instruction according to that data (Scholastic, 2004).

The Department of Defense Presidential Technology Initiative sponsored an evaluation of READ 180 in order to appraise the effectiveness of the READ 180 program on the literacy skills of older struggling readers (Goin, Hasselbring & McAfee, 2004). READ 180 research was conducted in nine Department of Defense schools in the United States and Germany with students from Grades 4-9 during 1999–2000. The project participants consisted of ten teachers and 229 students. A limited sample of 128 students with matching pre- and posttest Terra Nova

reading scores was used for the data analysis process. Scholastic Inc. (2004) uses a normal curve equivalent (NCE) which is an equal-interval scale and is how user scores are reported. A gain of one to two NCEs is said to be substantial growth.

Goin et al (2004) findings for students that participated in the READ 180 program suggest an overall positive effect on the standardized test scores in reading and language arts. Terra Nova Reading pretest showed a mean of 38.47 NCE and a posttest mean of 41.95 NCEs for a gain of 3.48 NCEs. In this study there were two groups, the “on-model” and the “off-model” students. “On-model” refers to the students that were provided with all the READ 180 hardware, books, and available software as well as given the Scholastic Reading Inventory (SRI) reading comprehension assessment at the beginning, midpoint, and end of student participation (Fleishman, 2004). The “off-model” group did not receive the READ 180 reading intervention.

“On-model” students participated in the study for at least one year. According to Fleishman (2004) findings in reading, the “on-model” students’ scores were significantly greater than the “off-model” students’ scores. The “on-model” students showed pretests mean of 39.9 NCEs and a posttest mean of 47.3 NCEs for a gain of 7.45 NCEs; whereas “off-model” students only showed a gain of only 1.37 NCEs. Goin et al (2004) conducted an analysis of covariance to correct for the noteworthy divergence between the on- and off-model students’ mean pretest scores (Goin et. al, 2004). Results established that the chief effect of the “on-model” against “off-model” comparison was statistically significant at the .024 level with the “on-model” students’ scores showing greater gains.

In North Carolina, students using READ 180 in Grades 4-8 showed greater gains on the North Carolina End-of-Grade standardized reading test. According to Admon (2004) READ 180 students showed significant growth; more than twice than what was projected. In grades 4-8,

approximately 51% of all students showed growth of no less than one achievement level. In grade 5 and 8 more than 60% of the students showed growth of no less than one achievement level.

The Los Angeles Unified School District's Intensive Academic Support Program participated in a READ 180 study during the 2000-2001 school year with eighth grade struggling readers and writers. As a baseline this study used the Stanford Achievement Test, Ninth Edition (SAT-9) scores of 1,073 students in the school system. Following this 537 students were placed in the READ 180 program and 536 students did not participate in any special intervention program. For comparison purposes, the both groups were matched on gender, ethnicity, language proficiency and pretest means (SAT-9) (Papalewis, 2004). Forty-two percent of the 537 students participating in the READ 180 program were distinguished as Limited English Proficient (LEP). Papalewis (2004) findings suggest an overall positive effect on the SAT-9 scores in language arts with significant gains of over 3 NCEs. A breakdown of LEP student's scores showed significant reading gains with a gain of 3.1 NCEs, whereas the comparison group lost 6.6 NCEs.

Des Moines Independent Community School District conducted a READ 180 study from 2001 through 2005. Approximately 1,200 middle school special education students participated in the study. According to Hewes, Mielke and Johnson (2006) both criterion-referenced and normative tests, including Des Moines District Fluency Probes, the Stanford Diagnostic Reading Test (SDRT), and the Scholastic Reading Inventory, scores were used to collect data.

Hewes et al (2006) findings indicate significant gains for READ 180 students in fluency and comprehension above and beyond the pragmatic yearly growth. Prior to this study, students had made an average of two to three months progress in reading per year (Fleishman, 2004). READ 180 was associated with annual increases of approximately 6 scale-score points on



SDRT4 Comprehension, and 5 scale-score points on SDRT4 Total enabling 18% of the participating students to place out of Special Education services for reading (Hewes et al, 2006). Twenty-five of first-time READ 180 students gained one or more NCEs on the SDRT during the second year of READ 180 implementation.

