Theses and Dissertations

2017

High School Science Teachers' Perceptions of the Effects of One-To-One Computing Devices on Student Engagement

Herbert S. Bocchino III
University of South Carolina

Follow this and additional works at: https://scholarcommons.sc.edu/etd

Part of the Curriculum and Instruction Commons

HIGH SCHOOL SCIENCE TEACHERS' PERCEPTIONS OF THE EFFECTS OF ONE-TO-ONE COMPUTING DEVICES ON STUDENT ENGAGEMENT

by

Herbert S. Bocchino III

Bachelor of Science
Florida Institute of Technology, 2003

Master of Education
University of South Carolina, 2011

_____

Submitted in Partial Fulfillment of the Requirements

For the Degree of Doctor of Education in

Curriculum and Instruction

College of Education

University of South Carolina

2017

Accepted by:

Susan Schramm-Pate, Major Professor

Richard Lussier, Committee Member

Russell Conrath, Committee Member

Kenneth Vogler, Committee Member

Cheryl L. Addy, Vice Provost and Dean of the Graduate School

DEDICATION

To my family, friends, and everyone who made this dissertation possible.

ACKNOWLEDGEMENTS

I would like to thank my dissertation committee – Dr. Susan Schramm-Pate, Dr. Richard Lussier, Dr. Russell Conrath, and Dr. Kenneth Vogler. I would especially like to thank Dr. Susan Schramm-Pate, my major professor, for her amazing feedback, persistence, and encouragement throughout this process. I know that this dissertation would not have been possible without her.

I would also like to thank my school district and my school. My principal, and all the administrators, has been a huge support and help throughout this process. I also must thank the staff of the guidance office of my school. Thank you for dealing with my constant requests for information and for always responding to me quickly and with a smile. Thank you to my students, who have been cheerleaders throughout this process. I did it for them.

And most of all, I want to thank my science department for agreeing to be teacher-participants. Some of you I've known my entire career, some of you have been my mentors, and some of you may be new, but you are family. Thank you for your friendship, support, and for working with me on this. Thank you for allowing me into your classrooms and into your heads. I couldn't have done it without you.

.

ABSTRACT

The identified problem of practice for the present action research study centers on ways in which teacher-participants in a working class poor, rural, southern high school can use the iPads in daily science classroom activities to more effectively to engage these students in their classrooms and make the curriculum meaningful. Data in the form of classroom observations, semi-structured interviews, and teacher in-service seminars was collected over a six week period. The results of the present action research study indicate a need for more professional development for incorporating iPads into science coursework for these teacher-participants at RHS despite their claim that they are well prepared to use the iPads in their science curriculum and pedagogy. The Action Plan that resulted from the present study is in the form of professional development for teachers that focuses on how iPads can be used in a constructivist pedagogy to enable better equity of historically marginalized groups of students such as young women, people of color, rural people, and working class poor people to access higher level science courses and post-secondary careers. The Action Plan details tools for iPad use with project-based learning that lends itself to student discovery, the creation of products, and personal meaning-making.

.

TABLE OF CONTENTS

LIST OF TABLES

CHAPTER 1

RESEARCH OVERVIEW

Introduction

Contemporary students grow up in a very different world compared to their parents and teachers. While most parents and teachers can recall a time before the internet, cellular telephones, and computers in every house, contemporary students have grown up with these devices integrated into their lives in a way which has been unprecedented. Seven years ago, Solomon and Shrum (2010, p. 1) described he first generation of American students "to have grown up with digital tools at their fingertips." The proliferation of one-to-one computing initiatives across the United States has many educators asking questions about the effectiveness of these technologies on student scholarly achievement and the ways in which we can use computers to relate to students' lived world experiences. Solomon and Shrum write,

> They're always 'on': texting to friends, meeting on social networks, and interacting with the world in a nonlinear fashion. They can get the information they want when they want it, follow an idea in ways that have meaning to them, and jump from one thing to the next as inspiration hits them. (2010, p. 1)

This level of integration of technology and non-linear thinking has enormous implications for contemporary schooling in the US and STEM (science, technology, engineering, mathematics) education in particular.

1

In order to meet the needs of twenty-first century students in the US, many schools and districts including the site of the present study, Ruraltown High School (RHS) (pseudonym), have adopted one-to-one computing initiatives in science classrooms using electronic tablets such as Apple iPads. These devices can be connected to the World Wide Web (www) or internet and are used as initiatives that provide today's students with a computing device (e.g. a laptop computer or an electronic tablet) that the student can take home and use in class for instant access to information (if they have access to www) and the ability to complete assignments. According to Greaves et al, 2012, student learning and achievement increases when educators are able to meet students where they are and in terms of technology today's students, regardless of socioeconomic class status (SES) are well versed in the use of the www, internet, and electronic devices.

The present action research study focuses on five high school science teachers and technology integration in the form iPads to enhance curriculum and pedagogy for low SES, rural, southern secondary students. In order to use devices such as iPads more effectively and to engage students in science, these five teachers need to possess the necessary knowledge, skills, and to have the essential support to integrate these devices in a successful manner in their classrooms. These five teacher-participants are viewed as professionals by the participant-researcher who honored that it was they who knew best how to reach and engage their local and particular students in their various science classrooms at RHS.

Problem of Practice

The identified problem of practice (PoP) for the present study focused on science teacher-participants' perceptions of using one-to-one computing devices, specifically Apple iPads, to engage students. Because Apple iPads are considered by the school district to be the 'silver bullet' that enables the science teachers to increase their students' scholarly achievement and to provide access and equity to historically marginalized groups of students at RHS such as low SES, young women, and people of color, the PoP of the present action study school focused on five high school teacher-participants who received limited preparation to operate and integrate the one-to-one iPads in their science classrooms. Preliminary investigations by the participant-researcher identified a lack of consensus among these teachers about preparation to use the iPads in their classrooms. Therefore, the researcher planned an action research cycle of implementation of the iPads, data collection, and reflection of the data with the teacher-participants to determine the support these teacher-participants needed in order to incorporate these district issued iPads in their science classrooms more effectively to increase students' scholarly activity and engagement. This research question for the present study was asked based on the PoP.

Research Question (RQ)

The present study was specifically guided by the following research question:

What is the impact of one-to-one computing devices (Apple iPads) on high school teachers' perceptions of student engagement in science classrooms?

Purpose Statement

The primary purpose of the present action research study is to enable five science high school teachers to effectively engage students in learning science with iPads through teacher preparation while recognizing that these five teachers know best how to engage their students in their science classrooms but can only effectively implement and use new technologies like the iPads in their curriculum and pedagogy when they are prepared to do so. The secondary purpose is to determine the teachers' perceptions of the iPads in science classrooms so that other science teachers will more effectively be prepared to implement iPads in order to engage these low SES, rural southern, high school students in science courses and careers. A tertiary purpose is to close the race, class, and gender gap in science courses at RHS to enable poor people, young women, and people of color to pursue college degrees and therefore potentially higher paying jobs in the STEM fields.

Conceptual Framework of the Study

Marzano (2003) wrote about the link between student motivation, engagement and achievement noting, "if students are motivated to learn the content in a given subject, their achievement in that subject will most likely be good" (p. 144). Following Marzano, who recommends as the action step of "providing students with tasks and activities that are inherently engaging" (p. 149), the present study describes teachers' perceptions of iPads as a way to engage contemporary high school science students.

Providing these low SES, southern, rural students in the present study with tasks that included an iPad, aroused their curiosity, increased their motivation to learn science, and in turn, increased their achievement in the science class on standardized tests. In their report from the Nellie Mae Education Foundation, Toshialis and Nakkula (2012) linked

student engagement to motivation and achievement and defined engagement as the step a student uses in between being motivated to learn and actually doing the task of learning. Therefore, a student who is engaged has already had the motivation to learn and is carrying out the processes necessary to learn, which leads to achievement (2012). This important and inherent link between student engagement and achievement is one of the theoretical bases for the present study.

The participant-researcher of the present action research study used the Marzano Model (2011) of student engagement that includes four components that must be considered in order to fully engage students including:

1. students' *emotions* about the learning;

2. students' *interest* in the learning;

3. students' *perceptions* of the importance of the learning; and

4. students' *perceptions* of the efficacy of the learning.

The Marzano Model (2011) is used throughout the present study to define and establish high school students' engagement in science content with iPads.

Education for Contemporary Digital Life

In order to make education more engaging and meaningful for these students, the participant-researcher followed noted theorists and educational researchers throughout the history of common schooling who advocated for formal schooling to reflect the contemporary life of students. In the nineteenth century in *My Pedagogic Creed*, famed educator, John Dewey (1897) argued that schools should reflect students' contemporary life noting,

I believe that the school must represent present life—life as real and vital to the child as that which he carries on in the home, in the neighborhood, or on the play-ground. (p. 7)

Following Dewey, Ralph Tyler (1949) similarly agreed in the mid-twentieth century that it was important to engage students in their experiences in contemporary life with active meaning making and constructivist pedagogy. At the beginning of the twenty-first century, Marc Prensky (2001a) argued that computers and information technology was necessary to connect with students whom he called, "digital natives" because they have grown up fluent in the digital language of computers, video games, and the World Wide Web (www) or internet. In Prensky's view, today's children have had access to information vis-à-vis the www or internet at their fingertips since birth and therefore is the responsibility of schools to incorporate technology in twenty-first century schooling.

In addition to engaging students and educating for the student's real-world contemporary lives, formal schooling needs to make a shift from a "behaviorist" philosophy of "traditional" education (e.g., lecture, rote memorization of facts) to a more "constructivist" philosophy of education (e.g., hands-on, active meaning making) according to Ertmer and Newby (1993) who argued that while behaviorist pedagogy does have its place in certain contexts, it does not provide the necessary level of cognition or higher-order thinking that the contemporary world requires because of the diversity of today's learners. Also, information technology such as iPads lends itself to constructivist pedagogy because it allows learners to actively explore and construct meaning.

Gender & STEM

It is important to also consider that women have been historically marginalized in higher level science and computer education courses and careers in the US. According to the American Association of University Women (AAUW) (2002b), although contemporary students have been socialized into computer culture through video games, these games (and educational software that emulates them) are mainly designed for men by men. In addition, they also state that there is a well-documented and well-studied gender gap in science and math that is preventing women from pursuing college degrees and therefore high-paying jobs in scientific fields (2002b). This is especially true for science, technology, engineering, and mathematics (STEM). Educators at this school need to be aware of this and must work toward eliminating gender biases in order to ensure equity for all students, especially in fields of STEM.

Key Words

Action research

Any systematic inquiry conducted by teachers, administrators, counselors, or others with a vested interest in the teaching and learning process or environment for the purpose of gathering information about how their particular schools operate, how they teach, and how their students learn (Mertler, 2014).

Digital Age

The contemporary period since the world-wide web (www) or internet and digital information technology exists (i.e. the 1990s to present) (Prensky, 2001a).

Digital Immigrant

"Those of us who were not born into the digital world but have, at some later point in our lives, become fascinated by and adopted many or most aspects of the new technology" (Prensky, 2001a, pp. 1-2).

Digital Native

"Our students today are all 'native speakers' of the digital language of computers, video games and the Internet" (Prensky, 2001a, p. 1).

One-to-One Computing Initiative

This is an initiative put forth by many schools and districts in which each student has access to his or her own computing device (like a laptop or tablet computer) during instructional time and sometimes at home (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2012).

Mobile Computing Device

These are portable devices capable of carrying out the functions of a computer, including accessing information both online and offline, word processing, and other content creation. This usually includes laptop and tablet computers, and sometimes smartphones (Greaves, Hayes, Wilson, Gielniak, & Peterson, 2012).

Student Engagement

For the purpose of this study, a four-part model as defined by the Marzano Model (2011) including: 1. a student's positive emotions toward the learning; 2. a

8

student's interest in the learning; 3. a student's perceived importance of the learning; and 4. a student's perceptions of efficacy toward the learning (i.e. Can I do this?).

Potential Weaknesses

Because this is an action research study, it was conducted with a local population of five science teacher-participants from Ruraltown High School with the intention of determining those teachers' perceptions about how one-to-one iPads affect their students' engagement and the purpose of improving student scholarly activity using iPads to engage all students in learning science or STEM fields. Due to the local nature and focus of action research methods, the results of the present study are not generalizable to a larger population. The findings will, however, be used to develop an action plan to address the identified PoP and to improve science teacher-participants' use of the iPads to engage students, and in particular women, in their classrooms which should translate to STEM courses and careers for historically marginalized populations such as rural and female students at RHS. The sample population includes five teacher-participants which is normal for action research and although they are all of different ages and experience in teaching, they all identify as white, which may bias some of their responses. In addition, it was assumed by the participant-researcher that these five teacher-participants achieved 'mastery' in the area of student engagement as established by Marzano Model (2011) after the introductory preparation in-service administered by the participant-researcher, however, there is no evidence of this.

Significance of the Study

The present study is significant because it supports what the RHS school administration needs to do in order to improve its use of iPads to engage its students in doing and learning science curriculum. The action plan detailed in Chapter Five of this dissertation lists a course of action in steps that we identified to improve the implementation of iPads in our science classrooms.

The present study provides of ideas for ways in which to improve rural, high school science teachers' practices using one-to-one devices (like iPads) in their classrooms. In addition, this study describes gender issues in STEM using computer education devices that is important because it emphasizes the need for self-reflection regarding issues of social justice, hidden biases, and oppression.

Conclusion

After a preliminary observation in three classroom sessions of each of the five teachers in various science courses at RHS, the participant-researcher met with the teacher-participants in one 45 minute semi-structured interview with each participant and in a collaborative in-service session that lasted five hours. In the in-service, we reflected and analyzed the observational and interview data using a data analysis coding and analysis technique delineated by Mertler (2014). We determined that six major themes emerged including: Theme One—Teachers' Perceptions of Student Engagement with iPads; Theme Two—Science Teacher Perceptions of iPads; Theme Three—Science Teacher Preparation with iPads; Theme Four—iPad Use in the Science Classroom; Theme Five – Teacher bias in Science; and Theme Six—Challenges to Using iPads in the

Science Classroom. We used these six themes to determine the action steps for the Action Plan detailed in Chapter Five of this dissertation.

Overview of the Dissertation

Chapter One introduces how a one-to-one iPad initiative affected five high school science teachers' perceptions of student engagement in their classrooms with the purpose of improving these five teacher-participants' practice of incorporating iPad technology to engage rural, southern, low SES students in science courses and STEM careers.

Chapter Two contains a review of the scholarly literature related to STEM and technology integration in curriculum and pedagogy as it relates to the present action research study. Chapter Two provides a historical and theoretical context for the action research study, while also summarizing contemporary research related to the problem of practice and research question.

