EFFECTS OF GUIDED AND UNGUIDED INSTRUCTION USING 1-TO-1 STUDENT IPADS IN 6^{TH} GRADE SCIENCE

by

Matthew Joshua Shargel

A professional paper submitted in
partial fulfillment of the requirements from the degree

of

Master of Science

in

Science Education

MONTANA STATE UNIVERSITY
Bozeman, Montana

July 2012

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

INTRODUCTION AND BACKGROUND

The rapidly changing technological fabric of America is being accompanied by an uncertain journey by education policy makers towards establishing responses to the changing needs and demands of the students they serve. Each generation in the past century has faced new frontiers and challenges. This generation will surely be defined by the rapid rise of the handheld, internet-enabled, personal phone and tablet computer, the most popular of which are the iPhone and iPad. The current iPad 2 is capable of processing at 1GHz, or 1 billion functions per second, a full 1,000 times faster than many school's first computers, the Apple IIe (Apple, 2011). In real world terms, a single iPad 2 could serve the computer processing needs of 1,000 student-computer needs in 1983. With such high computing potential many students, parents, administrators, and teachers have equally high hopes for tools like the iPad as conduits improved education.

With such a powerful device in the hands of students, what direction can educators take their classes to best explore the learning potentials in the iPad? So many educational ideas have fallen by the wayside, but the power and prior successes of Apple lends staying power to this cutting edge technology. There is great potential in a device that can easily, quickly, and seamlessly connect to digital class folders, virtual notebooks, the internet, and the overwhelming variety of educational applications being developed at an rapid pace. Students have high hopes of an interesting and new fashionable way of going to school. Teachers and administrators have high hopes for improved efficiency, delivering better content, and improved learning.

Project Background

In the spring of 2011 my school approved integrating the iPad by giving each incoming 6th grader an iPad of their own. Once the initial excitement waned, the reality of this educational change loomed large in teacher's minds and lesson plans. This project attempted to track and examine some of the positive effects this device had in my own science classroom.

Focus Questions

- How can student iPads be used to increase student learning, student interest, and work efficiency in the middle school science classroom?
  - How will digital science notebooks, based on an iPad platform, impact student attitudes and learning outcomes?
  - Will active, guided instruction impact student knowledge acquisition differently than passive, implicit modes of instruction in both iPad based and traditional notebooks?

This action research was conducted on sixth grade students in my middle school science classroom. Each grade level at this private independent school consists of 40 students divided into two science sections of 20 students each. Each class is approximately 20 boys and 20 girls. The ethnic breakdown of the school matches the diverse California, Bay Area community we serve. The school has students with a broad mix of first and second-generation immigrant families from China, Japan, Korea, Australia, Vietnam, Russia, England, Spain, Mexico, Israel, Canada, Nigeria, India, Iran, and France. Approximately 10 percent of the student population is African American.

Many students are of 2 or more mixed racial backgrounds. Students also come from a wide variety of socioeconomic situations. Nearly half of the school is on partial or full scholarships. The school does not have a free or reduced lunch program and the median household incomes for the cities feeding into the school range from about $60,000 to well over $200,000 per year. While many students are very affluent, some others have families in a low-income category.

CONCEPTUAL FRAMEWORK

Perhaps the largest variable in this action research project was the introduction of the iPad to classes that had previously been using traditional class materials. In examining the effects of this addition, it was important to consider the order in which the treatments take place. Integrating simulation into inquiry based learning environments can yield improvements in qualitative aspects of learning such as positive student educational perceptions (Toth, Morrow, & Ludvico, 2008). For groups of students exploring science-based inquiry problems, the order in which the mode of learning occurs can have an impact on educational outcomes. Student perceptions of learning have been shown to be most positive when virtual learning is presented before a hands-on experience (Toth, Morrow, & Ludvico, 2008). Curiously however, when students are given a hands-on experience first, being followed by virtual learning, attitudes towards the value of the virtual experience can be markedly diminished. In research on simulations with iPads it is important to thoughtfully order the virtual and hands-on experiences of students and to take this order into consideration in interpreting educational outcomes and assessments.

Initially in designing my own action research, I saw the question of simulation in shades of black and white. Either my students would learn more using the digital devices and virtual labs, or they would be hindered by them. No consideration had been made to the variety of combinations possible in integrating simulation with real experience. How will virtual science learning experiences hinder the project-based inquiry method of learning by altering the confidence students place in the real experience when an authoritative virtual source is present?

Few advances compare to the potential found in the iPad in its ability to portably stream content from multiple sources and interact with its user in novel ways. Initiatives at all levels of education are pushing the implementation of increased technology usage in education. This project distinctly lies in the shadow of this cultural shift, led by a clear national vision towards technology use in the classroom (U.S. Department of Education, Office of Educational Technology, 2010). Important foundations have already been laid on which learning units can be built to further explore differences between the virtual and the real. National, state, and local leaders highlight STEM (science, technology, engineering, math) curriculum to reinforce this impetus towards increased technology use (McHugh, 2005). A clear mandate has been made to better connect teachers and students to the resources and communities that can best impact the learning outcomes occurring in the classroom.

The methods and their order for this action research were taken through many different drafts over several months. Educational research has shown that a combination of both virtual and hands-on experiences can yield more student learning than simulated learning alone (Jaakkola, Nurmi, & Veermans, 2010). This effect occurs even in light that the combination group may have less time devoted to each form of learning. While beyond the scope of this project initially, combinations of hands-on and virtual experiences will surely take hold in my science classroom.

The background of the student is another important consideration. Even if the results of a study were to show little educational effect, a thoughtful division of the study population can show surprising trends (Winn, Stahr, Sarason, Fruland, Oppenheimer, & Lee, 2005). One result shows that in general the more experience a student has in a subject, the less useful simulation is in their learning cycle. As student mastery increases, so does the value of real-world activities just as the need for simulation decreases. Two students experiencing the same series of units with varying use of virtual and hands-on learning may experience different learning outcomes simply because of their distinct levels of proficiency and familiarity with the simulation tools. When implementing any new tool, and especially iPads, it is critical to note the wide variety of background experiences students' posses. Just as exposure to computers in the home may vary from student to student, there is a wide array of experience with hand-held technologies in the form of laptops, iPods, and iPads.

The smaller and less expensive iPod may offer a parallel look into successes and challenges of implementing this sort of technology into the science classroom. Surprisingly some of the most useful functions of these types of devices are some of the most basic. One of these is the more efficient use of the many simple functions these devices serve. Many of the built-in features in iPods and even more so in iPads will reduce the use of traditional science classroom tools such as timers, stopwatches, graph paper, rulers, calculators, dictionaries, and notecards (Banister, 2010). A focus on the grand and flashy apps on the iPad may actually distract from the most used functions of the device.

The allure of the iPad is intense to both student and teacher. But clearly a better understanding of the strengths and limitations of the device and how it is used is warranted. Careful consideration is needed of how and when simulation is integrated into hands-on learning. Not only must the teacher master the capabilities of the device, the background and foundational experiences of the learners must also be considered in the design and implementation of a successful iPad-based science program.

