USING TECHNOLOGY TO PREPARE FOR FUTURE SCIENTESTS

A Thesis by

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Submitted to the Department of Curriculum and Instruction
College of Education and the faculty of the Graduate School of
Wichita State University
In partial fulfillment of
the requirements for the degree of
Master of Education

July 2006
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DEDICATION

To Mom, Dad, Karrie, Granny, Gramps, and Aaron
ACKNOWLEDGEMENTS

I would first like to thank my wonderful fourth graders for agreeing to be my “specimens” during the research. I would also like to thank my colleagues for supporting me through this process and providing me with valuable resources. Thank you to Dr. Jeri Carroll, Dr. Kim McDowell, Dr. Andy Koenigs, and Dr. Randy Turk for serving on my committee and providing constructive feedback to help me produce a high quality product. Finally, I would like to express gratitude to my family members for their encouraging words and support through my college years and for making me feel like I have the best profession in the world.
ABSTRACT

This research studied the impact of technology integration during science lessons to help prepare fourth graders in a suburban elementary school for the Kansas State Science Assessment. The three instructional methods considered were inquiry-based learning and direct instruction without technology use; inquiry-based learning and direct instruction using laptops; inquiry-based learning and direct instruction using an interactive whiteboard. Sixty-one fourth-grade students participated in this study and were divided into three experimental conditions: science classes A, B, and C. Each class received six, 50-minute science test review sessions over a two-week period. The review sessions alternated each day between direct instruction and inquiry-based learning. During the direct instruction sessions, Class A received direct instruction while using an interactive whiteboard; Class B received direct instruction while using laptops; Class C was the control group, and direct instruction was similar to a lecture format. No technology was used with Class C. The inquiry-based learning sessions were the same for all three classes. Science-based pre- and post-tests were administered during the study along with a technology use survey. Data from the Kansas State Reading, Math, and Science assessments were also considered.

To determine if performances on the researcher-generated science tests were related to each other, partial correlations controlling for reading and math skills were computed for each group of students. Statistically significant relations between pre- and post-test science knowledge emerged only for the students in the no technology group. Gain scores were also calculated using the Kruskal Wallis test to determine the amount of change between pre- and post-intervention scores. Results indicated that significant group differences between pre- and post-test scores in science content knowledge did not emerge. Next, Kruskal Wallis statistical test was used to
determine if there were group differences in use of computers for homework and for non-school work. No statistically significant differences emerged. Lastly, to determine if the gains from pre-to post-test made by the *entire* sample (not subgroups) were statistically significant, a one-sample Kolmogorov-Smirnov test was used. Results indicated that gains made by the entire sample between pre- and post-tests were statistically significant.
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CHAPTER 1

THE PROBLEM

In 2001, standardized testing began to take on a new meaning. Shortly after taking office, President George W. Bush announced his vision for education by introducing the No Child Left Behind (NCLB) Act, a framework that would base federal education programs on accountability, flexibility, and choice. He described this educational reform as “the cornerstone of my Administration” because “too many of our neediest children are being left behind” (¶ 1, USDE, 2001).

Accountability in Schools

To monitor schools’ successes and ensure that no child is left behind, the requirements and expectations for student learning have become stricter. Thus, use of standardized testing has increased because standardized assessments allow a child’s score to be directly compared to another child’s score. By the 2005-2006 school year, each state had to administer a reading and math assessment in grades three through eight, and once in grades ten through twelve. Beginning in 2007, each state had to also give science assessments once in grades three through five, six through nine, and ten through twelve. The goal of NCLB is for all students to score “proficient or above” on these standardized tests by the year 2013 (KSDE, 2005).

Adequate Yearly Progress (AYP) also increases accountability in schools. AYP requires schools to show an increase in the percentage of students who reach a state’s requirements for academic proficiency. Schools that do not meet Adequate Yearly Progress for two consecutive years will be put on improvement plans to redirect them to achieve higher student performance in the future (KSDE, 2005). If a student is attending a school that has not met AYP, parents may choose to send the student to a higher performing school. Transportation to the chosen school
must be provided by the school district, and if needed, 5% or more of Title I funds must be used to help fund the transportation (USDE, 2001). Schools that continue to fail meeting AYP must allow low-income students to use Title I monies to receive tutoring or other supplemental public educational services.

Quality Performance Accreditation

Accountability in schools is not a new idea or trend. In 1968, the Kansas Legislature passed laws that would allow the Kansas State Board of Education to accredit all elementary and secondary schools in the state (KSDE, 2005). Twenty years later in 1988, the state’s governor helped create a School Accreditation Task Force to help with the process known as Quality Performance Accreditation (QPA). QPA would require schools to administer statewide standardized testing, prepare building report cards for the public, and create curriculum standards to ensure accountability. In 2001, a Kansas Department of Education task force reviewed and analyzed the QPA process. During this time, the No Child Left Behind act was presented by President George W. Bush. This gave the state’s task force an opportunity to align Kansas’ accountability system with the federal system (KSDE, 2005).

Several changes to QPA have been made in order to meet the NCLB guidelines. In the past, school improvement plans lasted five years and were reviewed by the Kansas Department of Education. Now, a multi-year improvement plan and results-based staff development plan must be in place. The plans will be created around student performance data and will not be reviewed by the state. Accreditation teams will still visit schools, but now schools have the flexibility to choose a team, known as an external technical assistance team, that they feel would be the most successful at helping the school reach its goals. Multiple forms of standardized testing have been used in the past, and those data were disaggregated by socioeconomic status,
gender, and ethnicity. New QPA regulations require the administration of state and local assessments that are aligned with state standards. The data will be disaggregated the same way but will also include participation and attendance rates for all schools and graduation rates for high schools. Another major change in QPA is the accreditation cycle. Schools will now be accredited annually instead of every five years. Accreditation will be based on AYP reports and state assessment data (KNEA, 2005).

Standardized Testing

In the past, improving students’ math and reading skills has been the emphasis in education. Because of NCLB mandates, other curricular areas, such as science, are receiving more attention. In 2007-2008, mandated state science assessments will be administered once a year in each of three grade-level spans. Kansas’ fourth graders will be participating in this assessment. The Fourth Grade Kansas Science Assessment consists of multiple-choice, single answer questions. Seventy percent of the questions pertain to scientific processes, and 30% pertain to scientific background and knowledge (KSDE, 2005). Fourth-grade students must be able to identify variables that were changed, measured, and kept the same in scientific investigations. All students taking the state science test must be knowledgeable of scientific process skills, be able to read and interpret different kinds of charts and graphs, and be able to identify questions that can be investigated rather than researched (KSDE, 2005).

Research shows that students in grades four through six only receive about 31 minutes of science instruction a day (Cavanagh, 2005). Because of the mandated state science assessments, it is likely that more emphasis and time will be required to teach science content; therefore, schools need to ensure that “highly qualified teachers” are teaching science. NCLB defines a highly qualified teacher as a person who is certified, who has earned a bachelor’s degree, and
someone who can prove competent in his or her content area (Peterson, 2005). Most elementary teachers are multi-subject teachers. They are not required to earn college credit for each subject they teach to prove that they are highly qualified; however, some form of assessment will be needed to ensure that educators are qualified to teach each subject. NCLB allows schools to monitor teacher qualifications through regular evaluations scheduled by administrators (USDE, 2001). Professional development will also play an active role to ensure quality teachers. Professional development opportunities can improve a teacher’s knowledge of a particular content area, offer classroom management skills, provide strategies for increasing student performance, and foster collegial relationships (NSTA, 2005).