In the same vein, another positive impact of technology in the classroom is accredited to Accelerated Math™ a daily progress-monitoring software tool. Accelerated Math's™ purpose is to oversee the progression of the development of mathematical skills. Accelerated Math™ provides an individualized lesson plan which then uses a comprehensive management system to observe and evaluate each student's learning processes. To determine the individual needs of each student, the program collects data based on individual responses and then adjusts instruction according to that data which in turn provides students with immediate feedback about their work (Forbush, 2001). According to Ysseldyke, Betts, Thill, and Hanngian (2004) a quasi-experimental study with 2,202 students using the STAR Math test as a baseline showed an overall positive effect. Students that used the intervention produced significant gains of 7.9 NCEs versus those not receiving the treatment only gained 0.3 NCE for a difference of 7.6 NCEs.

A more comprehensive approach to technology implementation occurred with The Apple Classrooms of Tomorrow (ACOT) project. The ACOT project was started to determine the impact of interactive technologies on the teaching and learning process. ACOT supplied teachers and students with an Apple computer both at school and at home. In ACOT classrooms, students and teachers had instant access to an extensive variety of technologies, including computers, videodisc players, video cameras, scanners, CD-ROM drives, modems, and online communications services. In addition, students could use an assortment of software programs

and tools, including word processors, databases, spreadsheets, and graphics packages (Apple Computer Inc., 1995). This project, which involved over 100 schools in an assortment of locations, resulted in a number of assessment reports. An evaluation of the ACOT program from 1987 through 1990 was conducted using a triangulation approach by the University of California; Los Angeles (Baker, Gearhart, & Herman, 1993). ACOT researched the impact of technology in more than 100 elementary and secondary classrooms. The study focused on student learning, assessment, teaching, teacher development, school design, the social aspects of education and technology.

According to Ringstaff and Yocam, (1996) the ACOT project was one of the longest ongoing learning studies of its type providing over a decade of data. Baker et al.'s (1993) findings suggest an overall positive effect on the attitude of both teacher and student. Means (1998) supports these findings by reporting a positive affect in motivation and self-esteem, increased technical skills, the ability to perform more complex tasks, and an increased use of more external resources. She also reports an increase in collaboration among peers, and an increase in communication skills during presentations. As a result of the ACOT program, a shift in how technology was used in the classroom occurred. According to Murphy, Penuel, Means, Korbak, Whaley, and Allen (2002) ACOT classroom used technology available to achieve individualized learning goals rather than strictly focusing on learning programming languages.

Another comprehensive approach to technology implementation was Project CHILD®. Project CHILD® (Computers Helping Instruction and Learning Development) was designed to facilitate motivation, involvement and feedback through engaging students in subject matter activities by providing up to six computer learning stations per classroom (Butzin, 2000). The CHILD model is intended to assist elementary schools with integrating technology through

hands-on learning activities in their reading, writing, and mathematics curriculum. Project CHILD® is in 47 schools in four states; Florida, Georgia, Kentucky and Indiana serving 15,675 students (Aydin, 2005). Project CHILD® research was conducted at Florida State University for children in grades K-5.

Project CHILD® students' achievement in reading and mathematics are compared with the achievement of students not in Project CHILD® as measured by the FCAT (Florida Comprehensive Assessment Test). FCAT scores for 19 Florida elementary school's students in grades 3-5 were examined to determine outcomes for CHILD students in 2007. This data is to be added to the historical record of academic performance for the participating CHILD students tested since 1989 (ISI, 2007).

After a decade long study of Project CHILD®, Butzin (2000), found elementary students consistently had "higher test scores and better discipline than their counterparts in traditional self-contained classrooms". The Institute for School Innovation (ISI) (2007) reports 99% percent of the CHILD students, to include special needs as well as free and reduced lunch students, who had been in CHILD classrooms before the third grade passed the FCAT reading test. This figure when compared to the 86% of all third graders statewide who passed the test supports Butzin's findings.

According to Aydin's (2005) findings, as students approach the mandatory retention benchmark in the third grade, children in Project CHILD® classrooms in primary grades are showing steadfast momentum at curbing failure. In 2006, 14% of Florida's third grade students did not meet the reading passing rate. However, that failure rate was only 1%, for Project CHILD® third graders to include special need students who had been in CHILD classes in the early grades (U.S. Department of Education, 2007). The school average failure rate for the non-

CHILD classrooms across 15 schools reporting was 8% and across nine districts containing these schools the district average failure rate was 12%. At 12 of the 15 schools surveyed, there was zero retention for CHILD students (U.S. Department of Education, 2006).