METHODOLOGY

This project examines the effect of the iPad on student notebooks and learning outcomes with and without direct guidance and modeling from the instructor. Two treatments have been introduced over the course of four units. These treatments first examined the effects of digital notebooks. The second treatment introduced increased teacher scaffolding via the iPad to explore the benefits of both the device as well as the added teacher modeling. These questions will were examined over the course of four, approximate two-week units in my sixth grade Earth Sciences course. Each unit consisted of three lectures, two shorter lab activities, three homework readings and section review assignments, three quizzes, and one test.

The format for these units was a divergence from the normal pace of class and my typical unit design. A usual week in my classroom consists of nearly 75% of class time being devoted to projects, labs, and other hands-on learning activities. In order to have similar units for clearer comparisons, the units for this study utilized the format from the publisher of our class textbook involving power point lectures, worksheets, and text-based quizzes and tests.

Students had been given their iPads at the beginning of the school year, three months before the study period began. Throughout the fall they had been given class time specifically devoted to iPad use. Students had also been using the devices in almost all of their classes including history, English, science, math, and foreign language. All students had been given styluses to write with and nearly all students had keyboards for their iPads.

In the first 10-day unit, students used iPads to create a digital notebook instead of a traditional paper version. For lectures they used the app Notability to take notes. During their homework reading they added to and edited their lecture notes from the day. For notebook observations in experiments and hands-on activities they input data and observations into their iPads. As they prepared and studied for each quiz and the final test, students were asked to use their iPad notebook as a study tool. During this unit, lessons were also presented in an implicit format. This means students were expected to create their own supporting materials for lectures, labs, and study tools. For example, students were asked to take notes, but no template was provided for them to fill in.

During the 10-day second unit, students used paper exclusively for notes, data, observations and studying. Again, students were encouraged to use only this form of notes for their study time and review leading up to the quizzes and test. This unit, as with the first, also featured primarily implicit and unguided instruction.

During the third 10-day unit, in which iPads were again to be used for note taking, I provided notes templates, pre-made digital flashcards, iPad based review worksheets and activities, and other guided instructional scaffolding tools. The goal was to provide a framework for students to use the iPad to a greater potential. I worked actively with my school's tech team to design and review these tools before I lead the unit.

During the fourth and final 10-day unit, I repeated the guided scaffolding format but entirely with paper instead. I used the same digital tools but in a non-digital format as closely as possible. This unit served as a baseline for the project as it best represented the historically normal practices in this classroom. (Refer to Table 1).

Table 1
Treatment and Unit Schedule

Order	Topic (10 days each)	Treatment
Unit 1	Earthquakes	Digital Notebooks / Implicit
Unit 2	Volcanoes	Paper Notebooks / Implicit
Unit 3	Erosion	Digital Notebooks / Explicit
Unit 4	Soil Science	Paper Notebooks / Explicit

Several data collection methods were used throughout the study. These took a variety of forms and were used with classes at different times during each unit (Table 2).

Table 2
Data Collection Methods

DATA COLLECTION METHODS MATRIX	Likert Survey	Students Interviews	Summative Assessment	Notebook Rubrics	Teacher Journal
	1	2	3	4	5
Primary Question: • How can student iPads be used to increase student learning, student interest, and work efficiency in the middle school science classroom?	X	X	X	X	X
Sub Question #1: • How will digital science notebooks, based on an iPad platform, impact student attitudes and learning outcomes?	X		X	X	
Sub Question #2: • What impacts will utilizing iPads in the classroom have on student and teacher outlook of iPads and technology in general as educational tools?	X	X			X

Table 3
Data Collection Instrument Description

1: Likert Attitude Survey – Quantitative data. Administrated as paper surveys given once with each unit at the mid-point. All students took surveys. Answers on a scale of 1-4. *Appendix A*
2: Interview – Qualitative perspectives. One-on-one student-teacher interviews video recorded. 12 students from each class (4 each; low, medium, high-achieving). Administered at the end of each unit before the unit test results were given back to students. *Appendix B*
3: Post-Test – Used as summative assessment yielding quantifiable data. Administered to whole group. Test consisted of sections on unit vocabulary, data interpretation, and basic scientific process short answer questions.
4: Notebook Rubric – Teacher generated rubrics yielded quantitative data. Rubrics shared with students before the unit. Treatment and non-treatment notebook rubrics were the same. Administered to whole group. *Appendix C*
5: Teacher Journal – A digital log of teacher attitudes, experiences, and goals.

This project examined the learning outcomes, as well as student and teacher attitudes towards iPads and technology in general. It entailed four science units of approximately 10 days each.

Several tools were used to gather initial data as part of the study (Table 2). The first tool was a written attitude survey conducted on the study participants at the end of the first unit. One question this project hoped to answer was how student attitudes changed about the iPad as it was used in variety of ways in this science course. Attitude surveys, along with individual student interviews, provided insight into these changes over time.

The second tool examines the quality of student notebooks with a quantitative score being created from a rubric. Each notebook was examined for neatness, formatting, vocabulary, key points, diagrams, drawings, data collection efficiency and clarity.

A third major assessment tool used was quantitative summative assessments given at the conclusion of each unit (Table 3). To examine the effectiveness of iPads at increasing student learning, these tests were absolutely critical. There are many factors beyond the iPad that will influence outcomes on these assessments. It is because of this, other assessment and evaluation tools such as interviews and attitude surveys were used to best triangulate the validity of conclusions.

A teacher journal was also used to track teacher attitudes throughout the project. Successes and difficulties in iPad implementation formed a major part of this journal. Also included were notes on suggested improvements as well as anecdotal feedback and advice from other teachers and students (Table 3).

Two sixth grade science classes were used for this research project. They consisted of groups of 20 students evenly divided into two sections of 10 boys and 10 girls each. Each student was given an iPad at the beginning of the school year. Students used their iPads in a broad variety of ways in each of their classes ranging from very active use of many apps in some classes to no use at all in others.

The course began with the start of the school year in September of 2011. The first unit, iPad-implicit, in the research project began on October 17th and ran for 9 days. Each consecutive unit ran an equal amount of time. At the end of each unit, interviews and attitude surveys were conducted during one class period, before the start of the next unit.

The research methodology for this project received an exemption by Montana State University's Institutional Review Board and compliance for working with human subjects was maintained.

DATA AND ANALYSIS

This survey of student attitude and educational outcomes used four methods of assessment to generate both qualitative and quantitative data: student notebooks, Likert Technology Attitude Surveys (LTAS), summative assessment scores, and student interviews (Table 3). When combined, these tools shed light from different angles on the effectives of this iPad implementation project. Analysis of the sum of these allow for a clearer picture of a rather complex series of conclusions reaching beyond the science lab. While they as a whole portray an insignificant set of outcomes for the research aspirations, they also serve as a rallying call for future plans and expectations for the study population and setting. The hope of clear and indisputable evidence for the research was not achieved by any individual piece of student analysis, however when viewed as a whole, some larger conclusions become evident.

In the following sections, each research assessment method will be examined individually. While each research method was designed with every good intention, some changes were implemented during the action research process that will be clarified in the following sections.