The heavy emphasis on standardized testing has many impacts on teachers and students. High-stakes testing forces teachers to pay more attention to state and local curriculums. Because of the awareness of standards, instructional strategies, and available resources, a higher level of standardization occurs across schools. The NCLB movement’s emphasis on accountability requires higher expectations for student performance; therefore, students who struggle will receive more support than in the past (McColskey & McMunn, 2000). Even though the purpose of standardized testing is to communicate the successes of students, successes of teachers may not be as great. More than ever, teachers are feeling the pressures of state tests. It is a teacher’s responsibility to ensure that each student is prepared to successfully perform. Because so much emphasis is placed on one test, other subjects and topics are often neglected. Teachers are also accused of “teaching to the test”. This can cause teachers to focus less on students’ learning and more on whether or not students can pass an assessment.

Participating in more than 100 million standardized tests a year, American students also feel the effects of testing pressures (Clovis, 1999). As standardized testing increases, test anxiety
among students increases. Test anxiety can have a huge impact on student performance. It is characterized by feelings such as apprehension, worry, and fear of failure (Supon, 2004). Why are standardized tests so stressful on students? Most tests have time limits, and sections of a test may take several days to complete. Students are used to some form of structure in the classroom, but standardized testing interrupts the daily schedule (Clovis, 1990; Supon, 2004). The fear of failure is also a prominent cause.

Purpose

The purpose of this research project was to evaluate the effects of technology integration during science instruction. Instructional strategies used during the science test preparation lessons were direct instruction, inquiry-based learning, and technology integration. Direct instruction refers to a highly-structured, teacher-centered instructional method commonly used for drill and practice and test review. Inquiry-based learning is student-centered and allows students to create their own questions and develop a path for answering the questions. Inquiry-based learning is used frequently during hands-on science experiments. The technology tools integrated in the project were an interactive whiteboard and wireless laptop computers. A technology use survey was also administered to examine correlations between computerized test scores and the amount of technology used at home.

Research Questions

Technology integration is becoming more and more popular in schools. The following questions were developed to investigate the effects of technology integration on science test scores:

• Question 1: What are the effects of interactive whiteboards during science instruction?
• Question 2: What are the effects of using laptop computers during science instruction?
• Question 3: Is there a difference in computer use for homework and non-school use between the groups?

Hypotheses

After reviewing past studies regarding direct instruction, inquiry-based learning, and technology integration, the following hypotheses were developed:

• Hypothesis 1: A combination of inquiry-based learning and direct instruction using an interactive whiteboard will improve science test scores.

• Hypothesis 2: A combination of inquiry-based learning and direct instruction using laptop computers will improve science test scores.

• Hypothesis 3: There will be differences between the groups in computer use for homework and non-school use.
Assumptions

The first assumption is that the elementary school in question was well-equipped with the technology needed for this research project: an interactive whiteboard and a class set of laptops. Technology is an important focus of the school district, and innovative technology ideas are highly supported. Along with having the needed technology, it is assumed that the technology worked, and technical difficulties were not encountered.

Another assumption is that the fourth-grade students who participated in the action research were present during the science test review sessions. Student attendance rates are exceptional at this school and average about 96% every year.

A third assumption is that students who completed the technology use survey answered the questions honestly. It is important that the results of the survey accurately reflect the participants in order to compare types of student computer use.

Overview

The next chapter reviews current literature and case studies that helped create a foundation for this thesis. The methodology in the fourth chapter describes the design of the study, including participants, interventions, data collection, and data instruments. The last two chapters of this thesis discuss the results of the project and provide the researchers’ conclusions and future implications.
CHAPTER 2

REVIEW OF THE LITERATURE

This chapter is a review of current literature and case studies pertaining to the three methods of instruction used in this project: direct instruction, inquiry-based learning, and technology integration. Information from the literature was used to guide the design of the action research.

Direct Instruction

A debate exists about which instructional method for teaching science, inquiry-based or direct instruction, initiates higher levels of student performance. Since its creation by Madeline Hunter in the 1960s, the direct instruction model has been known as a controversial method of teaching, especially in science (Lindsay, 2004). This methodology refers to a highly structured, teacher-controlled system of instruction requiring students to constantly interact with the teacher (Adelson, 2004). As suggested by Hunter (Allen, 1998), effective direct instruction considers several elements in a teacher’s lesson plan, such as objectives and standards, anticipatory set, teaching, guided practice, independent practice, and closure (Appendix A).

According to Hunter, her model of direct instruction is based on teachers’ decisions about what to teach, how to teach the subject matter, and how to facilitate and enhance the learning that takes place (Hunter, 1985). Hunter also viewed teaching as a “performance behavior like music, like dancing, like athletics, like surgery. You have to automate many behaviors so you can perform them artistically at high speed” (Goldberg, 1990). She emphasized the importance of having a concrete structure for each lesson, but at the same time, deciding which elements should make lessons different from one another.
Madeline Hunter had many followers who implemented direct instruction in their classrooms and who trained others about the model. However, as her direct instruction model became more and more popular, a lack of standardization occurred, and the model eventually became modified by others. Her model of direct instruction is now known by several names, such as clinical teaching, mastery teaching, the Hunter Model, the UCLA model, and the Seven Step Lesson Plan (Ryan, Jackson, & Levinson, 1986).

The Madeline Hunter direct instruction model is sometimes confused with a similar methodology call Direct Instruction, or DI. DI is more of a program than an instructional method. The program is based on placing students in homogeneous groups according to skill level while teachers follow pre-designed scripts while teaching students. The teacher will only progress to different skills when the entire group of students has mastered the concept. The Direct Instruction program is recognizable by the capital letters in its name. The Madeline Hunter direct instruction model is referred to in lowercase letters. The primary focus of this review is the Madeline Hunter direct instruction model.

Many educators and researchers argue that direct instruction is an effective teaching method. Some feel that because teachers explicitly present content when delivering Madeline Hunter’s direct instruction model, students are not expected to think at higher levels and are not given the chance to develop their own conclusions (Cavanagh, 2004). Because of increased standardized testing, science educators are concerned that teachers are replacing hands-on experiments and inquiry-based learning with direct instruction memorization strategies (Barton, 2005). Other researchers feel that the Madeline Hunter direct instruction model is best suited for classroom environments where students are expected to learn specific content, compared to an environment promoting project-based learning (Cavanagh, 2004). Because the teacher
concentrates on a structured model to follow, he or she restricts student learning. Once the student masters the content, the learning comes to a halt.

Even though direct instruction is challenged by many educators and researchers, research studies have shown positive correlations between direct instruction and students’ learning. David Klahr from Carnegie Mellon University and Milena Nigam (2004) from the University of Pittsburgh conducted a study of 58 third-grade students and 54 fourth-grade students to see if the children learned science concepts best with Madeline Hunter’s direct instruction model or by learning through discovery. The students were randomly assigned to a direct instruction or discovery learning group. In the direct instruction group, the students watched the teacher design several experiments investigating how objects moved on slopes while communicating frequently about the processes. The students in the discovery learning group were given the same materials for the slope experiments, but were not given any instructions. Then students from both groups were asked to design new slope experiments that used different variables to see if they could transfer what they had learned previously. Seventy-seven percent of the students who received direct instruction were able to design the experiment without difficulty. Only 23% of the discovery learning group performed similarly. The researchers concluded that third- and fourth-grade students who received direct instruction retained and transferred information when conducting scientific experiments compared to those students who received the inquiry-based instruction intervention (Klahr & Nigam, 2004).

Another case study researched the effects of direct instruction during physical education classes. Forty-seven elementary students in grades kindergarten, first and second grades were randomly divided into three experimental groups. Prior to the interventions, each student was tested on the standing long jump. The researchers told the students to jump as far as they
possibly could. After the pre-test, group A had the opportunity to practice more jumps without teacher direction. Group B received teacher demonstrations of the jumps and more practice jumps. Group C received Madeline Hunter’s model of direct instruction. The same conditions from the first two elements were included, along with constructive criticism and closure (Ayers et al., 2005). After the interventions, students performed post-test jumps. Group C, who received the direct instruction condition, resulted in significantly longer jumps than Groups A and B.

