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## Laptop computers in the K-12 setting : the effect on instructional strategies and student learning

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## **Laptop computers in the K-12 setting : the effect on instructional strategies and student learning**

### **Abstract**

Research has shown the benefits of computers. But mobile computing by the use of laptop computers has only recently been studied in K-12 classrooms. This review paper discusses various research studies that focus on how laptop computers affect student learning, how laptops affect instruction, teachers' perceptions about using laptop computers, and specific school districts that have implemented laptop computers into their curriculum. Overall, the research shows that laptops are more convenient and meet educational objectives once teachers and students adapt to the new technological way of learning.

**Laptop Computers in the K-12 Setting: The Effect on  
Instructional Strategies and Student Learning**

**A Graduate Review**

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**By**

**Sarah Merriam**

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This Review by: Sarah Anne Merriam

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## *Abstract*

Research has shown the benefits of computers, but mobile computing by the use of laptop computers has recently been studied in K-12 classrooms. Belanger (2000) indicated that organized laptop programs in higher education date back as far as 1988. In K-12 classrooms, however, laptops are rarely used due to the difference in curriculum standards. Waskowitz (2001) mentioned that even K-12 students could be impacted with distance learning produced with laptop computers by the impact of the Internet.

Waskowitz clearly described what our nation is facing today, "Let's get out our laptops and hook up to the Internet is now replacing the let's open up our notes and textbooks."

This review paper discusses various research studies that focus on how laptop computers affect student learning, how laptops affect instruction, teachers' perceptions about using laptop computers, and specific school districts that have implemented laptop computers into their curriculum. Carter (2001) mentioned the over all theme that is mentioned with research about laptop computers. This theme is found to be one-to-one computing revolutionizes the way teachers teach and the way students learn a desirable and essential outcome for the digital age we live in today. Overall, the research shows that laptops are more convenient and meet educational objectives once teachers and students adapt to the new technological way of learning.

## *Introduction*

With the initiation of microcomputers in 1977, computers have become increasingly widespread in K-12 classrooms (Belanger, 2000). According to Belanger, most schools have been looking at mobile computers or laptops in their classrooms for last decade. Belanger went on to include that organized laptop programs in higher education date back as far as 1988. Then, in the 1990s, laptops were first seen in private schools in the United States. Belanger concluded with the idea that in 1996, Microsoft began a program with Toshiba in Australian schools. Waskowitz (2001) mentioned "Distance learning is one of the most rapidly growing aspects of education and training in the world today." Thus, he mentioned that even K-12 students could be impacted with distance learning by the impact of the Internet. Waskowitz clearly described what our nation is facing today, "Let's get out our laptops and hook up to the Internet is now replacing the let's open up our notes and textbooks." Waskowitz showed that students can clearly learn at home, school, or on vacation and never get behind with make up work. Many examples that the author of this paper will site have been reviewed to see how laptops affect instructional strategies and student learning.

Stolarchuk and Fisher (2001) stated that many studies describe mobile computers having a beneficial effect on student achievement as well as on motivation, teacher's strategies, and the whole classroom environment. On the other hand, Stolarchuk and Fisher stated that mobile computers are often not used in schools. Yet, their study suggested that most computers in schools are not available at convenient times or places or the equipment is old. Thus, making laptop computers convenient to use. According to

Rockman (1998), since the Microsoft, "Anytime, Anywhere Learning" project much emphasis has been placed on mobile computers or laptops.

The school district where the author of this literature review is currently teaching has a Wiatt-Harkin Technology Project that is being implemented in the first, second, and third grade classrooms. The project started in the 2000-2001 school year. According to Thadani and Vandersall (2002), the participating schools are currently in their third year of the project. The Wiatt-Harkin Technology Project is designed to increase students' reading performance through intensive use of technology. Three schools in two districts are participants. Also, Thadani and Vandersall indicated that all three schools are being evaluated by the North Central Regional Educational Library's (NCREL) six Essential Conditions for success with educational technology. A. Dea (personal communication, January 21, 2003) is the media specialist at one of the three schools in the project. Thus, to grasp a better understanding of laptops in the classroom, by reviewing the literature, the author can relate ideas back to the school district.

Loschert (2003) wrote an article about mobile technology in the classroom. The article addressed states in America setting technology requirements for schools. Loschert showed that in 1994, 35% of public schools were connected to the Internet, while in 2001, 99% of the public school classrooms were connected to the Internet. Thus, showing the increasing need for teachers to be trained and knowledgeable in technology. This review discusses various districts that are using laptop computers in their school districts.