Student Notebook Results

Throughout the four-unit study period, students alternated between two forms of note-taking techniques for lectures, readings, and lab notes. First, the students wrote notes onto their iPads via the app, Notability. Alternatively, students used the traditional note taking form of lined paper and pencils. These two forms of notebooks were then collected at the end of each unit and compared in two different ways. Both forms of notebooks were scored according to a common notebook rubric with key grading categories of general formatting, both written and drawn observations, data organization, and conclusions. Next, teacher attitudes towards administrative functions, including collection, teacher review time, and re-distribution to students were examined. These were recorded in a teacher journal after each set of notebooks was submitted.

Notebook Rubrics

The first and most direct form of examining student notebooks throughout the study involved a look into their content and form through a rubric. Standardized data was collected and is summarized in Figure 1.

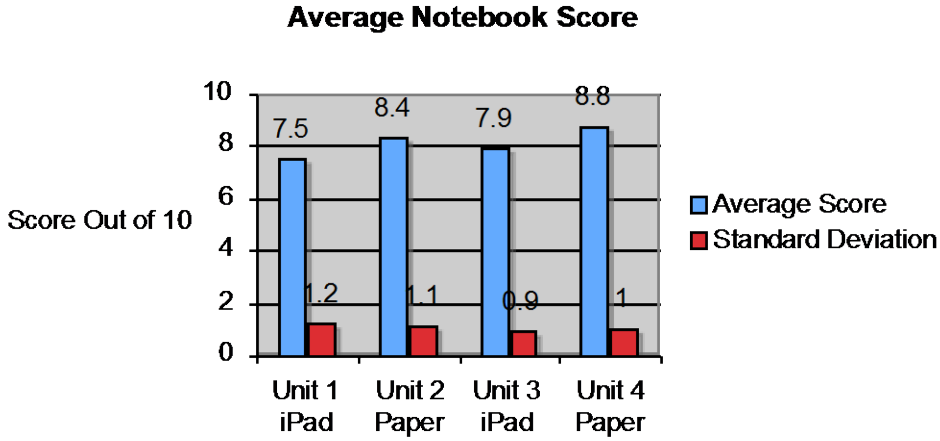

Figure 1. Average Notebook Score, (*N*=40).

The first clear conclusion appears in the difference between units 1 and 2, and units 3 and 4. In units 1 and 3, notebooks were iPad based and collected via Dropbox or printed and then submitted for grading. In units 2 and 4, notebooks were based on traditional, paper and pencil methods. The mean score for the paper-based notebooks in both comparisons was 11-12% higher than those for digital versions. Paper notebooks contained cleared writing, in most cases noticeably better handwriting, more detailed content, and cleared diagrams and drawings.

The lowest rubric scores were seen in the first unit with iPads. Two students out of the study group scored 5 points out of 10 in their first attempt at digital notebooks. These students also scored poorly on the subsequent paper versions, however both scored one point higher in paper versus digital notebooks. When compared side-by-side, as a quick check for reliability, the relativity of these scores was clearly correct. In these low performing students, the iPad version of their notebooks was clearly of poorer quality and contained less valid content.

At the other end of the achievement spectrum, five students scored a perfect 10 on their paper notebooks for unit 2. None of these high achieving students had equally high scores on either their unit 1 or 3 iPad based notebooks. The mean scores for these students' iPad based notebooks was 7.8 out of 10, compared to their perfect 10's on the paper notebooks. Clearly, these high achieving students, just as students at the other end of the spectrum, were not able to achieve the same level of quality and content via the iPad.

These results may have come from difficulties students have at maintaining a level of detail and completeness in notes and drawings taken on an iPad. The mechanisms of the device itself do not allow for drawings with details comparable to those taken on paper. In addition, digitally handwritten or typed notes and observations are more difficult to input into an iPad when compared to traditional paper techniques.

Notebook Handling and Administrative Functions

In addition to examining notebook quality and content, classroom efficiency in handling these documents was examined.

Notebooks were submitted four times in class during the study. Initially the study plan involved students providing paper copies of their handwritten notes but digital copies of their iPad-based notes. This plan was changed after classes first attempted submitting digital versions via Dropbox, a shared, cloud-based folder. This change in the study plan was in response to a technology and administrative bottleneck that occurred with the student work heading to Dropbox. The second attempt at submitting the iPad-based notebooks involved students wirelessly sending the documents to our classroom printer, collecting them from the printer, then stapling and submitting them. This printer-based activity was timed and compared to submission times for retrieving the notebooks from student three-ring binders, then stapling and submitting the work.

Submitting Student Notebooks – Dropbox

At the end of the first unit in the study, students were asked to submit their digital notebooks to a shared Dropbox folder. Dropbox folders had been successfully used to distribute content to students. Worksheets and handouts to be viewed on the iPad could be sent from a teacher computer to this cloud-based folder. Student iPad's would then automatically update these files onto their devices. This was a first attempt at reversing this technique, of changing the direction of the informational flow from teacher-to-student to students-to-teacher, in this science course. The outcome resulted in some very intense moments of frustration and significant class time use. One student said, "it [Dropbox] is easy to use for some things like opening an hand-out or a worksheet, but it can get pretty disorganized when every teacher is giving me materials at the same time."

Several students could not export their notes in a compatible format into Dropbox. Two others did not have their iPads available to work with at the time; one due to a dead battery and the other iPad had been confiscated due to misuse. By the next morning everyone in the class eventually uploaded files to the folder. But, after 20 minutes of class time, this was postponed to after class and homework time.

One entry from my teacher journal this day shows the frustration of this activity:

> What just happened? That was crazy! I thought this would be quick and easy to use and it was completely the opposite. I will NEVER do that again… and now I am dreading opening up all of these files – some of which I already know are in

> different formats in Pages and as PDF’s. I cannot believe anyone would find this method of collecting notebooks easier or more effective.

For both of the paper units, the time required to submit student notebooks was less than 30 seconds. When told to submit their work, students opened their binders, removed the paperwork, and passed them into the center isle. The greatest difficultly came when a few students needed to staple their work, however this was quickly completed in a matter of seconds.

The initial digital-difficulty can be attributed in part to effects of implementation lag. While initially poorer, the results for a new technique should improve steadily until the new methods eventually surpass the old way of doing things. This effect was expected, however not to this extreme. When compared to the time requirements for the paper versions, an extra 19.5 minutes were needed to gather student notebooks. A second difficulty presented itself when the notebooks were accessed for grading by the teacher in Dropbox.

Initial planning in this project should have foreseen the logical challenges of grading student work consisting of multiple pages on an iPad. The first challenge was simply examining the entirety of the work. The screen size of the iPad limited teaching viewing to two possible options. The first was a whole page image with impossibly small text. While the overall neatness and organization of the work was visible, the handwriting and typed text was too small to read. The second viewing option was a zoomed-in, landscape version of the notebook. Text was legible, however the entire page was not visible at one time. Scrolling was constantly necessary to read sentences and view larger drawn images. After a short time it became evident that this digital work would have to be printed or viewed on a larger computer to be effectively graded.

Submitting Student Notebooks – In-Class Printing

During Unit 3, a second attempt at iPad based notebooks, the class was instructed to print their notebooks via the classroom printer. This change was implemented in response to the major difficulties in the first unit. This too resulted in many difficulties and more teacher and student frustrations.