In Maryland, leaders of the Baltimore Curriculum Project have also seen a significant gain in test scores of students receiving direct instruction in the classroom, primarily in reading and math. Because of the improvement in standardized testing, directors of the project are designing curriculums that apply more direct instruction in science classes. California state officials have recognized the positive effects of direct instruction and have developed instructional material guidelines that require science teachers to spend at least 75% of teaching using direct instruction. Today, many school districts around the nation use direct instruction in all content areas, especially when students struggle academically (Cavanaugh, 2004).

Direct instruction has shown to be an effective method of teaching, even in science. Students of all learning levels have benefited from this type of instruction. The above research findings support this research project to include direct instruction as an instructional method while preparing kids for the Kansas State Science Assessment.

*Inquiry-Based Learning*

The other side of the debate possesses a popular science teaching method: inquiry-based learning. Grabe and Grabe (1998) define inquiry-based learning as follows:

Inquiry involves finding sources of information appropriate to a task, working to understand the information resources and how they relate to the task, and then, in those
cases for which some action is expected, applying this understanding in a productive way. (p. 21)

In an inquiry-based science classroom, students have more control of their learning direction, compared to the teacher-centered direct instruction model. Students select research topics; develop questions to ask; synthesize their data and information; and finally develop understandings and create connections (Hester, Owens, & Teale, 2002). The foundation for inquiry-based learning was created by John Dewey in the 1920’s (Fillippino, Ross, & Skinner, 2005). Dewey thought that traditional teaching was too focused on delivering concepts and knowledge, and more emphasis needed to be placed on learning through experience. In inquiry-based instruction, teachers become facilitators to help students arrive at their own conclusions.

Inquiry-based learning also has been challenged in the education world. Some researchers believe that most of what students and teachers know about science is taught, not discovered; therefore, more emphasis should be placed on teacher-centered instruction (Adelson, 2004). Because of the lack of structure and teacher direction, inquiry-based learning can be challenging for remedial students. This can lead to frustration and mental shutdowns of participating students. Missing or confusing data and feedback also are common in inquiry-based learning. Because students are given the opportunity to guide themselves, there can be more room for errors and misconceptions (Adelson, 2004). Time is also an issue. Inquiry-based learning requires more preparation on the teacher’s part for hands-on activities, and students take a longer time developing their questions, data, and understandings. Because of NCLB’s expectations of student performance, some teachers feel that inquiry-based learning uses too much instructional time, and more time should be spent directly teaching concepts that prepare students for state assessments (Hester, Owens et al., 2002).
Inquiry-based learning has also shown to be an effective practice. One case study examined the relationship between students’ physical science test scores and inquiry-based learning. During the first two years of the four-year study, seven physical science classes, consisting of 161 students were taught physical science concepts using traditional, low-level inquiry methods (Tretter & Jones, 2003). During the last two years of the study, four physical science classes, consisting of 94 students, were taught physical science concepts using a high-level of inquiry-based activities. Standardized testing results did not reveal a significant difference between the two groups of students; however, in the inquiry-based group, the researcher saw dramatic changes in students’ class attendance, class grades, and participation.

For three years, 8,000 low-income middle school students participated in an inquiry-based science program in Detroit. The results of the study showed significant gains in test scores during each year of the program. In one report (Barton, 2005), Ronald Marx, coauthor of the study, stated:

The findings indicate that students who historically are low achievers in science can succeed in standards-based, inquiry science when curriculum is carefully developed and aligned with professional development and district policies (¶ 12).

In a study in the El Centro School District in California, results showed that fourth and sixth graders’ science scores also improved while inquiry-based learning was implemented. The students made significant improvements on the Stanford Achievement Test 9th edition in math and reading (Barton, 2005). David Klahr, the researcher behind the Carnegie Mellon University study, as well as other researchers (Barton, 2005; Crane, 2005; & Tweed, 2004) agree that the best form of science instruction is a combination of direct instruction and inquiry-based learning. Teachers should be able to choose from a variety of instructional strategies that meets the
ultimate goal: student understanding. “If the goal is student understanding, then teachers have to understand how students learn” (Tweed, 2004, ¶ 12).

Inquiry is an important factor of science education. As per the research mentioned above, inquiry-based learning is an appropriate and effective instructional method to teach science and engage students in learning. Because students can benefit from different types of instructional strategies, and direct instruction and inquiry-based learning have shown to have positive effects on student learning, a combination of direct instruction and inquiry-based learning activities were selected for this research project.

*Technology Integration*

Technology integration is a common instructional strategy permeating today’s classrooms. For years, it was taught in isolation and was not related to a school’s curriculum. Today, technology integration can be seamless. When used appropriately, this form of instruction is a positive catalyst for learning. Technology integration can be defined as the process of enhancing educational activities by allowing students to experience and manipulate software programs, hardware devices, or other multi-media tools. All types of learners can benefit from using technology in the classroom. Research shows that students with special needs benefit from using technological innovations (Salinitri, Smith, & Clovis, 2002). The United States Department of Education (2004) defines technology for special needs students as any tool that is used to improve or maintain the capabilities of students. Technology can also stimulate higher-level thinking among students and challenge them to think “outside of the box.” Technology has shown to enhance learning within all types of students because of the unlimited number of engaging activities that accommodate students’ individual needs.
Interactive Whiteboards

The use of interactive whiteboards to enhance teaching and learning is becoming more prominent in today’s classrooms. An interactive whiteboard is a large, touch-sensitive screen that displays images from a computer and allows the user to navigate through computer programs, websites, and presentations by simply touching the screen with a finger or special marker.

Students and teachers alike can benefit from using interactive whiteboards. Research shows that students generally are more motivated to learn when using an interactive whiteboard (Becta, 2003). The board allows students to experience complex concepts through engaging presentations while the teacher uses different resources to accommodate multiple learning styles. During classroom presentations, students themselves seem more confident and are likely to be more creative while presenting. Teachers have discovered the wealth of web-based resources and can use interactive whiteboards to share information with an entire classroom. Teachers can also save and print lessons and notes on the whiteboard for future reference or to provide a review for absent students. Because interactive whiteboards are easy to use, teachers have become inspired to change their current pedagogy and integrate technology more into their lessons.

Many researchers are discovering the positive effects of interactive whiteboards in school settings. Researchers at Baylor University conducted a survey of 30 participant teachers’ attitudes toward using interactive whiteboards in the classroom. At the time, an interactive whiteboard was a relatively new technology tool; therefore very little research existed about its effectiveness. Researchers felt that gathering teachers’ opinions about their experiences with whiteboards would be an objective way to begin the evaluation process. The 67-item survey asked teachers to assess many aspects of the whiteboard such as ease of use, using applications, teacher enthusiasm, student motivation, preference of whiteboard to alternative presentation...
methods, and whiteboard activities. The results of the survey showed an overall positive tenor. Both students and teachers were more enthusiastic during lessons, and a majority of the teachers expressed the increase in planning more creative lessons (Bell, 1998).

Another study conducted by researchers at William Rainey Harper College (Damcott, Landato & Marsh, 2000) focused on integrating interactive whiteboards into physical science courses to analyze their effect on student learning during lectures. Four sections of physical science students were used in the study. Two of the sessions received physical science lectures via interactive whiteboards, and the other two sessions served as control groups and received typical lecture style presentations. After the content was taught, multiple-choice test questions were administered to all four sessions of students. The test scores revealed that there was a statistically significant difference in the scores between the experimental groups and the control groups, with the experimental groups having higher scores. New physical science content was taught in the same format, and another test was administered. Once again, the students who received the interactive whiteboard intervention scored higher. The researchers concluded that using interactive whiteboards during physical science lessons enhances student learning.