In the same vein of ACOT and Project CHILD®, the Maine Learning Technology Initiative (MLTI) was developed to put technology into the hands of students and teachers in Maine's 243 middle schools. This program, begun in the fall of 2002, provided every student in grades 7 through 8 and every teacher of these students a laptop computer. The comprehensive approach to this initiative also provided the schools and teachers with in-depth technical assistance and professional development to ensure successful integration of the laptop technology into the curriculum and instruction (Silvernail & Gritter, 2007).

Silvernail and Gritter's (2007) qualitative data suggests that 70 % of the students perceive that laptops have assisted their learning process. The qualitative data also finds that 70% of the teachers share the same perception as their students in that laptops do assist in the student learning process. Both teachers and students agree that the laptops have increased the quality and quantity of worked produced by students.

Silvernail and Gritter's (2007) quantitative data were collected through standardized measures. Grade 8 Maine Education Assessments (MEA) writing scores were examined for the year 2000 and then again in 2005. The average scale score for the year 2000, a year prior to implementation, was 534.11. The average scale score for the year 2005, several years after program implementation, was 537.55. Results indicate overall gain of 3.44 from 2000, for an effect size of .32; demonstrating progress of about one-third of a standard deviation. As reported in the year 2005, the writing proficiency standard on the MEA increased to 41.4% from 29.2% in

2000. Both Silvernail and Gritter's (2007) qualitative and quantitative data find the Maine Learning Technology Initiative had an overall positive effect on writing achievement.

Referencing the successful results of the Maine laptop initiative, the Denver School of Science and Technology (DSST), a public charter high school, is involved in a 1:1 laptop initiative from Hewlett Packard which provides every student with a wireless, networked laptop computer. Approximately 40% of the students are from low-income families and qualify for free or reduced lunch. The school is racially diverse, 35% -White, 29% -African-American students, 25%- Hispanic, 7%- Multi-racial, 2%- Asian, and 1% -other (Zucker & Hug, 2007).

According to Zucker and Hug (2007) the 1:1 laptop program integrates multiple technology and support components. These include professional development, web-based software, on-site technical support and several subject related technologies, i.e. probware. To assess the impact of the 1:1 laptop program, DSST created a Benchmark Assessment Program as a method of measuring individual progress. Zucker and Hug (2007) findings indicate 67% of DSST tenth graders scored proficient or advanced in mathematics which was more than twice the state average in 2007. Additionally, the American College Testing (ACT) scores of grade 11 students were fifth highest in the state.

The qualitative data collected from Zucker and Hug (2007) reveal that 65 % of the students say laptops have had a positive impact on how much they learn and how well they work with other students. Additionally, 90 % of teachers surveyed believe that laptops and the associated technologies have had a positive impact on how they teach. They also believe the improved quality of students' work products and the increase in students' independence as learners directly results from laptop usage. According to Zucker and Hug (2007) neither DSST

faculty nor student body wants to relinquish the laptop program as at least two-thirds now feel that this technology is essential to the learning and teaching process.

The preceding information illustrates many successes with technology implementation in the public school system. There is much reporting on positive affects in technology usage however, there is also a body of literature that suggests technology has had little or no impact as measured by standardized testing.

In 1986 IBM developed a reading intervention program, Writing to Read™, for students in grades K through 1. Using this program students learn and practice phonics, listen to and write stories while rotating through 5 learning stations. Two of these learning stations utilize computer technology to deliver instruction.

In 1991 Robert Slavin completed a meta-analysis of 29 studies of which thirteen were conducted by the Educational Testing Service (ETS) who analyzed IBM's Writing to Read program. Utilizing these results, Slavin (1991) analyzed the reading achievement effects of students receiving the intervention in comparison to equally matched control groups receiving no treatment across 22 school districts.

According to Slavin (1991) the Writing to Read treatment had no positive effect on the reading achievement of first graders. However, according to Schacter (1999) Writing to Read had a moderate positive effect in kindergarten students with a median effect size of .31. None the less, Slavin's (1991) findings indicate effects of Writing to Read on reading achievement were not sustained by students beyond the school year in which they participated in the program.

According to U.S. Department of Education's (2007) Report to Congress Executive Summary, five reading software products were used in a study of first grade students to determine their effectiveness on reading achievement. The software used in the study was

Academy of Reading®, Plato Focus™, Destination Reading™, the Waterford Early Reading Program™ and Headsprout™. All programs focused on increasing abilities in letter and word recognition, phonemic awareness, vocabulary building and word attack skills as well as building reading comprehension. All products provided students with individualized instruction through tutorials, practice and testing with immediate feedback. As a baseline this study used the Stanford Achievement Test, Ninth Edition (SAT-9) and the Test of Word Reading Efficiency (TWRE) scores of 2,619 students in 11 districts and 43 schools. Results indicate test scores were not statistically different from those students who participated in the reading intervention from those who did not.