Another student bottleneck occurred as 20 students sent paperwork to a printer at the same time. The printing speed of the class printer seemed to slow down significantly. The atmosphere of the classroom became chaotic as well when nearly every student tried to crowd around the printer to get their own work. With teacher guidance and patience, eventually all of the students had successfully printed their work and submitted it. This process took 24 minutes from start to finish. One student noted their frustration with this process, "…everyone was crowding around the printer and then when I found my work, we waited for everyone else to get their work too. It was pretty confusing."

As with the Dropbox format for Unit 2, while implementation lag can account for some of the slowdown, printing a class set of notebooks took 12 times longer than simply submitting the hand-written paper versions. What was hoped to have been a vast improvement was in fact a fantastic flop! The drawbacks of having students submit work via a single class printer are insurmountable. This challenge however may have a silver lining. With every question answered, many more can arise. Now a new format of student paperwork tracking appears possible and deserves a good look. The capabilities of the iPad may allow for the creation of high quality digital portfolios where work is not printed at all. And on the teacher's side, new document viewing apps may allow for an easier time at reviewing and commenting on this digital work.

Likert Technology Attitude Survey (LTAS) Results

A major part of this study examined how iPads in the science classroom might change student attitudes towards science, iPads in education, and technology in general. While an improvement in attitude would have been welcomed, it was also hoped that the increase in technology use would not negatively impact traditionally high student attitudes towards science in this setting. Although some students were absent at the end of each unit, eventually results from 40 out of 40 students were collected via attitude surveys for each unit. Every student completed the questionnaire after a brief series of directions as well as encouragements for honesty and completeness. The survey consisted of four categories of questions. The first were questions centered on positive statements towards school and science specifically. The second set of questions was grouped around positive associations between technology and school. A third set examined positive attitudes toward iPads. The fourth and final group probed possible negative attitudes toward iPads as learning tools, however this final group of data was in place only to act as a validity check against the positive attitude questions. Upon examining student responses to these last two categories, it was clear that students responded consistently to both sets of opposing questions. Thus, this fourth group of questions posed in the negative will not be examined. Question 13 of the survey was posed to examine student attitudes towards reading texts for pleasure on the iPad. (Refer to appendix A). Question 15 was posed to examine self-reported game use on the iPad.

No analysis of these survey questions will be used in this study. Table 4 summarizes the mean score and standard deviation for each category of the student survey.

Table 4
Mean Scores per Category from LTAS (N=40)

	Unit 1: Earthquakes iPad – Passive Implicit		Unit 2: Volcanoes Paper – Passive Implicit		Unit 3: Erosion iPad – Active Guided		Unit 4: Soil Science Paper – Active Guided	
Category	Mean 1-4 Scale (N=40)	Standard Deviation	Mean 1-4 Scale (N=40)	Standard Deviation	Mean 1-4 Scale (N=40)	Standard Deviation	Mean 1-4 Scale (N=40)	Standard Deviation
Positive Attitudes Towards School and Science Questions 1, 12, 19	3.7	.47	3.7	.50	3.53	.60	3.57	.53
Positive Attitudes Towards Technology Questions 2, 6, 14	3.1	.71	3.1	.70	3.2	.67	3.3	.60
Attitudes of iPad as a Positive Learning Tools Questions 4, 7, 10, 16, 17	2.6	.73	2.6	.70	2.6	.78	2.6	.76
13 Outside Books read for Pleasure	3.4	.9	3.4	.7	3.2	.8	3.3	.9
15 Play Games on iPad	2.9	1.0	2.6	.8	2.6	.9	2.6	.8

Note. 1=strongly disagree, 4=strongly agree

Category 1 - Positive Attitudes Towards School and Science

The class survey clearly shows the expected trend throughout the entire school. The nature of our private school ensures a very high enthusiasm for school, learning in general, as well as specifically science class. A mean score of 3.7 out of 4 with a relatively low standard deviation shows this initial high enthusiasm (Figure 2). The one student who noted their dislike for labs and hands-on activities made several erasure marks on their paper indicating that they may not have understood the question fully.

The hope was that these highly positive attitudes would not change throughout the study timeframe. There was a possibility that the change of focus from traditional methods towards iPads would negatively impact the enjoyment and satisfaction students had for the course. In examining the data however, it was clear that student attitudes in this first category did not change between units 1 and 2. The sole difference between units was the use of traditional and iPad based notebooks and instruction.

There was a change in positive attitudes however between units 1 and 2, and units 3 and 4. The Mean LTAS score for category 1 questions in units 1 and 2 was 3.7 while the Mean score in the same category for units 3 and 4 was 3.6. This represents an approximately 3% decline in overall positive attitudes towards science and school.

The responses to the LTAS within this category of student satisfaction with science and school are summarized in Figure 2.

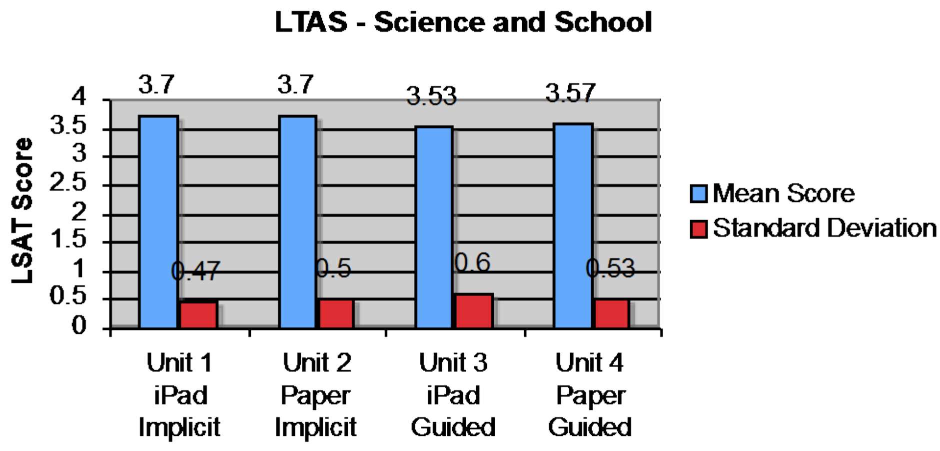

Figure 2. Mean Attitude Toward Science and School Survey Score, (*N*=40).

Category 2 – Positive Attitudes Towards Technology

This group of survey responses shows a much larger variety of attitudes than those directed towards school and science in general (Figure 3). While the majority of students indicated a positive attitude towards technology in their life and learning process, 8% of students responded both that they disagreed that technology made school more interesting for them or that it was reliable. While attitudes didn't change as much as was expected throughout the study period, some changes did clearly occur in student attitudes towards the role of technology in making school more interesting.