Identifying the effects of using interactive whiteboards with special needs students is also an interest of researchers. Salinitri, Smith, and Clovis (2002) designed a study to investigate the use of an interactive whiteboard in improving special needs students’ literacy. The research was divided into three phases: learning before the interactive whiteboard, introduction to the whiteboard, and a follow-up after the whiteboard’s use. During the first phase, students with special needs from a third-grade class and fifth-grade class received their normal language arts lessons. During the next phase, the same students received their normal language arts lessons with the addition of an interactive whiteboard. During the final phase, researchers collected pre-
and post-test data using spelling tests as an assessment tool. Pre-tests were administered before both the normal language arts lessons and those with the interactive whiteboard, and post-tests were given following the intervention. The test results showed that after the interactive whiteboard intervention, students who had the greatest difficulty on spelling tests showed the most improvement. The researchers concluded that the interactive whiteboard helped improve the language arts learning environment for students with special needs.

The results of the studies stated above show the impact that interactive whiteboards can have on many types of learners in different learning environments; therefore, integrating this form of technology into science test review sessions would more than likely increase teacher and student motivation and positively impact science test scores.

Laptops in the Classroom

Students depend on technology. Technology is the backbone of today’s learners, and it is important for teachers to address their learners’ needs. Many school districts across the nation have piloted laptop programs that provide laptop computers for every student. This type of program can provide an environment for learning anywhere. It also helps close the digital divide between low income and minority students from their peers.

Gulek and Demirtas (2005) conducted a study to determine the impact of a laptop program on student achievement. Two hundred fifty-nine middle school students volunteered to participate in this study. Students enrolled in the laptop program received the same curriculum as non-participants. The difference was that the participants could demonstrate skills mastery through computers. The laptops were used daily by the participants for the entire school year. Common laptop applications the students used were researching on the internet, writing essays, creating multimedia presentations, and note taking. Data was collected by using students’ overall
grade point averages, end-of-term grades in all courses, local writing assessment scores, and California standardized test scores. Results showed that the participants in the laptop program attained higher cumulative grade point averages than the non-participants. The experimental group also scored higher on the district writing assessments and end-of-term final grades. On the California standardized tests, a larger number of laptop participants scored at or above the national average on the tests. Researchers concluded that the laptop study had a significant impact on student achievement.

Another laptop study, conducted by the Center for Media Research in Berlin (Schaumburg, 2005), was designed to investigate the effects of laptop integration on girls’ computer literacy. Three hundred high school students, males and females, were participants in this study. Students in both the control and experimental groups were given subtests regarding knowledge of computers and computer confidence. Researchers used a two-factorial, multivariate analysis of variance to determine the laptops effectiveness. The results showed that girls in the control group scored significantly lower on the computer subtests compared to the boys. In the experimental group, the girls only scored lower than the boys on confidence ratings for computer use. The researchers concluded that the integration of laptops impacted girls’ overall computer literacy but did not increase confidence levels while using computers.

Summary

The studies in this literature review have examined the positive links between technology integration and the impact technology has had on educational factors such as student learning, motivation, and participation. Because the United States has one of the highest student-to-computer ratios in the world (Rowand, 2005), it is inevitable that educators are looking for new and innovative ways to integrate technology into their curriculums.
Even though studies have shown that technology can enhance learning, it is important to remember that students learn differently; therefore, teachers need to implement many types of methodologies to reach all learners. Direct instruction and inquiry-based learning have been traditional teaching methods used in all curricular areas. The case studies that evaluated direct instruction and inquiry-based learning have also shown positive effects on student achievement. Some researchers also believe that students who receive both types of instruction will benefit the most. In a science classroom, a combination of direct instruction, technology integration, and inquiry-based learning is likely to create an ultimate learning environment and meet the needs of all students.

In Chapter 3, a thorough description of the participants, instruments, and interventions used in the study is provided. The last two chapters of this paper provide results, analyses of the results, and the researcher’s discussion and conclusions about the study.
CHAPTER 3

METHODOLOGY

This chapter describes the participants, the instruments, and the interventions used in this study. Participant information includes demographics of the elementary school, along with background information about each of the three fourth-grade science classes. The instruments discussed are the science pre/post test, technology use survey, and Fourth Grade Kansas Science, Math, and Reading Assessments. Direct instruction with technology and inquiry-based learning are the discussed interventions.

Participants

The 61 fourth-grade students in this study attended a high socioeconomic, suburban K-5 elementary school in South Central Kansas. Of the 412 students enrolled in the school, 39% were female and 61% were male. Only 3% of the student body was considered to be economically disadvantaged. The majority of the students were Caucasian (approximately 91%) with the remaining 9% being from other ethnic groups such as Asian American, Hispanic, African American, and Pacific Islander. Technology is a high priority in the school. Each teacher has a wireless laptop to use the in the classroom along with three or four student computers. Seventy-five percent of the classrooms are equipped with data projectors that can be connected to computers, interactive whiteboards, and VCRs. The school houses nine interactive whiteboards, one classroom set of wireless laptop computers, and one classroom set of personal digital assistants (PDAs) that can be checked out by teachers.

The three fourth grades in the school were a sample of convenience. There were 20 students in Class A, 10 girls and 10 boys. Eighty percent of the class was Caucasian. Four students were identified as students with special needs, and one student was identified as a gifted
student. A full-time paraprofessional worked all day with the students with special needs. Accommodations for those students included taking modified tests, taking tests one-on-one with an adult, extended time to take tests, and modified assignments when needed. Class A participated in the science test review sessions in the afternoon, soon after lunch and recess. The classroom was equipped with one wireless laptop, a data projector, four student computers, and one interactive whiteboard. Class A was the class and classroom of the researcher.

Class B also consisted of 20 students, 9 girls and 11 boys. Ninety-five percent of the class was Caucasian. There were no students with special needs in this class. Class B participated in the science test review sessions during the first hour of the school day. Their regular classroom was equipped with one wireless laptop, a data projector, four student computers, and one interactive whiteboard. The intervention took place in the researcher’s classroom, Classroom A.

Twenty-one students were in Class C, 9 girls and 12 boys. Ninety-six percent of the students were Caucasian. One student was identified as a student with special needs and received the same accommodations as the special needs students in Class A. Class C participated in the science test review sessions toward the end of the school day. Their regular classroom was equipped with one wireless laptop, a data projector, and four student computers. The intervention took place in the researcher’s classroom, Classroom A.

Instruments

A researcher-generated technology use survey was administered to all three classes prior to the interventions to assess students’ uses of technology at home and school (see Appendix B). The researcher read aloud the questions to the students while the students read and answered the questions on paper. The students with special needs in Classes A and C took the survey without accommodations. Students also completed a researcher-generated pre- and post-test measuring
science knowledge (Appendix C). All the students, except for the special needs students, completed the paper/pencil pre- and post test independently before the inventions took place. The students with special needs took both tests one-on-one with an adult. The students read the test aloud to the adult. The adult was not allowed to make comments. Kansas State Reading, Math, and Science test scores were also used as data. All three state tests were administered via wireless laptop computers. Each test consisted of three subtests. The math and reading subtests were administered over a three-day period, one test on each day. The science subtests were administered over a two-day period, two tests the first day and one test on the second day. The special needs students took the test on the computer and had the same accommodations as the pre- and post test.