### *Methodology*

In this review, collecting reliable information for the research paper involved reviewing multiple sources. Having a diverse collection of resources allows for the



process of determining which research articles are reliable and which are considered insignificant. The following paragraphs describe specific research locations and the procedure of obtaining reliable information.

Gathering research information for laptops in the K-12 classroom was initiated by a discussion with A. Dea (personal communication, January 21, 2003) about the program that has been implemented in her school building. Thandani and Vandersall (2002) published the research for the Metiri Group about Dea's elementary that was implementing laptop computers in the first, second, and third grade classrooms. The Metiri Group is an education-technology consulting firm in California. Dea would be a reliable source to draw information from due to her credentials, work performance, and job title. This example of the implementation of laptops is evident in the school district that employs the author of this paper. Having the initial discussion with Dea sparked interest as to what benefits are laptops bringing to the classroom.

A. Dea's (personal communication, January 21, 2003) research from the Metiri Group and several research articles from EBSCOhost were obtained examined to write the review paper. A phone interview with a teacher at the Price Laboratory was used as a primary source, as well. The following paragraphs describe each source where reliable information was obtained

The Council Bluffs Public Library was another valuable source for information that was assessed. There were many articles that were found on EBSCOhost. EBSCOhost is an electronic database of research journals. The descriptors that were used with this online research journal database were as follows "laptops and K-12", "laptops in the classroom", and "mobility computing in the classrooms." Three online journal articles

that discussed examples of districts using laptops in the classroom were collected. thorough review of the articles and selecting the ones that are credible was initiated.

The Fox 42 News (2003) in Omaha, Nebraska had a special report about computers replacing books. The news special was taped and some examples from the program will be cited in the analysis and discussion part of this paper. This news station is trusted in the metropolitan area. The news researched and interviewed educators in the area validating the information. However, the Fox 42 News source is a limited source used in the paper.

The University of Northern Iowa Rod Library electronic resources were accessed. A couple of articles from the electronic sources provided by the Rod Library were obtained. One article was from the ERIC database for educators. The other was from the journal *Issues in Educational Research*. Some descriptors that were used with this database of journals were "laptops," "laptops and classrooms," "education and computers", and "students and laptops." Many descriptors were used due to some that produced information not related to the research topic. This source is credible due to the credibility of the University and the recognized publication journals. All sources from the Rod Library were considered useful and reliable by the author of this literature review.

An interview over the phone with a teacher at the Price Lab School located on the campus of the University of Northern Iowa was used to gather information about laptops in the classroom. The Price Lab instructor, K. Nelson (personal communications, March 16) discussed benefits and disadvantages about teaching and using laptops in the classroom. Nelson was a very reliable source and was discovered by a professor at the University of Northern Iowa, which supports his credibility.

The above locations where research was collected were all considered credible due to the fact that some of the research was observed and interviewed by teachers currently in research programs implementing laptop computers in the classroom. Primary sources make the sources credible. Most information was obtained from research articles located in public libraries, Internet databases, and personal communication with knowledgeable employees in educational institutions.

### *Analysis and Discussion*

The author of this paper will address the following topics in this literature review:

1. How the use of laptops affects instructional strategies
2. How the use of laptops affects student learning
3. The perceptions from teachers and students involving laptops in the classroom
4. Specific studies on school populations using laptops

As the author looks at various studies throughout the literature review, the four questions presented above will be analyzed and discussed thoroughly.

#### *How the use of laptops affects instructional strategies*

Many research studies indicated project-based instruction into curriculum that involves laptops in the classroom. According to Rockman (1998), Microsoft's "Anytime Anywhere Learning" program showed a majority of teachers participating in schools with laptops in the classrooms reported an increase in both cooperative and project-based instruction in their second year of laptop instruction. A. Dea (personal communication, January 21, 2003) stated, "I think instruction in a laptop classroom is more project-based than textbook-based. As access became greater, I think textbooks became more of a reference tool than the tool that drives instruction." Dea works with Thadani and

Vandersall (2002) to produce the Waitt Family Foundation/Harkin Technology Project in Iowa to two mid-size elementary schools, specifically first, second, and third grade classrooms. The project incorporated a rural elementary and an urban, inner city elementary. During the second year evaluation of the program, Thadani and Vandersall reported that both schools showed strong pedagogical practice with technology, projects-based instruction, open-ended learning objectives, and activities that fostered student engagement and self-direction. They reported evidence of teachers asking higher-order thinking questions and encouraging student reflection. The teachers were also modeling collaboration and cooperation skills to the children. These skills went further by having teachers develop lessons that integrated social studies and writing skills by using the technology.