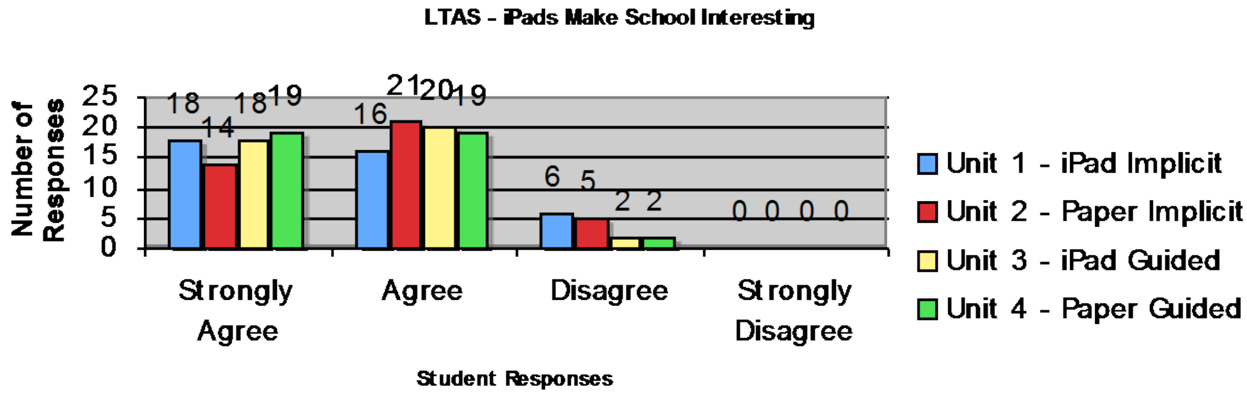

Figure 3. Mean iPad and School Interest Survey Score, (*N*=40).

At the end of the first unit, the number of students reporting an agreement or strong agreement that iPads make school more interesting was high, with 34 students in this category. 6 students disagreed with this statement, with no students strongly disagreeing throughout the project. At the conclusions of the second, third, and fourth units, the number of students in agreement or strong agreement was 35, 38, and 38 respectively. This gain came directly from students whose attitudes had changed throughout the project, with only 2 students in disagreement at the end of units 3 and 4, with the premise that technology makes learning more interesting. Also, the standard deviation of responses decreased, possibly indicating a general solidification of student's feelings about technology in education.

The implications of this are clearly a mandate to attempt to harness this enthusiasm towards positive school experiences and learning outcomes. Enthusiasm and interest clearly plays a major role in the focus students have in classes. A lesson that is less interesting may catch the interest of more students if iPads are integrated into the lesson plan. One student summed this point up in saying, "Anything we do with an iPad is fun for me. My brain just seems connected to it [iPad]." While viewed systemically this may cause Orwellian chills in many educators as to the direction of education, at a classroom level, the benefits of enthusiastic students cannot be overlooked.

Category 3 - Attitudes Towards iPads as Positive Learning Tools

While a change occurred in student correlation of technology to a positive learning environment, student attitudes remained the same throughout the study periods with regard to iPads as positive learning tools. There appeared to be a more even divide between students within this category.

It is not clear why attitudes did not change for iPads while those for technology in general did. Perhaps it is that the generality of this group of questions smoothed out the more subtle changes seen in the previous section. This set of questions involved 800 individual student responses or data points, 5 questions asked to 40 students over the course of 4 units while the previous category involving technology making school more interesting involved only 160 student data points.

From a look at many interviews I have the feeling that some students did in fact loose a small level of interest in science and in the iPad as a tool in science classes. This is not supported by the results of the LTAS, and it was not pervasive enough to stop the action research project as a whole. As a teacher however, my impression of the language used by students throughout the project, when describing the use of iPads in the course, became less enthusiastic and more middle of the road. Terms and phrases like, “it was fine”, or “science is good/ok”, began showing up in later interviews when they were absent in the first round of interviews after the first unit. This could be partially due to survey fatigue. Students may have lost their initial high levels of enthusiasm for the project and the associated interviews and surveys.

Summative Assessment Scores

One key objective of this research project was an attempt to increase student performance on summative assessments. The hope was that through improved content delivery, increased student interest, or some other factor, student learning outcomes would be more positive. It appears however that this was not the case. There was, in fact, a very slight decrease in student test scores between the first pair of unguided units, and the second pair of units involving more guided instruction. (Refer to Figure 4). Many factors could have had a hand in this outcome including student absences, unit content, topic interest, or subtle and unseen differences in delivery. One possibility stands out however.

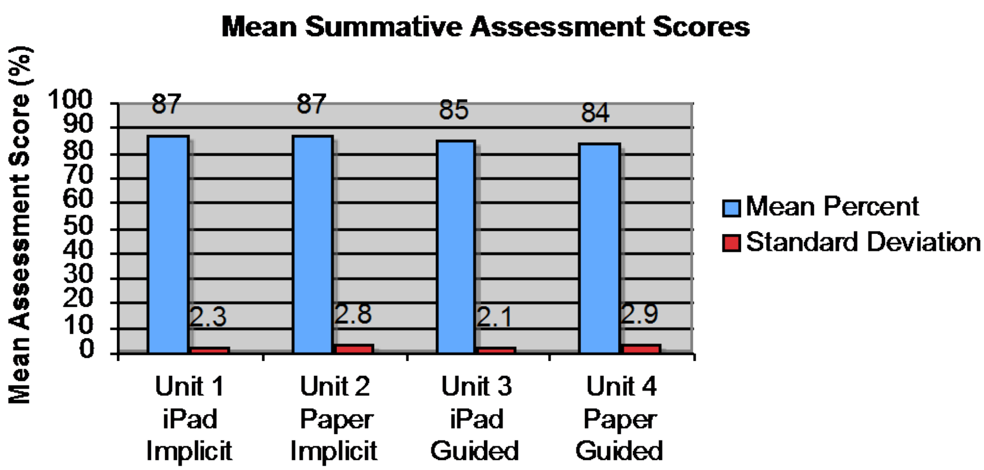

Figure 4. Mean Summative Assessment Scores, (*N*=40).

With pre-determined time frames for each unit, the increase in teacher guidance may have resulted in a net decrease in overall student processing time. More time spent guiding creation of flash cards, note outlines, and other learning devices, regardless of the format, either iPad or paper, appeared to detract from the time students had to practice and master the actual learning objectives including vocabulary review, reading, note taking, and topic related discussion time. Because of the relatively simple, knowledge-based content making up the units, student mastery of the majority of the learning objectives would seemed to have required simply more time spent on task. With content further up on Bloom's taxonomy, it would seem then that increased teacher guidance may have more influence over positive test performance.

Student Interviews

Student interviews were performed at the conclusion of each unit on a variety of students. A set of scripted questions was used, with leading questions at hand used to encourage student elaboration. These interviews yielded a large volume of responses but a surprisingly narrow range of general attitudes.

The first two questions examined attitudes toward the unit and the challenges and successes students felt with the materials and formats. All of the students stated some positive aspect of the unit that they felt successful in. Most students cited their success on the assessments, notebooks, and classroom questions and answer times. Most students also cited their enjoyment of science and the activities chosen for the unit.

When asked about their enjoyment using the iPad or the non-digital analog for the unit nearly every student mentioned some positive aspects of the iPad. Many students admitted values of their notebooks, flashcards, and other materials, but not with the enthusiasm many had for their iPads. The overall satisfaction or affection the students had for the devices was very evident. Several students reported their enthusiasm during interviews. One summed up the overall class feeling when she said, "I love everything on my iPad! It is really fun to find apps that are helpful with my schoolwork. I love it when teachers let us use them [iPads] for activities."

The only suggestions or changes, that were nearly universal, were their requests for a continued or even increased high level of hands-on activities. Most students frequently and repeatedly used combinations of the terms: "more/lots of" and "labs/activities/experiments/projects/demonstrations". Within the probing questions were trends of highest satisfaction towards the learning times that included active learning through labs and demonstrations.