Chapter Three details the action research method used for the study including the study site, the selection of the teacher-participants, ethical considerations, and explains the qualitative data collection and analysis plan for the study.

Chapter Four details the findings of the study. It contains a detailed account of the observational and semi-structured interview data for each teacher-participant, as well as the in-service where the team reflected on the data and derived the six major themes that emerged from the analysis and reflection and that shaped the Action Plan for the fall 2017 school year at RHS.

Chapter Five summarizes the findings of the study and then details an action plan that will address the major issues and concerns of the teacher-participants that were identified from the study. This action plan represents what the teacher-participants and I feel is needed in order to fulfil the purpose of the study and improve our practice using the iPads to engage students in learning science. Finally, this chapter also provides suggestions for future research and an overall summary of the action research study.

.

CHAPTER 2

LITERATURE REVIEW

Introduction

The purpose of Chapter 2 is to provide an overview of the scholarly literature related to one-to-one computing initiatives and student engagement in STEM (science, technology, engineering, mathematics) courses and careers. Schools and school districts across the United States are implementing one-to-one computing initiatives as a way to increase student engagement and enhance student outcomes. This is aligned historically with many theorists such as John Dewey (1897), Franklin Bobbitt (1949), and Marc Prensky (2001a) who argued that formal schooling should reflect the contemporary life of students in order to make the curriculum and pedagogy relevant to their lived world experiences. Contemporary life is very much defined by the ubiquity of information technologies like computers, tablets, and smartphones. Many students at Ruraltown High School (RHS) do not see themselves as STEM students because they are the children of working class poor families in a small, rural, southern community.

This review of the scholarly literature related to one-to-one computing initiatives in order to provide a historical and theoretical context for the study is organized around the themes of student engagement, education in the digital age, perceptions of one-to-one computing, and the technological needs of diverse learners in STEM.

Importance of Reviewing Literature

According to Dana and Yendol-Hoppey (2014), "when teachers inquire, their work is situated within a large, rich, preexisting knowledge base that is captured in such things as books, journal articles, newspaper articles, conference papers, and websites" (p. 86). Also, they write, "The fields of social work, medicine, and psychology have long recognized the importance of developing practitioners' ability to use existing research to enhance practice (p. 87). Thus, it is of vital importance that a researcher review current literature to place his or her study in the context of existing knowledge and methods. This literature review is intended to frame the present action research study in terms of historical and theoretical perspectives, especially using the progressive educational ideals of John Dewey (1897) and the technology-based educational theories of Marc Prensky (2011). It will also compare the study and its proposed methods to other current research and attempt to place the study in its contemporary context.

Historical Context

According to Joel Spring (2014), at the dawn of the twentieth century, public education was still defined by the nineteenth century's idea of the Common School: that schools should provide common education to all students in order to create common culture and reduce social conflict, to improve public morality and end crime and poverty, and to provide equal opportunity to all students. Over the course of the twentieth century and into the twenty-first century, Spring (2014) describes how the ideals of the Common School have been eroded away, leading to a much different idea that schools are instruments of the economy that should prepare students to be good consumers and for careers that will keep the US competitive in the global marketplace.

This transformation from the idea of schools as places for educating students to improve society to places for educating students to serve the economy has been a slow one, but one which has gained more traction in the last thirty years. Today, many argue in US society that STEM careers are important for the US to succeed on a global level.

In *Democracy and Education*, John Dewey (1918/2009b) suggested that in order to better serve student interests in education, schools should look to contemporary industry and students' potential post-school careers in order to select and create engaging experiences for learning. Ralph Tyler (1949/2013) echoed this in *Basic Principles of Curriculum and Instruction*, arguing for more vocational education in schools geared toward contemporary industrial jobs. While both men suggested vocational education in schools as a way to make the curriculum more relevant to contemporary students, neither envisioned it as a means to American economic prosperity. This changed in 1983 during the Reagan administration. The U.S. Department of Education's National Commission on Excellence in Education released the report *A Nation at Risk*. This report places the blame for America's decreasing ability to compete in global markets on poor education in public schools. It calls for an Essentialist "back to basics" approach in order to improve educational outcomes in order to better prepare students to compete in the world economy. In a similar vein, during his Presidency, Bill Clinton signed into legislation *Goals 2000* which likewise called for a more essentialist curriculum in education in order to increase the U.S.' competitiveness in global markets. (Spring, 2014).

In 2001, Congress passed the No Child Left Behind (NCLB) law (2002). This sweeping law required states to develop rigorous, measurable standards, required states to assess students on these standards, and required schools to use research-based strategies

to close achievement gaps between higher and lower performing subgroups of students. The law also issued severe penalties on schools that did not achieve these lofty goals. NCLB further cemented the idea that the purpose of schools is to prepare students to enter the workforce and contribute to the economy. The Obama Administration's educational policies, while providing states with some flexibility regarding the stringent requirements of the NCLB law, still fosters this idea of preparing students for work, enshrined now in the current idea of making sure students are "college and career ready (Conley, 2012)." At the same time, with the advent of new computing technologies and data analysis capabilities, an emphasis has been placed on using this data to track student progress and identify "effective" teachers versus "ineffective" teachers. While illustrating this shift in educational goals, Spring also argues that these changes have resulted in schooling that is very much directed toward the interest of large, multinational corporations instead of the whole of society (2014).

Theoretical Context

Regardless of the changes in the perceptions of the purpose of schooling, what is apparent is that schools are struggling to meet the needs of their students. As Tyler (2013) argued in 1949, schools cannot continue to operate in the same way that they did in the past in order to meet the educational needs of contemporary students. While many of Tyler's ideas are used in curriculum planning today (measurable objectives, selecting and ordering "educational experiences," etc.), some of his fundamental progressivist ideas (including studying the learners and crafting objectives that incorporate elements based on learner interests, the needs of contemporary life, etc.) are ignored in favor of a much more essentialist approach. Even before Tyler, Franklin Bobbitt (2013) cautioned in 1913

16

that schools were continuing the same practices in the 20th Century that were started in the 19th century, and that those practices while meeting the needs of the 19th Century learner do not necessarily meet the needs of the 20th Century learner. Yet today, the "three R's" are still as much a part of American education as they were in the 19th Century. In his 1916 book, *Democracy and Education*, John Dewey (2009b) mentions the use of the three R's in education, writing, "The schools devoted themselves to the three R's in the degree in which ability to go through the forms of reading, writing, and figuring were common elements in all kinds of labor" (p. 533). South Carolina even passed the Read to Succeed Act (2014) just last year aimed at addressing the "R" of reading by requiring teachers to undergo special training in literacy and the establishment of special summer reading camps, among other things, in order to be "college and career ready" (South Carolina Department of Education, 2015). This focus on essentialism is a mistake and has thus far failed to improve education in America (Festerwald, 2013).

Today, in order to prepare students to be "college and career ready," many districts and schools are implementing one-to-one computing, hoping that it will be a magic-bullet that will help teachers to increase student learning outcomes and meet the challenging requirements set forth by laws such as NCLB (2002) and Read to Succeed (2014). According to contemporary academics like Marc Prensky (2001a, 2001b), however, simply putting a device in the hands of our students is not going to automatically make them better learners. While the focus of the purpose of education may have changed dramatically, the basic tenets of the curriculum have not. This is a problem that needs to be addressed so that educators can meet the goal of preparing our students for college and careers.

Education for Contemporary Life

Franklin Bobbitt (1918) wrote, "The present program of public education was mainly formulated during the simpler conditions of the nineteenth century. In details it has been improved. In fundamentals it is not greatly different. A program never designed for the present day has been inherited" (as cited in Flinders & Thornton, 2013 p. 11). Upon reading this for the first time, one could jump to the conclusion that this was written in the present day; however, Bobbitt wrote this describing the state of public education back in 1913. He was arguing that the system of education he was writing about was not meeting the needs of contemporary students because, while improvements had been made, it was still a system of education designed to meet the needs of the past, not the needs of the present.

While his main argument was that students should be taught only what they will need to use in the future (i.e. skills they would use in their industrialized careers), his statement about the obsolescence of the current educational system still holds true today. In the past few years, it has been widely reported by the media that the Unites States is falling behind other countries in terms of education based on international test scores (Festerwald, 2013, Peterson, 2014, Ryan, 2013).

Other historical theorists also made the argument that the 19th century model of education was insufficient to educate contemporary students, including Maria Montessori (2013) (who lamented the scientific evolution of the classroom desk that became ever more advanced but still stifled student expression) and John Dewey (1916/2009b). While each of them had differing opinions about the best way in which to educate young minds, they all agreed that change was (and still is) desperately needed.

In many of his writings, John Dewey (1897, 1902/2009a, 1916/2009b) advocated for substantial change to the curriculum and methods of contemporary schools. The schools he was describing in his works were clearly grounded in 19th century ideas and methods; and while describing schools in the late 1800s to early 1900s, his descriptions are strikingly similar to schools today. Spring (2014) also argues that schools have not changed much in the past hundred years, and remain a relic of the 19th century. For Dewey, one of the greatest shortcomings of schools was the lack of education relevant to contemporary society. He writes in *My Pedagogic Creed* (1897), "I believe that the school must represent present life - life as real and vital to the child as that which he carries on in the home, in the neighborhood, or on the play-ground" (p. 7). Similarly, Ralph W. Tyler (1949) argued that (at least some) educational objectives should be derived from contemporary life. He stated:

> [Because] contemporary life is so complex and because life is continually changing, it is very necessary to focus educational efforts upon the critical aspects of this complex life and upon those aspects that are of importance today so that we do not waste the time of students in learning things that were important fifty years ago but no longer have significance at the same time that we are neglecting areas of life that are important and for which the schools provide no preparation. (p.17)

In this, Tyler meant that educators need to look to the needs of their students in the present when creating their curricular objectives, and not just rely on "what has always been taught." He also argues that "transfer of training" research supports this as well. He said, "studies of transfer of training, however, indicated that the student was much more

19

likely to apply his learning when he recognized the similarity between situations encountered in life and the situations in which the learning took place" (pp. 17-18). In the past 10 years, most teacher preparatory and professional development programs have emphasized the need for teachers to incorporate "real-world" examples and activities into their lessons, echoing what Ralph Tyler was saying in 1949 and what John Dewey was saying in 1897.

Call for Change

A 2005 brief by the National Center for Education Statistics reported that over 60% of teachers believed that Internet access in the classroom was essential for their teaching, and nearly 50% believed that a computing device for each student was essential. Today, more and more schools and school districts are investing in one-to-one computing initiatives that give each student a mobile computing device (usually a laptop or tablet computer) with access to productivity applications and the Internet, yet these devices are still being used in the context of a 19th century designed school system with the expectation that they will magically transform education to meet the needs of the twenty-first century student. This is not the case, however, for as Bobbitt (1918/2013) states, "And yet to do the nineteenth-century task better than it was then done is not necessarily to do the twentieth-century task" (as cited in Flinders & Thornton, p. 11), let alone the twenty-first century task.

<div align="center">

Model of Student Engagement

</div>

The link between student motivation, engagement and student achievement is clear and obvious to nearly all professional educators. In Democracy and Education, Dewey (1918/2014) devotes an entire chapter to the discussion of "Interest and

Discipline" among students and their relationship to learning. He argues that students must have interest in the curriculum in order to maintain the discipline necessary to actually learn. Marzano (2003) states, "if students are motivated to learn the content in a given subject, their achievement in that subject will most likely be good" (p. 144). Conversely, if students are not interested or motivated, they will most likely have little achievement. He recommends as an action step "providing students with tasks and activities that are inherently engaging" (p. 149). Providing students with such tasks arouses their curiosity, increases their motivation, and in turn, increases their achievement in the class. In their report from the Nellie Mae Education Foundation, Toshialis and Nakkula (2012) also link student engagement to motivation and achievement. In fact, the authors define engagement as the step a student uses in between being motivated to learn and actually doing the task of learning. Therefore, a student who is engaged has already had the motivation to learn and is carrying out the processes necessary to learn, which leads to achievement. The important and inherent link between student engagement and achievement forms one of the theoretical bases for this study.

In their 2008 study, Skinner, Furrer, Marchand and Kinderman propose a similar model that separates engagement into behavioral and emotional components. Behavioral engagement includes effort, persistence, attention, involvement, etc., while emotional engagement includes enthusiasm, interest, enjoyment, satisfaction, etc. Marzano (2011) proposes a model of engagement based on the work of Skinner that includes: 1. a student's positive emotions toward the learning; 2. a student's interest in the learning; 3. a student's perceived importance of the learning; and 4. a student's perceptions of efficacy toward the learning (i.e. "can I do this?"). Phillip Schlechty (2014) proposes a similar

model of student engagement that says students who are engaged are "attentive, persistent, and committed" (p. 8). For this study, student engagement is framed using Marzano's model. This model provides four components of student engagement that can be measured using the planned survey data collection tools.

Education in the Digital Age

Marc Prensky (2001a) coined the terms *digital natives* and *digital immigrants* in order to describe the relationship between the children in today's schools who have grown up immersed in digital technologies like the internet and cell phones (the *digital natives*) and those adults who grew into those same technologies (the *digital immigrants*). He also argues that the current system of education is not meeting the needs of students today because they think and learn in a way that is fundamentally different from the way in which the teachers think and learn. He elaborates further that there has to be a fundamental shift in teaching in order to meet their learning needs. This includes learning to speak their language and understand their less linear way of thinking. Other studies have built on Prensky's ideas, including one out of Shanghai, China by Gu, Zhu and Guo (2013) which found that while digital natives (students) and digital immigrants (teachers) use information and communication technology (ICT – including mobile computing devices) a similar amount, the *way* that they use these technologies is very different. They also found that the way the students use ICT at home and at school is very different as well, leading one to question why there is such a disparity and how can teachers bridge the gap between themselves and their digital native students.