Two research studies discussed laptops in the science classrooms. Stolarchuk and Fisher (2001) conducted a study that dealt with laptops in the science classrooms. Teachers from this study were interviewed about why the laptop student group did not have better cognitive achievement scores than the non-laptop group. Flick and Bell (2000) mentioned in their science study, "Technology modeled in science education courses should take advantage of the capabilities of technology and extend instruction beyond or significantly enhance what can be done without technology."

From teacher comments reported back to the research studies, the conclusion was that effective student learning was dependent upon, effective staff training. The teachers' comment from Stolarchuk and Fisher (2001) indicated that the students were occupied with computer instruction instead of paying attention to the science content. Stolarchuk and Fisher pointed out that instruction for teachers is necessary before implementing the

laptops, so that the curriculum focuses on integrating the technology of laptop computers effectively into the content areas. A. Dea (personal communication, January 21, 2003) also mentioned that she trains her teachers that are using the laptops in the first, second, and third classrooms at least twice a month. Loschert (2003) stated that training is very important when it comes to using the laptops effectively in the classroom. She stated "Although 99 percent of schools have access to the Internet, only about one-third of current teachers describe themselves as "well-prepared or "very well-prepared to use laptops or the Internet for instruction, according to the Center of Education Statistics."

The study by Smith (2002) reported an indication of various techniques of using laptops into the curriculum. Smith (2002) reported the use of laptops in McKinney, TX at the middle school level. The report indicated that laptops were most often used for research purposes. Students used the laptops for networks to locate information on the Internet and Web-based subscriptions. Also, the students in Texas used the laptops with software for multimedia presentations, such as PowerPoint. Thus, project-based instruction is evident from reports by Smith.

Other studies showed using the Internet as an instructional strategy was increased with the use of laptop computers. Waskowitz (2001) reported that adding the Internet to explore makes connections to the real world for student's interpretations. Waskowitz's example is having the students working with literature. When they look up the meaning of the literature on the Internet, the students make connections that make learning limitless. Thus, the teacher was the facilitator in the instruction of Internet lessons used with laptop computers. Brooks and Crippen (2001) developed a web site for descriptive chemistry quizzes. Brooks and Crippen wanted to produce a linear fashion of instruction

with each question. The web site produced results that showed presenting one question at a time helps lower the students' cognitive load or working memory so that students can pick up the abstract thinking and difficult content. Brooks and Crippen indicated with their web site the importance of Internet instruction on school and home learning. Waskowitz and Brooks and Crippen all stated that the teacher's role became the facilitator with laptop instruction. Smith stated that the teacher's role changes along with the curriculum across the content areas.

Research indicated that the use of laptop computers produced instruction that was individualized for each student. Rockman (1998) stated that the Microsoft "Anytime Anywhere Learning" program showed that the laptops help teachers have more individualized instruction for students with a wide range of needs and learning styles. Thus, individualized instruction through laptops better supported at-risk students.

Rockman (1998) also indicated that Microsoft showed in the third year of study that laptops encouraged collaborative work between students. Also, the third year also indicated that teachers used more constructivist instruction. In Microsoft's second year, 1997-1998 school year, they showed students involved in collaborative work and project-based instruction.

The Microsoft second year research conducted by Rockman (1998) supported what most of the studies (Smith, 2002; Waskowitz, 2001; Loschert, 2003) have indicated with laptops affecting instruction. Microsoft stated in the second year that laptops produced more teachers as facilitators, less lecturing, and more student-centered learning.

Research studies reported that classroom management became easier with students more involved in their learning. At the University of Northern Iowa Price

Laboratory, K. Nelson (personal communication, February 24, 2003) stated that once students learn the components of the computers then instruction of content is easily introduced using the laptops effectively. He also mentioned that classroom management was much simpler, thus creating more time for instruction. Waskowitz (2001) stated that classroom management during instruction became easier in computer, student-centered classrooms due to the students engaged in their learning. He stated that the classroom management led to impatience by the students about technical problems produced by the laptops. This supported the claim suggested by K. Nelson.

Overall, each of the above research studies showed that the most frequently used instruction with laptops in the classroom is project-based, leading to less teacher-directed instruction and more student-directed learning. Thandani and Vandersall (2002) reported that classroom management during instruction has declined. The outcome in their study the second year was eight out of the twelve classrooms observed minimal classroom management problems.

Fox 42 news (2003) produced a program that showed students actively engaged with few classroom disruptions. The reporter mentioned the idea that students were used to being on video games at home and that computers could be a lot like the video games. The school administrator replied on the news report that laptop computers were bringing a sense of real-world connection to the students that sometimes could not be elicited by books or lecture lessons by the teacher.