Interventions

During the planned research, three fourth-grade classes participated in six test preparation classes. The preparation classes took place two weeks before the state assessments in science. During the direct instruction sessions, the lessons were teacher-controlled, but the students constantly interacted with the teacher. The lessons followed the Madeline Hunter direct instruction model and included objectives/standards, anticipatory set, teaching, guided practice, closure, and independent practice. Science content taught during the direct instruction lessons were as follows: reading and interpreting nutrition labels; categorizing man-made and naturally made objects; comparing research to investigations. During the inquiry-based lessons, students had more control over their learning, compared to the direct instruction model. Students developed their own understandings of science content by using appropriate resources and manipulatives. Science content taught during the inquiry lessons were as follows: identifying
types and permeability of soils; comparing needs of organisms; investigating magnets and simple circuits.

Classes A, B, and C each received six, 50-minute science test review sessions over a two-week period. Three of the sessions were inquiry-based; three sessions were taught through direct instruction. For classes A and B, the review sessions alternated each day between direct instruction with technology integration and inquiry-based learning. For Class C, the review sessions alternated each day between direct instruction and inquiry-based learning. No technology was used with Class C. The test review sessions addressed state standards and indicators that students were taught prior to their fourth-grade year but would be assessed on the Fourth Grade Kansas State Science Assessment.

During the direct instruction sessions, Class A received direct instruction while using an interactive whiteboard, and Class B received direct instruction while using laptops. PowerPoint presentations (Appendix D) were used to display the content being taught. Class A viewed and interacted with the PowerPoint presentations via the interactive whiteboard. Class B viewed and interacted with the same PowerPoint presentations via laptops (one laptop for each student). Class C was the control group, and direct instruction was similar to a lecture format. To ensure that the same science content was being taught, the PowerPoint presentation slides used with Class A and Class B were printed on paper and used as worksheets for Class C. No projection of the slides occurred.

The two instructional methods alternated daily for each class: day 1—direct instruction; day 2—inquiry-based instruction; day 3—direct instruction; day 4—inquiry-based instruction; day 5—direct instruction; day 6—inquiry-based instruction. The inquiry-based learning sessions were the same for all three classes. The three inquiry-based review sessions allowed the students
in all three classes to develop and answer their own questions about science topics given by the teacher. The students used numerous materials and hands-on activities to help answer their questions.

The data and results discussed in the next two chapters address the aforementioned research questions of this study: What are the effects of interactive whiteboards during science instruction? What are the effects of using laptop computers during science instruction? Is there a difference in computer use for homework and non-school use between the groups?
CHAPTER 4
RESULTS

Quantitative data were collected and measured during this study. Instruments used in the
data collection process were Kansas State Math, Reading, and Science Assessments, researcher-
generated pre- and post science test, and a technology use survey.

Preliminary Analyses

Descriptive statistics are provided in Table 1.

Table 1

<table>
<thead>
<tr>
<th>Group Variable</th>
<th>Mean</th>
<th>Standard Deviation</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive Whiteboard</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science pre</td>
<td>70.25</td>
<td>16.02</td>
<td>40.00-90.00</td>
</tr>
<tr>
<td>Science post</td>
<td>91.50</td>
<td>10.40</td>
<td>60.00-100.00</td>
</tr>
<tr>
<td>State Science</td>
<td>80.07</td>
<td>10.78</td>
<td>61.80-98.20</td>
</tr>
<tr>
<td>State Math</td>
<td>80.46</td>
<td>16.13</td>
<td>37.80-95.90</td>
</tr>
<tr>
<td>State Reading</td>
<td>75.28</td>
<td>14.71</td>
<td>39.70-93.20</td>
</tr>
<tr>
<td>Laptops</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science pre</td>
<td>68.50</td>
<td>9.88</td>
<td>45.00-85.00</td>
</tr>
<tr>
<td>Science post</td>
<td>87.50</td>
<td>9.80</td>
<td>65.00-100.00</td>
</tr>
<tr>
<td>State Science</td>
<td>80.90</td>
<td>8.34</td>
<td>52.70-94.50</td>
</tr>
<tr>
<td>State Math</td>
<td>79.51</td>
<td>11.21</td>
<td>45.90-95.90</td>
</tr>
<tr>
<td>State Reading</td>
<td>73.57</td>
<td>11.29</td>
<td>54.80-95.90</td>
</tr>
<tr>
<td>No Technology</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Science pre</td>
<td>72.14</td>
<td>15.21</td>
<td>35.00-95.00</td>
</tr>
<tr>
<td>Science post</td>
<td>87.62</td>
<td>14.72</td>
<td>40.00-100.00</td>
</tr>
<tr>
<td>State Science</td>
<td>77.93</td>
<td>12.08</td>
<td>45.50-96.40</td>
</tr>
<tr>
<td>State Math</td>
<td>82.10</td>
<td>9.88</td>
<td>62.20-95.90</td>
</tr>
<tr>
<td>State Reading</td>
<td>74.55</td>
<td>12.09</td>
<td>53.40-93.20</td>
</tr>
</tbody>
</table>

Note. N=20, 20, 21, respectively.

To determine if the data were normally distributed, which would dictate use of parametric
or nonparametric statistics, the data were examined for violations of normality. Using the
Shapiro Wilks test of normality, it was determined that most variables violated assumptions of normality (p=.001), with the exception of the math scores from the state assessment (p<.06). Given that most of the variables violated assumptions of normality and given the small sample size, nonparametric statistics were employed.

*Primary Quantitative Analyses*

In order to address the first and second research questions (i.e., What are the effects of an interactive whiteboard during science instruction? What are the effects of laptops during science instruction?) three different analyses were computed. First, to determine if performances on the researcher-generated science tests were related to each other (i.e., pre- test performance related to post test performance) after removing variance common to reading and math skills, partial correlations controlling for reading and math skills were computed for each group of students. Table 2 illustrates the correlation coefficients. Statistically significant relations between pre- and post test science knowledge (controlling for reading and math skills) emerged only for the students in the no technology group.

Table 2

*Partial Correlations Between Science Scores, Controlling for Reading and Math*

<table>
<thead>
<tr>
<th>Group</th>
<th>Correlation Coefficient for Pre/Post Science Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interactive Whiteboard</td>
<td>.302</td>
</tr>
<tr>
<td>Laptops</td>
<td>.146</td>
</tr>
<tr>
<td>No Technology</td>
<td>.566*</td>
</tr>
</tbody>
</table>

Note. N=20, 20, and 21, respectively. *=p<.05.
Secondly, gain scores were calculated to determine the amount of change between pre- and post-intervention scores. These gain scores were statistically examined using the Kruskal Wallis test. This test is an alternative to the independent group analysis of variance (ANOVA), when the assumption of normality or equality of variance is not met. This, like many non-parametric tests, uses the ranks of the data rather than their raw values to calculate the statistic. With this nonparametric statistical test, gain scores are ranked from low to high (regardless of direction). The ranks associated with negative differences are summed and the ranks associated with positive differences are summed. The statistical test is then computed. This analysis will determine if the intervention had differential effects on students receiving instruction with technology versus those receiving instruction without technology. Table 3 illustrates the results of these analyses for all variables. Results indicate that significant group differences between pre- and post-test scores in science content knowledge did not emerge.

Table 3

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi Square</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Science (pre vs. post)</td>
<td>3.023</td>
<td>.221</td>
</tr>
</tbody>
</table>

Note. N=61.

Table 4 indicates the rankings of the three groups (i.e., interactive whiteboard, laptops, and no technology). It is interesting to note that although statistical differences between groups did not emerge in the researcher-generated science test scores, the students in the interactive whiteboard group were the highest ranked at the conclusion of the study while they were ranked second at pre-test. Additionally, those in the laptop group were outranked by the no technology group.
To determine if the gains from pre- to post-test made by the entire sample (not subgroups) were statistically significant, a one-sample Kolmogorov-Smirnov test was used.

Table 5 shows that results were statistically significant (KS-Z = 1.902, p <.001), indicating that gains made by all students were statistically significant.