Prensky goes on to argue in Digital Natives, Digital Immigrants, Part II (2001b) that the reason there is a growing disconnect between our students and school is that the

way they think is fundamentally different from the way that the teachers think, in the same way that a musician's brain is different from a scientist's. Recent studies have found that many of the assumptions once made about the brain are wrong. While it used to be thought that the brain's neuroplasticity was a feature of only the young brain, recent research has found that the human brain retains its ability to rewire itself and adapt throughout life. Recent studies have also shown that outside stimuli (including the culture one is raised in) has a profound effect not on just what people think about, but how they think as well. This forms the basis for why there are fundamental physiological and process differences between the brains of students today and those in the past. The digital native brain is "wired" to process information in a much less linear fashion (parallel processes and random access – similar to a computer) because it has been "trained" to think that way. Prensky argues that our students have grown up in an age where knowledge is at their fingertips: on the television media, on computers and the Internet, and now on smartphones in their pockets. Yet schools still operate under the assumption that our students come to us as "blank slates" that it is our job to fill with knowledge, a belief that Dewey (1916/2009b) vehemently opposed. We are ignoring what Tyler (1949) cautioned over 60 years ago; we are still teaching our students what was important fifty years ago but is no longer relevant while at the same time failing to teach our students what is relevant for the present. Prensky (2014) would definitely agree with this, arguing that students should be taught the "stuff of their time" like programming, genomics, bioethics, and nanotechnology. These are the skills he argues that our students will need to have to be successful in their world, while teachers are busy preparing them for a world of the past.

Effective change in the digital age

In terms of one-to-one computing, it is not just enough to put personal electronic devices (PEDs – cell phones, laptops, or tablet computers) in the hands of each student. One can also argue that the success or failure of these devices to transform education and meet the changing learning needs of our students depends on how they are integrated in the classroom. Milbrey McLaughlin (1976/2013) writes, "Many argue that without changes in the structure of the institutional setting, or the culture of the school, new practices are simply 'more of the same' and are unlikely to lead to much significant change in what happens to students" (p. 195). This can be as true of the "new" teaching practices she was writing about in 1976 as it is today about one-to-one computing in schools. In fact, she continues, "Contrary to the assumptions underlying many change strategies and federal change policies, we found that implementation did not merely involve direct and straightforward application of an educational technology or plan" (p. 196). Unfortunately, today this is how many schools are approaching the integration of one-to-one mobile computing devices. In the study school district, teachers have received training about how to use the devices given to students, and were given directives to integrate their use more into daily classroom activities; however, these devices have not yet had the desired miraculous transformational effect of making learning more accessible and more engaging to our students. While it is true that students are able to type papers and turn in work electronically, this does not appear to have increased student achievement in any class or at any school in the district.

So what is happening? Why are these devices that are supposed to be the "magical fix" that will engage our students and drive test scores up not having the desired effect?

24

According to McLaughlin (1976/2013), the reason is that "successful implantation is characterized by a process of mutual adaptation" (as cited in Flinders & Thornton, p. 196). She describes three different possible interactions that a desired change-agent (in her case, a project design, in this case integration of one-to-one computing devices) can have. First is the one that will lead to successful implementation, "mutual adaptation." In this situation, the institution (school), teachers, and students modified their attitudes, skills, and behaviors in order to bring about successful change. The second situation she describes in "cooptation." In this situation, the change-agent is adapted and modified in order to fit in with the status quo. In other words, no real change occurred because the teachers and students simply adapted the project to fit in with what they "had always done" and thought was successful. The last type McLaughlin describes is "nonimplementation," which is where the change-agent either breaks down during implementation or is ignored by the participants.

In the implementation of one-to-one computing devices in the study district, all three types of interactions have been observed, but mostly cooptation. A 2004 study by Vannatta and Fordham supported McLaughlin's assertions in terms of computers in the classroom. They found that teacher dispositions had a significant impact on the integration of computer technology into their classroom. Teachers who were more comfortable and more positive toward computers integrated them more frequently and effectively than those who did not. This is in line with McLaughlin's (1976/2013) finding that successful implementation of a new teaching method (in this case, one-to-one computing) is successful if all participants (teachers, students, and school administration) embrace it and "mutually adapt."

McLaughlin also indicated that teacher training in the new methods is important part of implementation and in fostering the acceptance of new ideas and methods. A 2005 study by Rosenfeld and Martinez-Pons supports this, finding that providing teachers with proper education on the theory and practice using classroom technology effectively increases the use of that technology in those teachers' classrooms. While training is a way to lead to mutual adaptation, McLaughlin does caution that one-shot trainings and outside experts or consultants are often ineffective. She describes the most successful trainings are ones that are continuous and meet the needs of the teachers as learners to implement the change. She writes, "Even willing teachers have to go through such a learning (and unlearning) process in order to develop new attitudes, behaviors, and skills for a radically new role" (as cited in Flinders & Thornton, 2013, p. 200). As Prensky (2001) states, "Today's teachers have to learn to communicate in the language and style of their students" (p.4) – the digital natives. This is a fundamental change in teaching and learning to meet the needs of a fundamentally different kind of student: students whose brains are wired differently and think differently; students who are used to instant access to information, instant gratification, and endless personalization. In order to meet the needs of our students today, we need to fundamentally change how we teach and, in the words of McLaughlin, "mutually adapt."

Creating Curriculum for Students in the Digital Age

In his famous text, *Basic Principles of Curriculum and Instruction*, Ralph Tyler (1949) lays out a framework for creating curriculum based on four important questions, "1. What educational purposes should the school seek to attain? 2. What educational experiences can be provided that are likely to attain these purposes? 3. How can these

educational experiences be effectively organized? 4. How can we determine whether these purposes are being attained?" (p. 1). His framework sought to update the outdated content and teaching methods of his day, still rooted in the traditions of the 19th century. He argued for a structured method of developing curriculum using predetermined content objectives that were relevant and changed with contemporary life, teaching that was precisely planned to meet those objectives, and that were constantly evaluated for effectiveness. Much of today's education does rely on predetermined educational objectives (content standards) and methods, yet they are still being taught in the 19th Century tradition of the "three R's:" reading, 'riting, and 'rithmatic.

William E. Doll (1993/2013) agreed with Tyler in that the curriculum of contemporary schools is still rooted in those 19th Century "three R's" and that post-modern change is necessary, however he proposed a different framework for creating a progressive curriculum. Doll argued for the "four R's:" Richness, recursion, relations, and rigor. For Doll, these "four R's" provided for something that Tyler's framework could not – the ability for curricular goals and objectives to take shape and change as the learning was occurring. Doll argued that having predetermined objectives, as Tyler and others suggested, made the curriculum too rigid and left out opportunities for learners to take learning in their own directions and pursue different avenues, all of which were valid, to reach the desired outcomes. Though this is a much more chaotic and unstructured method for creating curriculum, Doll argued that there needs to be some degree of turmoil in order for effective learning to occur as students create order from the chaos.

The "four R's" help to guide the creation of this less structured, more chaotic approach to curriculum. Richness in a curriculum according to Doll provides multiple layers of meaning and interpretation. Recursion refers to the spiral or cyclical nature of thinking and learning as thoughts and ideas loop back upon each other as new information is uncovered. Relations are the pedagogical and cultural relationships that the new learning forms between previous learning and other subjects as well as the community, world, and cosmos beyond the school walls. Rigor, according to Doll, is taking the ideas and information learned from a curriculum and examining them from all angles and perspectives. It is indeterminate, meaning not objectively measurable, and open to interpretation (as cited in Flinders & Thornton, 2013).

With the growing integration of one-to-one computing initiatives and personal electronic devices in the classroom, curriculum developers and classroom teachers are just beginning to appreciate that our students have different needs and methods of learning than they did in the past, and we need to change our thinking as well in order to keep up with it. Contemporary life has, as Tyler (1949/2013) argued, substantially changed what is and is not relevant for current students to learn. At the same time, as Prensky (2001b) argues that our students think in a less linear, more chaotic fashion, it seems that Doll's (1993/2013) ideas for a less linear curriculum should be at the forefront of how educators begin to tackle the task of changing education to meet the needs of our students.

Constructivist Theory and Pedagogy

According to Applefield, Huber, and Mahnaz (2001), "Teachers' personal theories of learning have long been viewed as having considerable influence on virtually

28

all aspects of teachers' decisions about instruction" (p. 35). These beliefs become apparent in the instructional strategies used by teachers during their lessons. Ertmer and Newby (1993) outline the three learning theories that have shaped education since the 19th century.

Behaviorism is the theory that learning is a change in observable behaviors. As such, behaviorists tend to use instructional strategies like lecture and rote memorization of facts. For them, the thinking of the student does not matter as long as they can repeat the correct answer or follow a procedure exactly. Military boot camp is an example of a behaviorist institution. This is the form that education in the 19th and much of the 20th Century has historically taken.

Cognitivism is the theory that learning is a discreet change between states of knowledge. Cognitivists are more interested in the thought processes and higher-order thinking (like problem solving) than in the behavior. Due to this emphasis on cognitive processes, cognitivists put greater emphasis on the role of the learner. The learner is actively involved in their own learning, while the teacher is responsible for the structure, organization, and sequence of information in order to influence the cognitive processing of the student. This fits in very well with progressivism as well, as both have an emphasis on hands-on learning and problem solving. Most teachers in current schools will probably hold cognitivist beliefs and will thus organize their lessons and instructional strategies accordingly. There will usually be more of an emphasis on applying learning to new situations and solving problems than on rote memorization.

Constructivism is the theory that learning is creating meaning from experience. Learners must "construct" their own meaning based on their own experiences. Because of this, the context of the learning is essential. Constructivist instructional techniques involve an emphasis on learner control and the ability of the learner to manipulate information and for that information to be presented in a variety of different ways. Constructivism is very much in line with what Doll was advocating as well, as is evident in the "turmoil" students encounter as they sort through and process information in order to make meaning. Cognitivism is also in line with Prensky (2001b) and his ideas that digital native students learn differently from students in the past with less linear thinking and more parallel processing. Cognitivist instruction allows students to approach information in a less linear way, while giving them the means to process that information to create meaning. Constructivism and its approach to learning and teaching could very well be a possible solution to engaging students in the 21st Century and meeting their unique learning needs.

Perceptions of One-to-One Computing

In much of the literature, there are three main factors that affect teachers' use of technology in their classrooms: training, availability and, most importantly, attitude. The previously mentioned study by Vannatta and Fordham (2004) found that technology training and, more importantly, teacher disposition are important predictors of technology use in the classroom. A similar study by Rosenfeld and Martinez-Pons (2005) found that training teachers in the use of technology increased its use in their classrooms. They also found a relationship among the availability of technology in the classroom, the use of this technology, and the competence in its use. This makes sense in that the more available

certain technologies (such as iPad) are in a classroom, the more the teacher will use them and the better they will get at using them. A 2012 study by Ritzhaupt, Dawson, and Cavanaugh over 2 years in Florida found that a teacher's level of education and experience teaching with technology significantly influenced the use of technology in his or her classroom. In addition, they found that how a teacher integrates technology in their classroom affects how frequently the students use it. The authors also found that the access to technology in the classroom significantly relates to its use.

Research is also showing that student attitudes about technology in the classroom are affected by similar factors like availability, but more importantly by how teachers are using them. Gu, Zhu, and Guo (2013) found that in China, surprisingly, students and teachers use technology about the same amount. The differences between students and teachers with regard to technology lie in how they use it and how important each perceive technology to be. Teachers tended to use technology more inside the classroom, while students used it more outside the classroom. They concluded that the way technology is being integrated into classrooms is not complying with how the students use the technology and their expectations for its use. Today, US students have grown up with the World Wide Web (www), computers, tablets, and smartphones however, most teachers have had to adopt these technologies as they have been developed. Therefore, there is a discrepancy between teachers and how they design lessons and expect technology to be used and students and their expectations for how technology can be used.

A 2012 study by Livingstone about schools in the UK found that while schools are willing to fill classrooms with computers, they are less willing to change their lesson plans to effectively utilize them. The author proposes two possible explanations. First,

there is a dearth of convincing evidence that technology use improves learning outcomes for students. Second, that there is a lack of consensus about how technology should be used: either to deliver traditional instruction or to be used in a radically different pedagogical way based on soft skills and digital literacy.

A study out of Turkey by Eskil, Ozgan and Balkar (2010) similarly found that when elementary students used technology more in school, they had a higher opinion about using technology in science and technology lessons. This makes sense because as students become more familiar with using technology in their classes, they should tend to form more positive opinions of it. They also found that in schools that used technology more frequently, the students were more adept at using it for learning in school. Again this makes sense as with anything, practice makes perfect. These studies further inform my research question because they indicate that it is not just the frequency of use of technology that has an effect on students, but also how the technology is being used in the classroom.

Technological Needs of Diverse Learners

Socioeconomic Status and Technology

It has been well recognized that socioeconomic status (SES) affects student performance and engagement in schools. Students from low SES households face higher rates of food and shelter insecurity, higher rates of transiency, and there exists a well-documented achievement gap between these students and their wealthier peers. The No Child Left Behind Act (2002) recognizes this in US law and includes provisions focusing on closing this achievement gap between poor students and wealthier students. School

districts once again hope that one-to-one computing initiatives are the answer to this problem.

There has been some research on the effect of classroom technology on students of low SES. In a study of 211 students of low SES of varying backgrounds and ability levels, Page (2002) found that technology enriched elementary classrooms enhance the mathematics achievement and self-esteem of students more so than non-enriched classrooms. He also found that the technology enriched classrooms were more student-centered than the non-enriched classrooms. However, this study also found that reading achievement was not affected. The author cautioned that "although classroom technology (and its effects) may not be a cure-all for many educational ills, it does appear to contribute significantly to the academic achievement and self-esteem of elementary students of low socioeconomic status" (p. 404).

Another study by Byker (2014) compared the "sociotechnical narratives" of two high poverty study sites, one in east Texas and another in India. The study found that even though the sites were geographically and culturally diverse, the sociotechnical narratives were remarkably similar. They included, "(1) A shared hope in the opportunity and possibilities with computer technology, (2) the development of literacy skills, and (3) similarity in knowledge tasks for the future" (p. 29). In other words, both study sites placed similar emphasis on using classroom technology to enhance literacy skills and also shared the same hope that access to technology would lead to greater improvements in student achievement and preparation for the future. This shows that even worlds apart, teachers and students of low SES have similar hopes and ideas about the possibilities enhancing student access to technology can bring.

While computing technology appears to have positive effects on students in poverty, these students still face significant disadvantages in this area. Gorski (2013) conducted a study of about 40 eighth grade students at a high poverty middle school. When he inquired about the home internet access of these students, only a handful responded that they had access at home. When asked if they had been assigned homework that required them to access the internet, they all responded in the affirmative. For students in poverty, once again the promise of placing technology in their hands comes up short. While school districts can and are placing computing devices in the hands of students, this still does not guarantee that they will have access to the information available through them at home.