#### *How the use of laptops affects student learning*

An increased level of achievement was shown at the elementary level in one study that took place in Iowa. Thadani and Vandersall (2002) showed in their report, from the

elementary level, that students with laptops showed a heightened level of achievement. The reading achievement that they were researching did not change, but students' increased positive attitudes to learn, became self-directed learners, technology-efficient, and technology fluent. The students showed a huge increase in peer assistance, especially when the other students needing help wanted help for technological problems. There was also a slight increase in Iowa Test of Basics Skills. A. Dea (personal communication, January 21, 2003) stated that she would like to look further at the results produced in the three year of Thadani and Vandersall's research with laptops in Dea's elementary school.

Rockman (1998) showed that Microsoft's "Anytime Anywhere Learning" program by Microsoft in its third year of research indicated laptops facilitated a cross-curricular learning in writing. Students were becoming better writers, specifically in editing their writing. One teacher in the Thadani and Vandersall (2002) research indicated that at the end of the second year of the study her third graders were becoming better writers as well. With the Microsoft study, students were also shown to have become more confident in their computer skills. The teachers in this study noted that students were choosing to do longer projects with more in-depth research. Microsoft indicated that they had a difficult time gathering test scores from students and schools because some took the test and others didn't. The difference in standardized test scores in both the Microsoft study and Thadani and Vanderall's study were not statistically significant. The tests were not designed to support project-based, student-centered learning that is mainly delivered with the use of laptop computers. Also, both studies were only in their second year when any comparisons of standardized test were recorded.



In Waskowitz's (2001) research students were attempting to refine their own writings. The students saw how easy it was to complete a final draft by using computer skills integrated reading skills to edit their papers to complete a final draft on the computer. Waskowitz reported that at William Penn Charter School, the overall growth that students made from September to December was significant. Waskowitz stated, "Students in the pilot program have become quite comfortable manipulating a fairly complex technological medium that can enhance their own abilities to think, write, and read in increasingly powerful ways. The turning on of laptops has opened doors." The computer brings the added sense of motivation to the students is the result of Waskowitz's, Microsoft's, and Thadani and Vandersall's research.

Pascopella (2001) gave more examples of learning taking place with laptops. Her focus was on laptops replacing textbooks. Pascopella primarily discussed the idea of learning with laptops being implemented at home, school, and in vehicles. She indicated students at Stephen Hayt Elementary School in Edgewater, Illinois used laptops in the cafeteria, auditorium, and outside. Thus Pascopella indicated that Stephen Hayt Elementary School was implementing laptop computers as a distance education component to the school. The students were learning about the world around them and during their own time. Waskowitz (2001) indicated that distance education involved learning everywhere. Laptops added to the idea of distance learning in the K-12 environment.

Pascopella also identified a school district that was called the Discovery Charter School that used laptops to show students that learning can become global. Students at the Discovery Charter School learned using Compaq notebooks. The students learned

about world events or vocabulary from the New York Times web site, kept track of personal health diets and fitness charts, and connected to San Diego's NASA space program to learn about space exploration and astronauts. Pascopella added at the end of the research that virtual classroom trips are also accessed with laptops to promote a more diversified learning environment. Waskowitz (2001) stated that "The mobility is fantastic, you are not stuck against a wall, but can be anywhere, writing, saving files, having access to files, Internet research, and share information with other people."

After reviewing positive reports of laptops in the classroom increasing learning, one report by Stolarchuck and Fisher (2001) stated that learning more science concepts in their study with laptops in a science classroom was not true. The students did not learn better or more science content. The skill of creating graphs and tables rose with students. However, their test had students do a paper/pencil test just like their non-laptop counterparts, making statistics a little unreliable. Fischer mentioned that this could have something to do with the statistical results of learning enhancement. Most of the learning enhancement was increased motivation to learn. Students in the study done by Stolarchuck and Fisher concentrated more on their computer skills, than on the science content. The Fox 42 news (2003) reported that students at the beginning of a computer program or course tend to focus on operating the machinery perfect, before worrying about subject content and material.

Carter (2003) reported on a laptop computer integration project that was happening in the states of Maine and New York. Carter showed that in 1998, the Metropolitan Achievement Test score of students in the laptop computer integration program was 64.9%, while the score for the students not participating in the laptop

computer integration program was 48.9%. In addition, Loschert (2003) reported increased standardized tests scores with the integration of laptop computers. Each researcher noted that student's motivation and computer skills became increasingly better with laptops integrated into the classroom. In addition, the studies showed that students preferred the student-centered instruction to increase their cognitive abilities.