Not a single student however ever mentioned their enjoyment or use of the non-digital written course materials. No mention was made of the paper flashcards, review sheets, or note taking outlines given to students. Several students mentioned these tools in digital form however in positive lights. Each of the two units where iPads were used, more than half of those interviewed mentioned the digital flashcard app.

"Flashcards [digital] were fun to make."

"I like putting pictures on my flashcards."

"The flashcard app was a really good way for me to review and learn."

Students also gave the same positive feedback for activities incorporating the iPad's digital camera.

"I like use my iPad to take pictures of the demo's."

"Taking a video or picture of a lab is a good way for me to learn the lesson."

"It is easy for my to take a picture with my iPad and then review the picture later."

Student interviews yielded not only a wealth of responses but also a deeper understanding and a recalibration of perceptions of where student attitudes towards science and technology use lay. Their love of science, experimentation, and demonstrations was clear. As always, students truly enjoy and learn from that which they see and experience firsthand. Their enthusiasm for iPads and continued advances in educational technology use was crystal clear and nearly universal as well. Achieving a balance between the two worlds of virtual and real is and will continue to be a major challenge and opportunity.

Teacher Journal

Throughout this research project a teacher journal was a cherished companion that offered valuable perspectives throughout the implementation of iPads in my program. In it were my thoughts, reflections, plans, and reactions to the highs and lows of the process at The Seven Hills School. Many trends were seen when this journal was examined upon completion of the project. Frustrations were plentiful and a nearly ubiquitous part of almost every entry. But within each week or two there were entries showing hope for the iPad. The occurrence of notes on an idea or technique that worked well continued to increase in frequency throughout and after the project timeline.

Two frustrations were most prominent throughout all of my journal entries. The first of these was the nearly constant limitations of the device for what I was trying to accomplish. Nearly every day at least one student was not able to use their iPad either due to it being broken, not having software updates, it being lost, or confiscated for misuse. When a student was missing a paper textbook, the solution was to just borrow one from the few I always kept on hand. A student without a functional iPad was a wrench in the pace of the class. They could not participate in nearly any of the iPad-based facets of the class. While some student absentmindedness is to be expected in the middle school classroom, my frustration at my inability to fix glitches with the devices was profound.

Even though Apple computers are notorious for their dependability, my classes found countless instances where apps or other software would not work. This was particularly frustrating as a teacher who leads classes with at least half of the time spent on labs, demonstrations, and other hands-on activities. The lack of function in the technology and my frequent lack of ability to fix it was a thorn in my side as a teacher trying to maintain control of my classroom. If a lab or demonstration does not work, I have all of the tools I need in my lab as well as the training and experience to fix the problem. On the iPad however, computer code within an app, school network functioning or lack there of, and device breaks, glitches, and updates were all beyond my control. These all would require a call or email to our campus tech support team and then a wait for a response from them. Despite these nagging shortcomings, many triumphs are clearly seen throughout the journal entries.

The determination of our school administration to offer support when requested was noteworthy on several instances. This was most clear in the design of the two iPad-based units during the project. I had requested support in working through the specifics of the treatments. I received immediate and thorough support from the head of our technology department. She checked in with me several more times before, during, and after each of these units as well. Despite the challenges of the program, her efforts blew wind into my sail and repeatedly infused me with hope and enthusiasm. While the iPad can cause a further substitution of real experience for the virtual, this was one instance where the iPad brought two educational professionals together who would have otherwise not collaborated.

Throughout this research project and the school year the development of new educational content for the iPad was substantial. It seemed that every few days a new app, iBook, or other tool was found or recommended. Examining the records of many of these in my journal appears as a series of failures dotted with the occasional success. One shining example is the iPad-based text, Man in Space (Immediate Media Company, 2011) While this was found just after the research phase of this project, and thus not used as part of this research, it is the highest quality digital text I have yet to see and it represents a quality of content that I had hoped to incorporate into my treatments. With its extremely current, 3-dimensional, photo and video rich content, I have renewed high hopes for the future of all iPad based science texts. Instead of a text with a few photos per section found in my current paper-based books, digital texts will have photo collages, video clips, interactive content and assessments, embedded dictionary definitions, and science topics that can be updated almost constantly to match current events and research.

My teacher journal has reminded me of the process through which my thinking has grown. With lessons or demonstrations that don’t work, I have about 20 minutes of patience before they are abandoned. There were countless times where I reached this 20 minute threshold with iPads in my classroom. It is this intense frustration that has given me my strongest memories of iPads this year. A look through my teacher journal however shows a different side altogether. A flowing current of hope pervades the year as a whole. I will not abandon the iPad as I have abandoned a failed lab or demonstration idea. The iPad's implementation lag has been significant but I know I am on the cusp of taking this tool and surpassing the educational results I had achieved through past pre-iPad methods.

INTERPRETATION AND CONCLUSION

The major focus of this action research was to examine the successes and challenges of a one-to-one iPad implementation in a lab-based and activity driven science course. Potential positive impacts would obviously involve student learning, but also student interest as well as the overall efficiency of the science classroom. While many frustrations occurred during the iPad-based units, many positive outcomes were observed too. And many of the frustrations have what appear to be pretty straightforward solutions.

For my first question on student learning outcomes and student attitude changes, the first conclusion that can be made is that iPads did not appear to impact positive student perceptions toward science. Had the implementation of this tool into the science classroom resulted in a decrease in these positive student perceptions, it would have been necessary and urgent to cease the program. However the Likert attitude surveys did not show any of these unexpected but feared declines.

In the first pair of units comparing iPad and paper based units with implicit forms of instruction student satisfaction with science and school according to attitude surveys remain unchanged with mean scores of 3.7 out of 4 in both surveys. And a nearly identical set of data was gathered with the second pair of units in which guided instruction techniques were implemented with scores of 3.53 and 3.57. This represents an insignificant difference of around 1% and it essentially confirms the results seen in the first pair of units. Student satisfaction for science and school in general remained steady between units where the treatment involved alternations between iPad and paper based notebooks and activities.

Qualitative data gathered from student interviews confirmed the lack of change in positive student attitudes towards science and school throughout the research timeframe. Students in all of the surveys from each unit, regardless of format for the unit, voiced clear favor for the class and school in general.

And even teacher attitude toward the class and school did not change during the survey period. While a look through the journal kept during this process shows many instances of frustration and doubt as to the effectiveness of a single aspect of the iPad, the class, or the lesson, there are no mentions of waning interests in course or approval for the students.

While it was hoped that iPads would create a spike in positive student attitudes towards school and science, the population of students with which the study took place may have precluded this possibility. They were already very enthusiastic in their support of the science program and learning in general (93% approval towards school and science). While their interest could have waned, although it appears to have not, there was perhaps little room from improvement. High teacher and student satisfaction levels were already present. When this project was being crafted this simple realization was basically overlooked. While nearly every course has room for improvement, the population for this study were already very satisfied and it was perhaps unrealistic to expect significant improvement beyond this level. Nearly every student cited their love for the hands-on aspects of my classes. Any teacher in a similar setting who is attempting to integrate iPads must maintain a high level of hands-on activities and lab based experiences.