Gender and Technology

While granting access to mobile computing technology to all students is done with the best of intentions to help all of those students, it can be argued that this technology remains a realm dominated by males. The American Association of University Women (AAUW, 2002b) argues that although generations of students have been socialized into computer culture through video games, these games and the educational software developed to emulate them are mostly designed for men by men. According to the AAUW, these games "often have subject matter of interest to Young Men, or feature styles of interaction known to be comfortable to Young Men" (p. 345). They also argue that these same games are marketed toward Young Men, and that educational software and games contain many of the same shortcomings. They also cite a study of popular K-6 mathematics computer programs that showed only 12% of the gender identifiable characters were female, and most of these characters were relegated to

passive roles like "princess." They cite another study of 30 randomly selected software titles used in schools and found that only 30% of the more than 3,000 characters were female, and these characters appeared mostly in categories of "domestic work" and "manual labor," while the roles of "adventurer" and "leader" were 80% male.

Many contemporary theorists and researchers advocate educational gaming and software as a means of engaging contemporary students. While Prensky (2005) argues for the use of gaming as a means to educate contemporary students who are disengaged by the traditional pedagogy of schooling, he does not offer an answer to the severe underrepresentation and sexist roles for Young Women in gaming, and in many additional fields of technology and science as well. Waddington (2015) also advocates gaming in education as a means of successfully implementing John Dewey's vision of schooling through occupations and contemporary real-world experiences, yet he too does not address the bias against Young Women. Indeed, in the world of programming and gaming, female gamers and coders severely underrepresented and often ignored, ostracized, or even threatened for daring to enter this predominantly male space. Fink (2015) cites that while women outnumber men in college education, only 20% of the bachelor's degrees awarded in engineering go to women, with computer science and physics hardly any better. She also states, "Their [Young Women] interest in STEM fields, in particular, drops way off during the middle school years, despite the fact that Young Women are academically as capable as Young Men" (p. 25).

In addition, the AAUW (2002a) identifies a clear gender gap between Young Men and Young Women in taking high school science classes. This is a real problem. The AAUW states:

This gap is a portent of the gender gap in college math and science programs and, later, in well-paying math and science careers. The rapid growth of technology has also fueled concern about Young Women' computer skills, which generally lag behind Young Men. Young Men significantly outnumber Young Women in higher-skill computer courses, while Young Women tend to cluster in lower-end data entry and word processing classes. (p. 277)

While there is no easy answer to the problems facing Young Women in technology fields, it does raise questions whether or not one-to-one computing initiatives have the same effects on Young Men and Young Women, including on motivation and engagement. It also places a special responsibility on science educators in one-to-one settings as the Young Women in their classes are twice disadvantaged compared to the Young Men. Science educators in those one-to-one settings especially need to be cognizant and vigilant about the gender biases affecting Young Women in both science and technology.

Action Research Methodology

The method of study for this research is action research. According to Mertler (2014), "Action research is characterized as research that is done by teachers for themselves" (p. 4). It is a systematic approach to research that is often described in a cyclical nature. Mertler describes a four-stage process: The planning stage, the acting stage, the developing stage, and the reflecting stage. These four stages can then be further divided into nine total steps, based on the scientific method. Like the scientific method, steps can be skipped or rearranged in order to suit the research being conducted or the needs of the researcher. These include:

1. Identifying and limiting the topic

2. Gathering information

3. Reviewing the related literature

4. Developing a research plan

5. Implementing the plan and collecting data

6. Analyzing the data

7. Developing an action plan

8. Sharing and communicating the results

9. Reflecting on the process (p. 36)

In action research, action planning and reflecting are key steps as they lead to subsequent action research cycles. As stated previously, the process is cyclical; the end result of one cycle of action research will lead to further questions and hypotheses that inform the next cycle.

Reflection is a key component to the action research process. Mertler (2014) describes two ways that action researchers should reflect upon their research while creating the action plan. First, in order to develop a plan for further professional development, he encourages action researchers to reflect upon the anticipated and unplanned outcomes of the research. Through this type of reflection, the action researcher can look back on the journey through which his research has taken him. Reflection should bring the action researcher full circle back to his research question and will most likely lead him to a greater understanding of what he was researching and most likely some new questions as well. It is through this type of reflection as well that the action researcher can begin to form a plan to address what needs to be done in the future,

including further professional development and/or changes to classroom practices to improve student learning outcomes.

The second way that action researchers should reflect upon their research is on the process and the research itself. Mertler (2014) states, "No research study – regardless of who conducted it – is perfect" (p. 215). By reflecting on his research study, an action researcher can discover hidden effects, outcomes, or weaknesses in his research design. Once he uncovers these, then he can propose an action plan for further research that will address these issues and strengthen his results, improving his conclusions as well.

In his text, Mertler (2014) provided guidance to action researchers to help decide on the type of study they should use, qualitative or quantitative, based on several factors such as personal beliefs, skills, and the nature of the study (p. 88). Based on the research question this study employed a qualitative design.

Conclusion

While one-to-one computing initiatives are becoming more and more common in schools and districts across the USA, the research on the effectiveness of these programs is still developing. While it is important that education reflects the contemporary lives of students and that information technology, like computers and smartphones, has become ubiquitous in contemporary society, it is still important that teachers effectively use this technology to enhance student learning. Cognitivist learning theory and pedagogy appears to be one answer to the problem of how to appropriately integrate one-to-one computing into contemporary classrooms. Chapter Three details how I used action

research methodology to find out how one-to-one iPads have impacted high school

teachers' perceptions of student engagement in science classrooms.

CHAPTER 3

METHODOLOGY

Introduction

The purpose of this chapter is to describe in detail the action research methods used in the present action research study to determine how one-to-one iPads affects high school teachers' perceptions of student engagement in science classrooms. The study took place during the fall semester between September 12, 2016 and October 21, 2016 at Ruraltown High School (pseudonym). Chapter Three is organized in the following sections: introduction, research design, data collection, data analysis, and conclusion.

Problem of Practice

In a rural high school in South Carolina, one-to-one computing initiatives are considered to be the silver bullet that will enable teachers to increase student scholarly achievement by engaging students in content-area learning. In the present action study school, teacher-participants have received limited training to operate and integrate the one-to-one iPads in their classrooms. The problem of practice centers on teacher-participants' ability to effectively use the devices to engage students in science learning using these contemporary technology tools. Preliminary investigations identified a lack of consensus among teachers about the effects of these devices on student engagement, and therefore a highly varied usage of the devices among teachers in daily classroom activities. Therefore, the action researcher planned a cycle of implementation and

reflection with the teacher-participants to determine the support these teachers felt they would need in order to use these iPads in their classrooms more effectively to ensure that their students are engaged and productive.

Research Question

This study was specifically guided by the following research question:

What is the impact of one-to-one computing devices (iPads) on teacher perceptions of student engagement in science classrooms?

Purpose Statement

The purpose of this action research study is to improve the use of the one-to-one computing devices (iPads) in order to more effectively engage students in learning science. Teachers know best how to engage their students in their classroom, but can only effectively implement and use new technologies like the iPads when they have appropriate skills and support in their use. Therefore, the participant-researcher will work together with the teacher-participants to devise a strategy that will provide teachers with the support they need in order to use the iPads more effectively so that science is more meaningful to the students and so that they can more actively engage with the material using a contemporary technology tool.

Research Tradition

The research question was addressed using action research. According to Mertler (2014):

Action research is defined as any systematic inquiry conducted by teachers, administrators, counselors, or others with a vested interest in the teaching and

learning process or environment for the purpose of gathering information about
how their particular schools operate, how they teach, and how students learn" (p.
4).

In simple terms, action research is a cyclical process with emphasis on developing
solutions to problems or improving classroom teaching. It follows the scientific method
similar to traditional research studies, but provides a greater focus on reflection. There
are many models of the action research process, but they all involve a basic cyclical
process of questioning, planning, gathering and analyzing data, developing an action
plan, and reflecting. The process is then repeated with new questions or problems based
on the results of the previous iteration. Preparing the so-called "action plan" informs the
"action" step of action research. The action plan, according to Mertler, is "essentially a
proposed strategy for implementing the results of your action research project" (p. 43).

Research Design

The nature of the research question and problem of practice was best addressed
using a qualitative study design. Specifically, an observational qualitative design was
used with data gathered from observations of teacher-participant classrooms and semi-
structured interviews with the teacher-participants. The study began with an in-service
professional development seminar that I led on September 12, 2016. This seminar
focused on ways that the teacher-participants could integrate the use of iPads into their
science classes in order to engage students. The teacher-participants and I shared ideas on
how to accomplish this using various instructional strategies.

Researcher

As a participant-researcher, my role was to both collect data and be a part of the research as well. I led the initial professional development in-service seminar with the teacher-participants sharing ideas for how to integrate the iPads in our daily classroom lessons in order to engage students in learning science. Following this, I collected data through classroom observations of and semi-structured interviews with the teacher participants. I tried to make sure that I was inconspicuous when collecting observational data. The teacher and the students knew I was present, but I did not interfere in the lessons. I also ensured that the teacher-participants felt comfortable talking with me during the semi-structured interviews. Thanks to our pre-established working rapport, this was not difficult to accomplish and I think that the responses they gave reflected their true perceptions and beliefs.

The Setting

The research site was a high-poverty rural high school located in a large school district in the southern US. It is an AA school with about 750 students in grades 9 – 12 and 60 teachers. While the poverty index is high (78.84%), the school is located in a large school district and benefits from the tax dollars of the wealthier school zones. The student body is almost exactly 50% male and 50% female. The student body is 80% white, 7.2% African American, 8.2% Hispanic, 0.2% Asian, 4% more than one race, and the remaining less than 1% American Indian and/or Native Hawaiian. Sixty-two percent of students are on free or reduced lunch, and the school has a poverty index (students on free or reduced lunch and/or Medicaid) of 78.84% (L. Schuester, personal communication, October 11, 2016).

The school has won many accolades and awards for many of its programs and extracurricular activities: its fine arts programs, especially the Marching Band; its Career and Technology Programs, including recognition as the number one agriculture education program in the state; State and Region championship athletic teams; and numerous extracurricular awards from diverse clubs such as its championship chess club, HOSA, and FFA. The school received an absolute rating of "Good" in its 2014 school report card, and a grade of 'B' per the ESEA Federal Accountability Waiver. The surrounding community is generally supportive of school initiatives, with many local individuals and businesses sponsoring school activities, clubs, and athletics, as well volunteering to provide outside learning opportunities for students, including internships.

Participants

The participants in this study included five teacher-participants from the research site. Teacher-participants were invited based on their teaching a science course during the semester in which the study occurred. All the teacher-participants were white because there are no teachers of color who teach science at Ruraltown High School. Teachers were informed that the study was for my personal dissertation research, and that the results will be shared with the school and district. They were able to decline participation in the study at any time and for any reason and were not be penalized in any way if they declined to participate (see Appendix A). Teacher-participants were assigned pseudonyms in order to identify them for data analysis purposes. These pseudonyms were used on all observations and interviews. Personally identifiable information of the teacher-participants was kept secure in an encrypted file located on the password

protected personal laptop computer of the participant researcher, separate from the collected data in order to protect the teacher-participants.

As shown in Table 3.1, the teacher-participants had a wide range of experience in teaching, both in total years and in years at the study school.

Table 3.1

Age, Years Teaching at the Study School and in Total for Teacher-Participants

Teacher Pseudonym	Years Teaching at Study School	Years Teaching Total	Age
Mrs. Blue	30+	35+	50 - 54
Mr. Green	0 – 5	0 – 5	25 - 29
Mrs. Purple	5 – 10	5 – 10	30 - 34
Mr. Red	20 – 25	25 – 30	60 - 64
Mrs. White	5 – 10	20 – 25	60 - 64

A detailed description of each teacher participant is available in Chapter Four of this dissertation. The teacher-participants were my colleagues at Ruraltown High School, and as such I already have a working relationship with them. Additionally, I consider them to be friends. Because of this relationship, they were extremely willing to work with me on this action research project.

Data Collection

After being informed of the study and obtaining consent (see Appendix A), I led the teacher-participants in a professional development seminar on September 12, 2016, focused on how the iPads could be integrated into the daily classroom lessons of the

teacher-participants in order to increase student engagement. The teacher-participants and I shared pedagogical techniques that we used in their own classrooms that we felt were successful at engaging the students in learning science. This allowed all the teacher-participants to have at least a basic knowledge set about how to possibly integrate the iPads in engaging ways in their classrooms. Teacher-participants were also informed of the model of student engagement for this action research study based on a four-part model by Marzano (2011). In this model, engagement includes student emotions about the learning, student interest in the learning, student perceptions about the importance of the learning, and student perceptions of the efficacy of the learning. The model is detailed in the Literature Review in Chapter Two of this dissertation.

Following the seminar, I began conducting classroom observations of the teacher-participants between September 13 and October 21, 2016. The observations were "observer as participant" since those being observed were aware of my presence, but I did not take an active role in the activities of the classroom (Mertler, 2014, p. 94). Each observation lasted between 20 and 45 minutes, based on the time availability and the time availability of the teacher-participants and lesson being taught. At the start of the observations, I recorded the date and time of the observation, the subject being taught, and the gender and racial breakdown of the class (the racial breakdown was verified with the teacher-participant afterward) in my field notes journal. No personally identifiable information about students or teachers was collected during the observations. The observations focused on the teacher-participant's use of (or lack of use of) the iPads and the engagement level and behaviors of the students. I recorded observation notes in a notebook I kept secure in a locked cabinet in my classroom when not in my possession.

The goal was to observe each teacher-participant 4 – 5 times over the course of the data collection period, but scheduling, time constraints, and a severe weather event that closed school for three days resulted in two of the teacher-participants (Mrs. Blue and Mrs. Purple) only being observed three times.

In addition to classroom observations, interviews with the teacher participants were also conducted. Interviews followed a semi-structured format (see Appendix B) and were recorded and password encrypted on my personal password protected laptop computer. Interviews were then transcribed within 48 hours so that trends could be identified. Interview questions focused on the teacher-participants' use of the iPads in their classrooms, if they thought this use was successful, and their perceptions of student engagement once again using Marzano's (2011) model. My as an experienced and successful teacher, curriculum leader, and trustworthy colleague were able to put the teacher-participants at ease during the interviews. This combined with reassurance that their identities were being protected allowed the teacher-participants to speak truthfully and freely when answering the interview questions. Each teacher-participant was interviewed twice during the data collection cycle, once toward the beginning and on the last day of data collection.