#### *The perceptions from teachers and students involving laptops in the classroom*

The study by Rockman (1998) found in Microsoft's second year of laptops in the classroom that teachers were more confident in using technology and actually enjoyed using the technology with their students. Teachers also noticed an increase in student motivation to learn, an increase in problem solving tasks, and more collaborative projects that increased student enthusiasm. The teachers also stated that if a school district were to implement laptops in the classroom they must consider establishing support for students, teachers, and parents. Moreover, the need to consider allowing enough time for integrating the new capabilities into the curriculum, managing technology, and establishing new assessment and evaluation strategies were addressed. The teachers also mentioned that schools starting a laptop integration program should consider setting a timeline for staff development, so that goals are set and reached. A means for sharing project-based, successful lessons with other educators was provided for the teachers participating in Microsoft's "Anytime, Anywhere Learning" program. Lastly, the teachers of the Microsoft program reported that they noticed in the second year that their teaching styles were changing. The first year of teaching with the laptops was difficult for most teachers to adjust to the student's enthusiasm, as well as newly formed assessments integrated into the existing curriculum.

Rockman (1998) reported teachers' and students' assessments of the "Anytime, Anywhere Learning" program. The teachers believed that laptops benefited all types of learners. They are the most helpful for advanced students; yet also reach students with special needs. The teachers liked the idea that they can have students work at their own pace and ways that interest them. Thus, the students showed more independence in their learning. Teachers named advantages of laptops in the classroom. Some were greater efficiency, immediate learning, increased work time, and an extended school day. Students in the Microsoft research program, "Anytime, Anywhere Learning," reported that they preferred to use computers to do school work, and the computers make the work fun and interesting. Laptop students also found more meaning in their projects that involved computers and/or the Internet compared to non-laptop student according to Microsoft. Rockman went on to mention in his study that changes in student attitude, motivation, and behavior were seen within a very short time. In addition, teachers perception of laptops in their rooms were that it was a tool that helped with individualized instruction and reaching various learning styles.

Rockman (1998) reported for Microsoft's "Anytime, Anywhere Learning" program that five models of laptops were currently in place at the K-12 level. The five are as follows: concentrated-each student has his or her own laptops for use at home or school, class set at school and shared among teachers, dispersed in any given classroom with not every student having a computer, desktop computers where only a few students are assigned a computer, and mixed combinations of the other four types of models. The report by Rockman reported that each model had advantages to them with instructional benefits and savings. The Microsoft program reported that some planning needed for

schools initiating laptops should be implemented to establish support to the school staff and in the community, allow sufficient time for integrating technology into the curriculum, and provide a means to which teachers can share results and successful lessons with other teachers/staff. Likewise, the other studies reviewed by the author of this literature review the Microsoft program reported teachers believing that laptops in their classrooms had a positive impact on students' cognitive abilities. Thus, analytical thinking and manipulating information was increased with laptops.

Waskowitz (2001) reported what teachers had to say about having laptops in their classrooms. For example, an eighth grade Spanish teacher wrote, "All my students did a better job on this assignment than usual. There was no loss of time or disruption going to the computer lab. The students were in a comfortable environment and it was a lot easier for them to partner at the desks. The students really like using the laptops and the assignment seemed fun to me as well as them." Yet another teacher mentioned that laptops were fine, except for the idea that the batteries do not last long. Thus, causing the teachers to move desk closer and thus plugging in the computers, yet they remain on the child's desk.

Waskowitz (2001) reported that teachers did not pay attention to the technical problems. Waskowitz reported that students became quite comfortable in the laptop classroom quickly. In addition, he warned of a disadvantage with laptop computers. This disadvantage was the idea of laptop failure, due to short-lived batteries. On the other hand, Waskowitz mentioned that teachers thought that the mobility was fantastic and equitable and outweighed the technical problems.

Stolarchuk and Fisher (2001) stated that teachers stressed the importance of an effective science laptop program. An effective science laptop program would use the laptops to teach, assimilate, interpret, and comprehend scientific knowledge. The laptops should not be used just to present data and produce reports. Stolarchuk and Fisher (2001) mentioned that laptops provide a more convenient way of accessing knowledge, than desktop computers.

Thandani and Vandersall (2002) indicated perceptions from teachers and students of laptops in the classroom were parallel to each other. Both teacher and student indicated that there was a positive attitude toward academic work. In the second year of the Wiatt-Harkin Technology Project, the teachers and students indicated that they were more comfortable with the laptops than they had been previously, planning was easier, writing skills appeared stronger, and more dependence on the Internet. Teachers did raise a concern in the second year of the Thandani and Vandersall's study. The teachers were concerned about how much support-time they would receive in the next year of the grant. Also, keyboarding skills were interrupting students' thoughts. The students were more focused on finding the keys than on worrying about the correct spelling or punctuation. One teacher's comment was, "I would hate to teach without the laptop computers. I don't think I could go back to the old way." K. Nelson (personal communication, February 24, 2003) also backed this statement. He stated that he loved teaching with the laptops. A. Dea (personal communication, January 21, 2003) stated that the computer was becoming the overhead to what teachers moved onto after the chalkboard. She went on to mention that technology continues to evolve throughout time.