The differences were demonstrated in effect size units, allowing for the comparison of test score results that were reported in different units. Effect sizes for the SAT-9 and the TWRE were fairly consistent with an average range of -0.01 to 0.06, which translates to an increase of 0 to 2 points in student percentile ranks. This was considered not statistically significant by the researcher. While Hecht & Close's (2002) results report significant positive effects of the Waterford Early Reading Program™, the U.S. Department of Education's (2007) What Works Clearinghouse analysis found that none were statistically significant with an effect size of less than 0.25.

The U.S. Department of Education's (2007) Report to Congress Executive Summary preformed a study to determine the effectiveness of three math intervention programs, iLearn Math™, Larson Pre-Algebra® and Achieve Now®, on sixth grade students. All programs focused on individualized instruction through tutorials, practice and testing with feedback. Topics covered include operations with whole numbers, integers, fractions, decimals, and

percents, probability and data analysis, plane and coordinate geometry, ratios, rates, proportions and measurement.

As a baseline this study used the Stanford Achievement Test, Tenth Edition (SAT-10) math scores of 3,136 students in 10 districts and 28 schools. Results indicate test scores were not affected by amounts statistically different from zero. Effect sizes for the SAT-10 had an average score 0.05

In 2004, the Fullerton School District in Orange County, California initiated a one-to-one Laptop for Learning program at three district schools with more than 1,000 students (Warschauer & Grimes, 2005). This pilot program provided Apple iBook laptop computers to 554 students attending Nicolas Junior High School, 395 students at Robert C. Fisler K-8 School and 62 Gifted & Talented Education (GATE) students at Hermosa Drive Elementary School. According to Warschauer and Grimes (2005) the program provided all hardware, software, technical support, professional development and wireless Internet access needed to successfully implement the initiative. At the start of the next academic school year, the initiative was expanded to include four schools, Nicolas Junior High School, Robert C. Fisler K-8 School, Hermosa Drive Elementary School, and Golden Hill Elementary School. This increased the study to more than 2,000 students (Donovan & Grimes, 2006).

This study used a matched cohort approach to avoid discrepancies in student population from year to year and to account for changes associated with the initiative. As a baseline, this study used the California Standards Test (CST) scores for students who were 7<sup>th</sup> and 8<sup>th</sup> graders in the year 2006 against the matched cohort of 6<sup>th</sup> and 7<sup>th</sup> graders in 2005 (Donovan & Grimes, 2006). Results indicate English Language Arts (ELA) test scores improved an average of 1.2 points more in two schools than the other schools, however, was this was shown not to be



statistically significant. While Donovan and Grimes (2006) found this program to be successful in promoting 21st century skills and resulted in more collaboration between students as well as an improvement in the quality of work, the CST ELA scores were statistically insignificant and provided no direct substantiation of improved learning through the Laptops for Learning program.

Using a research approach that went beyond the examination of standardized test scores Matzen and Edmunds (2007) explored the correlation between technology, constructivist classroom practices and the type of the professional development received. They investigated the possible impacts of incorporating a professional development program within the context of student-centered, computer-based technological practices. This type of professional development focused these instructional practices into the everyday curriculum of the classroom teacher, therefore, transforming the curriculum delivery method from the traditional instructional model to a constructivist model.

According to Matzen and Edmunds (2007) in order for this transformation to occur, teachers must first recognize how technology amalgamates with both the content of the curriculum and pedagogy. The purpose for providing this professional development is to present a catalyst for change with the intent for teachers to broaden their technological instructional practices rather than using technology solely for clerical classroom purposes. This approach to technology integration reengineers the traditional approach to instruction and learning for both the teacher and the student.

Research has shown that technology is changing both teacher and student roles in the classroom. As the students acquire a knowledge base about the technology, the teacher's role becomes more facilitative (Matzen & Edmunds, 2007). The tendency for teachers to use

technology from a long-established teacher-centered point of view stems from the lack of awareness about the technology itself. Once the teachers become familiar and at ease with the technology, they can begin to integrate the technology into the curriculum and use that technology as an incentive to experiment with innovative instructional practices.