Data Analysis

The data collected in this study was qualitative in nature, therefore I, with assistance from the teacher-participants, conducted an inductive analysis of the data. I developed a coding scheme that was used as observational data was collected. Following the recommendation of Dana & Yendol-Hoppey (2014), I read through the observational data multiple times and began to pull out common trends and patterns to develop the

code. These major trends and patterns were then copied onto numerous sticky notes. Once these smaller patterns were copied onto sticky notes, I then organized them into preliminary categories and themes. I then met with the teacher-participants during a collaborative planning session on October 26, 2016 and displayed the notes arranged in the categories to the teacher-participants. The teacher-participants were then asked to read through the sticky notes in each category and make suggestions for moving or reorganizing the data. The teacher-participants and I followed this with a discussion of the data, the participant-researcher adding to and rearranging the sticky notes as the reflection on and analysis of the data continued. The focus of the discussion then shifted from the analysis of the data to desired action steps that the teacher-participants expressed they needed in order to address concerns that emerged from the data analysis, and in order to improve their own usage of the iPads in their classrooms to better engage students.

Data from the interviews was analyzed in a similar fashion. The interviews were transcribed from their recordings into my data notebook. The interviews were then read and coded for major trends and patterns which were once again written on sticky notes. The notes were then read and organized into major themes and categories.

At the conclusion of the action research study, the results and action plan will be shared with the school administration, teachers, and the district research committee. It is my hope that this will begin a school-wide reflection on the use of iPads in classrooms, and may inspire other teachers to conduct future action research studies with the goal of improving their own practice using the iPads to engage students.

Conclusion

This chapter detailed how the observational qualitative research design was used to gather data regarding the effects of one-to-one iPads on high school teachers' perceptions of student engagement in science classrooms. Because the research question involved finding out teacher perceptions about the effects of iPad on student engagement, the observational and interview data was selected as the best way to address the research question. The observational data allowed me to zero in on the teacher-participants' core beliefs regarding education and on their level of use and proficiency with the iPads in their classroom. The semi-structured interviews offered the greatest insight into the teacher-participants perceptions of the effects of the iPads on their students' engagement. The details of these findings are reported in Chapter Four of this dissertation, and the Action Plan developed from those findings is detailed in Chapter Five.

CHAPTER 4

FINDINGS AND INTERPRETATION OF RESULTS

Introduction

Chapter 4 describes the data collection and findings involved in the action research study, *High School Science Teachers' Perceptions of One-to-One Computing Devices on Student Engagement*. The data analysis and implications of the findings of this qualitative action research study of five science teachers' perceptions of students' iPad usage in their classrooms is included in this Chapter. The teacher-participants attended a professional development in-service seminar led by the participant researcher who is highly skilled in the implementation of computers in science classrooms. I regularly set up formats for my teacher-participants to reflect on ways in which they use the iPads in their science classrooms to engage our low SES, rural, southern, white high school students. Suggestions for new ways to utilize the iPads are included in the Action Plan that resulted from this action research study and are detailed in Chapter Five.

Five science teacher participants from Ruraltown High School (pseudonym) who have received limited training to operate and integrate the one-to-one iPads in their classrooms were the subjects of the present research. Each of these five teacher-participants identified in the in-service seminar the specific areas where they wished to improve their use of the iPad devices in their science curriculum and pedagogy.

The present action research study focused on teachers' perceptions of student engagement while using the iPads in science classrooms. In order to provide focus and clarity for the teacher-participants and myself, I used a model of student engagement as developed by Marzano (2011). This model includes four components to student engagement: students' emotions toward the learning, students' interest in the learning, students' perceptions of the importance of the learning, and students' perceptions of the efficacy of the learning. The teacher-participants were provided with instruction on this model and were informed that it would form the framework for our discussions of student engagement.

Research Question

This study was specifically guided by the following research question:

What is the impact of one-to-one computing devices (iPads) on high school teacher perceptions of student engagement in science classrooms?

Data Collection

Five science teacher-participants are the subjects of the present action research. Data collection from September 12, 2016 to October 21, 2016 included eighteen 20 to 40 minute observations with field notes.

Science Classroom Observations

Each teacher (with two exceptions) was observed four times for 20 to 40 minutes; Due to scheduling and the closing of school for three days due to inclement weather, Mrs. Blue and Mrs. Purple were only observed three times. Observation data was recorded by the participant researcher in a data notebook. Trends and patterns in the data were

analyzed in an ongoing basis which allowed the participant-researcher to look for these trends and patterns as the emerged in subsequent observations. Early trends identified by the participant researcher include the differences between engagement patterns of Young Men and Young Women using iPads, and the patterns of usage of the iPads among the teacher-participants. These trends were then coded by the participant researcher in the data notebook using the action research data collection and analysis method delineated by Mertler (2014). The coding and analysis of early observations allowed me to refine my observation strategy to confirm or eliminate those identified trends. As the observations went on, the coding process became easier as many of the same patterns and trends were observed multiple times in multiple classrooms.

Semi-Structured Interviews

Data was also collected through semi-structured interviews with the teacher-participants, once toward the beginning of the data collection cycle and once on the last day of data collection. Semi-structured interviews were audio recorded and later transcribed within 48 hours by the participant researcher. This data was also coded using the methods delineated by Mertler as major trends and patterns emerged.

Following an initial data analysis by the participant-researcher, the teacher-participants joined the participant-researcher in an inductive analysis of the data during a second in-service on October 26, 2016 (five days following the conclusion of the data collection period), and helped to identify and describe the major themes present. As the teacher-participants and I reflected on the data together, we devised an action plan for the

fall of 2017 that will address a number of identified issues involving iPads in science

classrooms at RHS.

Findings of the Study

The five high school science teacher-participants who were the subjects of the

present action research study were Mrs. Blue, Mrs. White, Mrs. Purple, Mr. Green, and

Mr. Red. A detailed description of each teacher participant can be found in his or her

specific section of this chapter.

The data indicated that each teacher-participants felt that the iPads can enhance

student engagement when used appropriately as a tool for learning. Four of the five

teachers were observed using the iPads to engage students during the data collection

period, meaning the participant-researcher observed the students as being overall engaged

with the lessons when the iPads were being used. Only one teacher-participant, Mr. Red,

was not observed using the iPads during his lessons. The following section is organized

by teacher-participant. A detailed description of each teacher-participant is followed by

an in-depth description of the observational and interview data I collected.

Mrs. Blue

Demographics. Mrs. Blue is a veteran teacher in her early 60s with over 35 years

of teaching experience. She is the current Science Department Chair at RHS, a position

she has held for many years. Mrs. Blue is a SC native and mother of two children and a

grandmother to three grandchildren. She began her teaching career at a high-poverty,

majority African American school in the Low Country coastal region of South Carolina.

After five years teaching there, she moved to the area near RHS and joined the science

department. Mrs. Blue has a sweet disposition, but she is no pushover. Her students greatly respect her for not only her teaching ability, but also her willingness to help every student to succeed in her class. Certified in Biology, she has taught Biology 1 for most of her teaching career. In the past, she has also taught ninth grade Physical Science and AP Biology as well. Mrs. Blue has been a mentor to me and she mentored me as a new science teacher. She encouraged me to be a creative instructional leader. She holds politically liberal views, and is especially vocal about the need for the theory of evolution to be taught in science class and not religion-based creationism or intelligent design theories. Mrs. Blue is also an avid outdoorsperson, enjoying frequent kayak and ski trips with her husband. In her community, she is also active in environmental causes to protect the waterways and natural beauty of SC. Always willing to try new things in her classroom, she has continued to evolve and develop as a teacher as her students have also changed in the transition to the digital natives of the 21st Century.

Observational data. Mrs. Blue was observed engaging her students using the iPads as a technology-enhanced reference tool. In one example lesson, she provided the students with videos, websites, and a digital version of the textbook that students could access on their iPads to help them fill in guided notes sheets on the cell cycle and stem cells. Students also had access to a physical textbook as well. The students worked together collaboratively in groups, viewing the videos and looking up information and sharing answers and explaining when another member of their group needed help. The students also called on Mrs. Blue for assistance when they had difficulty finding or understanding a concept from the guided notes. Not all students had iPads, so Mrs. Blue made available some laptop computers that the Science Department has for use with

digital probes. Some students in each group also chose to use the physical textbook versus the virtual one. Following the completion of the guided notes, Mrs. Blue reinforced the concept and further engaged the students by having each group complete a web-based activity instructing about stem cells and stem cell technology. The activity also included videos for the students to watch as well as animations and virtual activities requiring the students to use the knowledge they learned from the videos. These techniques indicate Mrs. Blue to have a cognitivist view of education (Ertmer & Newby, 1993). This is evident in the design of the lesson that used practice with feedback and that students had to apply their knowledge to a new situation in the reinforcement activity.

The same lesson structure was observed again from Mrs. Blue in a lesson on genetics. Again, she provided students with digital resources on the iPad as well as a print copy of the textbook, and students worked collaboratively in groups to fill in the guided notes. This was again followed by a reinforcement activity. Students were observed remaining engaged and on task throughout the lesson, with few exceptions.

Interview data. When asked if her students were engaged in her lessons, Mrs. Blue responded that most of her students were. In Biology, she claimed that her students really enjoyed some of the videos she had them watch on the iPads, especially *The Magic School Bus*. The participant-researcher probed further and asked follow up questions regarding her students' engagement using Marzano's (2011) four-part model. When asked if her students were interested in the content of her lessons, she responded, "Some of them are, some of them aren't." When asked if she thought her students thought what they were learning was important, she responded again, "Some of them, yeah, some of them, no. They say it every day, 'I hate this, I don't see any reason for doing this.'"

(Personal communication, October 24, 2016). When asked if she thought that her students could be successful at what she asked them to do, she quickly responded "Yes." When asked how her students used the iPads in her classroom, she responded,

> Those that have them [iPads] and bring them do use them. They use them to do their vocabulary, to take notes, and the ones that have them do use them to listen to the videos on their iPads and their earbuds. (Personal communication, October 24, 2016)

Asked if there were differences between the engagement of young men and young women, her response was, "it depends on the student." When asked what support she would need to make better use of the iPads in her classroom, she responded that she would like to have more ideas for how to integrate them.

Mrs. White

Demographics. Mrs. White is a teacher in her mid-fifties with over 20 years of teaching experience. She had been teaching at Ruraltown High School for many years, but left in order to teach at a private Christian school attended by her two sons. Once her youngest graduated, she returned to Ruraltown High School to teach Chemistry 1 and Physical Science. She enjoys nature as well and spending time outdoors with her family and friends. Mrs. White has a very sweet disposition, like Mrs. Blue, and her students deeply respect and emotionally connect to her. An extremely caring teacher, she is willing to go the extra mile to help every student to succeed. Being keenly aware of the unique struggles faced by students in a high-poverty area, she is also willing to take the time to inquire about her students' personal lives so that she can better understand the

personal challenges that they face and to help in any way she can so they can have more success both inside and out of her classroom. She is also always looking to learn and try new things in her classroom, especially teaching strategies that embrace technology (like the iPad) and better engage her students. For example, she has embraced using learning stations as an engaging strategy in her classroom and has led professional development at the school and district level on this topic.

Observational data. Mrs. White was also observed engaging her students using the iPad. In one lesson on chemical reactions and bonding, Mrs. White had set up different stations around her laboratory. Students were to complete a different learning task at each station. One station required students to watch a video on their iPad and answer questions. At another station, students read an article related to the topic and answered analysis questions. At another station, the students did a hands-on experiment. At a fourth station, the students used model kits to determine the three-dimensional structure of certain molecules. At another station, the students worked together to solve practice chemistry problems. At the final station, students played a game on their iPad in which they matched items and competed to do so in the best time. Students were required to fill in and turn in their work digitally, but students who preferred to write using a pen or pencil could do so but had to take a picture of their work to submit digitally. Mrs. White facilitated by walking around the room and assisting student groups when necessary. After a certain amount of time at each station, she called for the students to rotate to the next station so that they could complete all of the activities. Students were observed to be highly engaged in this lesson, especially at the stations with the hands-on experiment, model kit, and matching game.

Mrs. White did not always use the iPads in her lessons, however. In another observation, Mrs. White had her students completing practice problems balancing chemical equations. This was done completely with paper-and-pencil. Students did work collaboratively in groups and Mrs. White monitored and aided when needed. She also had an answer key at the front of the room in which students could check their work and then ask for assistance if needed. This was followed by a paper-and-pencil quiz. While the iPads were not used in this lesson, the students were engaged in the lesson and were diligent in working through the practice problems and asking for help before the quiz.

In another lesson, Mrs. White had students use the iPads to prepare their lab write-ups for a laboratory experiment identifying chemical properties of mystery solutions that they would be conducting the next day. At the beginning of the lesson, Mrs. White lectured about how to properly format the lab write up. Students were passively listening to this. Once her lecture was complete, students were given 10 minutes in the lab with examples of the possible equipment they could use and tests they could perform to identify the liquids. The students were tasked with finalizing their own procedure for the next day (it was apparent that the students had been given time previously to work on this). This part was done without the iPads. After 10 minutes, she brought the students back to the classroom and had them use their iPads to pre-format their lab write-ups and to write their procedures. All of the students were engaged in their work, except for three students who did not have an iPad. These students observed their lab partner typing.

Based on her instructional design, Mrs. White could also be considered to be cognitivist (Ertmer & Newby, 1993). Mrs. White provided her students with many

opportunities practice their skills with feedback, and she had very much structured and organized the learning experiences for how she felt her students would optimally learn.

Interview data. When asked if her students were engaged in her lessons, Mrs. White also responded that she thought that they were. When further asked if her students enjoyed her lessons, she responded that she thought so. She said, "I think that moving into the lab and requiring them to create the design of their lab, and it helped that they were working in smaller groups, and scaffolding helped" (personal communication, October 24, 2016). When reflecting on her lesson requiring students to design their laboratory experiment, she said "I think they were interested in parts [of the lesson], but I don't know that they were excited. I don't know that they enjoyed the chemistry" (personal communication, September 15, 2016). When asked if she thought her students thought that the learning was important, she said, "I think so. I don't know if they thought it was important just for the grade or if they think it will help them in life" (Personal Communication, October 24, 2016). Like Mrs. Blue, when asked if she thought her students believed that they could be successful at what she was asking them to learn, she quickly responded "Yes." Asked about the success of using the iPads in general, she responded mostly positively, but did comment, "Some of the kids do not like submitting stuff on Schoology, they want a paper copy" (Personal Communication, October 24, 2016). When asked what additional support she would like, she mentioned that she would like more consistency with the apps that the students use in classrooms. She mentioned the Notability app specifically. She said,

> We're all doing something different. Some of them [students] have notability
> because it was put on their iPad, but some don't. I don't know exactly what apps

they're putting in, or how to edit certain things; they [the students] seem to adapt

pretty quickly, but that would maybe be something that could be more smooth.