Two research studies indicated that teachers would not try to teach without the laptop computers. Loschert (2003) reported that a teacher from Omaha, NE stated, "Now that I've had a taste of the classroom that I've always imagined, where students each have their own computer and collaborate and work together. I can't imagine teaching without them." In addition K. Nelson (personal communication, February 23, 2003) from the University of Northern Iowa Price Lab addressed that he would much rather teach with the laptops, than without. He mentioned that discipline problems have been fewer and fewer with the use of the laptop computers.

Furger (2001) reported that Mott Hall, a math, science, and technology academy in New York Community School District Six had implemented laptops in the classrooms. They do primarily project-based instruction. The staff professor of this project was Marc Brillar. He stated, "We had staff members who bought into this immediately, and we had staff that needed to be persuaded." Mr. Brillar also stated that his staff started out with changing the curriculum to meet the laptops, but now are looking into adding more technology such as handheld pcs that can download information to the laptops. He commented on the fact that teachers were starting to feel comfortable about technology.

The above research studies all suggested that teachers' perceptions of what was transpiring in their classrooms were consistent with the benefits of problem-solving and student-centered learning. The studies also included that full-time access to laptop computers increased students' positive perceptions of learning. Thus, the computers motivated them to learn and think critically.

*Specific studies on school populations using laptops*

Carter (2001) stated that when two huge metropolitan areas such as New York and Maine decided to implement laptop computers, then the country followed. This is what American schools have gone through the last few years. Carter also addressed that with the President Bush's plan of "more freedom, more accountability", laptop programs are being viewed as an effective strategy to address the poor attendance, lower achievement scores, and equal access to technology among all students. The laptop program impacted student learning and teacher instruction. The above sections addressed by the author of this review have shown the instructional strategies and student learning that is taking place with laptops programs. The author in this section will identify specific examples of schools working with laptops in the classrooms.

Thadani and Vandersall (2002) were in charge of presenting the research produced by the Waitt Family Foundation/Harkin Technology Project in Iowa to two mid-size elementary schools, specifically first, second, and third grade classrooms. The project incorporated a rural elementary and an urban, inner city elementary. With this grant the first, second, and third grade classrooms have laptop computers in each room. Both schools have reported seeing positive results. The author of this review toured the urban, inner city school that had laptops present and interviewed A. Dea (personal communication, January 21, 2003). This tour was after school, however, the author reported students staying after school to work on projects, and first grader was asking the teacher a computer question before leaving, another first grader was asking about the laptop lesson that they were going to work on the next school day. The teacher also presented PowerPoints, webquests, papers, and other projects that had been done using



the laptop computers. This presentation of student work indicated the research-based project-based learning is accurate with studies involving laptop computers.

According to Furger (2001), Mott Hall School, located in New York Community School District Six, reported specific students involvement with laptops. The school adopted laptops in 1996. The principal stated “ We saw the introduction of laptops as a wonderful opportunity to reexamine and to confront the Digital Divide.” One science example used at Mott Hall that Furger reported involved students dropping a temperature probe into a beaker and connecting it to a laptop computer that records the temperature, graphs, and charts the changing water temperature. Furger mentioned that this technological equipment lets students work with similar devices that scientists work with everyday. In every room at Mott Hall, the laptops were used for students to access the Internet, play a chess game against a faraway opponent, or edit a multimedia presentation.

K. Nelson (personal communication, February 24, 2003) reported that at the Price Laboratory School at the University of Northern Iowa the students were using the laptop computers to develop web pages. He stated that students became impatient when the laptop computers did not do what they wanted them to do. In addition to web pages, students worked on webquests. Thus, the Price Lab showed the idea of laptops providing a project-based instruction that educational research supported.

Loschert (2003) reported the use of laptops, pocket pcs with keyboards, and probes in Mr. Vincent’s fifth grade classroom at Willowdale Elementary School in Omaha, NE. This school has implemented handheld pcs and keyboards for each student in the class, rather than still using laptop computers. Loschert shows how one student

downloads her homework that she did at last night onto a laptop located at the school computer lab. This mobility provides convenience for students that were absent and just needed their handheld instead of textbooks to do their homework. This same student that downloaded her homework stated that she can check out the news, their own class website, and play a game once in awhile. On their own class website she can win prizes from Mr. Vincent for answering a question correctly. For an English assignment, the students in Mr. Vincent's fifth grade class were editing essays. The process for students was to exchange handheld pcs and discuss suggestions without a pencil and paper. The report from Loschert stated that Mr. Vincent and the fifth graders were using the handheld pcs and keyboards effectively, encouraging mobile, technological learning by motivating students. Parents at Mr. Vincent's school were encouraged to check out laptop computers and the pocket pcs. This helps the parents become active in their child's learning.