Matzen and Edmunds (2007) further explore a specific professional development program, The Centers for Quality Teaching and Learning model (QTL™) that would provide the opportunity for a faculty to become familiar and at ease with the technology that is available. QTL™ is a rigorous staff enrichment program that occurs seven hours a day over the course of seven days. QTL™ models the relationship between the use of computers, instructional practices, and the curriculum (Matzen & Edmunds, 2007)

In the initial days of the staff development process, the teachers take on the part of the student in a hands-on environment; this supplies them with the necessary practice to become familiar with the technology. QTL™ provides activities that have been established from the standard course of study and are associated with how students gain knowledge; all the while connections are being made between the curriculum and technology. The last 14 hours of training is for maintaining comfort levels and addressing curriculum and technological issues that unexpectedly arise during the training process.

The results indicate that change is occurring. The QTL™ program models effective technology integration for the teachers regardless of prior teaching approaches. Technology can be a catalyst for change providing there has been an adequate amount of training and proper technical support throughout the implementation process. In reviewing the QTL™ model, the components of on-site support for both technology and classroom implementation of new curricular approaches should be emphasized to truly realize the change in curriculum delivery

the training model attempts to effect for the classroom teacher. This approach to curriculum has the capability to transform all teaching and learning in the classroom.

Technology has had a profound impact on teaching and social interaction within the classroom (Kirby and Kaillio, 2007). Teachers have found that using computers, digital media, and other computer related technologies can capture and grasp students' interest (Shelly et al. 2008). White, Ringstaff, & Kelley (2002) stated, when proper specifications are in place "computer-based technology can play a significant role in contributing to a positive, productive learning experience".

While Anderson and Ronnkist (1999) state drill-and-practice software applications are still the standard use of computers in public schools across the nation and did not find much impact on the teaching and learning process as a result, findings by Colombo and Colombo (2007) present a different view. New Read/Write technologies available to the classroom such as blogging can increase instructional time by supplying teachers with a user-friendly online format to reinforce strategies, establish new subject matter and ideas, review essential information, review for exams, and provide enrichment. The next chapter will discuss conclusion and recommendations.

## Chapter 4

### CONCLUSIONS AND RECOMMENDATIONS

#### Introduction

In the preceding chapters the researcher has explored prevalent technologies currently used in American public schools as well as the effects of technology implementation across the nation. Chapter 1 presented a statement of the problem for the researcher; is technology integration into the classroom having an impact on student learning? Using this question a plan was developed review the pertinent literature on the implementation of technology. To narrow the focus of the study a definition of technology was developed. The definition was comprised of a list of computer based technologies that are currently in use in today's public schools. Chapter 1 also presents a history of technology integration into the classroom.

Chapter 2 presented an overview of technology use in the classroom. It presented research as to what is available for today's classrooms as well as how it is used. The researcher found that certain technologies were used by students, teachers or both. These distinctions were presented as locus of control student, locus of control teacher and those that have a shared locus of control. The value of technology integration changes drastically depending upon the locus of control examined.

Chapter 3 focused primarily upon research pertaining to the impact of technology integration into the classroom. Examined was the research pertaining to hardware, software, and programmatic interventions in the classroom. While statistical analyses of standardized test scores in most instances revealed no significant impact, qualitative analysis of other factors revealed that technology incorporation has improved the overall quality of the learning and teaching environment for students and teachers.

Based upon the findings of these chapters, chapter 4 will present conclusions pertaining to effective implementation of technologies currently used in American public schools as well as factors contributing to effective technology implementation. This chapter will discuss the researcher's insights about technology integration as well as recommendations for further research.

## Conclusions

The impact of computer-based technology and information about computer-based interventions has been found to have a positive affect on student learning, engagement, and motivation. Successful technology integration into the classroom depends upon several factors; the technology must support the curriculum, provide sufficient professional development for teachers, provide a solid infrastructure to support the technology itself, and willingness of participants to use the technology properly. It has been found when these factors are met positive student outcomes are achieved and qualitatively measurable.

Research indicates that in most instances, technology being used in the classroom does have an overall positive impact on the learning environment. Studies show that students are more actively involved in their learning and are taking a proactive role in the classroom. As a result of technology implementation into the classroom, students are able to take responsibility for their own learning, use self-assessment and reflection to improve performance and communicate progress towards the achievement of curriculum standards. In a technology focused classroom, discipline issues are curtailed and teachers are able to provide students with quality higher-level thinking lessons. This lends itself to students working more collaboratively with one another and producing quality work products.