Student attitudes did decline however between pairs of units. The mean Likert technology attitude score for positive perceptions toward science during the implicit pair of units was 3.7 out of 4. This score dropped a significant amount, about 11% during the second pair of units using guided instruction. While no mention of this is found in the student interviews, the questions used during the interviews did not probe towards an answer to this decline. The data had just been collected and had not been processed at the time. However since the conclusion of the formal data gathering cycle of this action research project, further repeated student interviews have yielded a rather clear and what should have been predictable insight into the cause for this decrease.

The guided instruction, simply and repeatedly said by many students, involved more paperwork or “busywork” that may have been unnecessary for the level of difficulty presented by the units of study. In the literature review for this project, the idea of guided instruction was a positive teaching technique when applied to relatively complex topics in which students had little experience. When first presented with circuit diagrams, guided instruction paired with simulation yielded higher student outcomes than unguided instruction (Jaakkola, Nurmi, & Veermans, 2010). In this project however, the topics were purposefully selected to be manageable and to have a uniformity that allowed for what was hoped for as comparability between units. When paired with an apparently unnecessary framework of worksheets, review materials, and pre-made flashcards, this appears to have ultimately been the seed cause for this decline in positive attitudes towards the class (from 3.7 to 3.5). While the guided portion of the project showed a clear decline in attitudes, student's feelings towards their iPads were anything but negative.

Throughout the interview process students regularly had praise for their iPads. Even though test scores did not improve throughout the same timeframe, student positive association with technology and school increased during the guided units. This may be due to the fact that more intentional iPad-based learning tools were implemented as part of the instruction. The capabilities of the device, beyond that of just a note-taking tool, were explored and demonstrated more actively in unit 3. And one interesting effect occurred in that the positive effects of the use of iPads appear to have carried over into the final project unit involving paper. Between the first and third units during which iPad uses were being explored, the number of students marking agreement with positive attitudes towards technology went from 34 to 38. And during this same timeframe the number of students with negative attitudes, or disagreeing with a positive attitude, went from 6 to 2. Then these attitudes remained unchanged during the final unit when the iPads were entirely put away.

It appears that students were increasingly convinced in their general satisfaction with the devices throughout the study period and maintained this approval even when the devices were no longer being used. This overall positive student feeling towards iPads shows evidence for the need of continued research towards and support of the iPad as a learning tool.

VALUE

Many changes in my teaching have occurred already and will be implemented next year as the units used in this research unit will be repeated with new class. The first of which will be a more judicious and informed application of actively guided and more passive forms of instruction. In this study timeframe the use of guided instruction appears to have been unnecessary (summative test scores declined from 87% to 84.5%) and another attempt will be made with the same units next year but without the same level of extra worksheets, student outline and note templates, and pre-made flashcards. Units will be carefully reexamined as to not bore students with guidance on that which they already have a good grasp on their own.

A second change will involve the understanding that an increase in digitization is fine as long as it in accompanied with maintenance of high level of hands-on activities. The results from the student interviews should not have been surprising but were mainly expected nonetheless due to their frequency throughout the respondents. A classroom involved with significant active learning is one that excites and interests students regardless of the tools that are used to achieve the activity.

The use of digital flashcards had many positive aspects that had not been expected when this project was being formed. The ability to create and distribute standardized sets of flashcards was impressive. As was the possibilities for students creating and sharing their own sets of cards. Lastly, the ease involved with included more than two sides on a flash card, with a third side showing a photograph, was very positive.

As the technology continues to change, a middle school teacher’s search must continue for not only tools specific to their course topics but also digital tools that span across the classrooms, as these clearly will further capture the interests of students. Just as informed science teachers must stay on top of current events relevant to student’s lives, they must also continue to pursue knowledge of the technologic language that our students are accustomed to and immersed in.

Another clear place for improvement is and will continue to be the combination of data collected and recorded via the iPad along with that collected through traditional paper based note booking. In this project the units with students creating purely digital science notebooks showed a very clear decline in quality of work, quantity and completeness of content (an 11-12% decrease in student notebook rubric scores). The iPad excels in many regards over the traditional notebook. There is great potential for the use of digital data loggers and the embedded video and still cameras on iPads. However, when observations are to be made as drawings or diagrams, a piece of paper and a pencil have yet to be beat. It is in the combination of these two formats that a solution to the digital notebook conundrum may lay. iPads could be used to take photos of paper-based assignments. These digitized files could then be organized, submitted, graded, and archived in a more streamlined fashion than with traditional science notebooks.

While there were many successes in this action research project, there were also clear instances where the iPad decreased the efficiency of the classroom. On several instances, lesson plans and learning objectives took a back seat to a technologic glitch or difficulty with the device. The distribution and collection of work was very glitchy, with digital formats for these tasks taking many multiples of the amount of time needed for traditional methods. The time taken to submit a copy of a student notebook was a clear example of this disparity (30 seconds with paper notebooks / 20 minutes with iPads). At this point the iPad has clearly failed in its ability as a paperless substituted for regular class worksheets, quizzes, and other assignments requiring teacher submission for review or grading. This is one area where I will simply wait for the greater collective of teachers and programmers to explore and identify the best practices for these administrative tasks. I will however be eagerly awaiting what is surely being developed though in terms of digital paperwork as a complete replacement for multiple choice tests and quizzes, worksheets, and other handouts.

A major outcome of this study has been a renewed determination to explore and know the tools available. One question that will be a continuous force in my teaching will be what other tools could be used effectively and in what combinations? With the introduction of technology in the classroom comes the responsibility to keep pace with rapidly changing technology available to the consumer. A commitment to actively try out new demonstrations, units, technologies, and techniques must continue to remain central to any future teaching assignment. With this is also the need for a clear minded and critical focus to adapt or change ideas that work poorly or inspire little student interest or enthusiasm. Sometimes however, it must be remembered that a slight change in delivery can make significant differences in the palatability of coursework to classes.

Despite my occasional fears to the contrary, it is clearly still the job of the classroom teacher to interact with and respond to students and challenge them while at the same time, work within the grander scale of educational policymaking. Visions of the future will include technologies that would appear to simply be magic to us. But behind the top hats and hidden mirrors will surely remain the constantly toiling but inspired and passionate teacher.

REFERENCES CITED

Apple iPad2 Processing Speed. Apple. Retrieved 19 April 2011 from www.apple.com/ipad/specs/.

Apple IIe Release Date. Wired. Retrieved 19 April 2011 from www.wired.com/science/discoveries/news/2007/06/dayintech_0605.

U.S. Department of Education, Office of Educational Technology. *Transforming American Education: Learning Powered by Technology*, Washington, D.C., 2010.

Apple Launches iPad 2. (2010). Apple. Retrieved 30 March 2011, from www.apple.com.

Banister, S. (2010). Integrating the iPod Touch in K-12 Education: Visions and Vices. *Computers in the Schools*, *27*(2), 121-131. DOI: 10.1080/07380561003801590.

Forster, E. (1909). *The Machine Stops*. Oxford, U.K.: The Oxford and Cambridge Review.

Honey, M., & Hilton, M. *Learning Science Through Computer Games and Simulations.* Committee on Science Learning: Computer Games, Simulations, and Education; National Research Council (2010).

Jaakkola, T., Nurmi, S., & Veermans, K. (2011). A Comparison of Students' Conceptual Understanding of Electric Circuits in Simulation Only and Simulation-Laboratory Contexts. *Journal of Research in Science Teaching*, *48*(1), 71–93. DOI 10.1002/tea.20386.