Pascopella (2001) discussed the Tracy Unified School District Learning Center in California, which opened a Discovery Charter School where all students have laptops. The laptops replaced textbooks. The school opened in August of 2001 with 125 fifth and sixth graders. The estimated growth by 2004 will be 2400 pre-school through 12<sup>th</sup> grade students. Compaq Corporation provided the computers at the Discovery Charter School. Examples that Pascopella stated showed students using the laptop. Some examples are that the students go and learn about world events or vocabulary from the *New York Times* web site, keep track of personal healthy diets and fitness regiments on charts, and connect to the University of California at San Diego's space program to learn about NASA. The

school also has students attend 205 days instead of the traditional 180 days. Thus, by the tenth grade, the students will have completed high school.

The above examples of various schools implementing mobile computing encouraged students to be active learners. The students have instantaneous information at their fingertips (Rockman, 1998). Carter (2001) discovered that the laptop programs implemented in schools support President Bush's educational implementation of No Child Left Behind." Carter stated that if each student were given a laptop in effective instruction, then equal opportunity would be given to each child. Over all, the schools presented above showed that mobile computing is affecting K-12 students by increasing their motivation to be active learners.

### *Conclusion and Recommendations*

This paper has provided an overview of various studies showing the benefits of implementation of laptop computers in the K-12 school setting. Belanger (2000) mentioned that most schools have been looking at mobile computers or laptops in their classrooms for last decade. Today, finding laptops in K-12 classrooms is becoming widespread. Stolarchuk and Fisher (2001) discovered that laptops appeared to have little effect on students' perceptions of science classroom environment. However, students' perceptions were found to be more positively associated with students' attitudes and their cognitive achievement. The data in Stolarchuk and Fisher's study revealed that the first few years of using laptops in the science classroom, students learned more about computers than science.

A. Dea (personal communication, January 21, 2003) reported that the teachers she is managing for the Wiatt-Harkin grant, which establishes laptops in the first, second, and

third grade classrooms, mentioned the students were learning more about computers in their first year and showed growth in integrating the curriculum and technology in the second year. Thadani and Vandersall (2002) reported that the Wiatt-Harkin grant in its second year evaluation showed students ability increased in keyboarding skills, which in turn creates more time for extending learning on the laptops. The teachers that are part of the Wiatt-Harkin grant reported that a concern about technical problems should be addressed for anyone implementing laptops into the classroom. Moreover, reported by Vandersall and Thadani was the concern over budget cuts interfering with teacher training to further support the program. Dea, Vandersall, and Thadani reported that student's motivation to learn and attend school increased, as well as the problem-solving and student-centered projects. Further, the teacher's role became more of a facilitator.

Laptops have showed in several studies that they benefited schools. Pascopella (2001) reported that computer mobility is becoming greater in K-12 schools. Further laptops are becoming noticeable in classrooms and becoming an effective learning tool for students. Pascopella discussed Stephen Hayt Elementary School in Chicago that had students on laptops in the cafeteria, auditorium, and outdoor gardens. In addition, another school in Silicon Valley, California the students got laptops instead of textbooks and the fees are about equal to book fees. Pascopella reported that parents' perceptions of the fees were favorable. Loschert (2003) stated that Willowdale Elementary in Omaha, Nebraska was benefiting from mobile computing. Loschert also mentioned that 99% of public schools in 2001 had Internet access, making learning more accessible with mobility and instant access. Besides teacher training and staff development happening in the K-12 schools, Loschert suggested that teacher education programs should be preparing future

teachers to work with more than word processing programs. Yet, Loschert stated that technology is still just a tool and does not replace teachers. There is a quote from Mr. Vincent, a teacher at Willowdale Elementary in Omaha, Nebraska. Mr. Vincent stated. “I’m all about the teaching. The technology is definitely cool, but the teaching comes first.”