Research suggests students are eager to use technology in the classroom setting similar to their expectation to use technology outside of school. Research also reveals teachers can either be eager or hesitant to use technology in the everyday classroom setting depending upon the curricular and technological support provided. The preceding fact has also been attributed to student success when using technology in public schools. An obvious conclusion of these statements is that when technology integration is purposed towards a specific curricular function or affective student goal, overall positive results occur.

Research indicates that a positive effect of successful technology integration is the shift in teacher roles. Teachers are less likely to lecture and more likely to facilitate. Not only has technology improved the quality of learning that occurred in schools that have embraced it, but it has enhanced entire communities as well.

An example of broader ramification directly resulting from technology integration is the 1:1 laptop initiative in Fullerton, California. The mayor provided city-wide wireless Internet connectivity so all students could partake in the piloted program. In this instance not only did the technology initiative create an opportunity for enhanced authentic learning, but it increased the quality of life for all residents living within the city.

The key to getting 100% buy in from teachers is to have all staff be very comfortable with the technology initiative. Unfortunately most teacher education programs, until recently, did not dedicate a significant amount of teacher training to technology. One finds that many veteran teachers may not be as comfortable using technology as a more recent education graduates may be. It is important for all involved in integrating technology into the classroom to have a profound understanding of the many aspects and nuances technology usage can bring to

the classroom. This understanding can only be developed through appropriate technology-based curriculum staff development

Technology can be used to augment student interaction with the curriculum as well as enhance student products. To effectively integrate technology, time and monetary resources must be devoted to increasing staff expertise in technology use. Through staff development that is grounded in the curriculum, teachers must be afforded the opportunity to first master the technology that is to be implemented. This creates a foundation so that technology can be used organically to support effective learning and have a positive effect on student outcomes.

A primary issue of concern for administrators and policy makers in general, in determining whether or not to implement technology, is the lack of statistically significant results as measured by standardized tests. It is difficult to measure technologies effects using standardized tests because all too often standardized tests do not measure all the cognitive aspects of student learning that are involved in technology integration. Research suggests that many of the positive influences of technology integration, while not measured by quantitative analyses of standardized tests, are revealed by qualitative studies.

While not usually addressed by standardized tests, qualitative approaches to data can measure discipline, collaboration and overall quality of student productivity. These factors take into account expectations students will face in the world of work after graduation.

Another factor to consider concerning standardized tests is that these methods of assessment may be antiquated when one considers the demands of 21<sup>st</sup> century work place. At its best, the educational system provides students with technology that gives instant feedback, instant access to information and instant access to peers and curricular experts. The educational system then asks students to take a standardized test which is paper and pencil based, takes the

better part of a week to complete and the better part of a year to receive results. Even when standardized test are presented in a web-based format, the method in which the learning is assessed may not correlate to the methods students use to acquire and apply knowledge.

This paper demonstrates that technology implementation is more than just students using computers. It is a combination of administrators, teachers and curricular standards integrated with effective technology use that creates an enhanced learning environment. Student interaction within this environment helps them to successfully gain the 21<sup>st</sup> century skills they are expected to demonstrate in the current global work force. Existing measures of assessment often fail to quantify the educational nuances of this environment that directly supports student growth when acquiring these skills.

#### Recommendations for further research

A recommendation for further research pertains to the introduction of WEB 2.0-based education. WEB 2.0-based education in its earliest stage offers astonishing potential to the teaching and learning process. Research on these new technologies may reveal that our current approaches to technology integration may be as antiquated as the methods we currently use to assess student learning after technology implementation. Twenty first century workplace skills require students to be knowledgeable and proficient in a technology-based collaborative environment. These skills may not be developed or appropriately assessed in the current way we use technology and assess student learning. Therefore, further research is needed to be done on the newer technologies to determine the effectiveness and total impact of WEB 2.0 and 21<sup>st</sup> century technologies.



## Recommendations for policy makers

When considering technology implementation, school administrators as well as policy makers should ask themselves the following questions:

- What design will be most cost effective and feasible with the existing learning environment?
- What design can best accommodate the evolving methods of integrating technology into curriculum?
- What improved methods of evaluation will be used to determine results achieved through this integration?

It is clear that the implied learning expectations for students do not always match the methods of assessment presently used today. New methods of assessment will have to be developed, especially if continued technology implementation will be tied to student learning outcomes. Technology infusion in the K-12 classroom holds promise for providing best educational practices so that all students become productive members of the 21st century global work force.

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