(Personal communication, October 24, 2016)

Commenting on the difference in engagement between the Young men and young women

using the iPads, Mrs. White said, "Young men struggle a lot with the secretarial portion

of a lab report. Young women do better with that" (personal communication, September

15, 2016). In her second interview, however, she said that the engagement of young men

and women was mostly the same (personal communication, October 24, 2016). This

reveals an unconscious bias in Mrs. White toward "traditional" gender roles and a binary

view of gender. Keller (1995) states "The most immediate issue for a feminist perspective

on the natural sciences is the deeply rooted popular myth that casts objectivity, reason,

and mind as male, and subjectivity, feeling, and nature as female" (p. 6-7). This is

generally surprising coming from a female science teacher, as it highlights an

unconscious bias against the young women in her class and toward the Young Men.

Although she has the best of intentions regarding the needs and education of her students,

this bias may in fact be reinforcing outdated gender stereotypes and a culture in science

that fails to value female contributions. Keller continues:

The consequence of such a division is not simply the exclusion of women from

the practice of science. That exclusion itself is a symptom of a wider and deeper

rift between feminine and masculine, subjective and objective, indeed between

love and power – a rending of the human fabric that affects all of us, as women

and men, as members of society, and even as scientists. (p. 7)

This indicates a need for some form of education on gender biases in order to help Mrs. White develop as a teacher.

Mrs. Purple

      Demographics. Mrs. Purple is in her early-thirties and has nearly 10 years of teaching experience. Mrs. Purple came into teaching through the South Carolina Program of Alternative Certification for Educators (PACE). The wife of a deployed Army soldier, she graduated with a Bachelors in Biology, intending to go to medical school. Upon returning to her home state of South Carolina from North Carolina when her husband was deployed to Afghanistan a third time, she heard about the PACE program and decided to try her hand a teaching. She was hired at Ruraltown High School to teach Chemistry 1 and Physical Science. She has since become a valued member of the faculty and has taken on the added responsibilities of teaching the AP Environmental Science and Anatomy and Physiology courses. Mrs. Purple is a self-described devout Christian and has two young men in whom she has discovered and nurtured a love of science. Another kind and caring teacher, she is well liked and respected by most of her students. As one of the younger members of the Science Department, she is more adept at using technology than some of her more experienced science teacher peers. She is also always seeking out new and engaging teaching strategies in order to help her students learn. One of the hardest working teachers, she spends a minimum of an hour after school each day preparing for the next and continues to find ways to tune her teaching methods to meet the needs of her twenty-first century RHS students.

      Observational data. Mrs. Purple was observed engaging her students by having them use the iPads to create products related to the concepts in her class. In a lesson that

was part of a unit on the physiology of the brain, she had students using the devices to plan and film their own anti-drug public service announcements (PSAs). The students were in groups and each group was assigned a different drug. Students had previously learned the structure of neurons, how an action potential works, and about synapses in the brain and how drugs affect those synapses. They had also previously researched real-life testimonials of people who had abused their assigned drug. Mrs. Purple began by showing the class some examples of anti-drug PSAs from the past on YouTube. She then led a class discussion about the effectiveness of these PSAs on informing the public (especially teenagers) about the drug and its dangers, as well as its effectiveness in convincing teens not to use that drug. After this class discussion, she emphasized that the students' PSA videos had to not only convince their peers not to use the drug they were assigned, but also had to inform them of how it affects their bodies and the synapses in their brain. The student groups went to work on their PSAs. Some groups went right to filming video on their iPads. Some groups began by planning what they wanted to film and writing a script. Others began by looking for images on the Internet that they could include in their videos. All groups were engaged in the lesson and were collaborating to create their videos.

In another lesson on movements and muscles, Mrs. Purple had her students complete an activity that had them demonstrating and taking pictures of various body movements, including complex poses involving multiple movements at once. She began the lesson by first reviewing each of the movements with the class. She called out each movement and the class responded with a demonstration of that movement. She also related these movements to the muscles that caused them and showed the students where

in the textbook to look up the movements and find the muscle that causes them. The students then worked in groups to fill in a digital document on their iPads with pictures of the identified movements as well as identification of the muscles that caused these movements. Students were engaged, taking pictures of each other with the iPads, correcting each other's movements, and inserting these pictures into the digital file.

Her instructional design indicated that Mrs. Purple is a cognitivist as well (Ertmer & Newby, 1993). She structured and organized her lessons in order to optimize learning and emphasized the active involvement of her students. She also developed activities that required her students to apply their knowledge in different ways.

Interview data. Mrs. Purple also responded that she thought her students were engaged in her lessons using the iPads. She also noted, "I have a few that were goofing off, a few that are doing a great job, and most of them are in the middle" (personal communication, September 26, 2017). Regarding her anti-drug PSA project, she commented that her students were excited to do the project. Elaborating, she said,

> The topic is engaging, they are naturally interested in that [effects of drugs]. I
> think that getting to do something that is not sitting at their desk listening to me,
> something that is student-driven and focused increases their motivation. (Personal
> communication, September 26, 2016)

When broken down by the Marzano Model (2011) of engagement, she responded positively to each component question as well. Asked whether her students thought that what they were learning was important, she responded "I think they really understand the importance of the anti-drug PSAs" (personal communication, September 26, 2016). As

with Mrs. Blue and Mrs. White, when asked if she thought her students believed that they could be successful at what she was asking them to learn, she responded "Yes, but some of them required a little more encouragement and hand-holding than others" (Personal communication, September 26, 2016). Regarding her use of the iPads in class, she said that her students used them for the specific assignments that she gave that required creating video or taking pictures. They also used them for doing research, viewing videos, and catching up if they were absent. Regarding the success of using the iPads, she said, "It holds them [students] accountable and it provides them a place where they can synthesize what they are learning" (personal communication, October 24, 2016). When asked what support for the iPads she would like in the future, she responded that she would like more suggestions for free apps and suggestions for ways to use the iPads more frequently and effectively for non-project based learning. She would also like more time to try and implement new teaching methods using the iPads as well. Mrs. Purple concurred that Young Women are more engaged with the iPads in her lessons as well. Referring to the anti-drug PSA assignment, she said "Young Women are more engaged with the iPad for this project." In her second interview, however, she did say that she thought there was little difference between the engagement of the Young Men and Young Women.

Mr. Green

Demographics. Mr. Green is a new teacher in his late-twenties with less than 5 years of experience. He recently graduated from a private SC college with a Master's degree in teaching science. Having attended private school in South Carolina for his entire academic life, he had not previously experienced public schooling before being

hired at RHS. Despite this, he has proven himself an excellent teacher. He currently teaches Physical Science, Physics 1, and Biology 1. Mr. Green was involved in sports growing up, so he has taken on the additional responsibility of coaching. He currently is an Assistant Varsity Football Coach, and Head Junior Varsity Basketball Coach. Referred to by his students as "Coach Green," he is well liked and respected. He is often stricter in his classroom than most of the other science teachers but he still manages to maintain a good rapport with the students, especially the student athletes. Being the youngest teacher in the department, he is also one of the most technologically adept. He is also willing to try new teaching strategies that help his students engage with the lesson more effectively.

Observational data. Mr. Green was observed engaging his students using the iPads as well. In one lesson, he attempted to engage students by incorporating the iPads into a laboratory activity about the properties of matter. The students were tasked with separating out the components of a mixture of different solids (pebbles, corn, salt, sand, iron filings) using their different properties. Mr. Green paired up students in groups of two and made sure that each group had at least one iPad. Then, students were told the components of the mixture and that their task was to separate them using their different properties. Mr. Green led students through creating a procedure to follow, which students had to document and turn in digitally on the iPad. Students could type the procedure or write it on paper and take a picture to submit. While the students were working on their procedures, Mr. Green walked around the room from group to group, assisting when needed. The students were also asking questions if they needed help. Once they had the procedure, Mr. Green took the students to the lab to conduct their experiment. The students had to fill out an electronic document with their results, and they had to insert

pictures or video of themselves carrying out each step of their procedure separating the mixture. Students were engaged in this process and, except for one group, working diligently on the activity. One group of Young Men was less engaged, and Mr. Green spent most of his time keeping them on task, though he did help other groups when they needed it.

In another lesson on the Periodic Table of Elements, Mr. Green had his students working on practice problems from a digital document on the iPad. The problems required students to interpret information about specific elements from the Periodic Table. Students once again could complete the problems electronically or on paper, but they still had to be turned in electronically at the end of the lesson. Students also had access to a Periodic Table through an interactive iPad app or via a paper copy. The teacher circulated around the room, assisting students as they completed the problems. Students who needed help raised their hands for assistance or asked each other for help. Students without iPads worked with a partner who had a device. Throughout the lesson, students remained engaged and on task working through the problems.

In another lesson, Mr. Green used a Power Point presentation at the front of the room to deliver content in a lecture as students filled in guided notes. He did not allow the iPads to be used at this point, since the guided notes were paper-and-pencil. While the students were on task, they seemed bored and less engaged. The lecture/Power Point presentation went on for 25 minutes, after which the students asked if they could review for the next day's test using Kahoot. Kahoot is a website available for free to educators that allows them to create interactive trivia-type contests. Students use their own devices to join the game and answer the questions, earning points based on how quickly they

answer. In this way, teachers can turn the review or learning process into a game. Mr. Green agreed, and had students take out their iPads while he loaded a Kahoot trivia game related to the content. The students immediately became excited and were thoroughly engaged in the competition.

His instructional design indicated that Mr. Green is also a cognitivist (Ertmer & Newby, 1993). He provided his students with organized and structured lessons and provided opportunities to apply their knowledge in diverse ways. He also mostly emphasized the active involvement of his students in the lessons.

Interview data. When asked if he thought his students were engaged in lessons using the iPads, Mr. Green responded that it depended on what they were doing. He noted that his students were more engaged when they were doing semi-independent or group work or when they were doing self-guided notes. Regarding his students' enjoyment of the lessons, he responded,

> I think at times they did. In my Physical Science classes they got a little
> uninterested because we kept doing the same thing a lot to reinforce it with
> chemical formulas, but with those it's really the only way to get it down.
> (Personal communication, October 24, 2016)

He also responded that when they did laboratory activities, they became more interested and got into using their iPads to video their results. When asked whether he thought his students thought what they were learning was important, he said, "When I made connections between the content and some real-life things going on for them, then yes, but in general they gave the response, 'Why am I going have to know this?'" (Personal

communication, October 24, 2016). When asked if he thought that his students believed that they could be successful at what he was asking them to learn, he was the only teacher to not respond with a quick "Yes." He said,

> With that material [chemical reactions], I think some of them got to the point where they thought they could be successful. Some others still were like "I will never be able to do this," and went down that road. Some of the kids in my class are like, "I'm not good at science," or "I've never been good at science," so I don't know how much they were going to try. (Personal communication, October 24, 2016)

When asked if he thought using the iPads was successful, he responded,

> Yes, when they [students] were able to go off on their own and do some things, they are more engaged. Also, it makes it easier to keep track of and share things because it's one less thing to come up with or keep track of because it's electronic and it's just there. It's just a matter of if they have it and if they bring it and it's charged. (Personal communication, October 24, 2016)

Regarding additional support he would like to have to use the iPads more effectively, he said he would like a system where each student actually had an iPad, it would make things easier. He said, "It's very tough to do independent work on them [iPads] when kids don't have them or bring them" (personal communication, October 24, 2016). When asked if he thought there was a difference between the engagement young men and young women using iPads in his science classes, he said

Class to class it varies. In Biology, the young men are more engaged because the

mixture of young women in there are all friends and they distract each other. In

Physical Science, the young women are more engaged and achieving higher than

the young men. (Personal communication, October 24, 2016)

Mr. Red

Demographics. Mr. Red is in his early 60s and has almost 30 years total teaching

experience, most of which has been at RHS. Mr. Red is a native South Carolinian and

started his career in the U.S. Marine Corps. He joined the Marines right out of high

school, and attended college after getting out. When he attended college, he was older

and more mature than his classmates, which made his college experience atypical.

Initially planning to go into forestry, he switched his major to Earth Science and

graduated with a Bachelor's degree. He then went in to teaching and has spent his career

since educating students from mostly low-socioeconomic status communities, including

Ruraltown. Mr. Red is a self-described devout Catholic and very politically conservative.

He met his wife while she was a School Psychologist at RHS and they have two children.

His daughter is attending college in the Low Country of SC, and his son is current Senior

at RHS. Mr. Red is active in the Church and as a Boy Scout leader in his son's troop. He

also spends many of his summers as head of the local Boy Scout Summer Camp. Being a

former member of the US Marine Corps, Mr. Red tends to be the most strict of all the

science teachers who participated in the present study. He is one of the only Earth

Science teachers in RHS's district. He also teaches a freshman level, "Environmental

Studies" course designed for the students whose math abilities make them unprepared for

"Physical Science" and a "Biology" course for the students in the non-diploma seeking

"Occupational Credential Program" (OCP). In the past, Mr. Red has also taught the "Physical Science" course and the "Physics" course. He often integrates personal stories of his experiences as a Marine into his lesson plans. Mr. Red has strong beliefs about teaching students in poverty and truly does care about his students and their success. However, those beliefs often come into conflict with research-based best practices. He is willing to try new teaching strategies, but if they do not work right away he often reverts to "traditional" teaching methods (e.g., lecture, note-taking, worksheets, testing). While he has spent his entire career teaching students in high-poverty communities and is a strong fighter for his students' success, he does expect his students to conform to his male, white, middle-class, heteronormative behavioral standards.

Observational data. Mr. Red was the only teacher who was not observed using the iPads successfully to engage the students in science. In the first observed lesson, he spent the entire time lecturing to the students about the phases of the moon and eclipses. Most of the students were compliant and taking notes, but there were many who were off task and not paying attention. Some were on their phones, some were playing games on their iPads, and some were doing work for other classes. Some students were taking pictures of the Power Point slides on their iPads as Mr. Red lectured, but did little beyond that.

In another lesson on earthquakes, Mr. Red once again chose lecture as his primary instructional method. He began by reviewing the prior day's lesson, asking questions to the class as a whole. Most of the students responded to the teacher's questions, but many were not paying attention. Mr. Red then passed out a laboratory activity sheet that the students were to complete about triangulating the epicenters of earthquakes. The teacher

then spent the next 20 minutes lecturing to students about how to do the calculations on the lab sheet. Half of the students were not paying attention and were doing other things. Some were on their phones again and some were playing games on their iPads. During his instructions, Mr. Red instructed students that once they complete their calculations, they need to use their iPads to create a video explaining what they had done to get their answer. Once he released the students to do the activity, about half of them got right to work while the other half did not know what to do. Mr. Red had to go back and explain to each of those student groups what to do for the activity again. Once they understood what to do, the students were on task.