Looking back through the research studies, the researcher concluded that various techniques used with the laptops in classrooms were changing the way students were learning. Waskowitz (2001) also reported that the Internet is changing our schools ways of not taking notes, but reading or typing on the computer. One major concern of Waskowitz’s study was the need for penmanship and writing versus typing. Stolarchuk and Fisher (2001) mentioned that students spent more time on their typing skills than on the content when using laptop computers in the classrooms. Consequently, they recommended teaching typing and computer skills before applying the content with the technology. The technology was the tool, using it effectively was very important to see success with students learning. Thandani and Vandersall (2002) reported that the first, second, and third grade students that were using the laptop computers go through a keyboarding program that last a few weeks at the beginning of the school year. Then, the teachers continually monitor it throughout the year. This keyboarding does not take the place of the handwriting skills that usually take place in a first, second, and third grade classroom. Thandani and Vandersall stated that the school districts involved in the laptop computers need to implement both handwriting and typing. However, the biggest advantage over the laptop computers was that kids will checkout a laptop computer, but they will not take home a pencil and paper.

Some of the research reviewed brought about recommendations for the alteration of equipment or hardware. Smith (2002) reported that the batteries only lasted between one to two hours. This made it difficult for the middle school teachers to use the laptops for their ninety-minute sections of classes. Smith's report made the suggestion that the laptops are in the classroom, but are plugged into the walls and the students still have them sitting on their desks. Despite the equipment failure, Smith stated the school still continued to utilize the laptops effectively.

Carter (2001) discussed one of the biggest challenges to making a laptop program work. Carter discussed lots of extra training and support for teachers, administration, parents, and students. In addition, Carter mentioned one example of what a school district implemented to its teachers to make having laptops in the classroom more effective. The Professional Development Academy developed by the University of Connecticut produced a program that has Hartford teachers trained to be proficient in Microsoft Office and the Internet. Then they move on to full technology integration into the curriculum. In addition, to motivating teachers to stick with the technology in their classrooms, the program sent technology facilitators into the classrooms to co-teach technology-integrated lessons. In addition, Carter mentioned a school in Oklahoma. The Shawnee Public Schools in Oklahoma have teachers who sign up to be a part of the laptop program. Then, they have to participate in a teacher summer camp. This camp involves a six-week series of programs on different topics from basic word processing to effective laptop lessons. In addition, the teachers received a stipend along with a computer, digital projector, printer, and software for their classroom. Another idea that Carter felt was also effective in the laptop program at Shawnee was that parents were

encouraged to use computers by offering basic training at their parent resource center. The laptops were also available to be checked out by families. From Carter's research, staff development and or training for teachers as well as parents should be recommended for most schools implementing laptops in the K-12 classrooms. The research indicated that in order for the laptops to be effectively integrated into the curriculum, staff development was needed.

Teachers in one study were rewarded for their effective implementation of laptops in the classroom. Smith (2002) reported that a district has set up a policy that encouraged teachers to utilize technology. The teachers got a laptop if they were successful with implementing the computers into their classes. The teachers also had to document and show how the laptops were influencing student learning. Smith's research indicated that with effective encouragement for teachers, the teachers were shown to continue to use the technology in their classrooms. A recommendation from Smith's research was to continue to encourage teachers and provide any support they need to implement the laptop computers.

Waskowitz (2001) stated that despite some limitations with technological glitches, the evidence of student learning and motivation outweighs the limitations. He stated that the educational future of laptops seems "limitless and uncharted." K. Nelson (personal communication, February 23, 2003) mentioned that he said there had not been too many problems with the laptops. There was the occasional freeze of the laptop monitor.

This paper has provided an overview of various studies showing the benefits of implementation of laptop computers in the K-12 school setting. Belanger (2000) mentioned that most schools have been looking at mobile computers or laptops in their

classrooms for last decade. Today, finding laptops in K-12 classrooms is becoming widespread. Stolarchuk and Fisher (2001) discovered that laptops appeared to have little effect on students' perceptions of science classroom environment. However, students' perceptions were found to be more positively associated with improved students' attitudes and their cognitive achievement. The data revealed in Stolarchuk and Fisher's study revealed that the first few years of using laptops in the science classroom, students learned more about computers than science. Other research studies indicated that problem-based learning that had the students at the center of their own learning revealed a higher-order thinking skill being implemented among the students. The teachers were the facilitators with much needed staff development before implementing the laptop computers effectively into their curriculum.

After reviewing the research presented in this review paper, the following recommendations were established by the author of this paper. One recommendation is to allow significant time for staff development so that teachers are implementing the new technology into their curriculum effectively. A second recommendation is for schools to look for funding because the funding is out there to establish laptop computers in the classroom. Carter (2001) mentioned the over all theme that is with most research about laptop computers, "One-to-one computing will ultimately revolutionize the way teachers teach and the way students learn a desirable and even essential outcome for the digital age." Overall, the research shows that laptops are more convenient and meet educational objectives once teachers and students adapt to the new technological way of learning.



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