Table 5

One-Sample Kolmogorov-Smirnov Test

<table>
<thead>
<tr>
<th></th>
<th>pre</th>
<th>post</th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>61</td>
<td>61</td>
</tr>
<tr>
<td>Normal</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parameters</td>
<td>Mean</td>
<td>Std. Deviation</td>
</tr>
<tr>
<td>(a,b)</td>
<td>70.3279</td>
<td>13.8404</td>
</tr>
<tr>
<td></td>
<td>88.8525</td>
<td>11.8460</td>
</tr>
<tr>
<td>Most Extreme</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Differences</td>
<td>Absolute</td>
<td>Positive</td>
</tr>
<tr>
<td></td>
<td>.151</td>
<td>.081</td>
</tr>
<tr>
<td></td>
<td>.244</td>
<td>.173</td>
</tr>
<tr>
<td>Kolmogorov-Smirnov Z</td>
<td>1.180</td>
<td>1.902</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.123</td>
<td>.001</td>
</tr>
</tbody>
</table>

a  Test distribution is Normal.
b  Calculated from data.
To address the final research question (i.e., Are there group differences in computer use for homework and non-school use?) two items from the survey (items 5 and 7) were examined (see Table 6).

Table 6

<table>
<thead>
<tr>
<th>Variable</th>
<th>Chi Square</th>
<th>p value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Computer use for homework</td>
<td>2.00</td>
<td>.368</td>
</tr>
<tr>
<td>Computer use non-school</td>
<td>2.00</td>
<td>.368</td>
</tr>
</tbody>
</table>

Note. N=3 groups’ summary

Other items were analyzed using frequency distributions by group but were not further analyzed as they only provided descriptive information and could not address the research question (see Table 7, Appendix E). The Kruskal Wallis statistical test was used to determine if there were group differences in use of computers (for homework and for non-school work). No statistically significant differences emerged.

Summary

The following research questions were addressed in this study: (a) What are the effects of an interactive whiteboard during science instruction? (b) What are the effects of using laptop computers during science instruction? (c) Are there group differences in computer use for homework and non-school use? Statistical analyses of quantitative data were performed to help identify the impact of technology during science instruction and to determine whether or not the type of technology use is different between groups. As a result of the analyses, the following hypotheses were tested: (a) A combination of inquiry-based learning and direct instruction using an interactive whiteboard will improve science test scores, (b) A combination of inquiry-based
learning and direct instruction using laptop computers will improve science test scores, and (c) There will be differences between the groups in computer use for homework and non-school use.

The next chapter discusses the data and results from the state assessments, pre- and post science test, and student technology use survey. The researcher’s conclusions, implications for future research, and final remarks are also included in this chapter.
CHAPTER 5
DISCUSSIONS AND CONCLUSIONS

This research studied the impact of technology integration during science lessons to help prepare fourth graders in a suburban elementary school for the Kansas State Science Assessment. Results of this study indicate that significant differences between Classes A, B, and C did not occur. However, it is important to note that the students in the interactive whiteboard group (Group A) were the highest ranked at the conclusion of the study while they were ranked second at pre-test. Furthermore, gains from pre- to post-test made by the entire sample (not subgroups) were statistically significant.

Limitations

This research was limited to three fourth-grade classrooms at one K-5 elementary school. The other three elementary schools in the district also administer the Kansas State Science Assessment to their fourth graders; therefore, the results of this research project will be communicated to the schools after completion. Other limitations of this project included:

- Students may have been absent during test review sessions.
- Data for students with individualized education plans were not disaggregated from the results.
- Each of the three classes of science students participated in the science review lessons at different times of the day. The state science assessment was also administered at different times of the day.
- Class C was considered an overall higher-performing class compared to Classes A and B.
- The researcher may not have been aware of other variables that occurred during the study.
Discussion

The research questions that provided the foundation for this study were (a) What are the effects of an interactive whiteboard during science instruction? (b) What are the effects of using laptop computers during science instruction? (c) Is there a difference in computer use for homework and non-school use between the groups? Hypotheses tested in the study were (a) A combination of inquiry-based learning and direct instruction using an interactive whiteboard will improve science test scores, (b) A combination of inquiry-based learning and direct instruction using laptop computers will improve science test scores, and (c) There will be differences between the groups in computer use for homework and non-school use.

To address the first and second hypotheses, raw data averages on the pre- and post- tests showed that the interactive whiteboard class, Class A, scored higher than the other two groups. However, after removing variance common to reading and math skills gathered from state assessment scores, statistically significant relations between pre-- and post-test science knowledge emerged only for the students in the no technology group; therefore, the results do not support either hypothesis. A possible reason for this outcome was that Class C, the no technology group, was an overall higher achieving class than the other two groups. Another factor could have been the limited number of science review sessions. The research consisted of six review sessions, and only three of those sessions provide students with technology interventions. Participating in the science review sessions and state assessments at different times of the days could have also affected student performance. It was also realized that all three classes use interactive whiteboards and laptops on a weekly basis. Even though Class C did not have a technology intervention during the science sessions for two weeks, it is likely the students used the laptops and interactive whiteboards outside of the science classroom during that time.
Gain scores were also calculated to determine differences between pre- and post-intervention scores. Results indicated that significant group differences between pre- and post-test scores in science content knowledge did not emerge. It is interesting to note that although statistical differences between groups did not emerge in the researcher-generated science test scores, the students in the interactive whiteboard group were the highest ranked at the conclusion of the study while they were ranked second at pre-test. Additionally, those in the laptop group were outranked by the no technology group. When analyzing the pre- and post-test data by individual student, results were statistically significant, indicating that gains made by all students were statistically significant. These results may indicate inquiry-based learning and direct instruction by themselves (without technology) impacted the performance of the students.

To address the final hypothesis, data from the student technology survey were gathered. Results showed that there were no significant differences between the three groups regarding the amount of computer use for homework and non-school work. The results from the survey do not support this hypothesis. Descriptive statistics from the survey did reveal that 71% of the students in this study would prefer to take tests on the computer rather than pencil-paper or orally. However, when taking science tests, 62% of the students would prefer to take a performance-based assessment. The survey also revealed that 81% of the participants like to use technology when learning.

*Implications for Future Research*

Technology is here to stay. Even though the results of this research project did not show significant differences between groups with or without technology interventions it is important for educators to stay current with research about innovative technological tools to enhance learning. In some studies regarding technology, researchers have arrived at similar conclusions:
the technology intervention groups did not show significant differences (Bell, 1998). However, those same researchers collected qualitative data that showed an increase in student motivation while using technology. Motivating students to want to learn is a common theme in every classroom. Future studies involving the effects of technology integration may want to focus more on student motivation to learn instead of focusing completely on test scores.

Computerized testing is another topic that needs more attention. Many states are now choosing to administer on-line standardized tests in schools. If students are not taking computerized tests on a regular basis, test anxiety may increase and student performance may decrease when computerized tests are administered. Past research has studied the effects of computerized tests versus pencil/paper tests (Valdez, 2005). Results of the studies have shown that students who take computerized tests respond at a higher level compared to students who take pencil/paper tests. The researchers believe that any type of technological tool used during learning activities needs to be available during testing. Assessment procedures should be similar to learning procedures.

Another recommendation to consider would be to conduct similar studies that focus on special needs students. Implementation of assistive technology, including computers, software programs, voice recognition systems, and personal listening devices can aid struggling students (Wood, 2004). Helping struggling students gain confidence and competence while using a variety of technologies is an integral component of today’s education.

Final Remarks

Even though the results of this research did not support the researcher’s hypotheses, valuable information was gained during this study: technology did not hurt student performance;
students in the intervention groups enjoyed using the technology to learn; a majority of students in each group prefer to use technology in their learning environments.