In another lesson on plate tectonics and volcanoes, the teacher used Google Earth projected on the front screen, once again using lecture as the primary instructional method. This lecture went on for 30 minutes, and as it went on fewer and fewer students were paying attention. Several students were once again on their phones or playing games on their iPads. Mr. Red also had technical difficulties finding a specific place he was looking for on Google Earth, during which time more students disengaged and stopped paying attention.

Mr. Red is a behaviorist (Ertmer & Newby, 1993). His lessons mostly involved the passive acquisition of knowledge from the teacher. The laboratory activity that he had students complete only asked them to follow some steps to get to a correct answer. There was no consideration for critical thought. He was simply looking for memorization of facts and that he could observe students completing the assigned task correctly. This could be a reflection of his military background, where observable changes in behavior are the sole desired outcome.

Interview data. Mr. Red also thought that his students were engaged in his science lessons. Asked if he thought his students enjoyed his lessons, he responded "Yes." With regard to whether his students were interested in the content of his lessons, he again responded, "Not at first. Once they made connections they were. Especially the lunar phases. They came in the next day talking about the phase from the night before" (personal communication, September 16, 2016). When asked if he thought his students thought what they were learning was important, he said, "Yes, later. They come back with 'they used that term on the news today!' They don't realize the importance until later" (personal communication, October 21, 2016). Asked what his students use the iPads for in his classroom, he responded that they do research and look for information with them, use them to take notes, write in documents and share it back to the teachers, and take pictures or find pictures on the web to insert into documents and send back to the teacher. When asked if he thought using the iPads was successful, he said, "For the bulk of kids, yes. The results I get are real laissez faire about turning it in if it's not a summative grade" (personal communication, October 21, 2016). In one interview, when asked if there were differences between the engagement of young men and young women, Mr. Red quickly said "no," but then when he elaborated he said, "If I were to guess who would be more engaged (in geology), I'd say young men. But nine-out-of-ten it's young women who are more engaged." He continued, "I think this is a cultural thing. Guys don't see male teachers as similar to themselves. They look at coaches more so. Guys don't identify with teachers because they don't have these kinds of figures at home."

Interpretation of Results of the Study

After a preliminary observation in three classroom sessions of each of the five teachers in various science courses at RHS, the participant-researcher met with the teacher-participants in one 45 minute semi-structured interview with each participant and in a collaborative in-service session that lasted five hours. In the in-service, we reflected and analyzed the observational and interview data using a data analysis coding and analysis technique delineated by Mertler (2014). We determined that six major themes emerged including: Theme One—Teachers' Perceptions of Student Engagement with iPads; Theme Two—Science Teacher Perceptions of iPads; Theme Three—Science Teacher Preparation with iPads; Theme Four—iPad Use in the Science Classroom; Theme Five – Teacher bias in Science; and Theme Six—Challenges to Using iPads in the Science Classroom. We used these six themes to determine the action steps for the Action Plan detailed in Chapter Five of this dissertation.

Theme One: Teacher Perceptions of Student Engagement with iPads

Based on the interview data, teacher-participants' initial perceptions of student engagement were not always accurate. When asked directly if they thought their students were engaged, all five teacher-participants initially said "yes" or "mostly." When the participant-researcher probed deeper with further questions, the teacher-participants' answers became more complex.

Marzano's model of engagement. The Marzano Model (2011) breaks down student engagement into four parts:

1. students' emotions toward learning;

2. students' interest in the learning;

3. students' perceptions of the importance of the learning; and

4. students' perceptions of the efficacy of the learning.

Student's emotions toward learning. When asked questions about their students' engagement using the iPads broken down per Marzano's four-part model, the teacher-participants answers became more ambivalent. When asked if they thought their students enjoyed their lessons, for example, Mrs. Blue responded that some did while some did not. Mrs. White said "I think they were interested in parts (of the lesson), but I don't know that they were excited." Mrs. Purple and Mr. Red responded that they thought their students did enjoy their lessons, and Mr. Green said that his students mostly enjoyed his lessons. This is a key component of student engagement because when students have positive emotions toward a lesson and enjoy it, then they are more willing to focus their mental energy toward the learning.

Students' interest in the learning. When asked if the students were interested in the content of the lessons, Mrs. Blue responded again that some are and some are not. Mrs. White, Mrs. Purple, and Mr. Green responded that their students were interested when they were using the iPads for self-directed, collaborative, or hands-on work. Mr. Red said that his students became interested once they made connections to the real-world, meaning the students' world outside of the classroom.

Students' perceptions of the importance of the learning. When asked if she thought her students thought that the learning was important, Mrs. Blue said again that some yes, and some no. She reported that some students say every day "I hate this, I don't see any reason for doing this." Mr. Green echoed this, saying that some of his

students often asked him "Why am I going to have to know this?" Mrs. White said, "I think so. I don't know if they thought it was important just for the grade or if they think it will help them in life." Mrs. Purple responded with a "Yes," Mr. Red responded with a "Yes," but after the students were able to make connections between what they were learning and the real-world.

Students' perceptions of the efficacy of the learning. When asked if their students thought that they could be successful at what they were being asked to learn, Mrs. Blue, Mrs. White, Mrs. Purple, and Mr. Red all responded with a resounding "Yes," meaning that they all thought that their students perceived they could accomplish what the teachers were asking them to do. Mr. Green was the only one who was more ambivalent, responding specifically regarding the topic of chemical reactions, he said that some of his students did think they could be successful but some did not. He brought this back to the student response that they did not like science and were never good at it.

While all five teacher-participants initially responded "Yes" when asked if they thought their students were engaged in their lessons using the iPads, their answers became more complex when the questions were broken down using Marzano Model (2011). This was especially true regarding these teacher-participants' perceptions of their students' perceptions of the importance of the learning in their individual science classes. Only Mrs. Purple responded to this question with an unequivocal "Yes." This could possibly indicate that the teacher-participants need more help in coming up with ways to help students understand why learning science is important. Conversely, the teacher-participants' overwhelming "Yes" response to if they think that their students perceive that they can be successful in their class indicates that the teacher-participants are skilled

at making the learning accessible to all of their students. These issues could be addressed by providing teachers with additional professional development regarding constructivist learning theory and pedagogy.

According to Applefield, Huber, and Moallem (2000), teachers' personal theories of learning have a large influence on their instructional decisions. Constructivism, in which the learner is responsible for building and transforming knowledge, is the theory of learning that has been embraced by those involved in educational technology. Greater understanding of the theory and its pedagogical implications (e.g. project-based learning) can help the teacher-participants to more fully engage their students using the iPads.

Theme Two: iPad Potential

Theme Two was identified from the data since the teacher-participants believed that the iPads are capable of enhancing student engagement and that they have received sufficient professional development to use the iPads in their science classrooms. Evidence of this is apparent in how these teacher-participants used effective strategies to engage their students in science using the iPads. In fact, much of what the teacher-participants did in the classroom using the iPads was successful in engaging students in science according to the Marzano Model (2011). For example, in Mrs. Purple's class, she used project-based learning incorporating the iPads to engage her students. Reflecting on her anti-drug PSA lesson, she said, "The topic is engaging; they are naturally interested in that. I think getting to do something that is not sitting at a desk and listening to me, getting to do something that is student driven and focused increases their motivation." Mr. Green echoed this, saying that his students enjoyed being able to video and photograph themselves for the laboratory lesson. Mr. Red also wanted to use the iPads

more in a similar way. He said, "When we were using flubber, two groups were really engaged filming what was happening. I'd like to make that part of the assignment in the spring; film it and share it to me with a voice over commentary about what is happening." Mrs. Blue said that her students enjoyed working in groups and having the videos available for them to use right on the iPad. Mrs. White said that her students were highly engaged when they used the iPads at the different lab stations. She did note, however, "Some kids do not like submitting on Schoology. They want a paper copy." While Mr. Red did see the potential of using the iPads to increase student engagement, he was the only one not observed making use of the devices in an effective way. In his interviews, he did say that some students used the iPads to take notes, but this was observed rarely by the participant-researcher. Once again, professional development regarding constructivist learning theory and pedagogy could greatly help the teacher-participants to better fulfill the potential of the iPads as science learning tools.

Theme Three: Teacher Preparation in Science

Each of the teacher-participants felt that they had enough preparation to use the iPads in their classroom, but most did have some ideas for ways that they could learn more to improve their use. Mrs. Purple said that she would like additional support using the iPads "when we are not doing a project based learning experiment." For example, she had heard of a way to make videos more engaging by embedding questions into them that students had to answer before they could move on and would like some professional development on how to use that in her classroom. Mrs. White wanted to learn about some specific apps that might be used in her classroom. She had some apps that she already used, but wanted to be able to find more, especially that were more "user-friendly." Mrs.

Blue wanted to learn some new techniques for using the iPads in her classroom. Mr. Red was the most vocal about this topic, saying that he already knew how to use the device, that it was the students who really needed the training to use the devices for learning rather than gaming. He said:

> We assume they know how to use the iPads, but they don't. Too much is gaming. They understand the iPads as a gaming device but not as a research tool or collaboration device. The one adept at using technology have no problems, but the majority don't know how to, for example, insert pictures into documents or use email. We're working with a false assumption that all our students are tech savvy.

Mr. Red was the only teacher who did not have any ideas for ways he could improve his use of the iPads.

The major issue here is that while the teachers, especially Mr. Red, feel like they have had enough professional development regarding the iPads, it is clear that they can benefit from further education. Recalling how Prensky (2001a) divides contemporary students and teachers into 'digital natives,' who have grown up with information technology at their fingertips for their entire lives, and digital immigrants who have had to grow into the technology age, the teacher participants need to better understand how their 'digital native' students learn and think differently than they did.

Rosenfeld and Martinez-Pons (2005) found that providing teachers with proper education on theory and practice in using classroom technology increases those teachers' use of that technology in their classrooms. This emphasizes the importance of providing education for the teacher-participants in constructivist theory as well as pedagogy.

Ritzhaupt, Dawson, and Cavanaugh (2012) found that a teacher's experience and education in teaching with technology directly influenced the use of technology in his or her classroom, once again reinforcing the idea that professional development targeted to the needs of the teacher participants is necessary to increase their use of the iPads in their classrooms. This indicates that while the teacher-participants may feel that they have had enough professional development on using the iPads in their classrooms, more education can only enhance their abilities and use of the devices.

Theme Four: iPad Use in the Science Classroom

The final theme related to teacher perceptions and use of the iPads is that all of the teacher-participants were extremely open to using the iPads in their classrooms, however the teachers with more than 15 years experience tended to use the iPads less than the less experienced teachers. Once again, this corroborates previous research by Ritzhaupt, Dawson, and Cavanaugh (2012), Rosenfeld and Martinez-Pons (2005), and Vannatta and Fordham (2004) that teacher attitudes, experience, and education regarding technology all influence their use in the classroom. There was one exception to this, Mrs. Blue, who was observed using the iPads the most frequently in her classes. The major reason for this discrepancy is that Mrs. Blue only teaches "Biology" courses which has required her to implement new State standards over the 2016-2017 school year. As such, the curriculum was completely rewritten with curriculum materials that integrated iPads into the units pre-packaged. Mrs. Blue, therefore was able to use the iPad devices on a more consistent basis in all her classes. It is important to note, however, that the increased use of the iPads by the less experienced teachers did not necessarily increase the observed student engagement. In fact, engagement was observed by the participant-researcher to be

the most consistent in Mrs. White's classroom, surprisingly even on days where iPads were not used at all. Once again, providing professional development targeted to the needs and interests of the teacher participants can help to increase their use of the iPads in their classrooms.

Theme Five: Teacher Bias in Science

When asked whether or not there were differences between the engagement of young women and men in their science classes, Mrs. Blue, Mrs. Purple, and Mr. Red all initially responded that they were basically the same in terms of engagement. Mrs. White and Mr. Green were the only ones to say that there was a difference, but Mr. Green qualified his response by saying that it depended on the class and that he had one class where the women were more engaged and another where the men were more engaged. Mrs. White said that the women in her class were more engaged with the "secretarial tasks" like typing a report than the men. During the in-service while the teacher-participants and participant researcher were reflecting on the data, the teacher-participants' opinions began to change as more and more differences between the engagement of men and women in these five teachers' classrooms began to become apparent. Table 4.1 shows the patterns that emerged in the teacher-participants' perceptions of differences between male and female identifying students during the inductive analysis of the observational data and reflection of the teacher-participants and participant researcher.

Table 4.1

Patterns of Teachers' Perceptions of Engagement in Young Men v. Young Women

Young Men	Young Women
Young Men were in general more distractible than Young Women.	Young Women tended to have higher engagement than Young Men
Young Men tended to switch between on and off task behaviors (e.g. a game) more frequently than Young Women.	Young Women would also switch between on and off task behaviors (e.g. a text message), but less frequently.
Young Men were more likely to wait for the teacher to notice they needed help than to ask for help directly than Young Women.	Young Women were more likely to ask the teacher for help than Young Men.
Young Men disengaged from lecture more quickly than Young Women.	Young Women tended to maintain focus longer than Young Men.
Young Men were more engaged with competitive activities than Young Women.	Young Women were more engaged at tasks involving typing than Young Men.
Young Men without an iPad were more likely to let their partner do all the work than Young Women.	Groups with at least one girl in them tended to stay more engaged.
Young Men were more likely to play games or watch videos when they disengaged.	Young Women were more likely to send text messages or photos when they disengaged.
Black Young Men tended to disengage more quickly than black Young Women.	Hispanic Young Women tended to disengage more quickly than Hispanic Young Men.
Young Men tended to want to work in groups more than Young Women.	Young Women tended to want to work alone versus in a group more often than Young Men.
Young Men tended to be slower to begin working and transition between tasks than Young Women.	Young Women were quicker to begin working and transition between activities than Young Men.