Man in Space. (2011). Immediate Media Company (Version 8.15.11) [Mobile application software]. Retrieved from http://itunes.apple.com/.

McHugh, J. (2005). Connecting to the 21st-Century Student, *Edutopia*, retrieved April 3, 2011 from http://www.edutopia.org/ikid-digital-learner.

Negroponte, N. (1995). *Being Digital.* New York, NY: Random House Inc.

Toth, E., Morrow, B., & Ludvico, L. (2008). Designing Blended Inquiry Learning in a Laboratory Context: A Study of Incorporating Hands-On and Virtual Laboratories. *Innovations in Higher Education*, *33*, 333–344. DOI 10.1007/s10755-008-9087-7.

Winn, W., Stahr, F., Sarason, C., Fruland, R., Oppenheimer, P., & Lee, Y. (2005). Learning Oceanography from a Computer Simulation Compared with Direct Experience at Sea. *Journal of Research in Science Teaching*, *43*(1), 25–42. DOI 10.1002/tea.20097.

APPENDICES

APPENDIX A

LIKERT TECHNOLOGY ATTITUDE SURVEY*

**Based on Frantom, Green, Hoffman, 2002, pg. 249*

Name ___________________________

I want to find out YOUR opinion about iPad use in class. Participation in this research is voluntary and participation or non-participation will not affect a student's grade or class standing in any way. Your honest thoughts are extremely valuable in guiding the future course of this science class and improving my teaching ability. Put an "X" in the box that comes closest to what YOU think. Please answer all items.

	Strongly Agree 1	Agree 2	Disagree 3	Strongly Disagree 4
1. I like school.				
2. Technology makes school more interesting.				
3. I do not like using iPads for my schoolwork.				
4. I learn more in classes where iPads are used more.				
5. I learn more from hands-on activities and labs.				
6. Technology is very important in my life.				
7. I like taking notes on my iPad.				
8. Technology is difficult for me.				
9. I learn more when I don't use my iPad.				
10. I like using iPads for my schoolwork.				
11. I prefer reading school assignments on paper instead of on my iPad.				
12. I like science class.				
13. I read books for pleasure outside of school a lot.				
14. Technology is reliable and works for me.				
15. I play lots of games on my iPad.				
16. Drawing on my iPads is better for me than paper.				
17. I like to read books for fun on my iPad instead of a paper version.				
18. Technology is unreliable and doesn't usually work for me.				
19. I like hands-on activities and labs.				

Adapted from

Frantom C. G., Green, K. E. & Hoffman, E. R. (2002). Measure development: the children's attitude towards technology scale (CATS). Journal of Educational Computing Research, 26 (3), 249-263.

APPENDIX B

STUDENT INTERVIEW QUESTIONS

- How did this unit on ______ go for you?
  Probing Question – Why do you say that?

- What were some of the biggest struggles you had with the unit?
  Probing Question – Why do you think that was so?

- Did you like using your notebook/iPad/textbook for this unit?
  Probing Question – What about it did you like or dislike?

- How do you think your classmates felt about using their notebook/iPad/textbook?
  Probing Question – What do you think they would say about you?

- Given the choice, which do you prefer?
  Probing Question – Why do you say that?

- What changes to the methods you've experienced would you like to see?
  Probing Question – What effect do you think that would have?

APPENDIX C

NOTEBOOK RUBRIC

Notebook Rubric
Shargel – Science

Category	Desired Features	Score
Formatting *6 points possible*	Paper Header (name, class, date) Writing Tool Selection Title and Wording Neatness Paper Orientation Legibility	
Written Observations *4 points possible*	Clarity Accuracy Concise Summary Correct Terminology Use	
Drawn Observations *5 points possible*	Clarity Accuracy Key Elements Identified Labels Simplicity	
Data Organization *4 points possible*	Table, Graph, etc. Set-Up Titles Labels Units	
Conclusions *3 points possible*	Accuracy Concise Clearly Written	

APPENDIX D

INDEPENDENT REVIEW BOARD EXEMPTION

MONTANA
STATE UNIVERSITY

INSTITUTIONAL REVIEW BOARD

For the Protection of Human Subjects
FWA 00000165

960 Technology Blvd. Room 127
Immunology & Infectious Diseases
Montana State University
Bozeman, MT 59718
Telephone: 406-994-6783
FAX: 406-994-4303
E-mail: cheryli@montana.edu

Chair: Mark Quinn
406-994-4707
mquinn@montana.edu

Administrator:
Cheryl Johnson
406-994-4706 or 6783
cherylj@montana.edu

MEMORANDUM

TO: Matthew Shargel

FROM: Mark Quinn, Ph.D. Chair *Mark Quinn CJ*
Institutional Review Board for the Protection of Human Subjects

DATE: November 17, 2011

SUBJECT: *"Student Performance and Attitude Changes Through Implicit and Explicit Instruction with iPads in 6th Grade Science" [MS111711-EX]*

The above research, described in your submission of November 17, 2011, is exempt from the requirement of review by the Institutional Review Board in accordance with the Code of Federal Regulations, Part 46, section 101. The specific paragraph which applies to your research is:

_X_ (b)(1) Research conducted in established or commonly accepted educational settings, involving normal educational practices such as (i) research on regular and special education instructional strategies, or (ii) research on the effectiveness of or the comparison among instructional techniques, curricula, or classroom management methods.

_X_ (b)(2) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures or observation of public behavior, unless: (i) information obtained is recorded in such a manner that human subjects can be identified, directly or through identifiers linked to the subjects; and (ii) any disclosure of the human subjects' responses outside the research could reasonably place the subjects at risk of criminal or civil liability, or be damaging to the subjects' financial standing, employability, or reputation.

___ (b)(3) Research involving the use of educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior that is not exempt under paragraph (b)(2) of this section, if: (i) the human subjects are elected or appointed public officials or candidates for public office; or (ii) federal statute(s) without exception that the confidentiality of the personally identifiable information will be maintained throughout the research and thereafter.

___ (b)(4) Research involving the collection or study of existing data, documents, records, pathological specimens, or diagnostic specimens, if these sources are publicly available, or if the information is recorded by the investigator in such a manner that the subjects cannot be identified, directly or through identifiers linked to the subjects.

___ (b)(5) Research and demonstration projects, which are conducted by or subject to the approval of department or agency heads, and which are designed to study, evaluate, or otherwise examine: (i) public benefit or service programs; (ii) procedures for obtaining benefits or services under those programs; (iii) possible changes in or alternatives to those programs or procedures; or (iv) possible changes in methods or levels of payment for benefits or services under those programs.

___ (b)(6) Taste and food quality evaluation and consumer acceptance studies, (i) if wholesome foods without additives are consumed, or (ii) if a food is consumed that contains a food ingredient at or below the level and for a use found to be safe, or agricultural chemical or environmental contaminant at or below the level found to be safe, by the FDA, or approved by the EPA, or the Food Safety and Inspection Service of the USDA.

Although review by the Institutional Review Board is not required for the above research, the Committee will be glad to review it. If you wish a review and committee approval, please submit 3 copies of the usual application form and it will be processed by expedited review.