The results of this study will be shared with other educators to encourage pedagogical thinking about technology use in classrooms. Technology is an integral factor in the lives of today’s students, and it is important that we prepare them for the world in which they will be living.
REFERENCES


APPENDICES
APPENDIX A

Sample Madeline Hunter Direct Instruction Lesson Plan Format

Standards:

Fourth Grade Science
STANDARD 6: SCIENCE IN PERSONAL AND ENVIRONMENTAL PERSPECTIVES:
The student will demonstrate personal health and environmental practices.

Benchmark 1: The student will develop an understanding of personal health.

Objectives:
1. The student assumes some responsibility for his/her own health
2. The student discusses the nutritional value of various foods and their contribution to health
3. The student reads and compares nutrition information found on labels and discusses healthy foods

Anticipatory Set:
Address background knowledge by asking and discussing the following questions:
• Where can you find nutritional labels?
• Why do foods have to have nutrition labels?

Teaching:
• Show students an example of a nutrition label.
• Identify the important parts of the label (serving size, calories, nutrients, ingredients, etc.)

Guided Practice:
• Show the students a different nutrition label.
• As a class or in small groups, identify the same important parts of the label.

Independent Practice:
• Give students another nutrition label.
• Ask each student to independently label the important elements

Closure:
• Discuss students’ independent work
• Review the importance of food labels
• Ask students to name healthy snacks
APPENDIX B

Technology and Computer Use Survey

1. I am a....
   - Girl
   - Boy

2. Which of the following do you own or use regularly (Check all that apply):
   - MP3 player or iPod
   - MP3 player (iPod, other)
   - Cell phone
   - Walkman/CD player
   - Gameboy
   - X-Box or Playstation
   - PDA
   - Computer

3. At home, what types of activities do you use the computer for? (check all that apply)
   - Instant Messaging
   - E-Mail
   - Games
   - Internet Research for school work
   - Downloading Music
   - Blogging
   - Typing Homework
   - Surfing the web for fun
   - I don’t have access to a computer

4. How many hours a day do you spend doing homework? (outside of school)
   - less than one hour
   - about one hour
   - about two hours
   - three or more hours

5. How many hours a day do you spend doing homework on the computer (outside of school)?
   - less than one hour
   - about one hour
   - about two hours
   - three or more hours
   - I don’t have access to a computer
6. Which of the following do you usually use the computer for the most when using it to complete your homework?
   - [ ] internet research for school work
   - [ ] typing homework
   - [ ] other
   - [ ] I don’t have access to a computer

7. How many hours a day do you spend on the computer doing NONschool work?
   - [ ] less than one hour
   - [ ] about one hour
   - [ ] about two hours
   - [ ] three or more hours
   - [ ] I don’t have access to a computer

8. Do you usually like or dislike using technology to help you learn?
   - [ ] I like it
   - [ ] I dislike it
   - [ ] I don’t know

9. How do you usually feel when you take tests?
   - [ ] Confident
   - [ ] Nervous
   - [ ] I don’t know

10. How do you usually feel when you take a test on a computer?
    - [ ] Confident
    - [ ] Nervous
    - [ ] I don’t know

11. How do you usually feel when you take a pencil/paper test?
    - [ ] Confident
    - [ ] Nervous
    - [ ] I don’t know

12. If you could choose, which way would you prefer to take tests?
    - [ ] pencil/paper test
    - [ ] test on the computer
    - [ ] orally take a test

13. If you could choose, which way would you prefer to take a science test?
    - [ ] pencil/paper test
    - [ ] test on the computer
    - [ ] orally take a test
    - [ ] perform an experiment
APPENDIX C

Pre-/Post Test

1. Which question can be answered by investigating?
   a. Which brand of paper towels is the strongest?
   b. Who was the person who invented paper towels?
   c. How is the paper towel made?
   d. Why was the paper towel invented?

2. Which question can be answered by investigating?
   a. Will amount of sunlight affect the growth of a plant?
   b. What does a plant do with sunlight?
   c. How does a plant make its food?
   d. Where are the most kinds of plants found?

3. Susan wanted to know if her daisies would grow better in the sun. What would be the best way to find out?
   a. Place half of her daisies in the sun and half in the shade. Record the amount of growth after two weeks.
   b. Place all of her daisies in the sun and record the amount of growth after two weeks.
   c. Place all of her daisies in the shade and measure the amount of growth after two weeks.
   d. Place half her plants in the sun and give them half as much water as the half in the shade.

4. Billy noticed that the hard candy in his mouth changed color from red to yellow after one minute. After another minute, it had changed to green. After another minute, it was yellow. From his observations, what can Billy say about the candy?
   a. It changed color every minute.
   b. It will be red in another minute.
   c. It will be orange some time.
   d. It will not change color again.

5. If an object is being pulled toward a magnet, what can we say about the object?
   a. It is attracted by the magnet.
   b. It is repelled by the magnet.
   c. It is made of a sticky substance.
   d. It is not a nail.
6. Which shows magnets repelling?
   a.  
   b.  
   c.  

7. How was the Grand Canyon formed?
   a. erosion  
   b. landslide  
   c. volcanic eruption  
   d. tornado

8. Carl filled a cup with crushed ice and let it melt. Which weighed more, the solid ice or the liquid water after the ice melted?
   a. They weighed the same.  
   b. The solid ice weighed more.  
   c. The liquid water weighed more.  
   d. There is no way to find out.

9. Which snack would be the healthiest?
   a. Carrots and apples  
   b. Potato chips and dip  
   c. Brownies and ice cream  
   d. Candy and peanuts

10. During Earth Week, Jane wanted to do her part in saving the Earth. What is one thing that she and her classmates can do?
    a. Start a recycling bin at school.  
    b. Save can labels and bring them to school.  
    c. Water the neighbors’ lawns.  
    d. Wash their parents’ cars.

11. Terry is working in the recycling center and is in charge of sorting the things that have been dropped off. Which plan would keep the objects organized by the material they are made from?
    a. all cans, bottles, and paper in separate places  
    b. cans and bottles together, paper separate  
    c. bottles and paper together, cans separate

12. Which tool would best help a student see the colors and design of a butterfly’s wing?
    a. hand lens  
    b. a ruler  
    c. an eyedropper  
    d. a mirror
13. Which tool would best help a student measure 30 ml of water?
   a. balance
   b. scale
   c. graduated cylinder
   d. ruler

14. Nate wanted to know if his Alka Seltzer tablet would dissolve faster in water as a whole tablet or as a crushed tablet. What would be the best way to find out?
   a. Drop two whole tablets into water
   b. Using the same amount of water in two cups, drop the tablets in and record time to dissolve
   c. Drop the whole tablet into water and the crushed tablet into vinegar
   d. Put half of a tablet in one cup of water and the other half in another cup of water, and record the time to dissolve

15. Use the following chart to describe the high temperatures from October 1st to October 10th.

<table>
<thead>
<tr>
<th>October</th>
<th>High Temperatures in Fahrenheit</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>81</td>
</tr>
<tr>
<td>2</td>
<td>68</td>
</tr>
<tr>
<td>3</td>
<td>70</td>
</tr>
<tr>
<td>4</td>
<td>75</td>
</tr>
<tr>
<td>5</td>
<td>64</td>
</tr>
<tr>
<td>6</td>
<td>61</td>
</tr>
<tr>
<td>7</td>
<td>58</td>
</tr>
<tr>
<td>8</td>
<td>55</td>
</tr>
<tr>
<td>9</td>
<td>51</td>
</tr>
<tr>
<td>10</td>
<td>49</td>
</tr>
</tbody>
</table>

   a. October started out warm and ended up cooler.
   b. The coldest temperature was at the first of the month.
   c. Every day got cooler than the day before
   d. Not enough information

16. Put the following soil types in order from least permeable to most permeable.
   Sand    Gravel    Clay    Humus Loam

17. What do the following objects have in common?: light bulb, t-shirt, pencil, silly putty
   a. they are made out of the same materials
   b. they are man-made
   c. they are naturally made
18. Which of the following is a man-made substance?
   a. oil
   b. gasoline
   a. water
   b. lava

19. Which of the following characteristics does guinea pigs and mealworms share?
   a. segmented bodies for moving
   b. legs for moving
   c. antennae for feeling
   d. fur for warmth

20. Choose the correct order for the life cycle of a mealworm:
   a. egg, larva, pupa, beetle
   b. egg, pupa, larva, moth
   c. egg, pupa, larva, beetle
APPENDIX D

Example Multimedia Presentation

Slide 1

Nutrition Labels

Where can you find nutrition labels?

Why do foods need nutrition labels?

Slide 2

Nutrition Labels

Serving Size

Nutritional Information

Ingredients

How do you think manufacturers decide on which order to list the ingredients?

Slide 3

It's Your Turn!

How many calories per serving does this food contain?

How many servings does this food contain?

What is the main ingredient in this food?

Slide 4

It's Your Turn!

Label B

Nutrition Facts

How many calories per serving does this food contain?

How many servings does this food contain?

What is the main ingredient in this food?
APPENDIX E
Technology Survey Results

TABLE 7

<table>
<thead>
<tr>
<th>Technology Survey Results</th>
<th>Class A Interactive Whiteboard (20 students)</th>
<th>Class B Laptops (20 students)</th>
<th>Class C No Technology (21 students)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Percent of students who own or use these tools regularly:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MP3 Player or iPod</td>
<td>20%</td>
<td>65%</td>
<td>38%</td>
</tr>
<tr>
<td>Cell Phone</td>
<td>15%</td>
<td>30%</td>
<td>33%</td>
</tr>
<tr>
<td>CD Player</td>
<td>55%</td>
<td>65%</td>
<td>43%</td>
</tr>
<tr>
<td>Gameboy</td>
<td>55%</td>
<td>70%</td>
<td>62%</td>
</tr>
<tr>
<td>X-Box or Playstation</td>
<td>55%</td>
<td>80%</td>
<td>62%</td>
</tr>
<tr>
<td>PDA</td>
<td>20%</td>
<td>40%</td>
<td>38%</td>
</tr>
<tr>
<td>Computer</td>
<td>90%</td>
<td>95%</td>
<td>86%</td>
</tr>
<tr>
<td>3. Percent of students who use the computer for the following activities:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IM-ing</td>
<td>20%</td>
<td>30%</td>
<td>29%</td>
</tr>
<tr>
<td>Email</td>
<td>45%</td>
<td>45%</td>
<td>52%</td>
</tr>
<tr>
<td>Games</td>
<td>90%</td>
<td>100%</td>
<td>90%</td>
</tr>
<tr>
<td>Internet Research</td>
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<td>75%</td>
<td>76%</td>
</tr>
<tr>
<td>Downloading Music</td>
<td>25%</td>
<td>40%</td>
<td>48%</td>
</tr>
<tr>
<td>Blogging</td>
<td>0%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>Typing Homework</td>
<td>75%</td>
<td>75%</td>
<td>62%</td>
</tr>
<tr>
<td>Surfing Web for Fun</td>
<td>50%</td>
<td>70%</td>
<td>62%</td>
</tr>
<tr>
<td>Do not have access to computer</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td>4. Hours a day spent on homework:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>60%</td>
<td>50%</td>
<td>48%</td>
</tr>
<tr>
<td>About 1 hour</td>
<td>35%</td>
<td>35%</td>
<td>48%</td>
</tr>
<tr>
<td>About 2 hours</td>
<td>5%</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td>Three or more hours</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>5. Hours a day spent on homework on the computer:</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>60%</td>
<td>45%</td>
<td>52%</td>
</tr>
<tr>
<td>About 1 hour</td>
<td>30%</td>
<td>45%</td>
<td>29%</td>
</tr>
<tr>
<td>About 2 hours</td>
<td>0%</td>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>Three or more hours</td>
<td>0%</td>
<td>0%</td>
<td>0%</td>
</tr>
<tr>
<td>Do not have access</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td></td>
<td>Class A Interactive Whiteboard (20 students)</td>
<td>Class B Laptops (20 students)</td>
<td>Class C No Technology (21 students)</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------</td>
<td>------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td><strong>6. Which do you use the computer for the most when completing homework:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internet research</td>
<td>10%</td>
<td>75%</td>
<td>71%</td>
</tr>
<tr>
<td>Typing</td>
<td>80%</td>
<td>10%</td>
<td>10%</td>
</tr>
<tr>
<td>Other</td>
<td>5%</td>
<td>15%</td>
<td>14%</td>
</tr>
<tr>
<td>Do not have access</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>7. Hours a day spent on the computer doing NON-school work:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than 1 hour</td>
<td>25%</td>
<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>About 1 hour</td>
<td>35%</td>
<td>20%</td>
<td>29%</td>
</tr>
<tr>
<td>About 2 hours</td>
<td>20%</td>
<td>35%</td>
<td>24%</td>
</tr>
<tr>
<td>Three or more hours</td>
<td>15%</td>
<td>35%</td>
<td>29%</td>
</tr>
<tr>
<td>Do not have access</td>
<td>5%</td>
<td>0%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>8. Do you like or dislike using technology to help you learn:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Like it</td>
<td>85%</td>
<td>90%</td>
<td>67%</td>
</tr>
<tr>
<td>Dislike it</td>
<td>5%</td>
<td>0%</td>
<td>10%</td>
</tr>
<tr>
<td>Do not know</td>
<td>10%</td>
<td>10%</td>
<td>24%</td>
</tr>
<tr>
<td><strong>9. How do you usually feel when you take tests:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confident</td>
<td>25%</td>
<td>25%</td>
<td>33%</td>
</tr>
<tr>
<td>Nervous</td>
<td>55%</td>
<td>55%</td>
<td>57%</td>
</tr>
<tr>
<td>Do not know</td>
<td>20%</td>
<td>20%</td>
<td>10%</td>
</tr>
<tr>
<td><strong>10. How do you usually feel when you take tests on the computer:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confident</td>
<td>50%</td>
<td>55%</td>
<td>76%</td>
</tr>
<tr>
<td>Nervous</td>
<td>25%</td>
<td>30%</td>
<td>19%</td>
</tr>
<tr>
<td>Do not know</td>
<td>25%</td>
<td>15%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>11. How do you usually feel when you take a pencil/paper test:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Confident</td>
<td>30%</td>
<td>50%</td>
<td>43%</td>
</tr>
<tr>
<td>Nervous</td>
<td>60%</td>
<td>45%</td>
<td>52%</td>
</tr>
<tr>
<td>Do not know</td>
<td>10%</td>
<td>5%</td>
<td>5%</td>
</tr>
<tr>
<td><strong>12. Test-taking preference:</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pencil/paper</td>
<td>5%</td>
<td>25%</td>
<td>19%</td>
</tr>
<tr>
<td>Computer</td>
<td>85%</td>
<td>65%</td>
<td>62%</td>
</tr>
<tr>
<td>orally</td>
<td>10%</td>
<td>10%</td>
<td>19%</td>
</tr>
<tr>
<td></td>
<td>Class A Interactive Whiteboard (20 students)</td>
<td>Class B Laptops (20 students)</td>
<td>Class C No Technology (21 students)</td>
</tr>
<tr>
<td>-------------</td>
<td>---------------------------------------------</td>
<td>-------------------------------</td>
<td>------------------------------------</td>
</tr>
<tr>
<td>13. Science test-taking preference:</td>
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<td>10%</td>
<td>14%</td>
</tr>
<tr>
<td>Computer</td>
<td>10%</td>
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<td>35%</td>
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