The teacher interview data also reveals a bias toward traditional gender roles. This is especially apparent in Mr. Red and Mrs. White's responses. Mrs. White's reference to typing the lab report as "secretarial work" indicates a traditional female gendered-bias to tasks such as assisting males with note-taking. Furthermore, Mr. Red was quoted as saying that one of the reasons he thinks that the young men in his class are less engaged than the young women is that young men from low socioeconomic class status (SES) homes do not perceive male teachers to be like themselves because they do not have those kinds of male figures who teach professionally in their lives. This revealed patriarchal, heteronormative, sexist, and classist assumptions on Mr. Red's part that the young men in his classes were coming from homes defined by traditional gender roles and also blue-collar professions. He assumes that they do not encounter male figures who engage in intellectual pursuits. Mrs. Purple concurred that young women are more engaged with the iPads in her lessons as well. Referring to the anti-drug PSA assignment, after initially saying that she did not see any difference in the engagement of young men vs. young women, she said "Young women are more engaged with the iPad for this project. Mrs. Blue had a different view. When asked if there were differences between the engagement of young men and young women, her response was, "it depends on the student." Mr. Green also demonstrated a more situational attitude toward the difference in engagement between young men and women, saying, "Class to class it varies. In one class, young men are more engaged because of the mixture of young women. In another class, young women achieve higher." He elaborated that by "mixture of young women" in his one class, he meant that there was a large group of friends who tended to distract each other and not participate in class. These results indicate a need for more professional

development for the teacher-participants in the area of gender diversity. Some of the opinions held by the teacher-participants, especially that of Mrs. White and Mr. Red, indicate an over reliance on gendered stereotypes associated with the public and private spheres. More education about the effects of gendered stereotyping of young women in STEM will help change the opinions of the teachers and administrators at RHS.

Theme Six: Challenges to Using iPads in Science

When reflecting on the challenges that prevented them from using iPads more often or for using some of the strategies that proved effective in other classrooms, the teacher-participants agreed that their greatest obstacles were student apathy toward learning and the number of students who did not bring their iPad with them to class on a daily basis. The student are labeled as low SES (the poverty index for this southern, rural school based on free or reduced meal status is 77%), and the teacher-participants perceive this to be the reason that many students do not show interest in learning or doing well in school thus ,making it extremely difficult to engage them in science courses and careers.

The teacher participants also thought that this apathy manifested itself in the students refusing to bring their iPads to school on a daily basis, not charging their devices, or even lying to their teachers about not having a device. Students not having an iPad is probably the single greatest obstacle that the teacher-participants identified to using the devices daily in their classrooms. Per Mr. Green, "I wish there was a system where each kid really had an iPad [at school]. It would make things easier. It's very tough to do independent work on them when the kids either don't have them or don't bring them to class."

In addition, Mr. Red was very vocal about the students not being able to use the iPads as learning tools. He argued that RHS was operating under the false assumption that all of its students are proficient at using iPads while in truth the RHS students were able to use the iPads to play games and search the internet, but they often lacked the skills necessary for more intensive learning and creation tasks associated with science. While some of the other teachers did identify gaps in what some students knew about using the iPads, they did not identify this as an overall trend until Mr. Red brought it up as they were reflecting with the participant-researcher on the collected data. Mr. Red asserted that the students are proficient at playing games on the iPad and can take an image such as a photograph or chart, but many (if not most) of his students do not know how to insert an image into a word document such as a presentation such as Apple's Prezi software in order to submit their work on a project-based science unit online. Upon his insistence, the other teacher-participants were convinced and agreed that this was a problem.

Finally, another major challenge that the teacher-participants felt prevented them from using the iPads in their classrooms more was time. According to Mrs. Purple, limits on her time are the major reason that she has for not using the iPads more. Mrs. White felt similarly, that while she would like to have more computer applications (also known as 'apps') that the students can use in her class, she simply does not have the time [nor wish] to go through the 'App Store' at Apple and test them to find the best ones to meet her needs. Mrs. Blue said that she is able to use the iPads on a daily basis mostly because she was 'given' the pre-packaged "Biology" curriculum by the State that included iPad units of study, so she does not have to worry about creating most of her lessons or guided

notes and can focus her planning time on finding activities and videos to supplement what was supplied to her.

Conclusion

Four out of the five teacher participants were observed using the iPad devices to successfully engage the RHS students and enhance their science lessons. However, the data also shows that teachers' perceptions of student engagement may be incomplete according to the Marzano Model (2011). When broken down into the four parts of the Model, the teacher participants agreed that most of their students enjoyed using the iPads and thought that they could accomplish what the teacher was asking them to do. However, the teacher-participants were much less sure if their students were interested in their lessons, and were much less positive that their students thought that what they were learning was important. This demonstrates a gap in student engagement that needs to be addressed in the classroom. This could be addressed through additional professional development regarding constructivist learning theory and pedagogy, as well as additional time and assistance for teachers to find, implement, and share better quality computer applications (or 'apps') for the Apple iPads.

Some of the more troubling findings of the study included the teacher-participants hidden attitudes toward their students, especially Mr. Red. All of the teacher-participants felt that the students in their classroom held a particular apathy toward learning and school in general. They often blamed this apathy on why certain students or classes were not engaged or not doing well in their science classes. While apathy may be present in their classrooms, it is the responsibility of educators to help students increase their scholarly activity. This may come back to the students perceiving what they learn to be

important and making personal connections to the learning. If students believe that what they are learning is important and relevant to their own lives then they are more likely to be more engaged or at least willing to engage (Dewey, 1897).

Mr. Red's assertion that his students were the ones who needed to learn to use the iPads better (not him) shows his lack of understanding as an instructional leader according to Dewey's notion of the head learner (1897). This was reflected in the observed lack of use of the iPads (though he insisted that his students did use the devices to take notes), as well as his reliance on lecture, an instructional strategy that research says is the least engaging. Fortunately, however, he did show willingness to try new things based on what the other teacher-participants found to be successful in their own classrooms after reflecting on the data with the participant-researcher.

Most of these issues can be addressed by the teacher-participants' ability to fully engage the students in science courses and STEM careers. The teacher-participants were, for the most part, very good at engaging the students in the "what" of learning science and the "why" in terms of the courses' content. They were also good at encouraging their students to believe that they could accomplish more than they had ever imagined for themselves. However, getting students to understand the importance of post-secondary schooling and the connection to their lived world experiences was difficult. This is the number one area that the Action Plan will address in the Fall of 2017 for the teacher-participants and participant-researcher in order improve in their STEM practices for these rural, southern, low SES youth. This will be done by incorporating "real-world" connections to the material that the students are learning such as environmental sciences connected to the rural country-side, farms, mountains, and oceans of SC. In order to

enable these students understand that what they are learning is important to their home state, they must make a connection from the learning to their own lives and the lives of their people. This needs to be done in multiple ways and multiple times. For example, the teachers can consider the individual situations of their students when attempting to make those connections in science courses. The students' races, genders and cultures, among other factors, all influence how they perceive their worlds and how they can connect personally to their learnings.

In the Action Plan, these science teachers will reflect more on whether their students are truly engaged in science learning or simply compliant. Some students may not think that science learning is important to their personal lives, but may be compliant simply to, as Mrs. White says, "Jump through the hoop" to get a good grade. While grades can be a motivator for students, it would be remiss of any of these science teachers accept that as the only way to motivate a student. It is a missed opportunity for these students to truly appreciate the impact science courses or careers may have on their lives. In addition, even though the teacher-participants feel that they have had enough professional development, it is clear that some additional education regarding constructivist learning theory and pedagogy (Dewey, 1897; Tyler, 1949; Marzano, 2011), as well as professional development regarding more effective apps can only help the teacher-participants to improve their use of the devices to engage their students in learning science.

The identified problem of practice centered on the high school science teacher-participants' ability to effectively use the iPads to engage students in learning science. The research question asked, *what is the impact of one-to-one computing devices (iPads)*

on high school teacher perceptions of student engagement in science classrooms? The

present action research study revealed that the science teacher-participants have a

positive perception of the *potential* for iPads to be used to engage students in learning

science, but they also perceive numerous obstacles that are making it difficult for them to

use the devices to their full potential.

Chapter 5 of this dissertation contains a summary and discussion of this action

research, as well as an Action Plan based in the present study. The action plan presented

in Chapter 5 was developed with the collaboration of the teacher-participants and the

participant-researcher. This action plan details recommended steps that the RHS Science

Department and other faculty and staff will take to address the challenges identified with

the incorporation of iPads in order to engage students in science courses and careers. In

addition, Chapter 5 presents a reflection on the current action research study and makes

suggestions for improvement and recommendations for areas of future research.

CHAPTER 5

SUMMARY, CONCLUSIONS AND ACTION PLAN

Introduction

Chapter Five presents the summary of the conclusions of the present action research study, *High School Science Teachers' Perceptions of One-to-One Computing Devices on Student Engagement* and details an Action Plan designed by the participant researcher and the teacher-participants to address the challenges identified in the findings and data interpretation. This action research study was conducted with five science teacher-participants at Ruraltown High School (RHS) (pseudonym), a high-poverty, mostly white, rural high school in the midlands area of South Carolina. The identified problem of practice (PoP) for the present study focused on science teacher-participants' perceptions of using one-to-one computing devices, specifically Apple iPads, to engage students.

The primary purpose of the present action research study is to enable five high school science teachers to effectively engage students in learning science with iPads through teacher preparation while recognizing that these five teachers know best how to engage their students in their science classrooms but can only effectively implement and use new technologies like the iPads in their curriculum and pedagogy when they are prepared to do so. The secondary purpose is to determine the teachers' perceptions of the iPads in science classrooms so that other science teachers will more effectively be

prepared to implement iPads in order to engage these low SES, rural southern, high school students in science courses and STEM careers. A tertiary purpose is to close the race, class, and gender gap in science courses at RHS to enable poor people, young women, and people of color to pursue college degrees and therefore potentially higher paying jobs in the STEM fields. Because Apple iPads are considered by the school district to be the 'silver bullet' that enables the STEM teachers to increase their students' scholarly achievement and to provide access and equity to historically marginalized groups of students at RHS such as low SES, young women, and people of color, the PoP of the present action study school focused on five high school teacher-participants who received limited preparation to operate and integrate the one-to-one iPads in their science classrooms. Preliminary investigations by the participant-researcher identified a lack of consensus among these teachers about preparation to use the iPads in their classrooms. Therefore, the researcher planned an action research cycle of implementation of the iPads, data collection, and reflection of the data with the teacher-participants to determine the support these teacher-participants needed in order to incorporate these district issued iPads in their science classrooms more effectively to increase students' scholarly activity and engagement. The identified problem of practice centers on science teacher-participants who were required to use iPads in their classrooms but were ill prepared to use them to engage students and to make science relevant to their lived world experiences. This PoP led to the development of the Research Question: *What is the impact of one-to-one computing devices (iPads) on teacher perceptions of student engagement in science classrooms?* The purpose of the present study was to improve science teacher-participants' use of the iPads to engage low SES, rural, southern students

in their classrooms. Following the Summary of Results and Action Plan, there are Suggestions for Future Research. Finally, this Chapter ends with a Conclusion that summarizes the present action research study.

Summary of Results

Five high school science teacher-participants (Mrs. Blue, Mrs. White, Mrs. Purple, Mr. Green, and Mr. Red) represent a wide range of ages (late-twenties to early-sixties), experience (less than 5 years to 35+ years), and STEM subject areas including: Physical Science, Biology, Chemistry, Earth Science, Physics, and Anatomy. The participant-researcher led these five teacher-participants in a professional development in-service seminar using formats that enabled them to reflect on the ways that they used the school district issued Apple iPads in their science classrooms to engage the primarily low SES, rural, and mostly white southern student population. These teachers' suggestions for new ways to use the iPads in their classrooms were discussed after classroom observation in semi-structured interviews and in two teacher in-service seminars. Data collection lasted from September 12, 2016 to October 21, 2016. Following the data collection, the participant-researcher led the teacher-participants in another in-service seminar on October 26, 2016, where they collaboratively analyzed the data collected and conducted an inductive analysis of the data using the coding method delineated by Mertler (2014).

The Findings

The observational data showed that four out of the five science-teacher participants (Mrs. Blue, Mrs. White, Mrs. Purple, and Mr. Green) used the iPads in ways that engaged the students in science content. The data also indicated that each of these

teacher-participants held a constructionist philosophical view of learning and teaching. Mr. Red was the only teacher not observed using the iPads to engage his students in science content. The data indicated that Mr. Red held a behaviorist philosophical view on learning and teaching. Chapter Four contains a detailed description of these findings. The semi-structured interview data revealed six overarching themes in the science teacher-participants perceptions of the iPads. The themes include: Theme One: Teacher perceptions of student engagement with iPads; Theme Two: iPad potential for science; Theme three: Teacher preparation in science; Theme Four: iPad use in the science Classroom; Theme Five: Teacher bias in science; and Theme Six: Challenges using iPad in science.

Theme One revealed that the five science teacher-participants has mostly positive but incomplete perceptions of the effects of the one-to-one iPads on their students' engagement in learning science content. In addition, this theme revealed that the science teacher-participants were likely to draw conclusions about their students prematurely, including about their engagement using the iPads.

Theme Two revealed that the science teacher-participants believe that the iPads are capable of enhancing student engagement in learning science. Theme Three revealed that while the science teacher-participants felt that they had enough professional development regarding the use of the iPads in their classrooms, they still could use some additional education on a constructivist learning theory and pedagogy as well as specific computer applications (i.e., 'apps') that can better engage their students in learning science. Theme Four revealed a varied use of the iPads among the teachers of different age groups. The teachers with less than fifteen years of experience were more likely to

use the iPads more frequently than the teachers with more than fifteen years of experience. The exception to this was Mrs. Blue, but this was probably due to her having more time to find appropriate apps for Apple products, activities, and resources to use with the iPad since her Biology 1 curriculum materials were provided to her by the State. Theme Five revealed that the teacher-participants held an unconscious bias toward traditional gender roles. According to the American Association of University Women (AAUW, 2002a), there is a well documented gender gap in STEM that discourages girls from taking courses and pursuing careers in advanced STEM fields like physics and computer science. The teacher-participants' adherence to traditional gender norms and roles may be harmful to the girls at RHS and may be contributing to that gap.

Themes One through Four can be addressed mainly through additional professional development regarding a constructivist theory and pedagogy. Several studies (Vannatta & Fordham, 2004; Rosenfeld & Martinez-Pons, 2005, and Ritzhaupt, Dawson, & Cavanaugh, 2012) confirm that teacher disposition, education, and experience are key determinants to how often they will make use of new technologies in their classrooms. In addition, the problem of teacher bias toward traditional gender roles identified in Theme Five can also be addressed through professional development about gender and STEM. Therefore, the Action Plan provides recommendations for professional development that address concerns brought up in Themes One through Five.

Theme Six revealed several challenges that the science teacher-participants faced when trying to implement the iPads in their science classrooms. Students not having their iPads in class, either because they did not bring it, did not charge it, or their parents refused to let them be issued one, is probably the teacher-participants' greatest challenge

to using the iPads on a more frequent basis. The Action Plan provides suggestions for remedying some of these problems. An additional challenge identified by the teacher-participants was a lack of time allotted for the teacher-participants to research and develop instruction using the iPads.

The Action Plan provides suggestions for how to remedy this problem as well. One of the more troubling findings revealed in Theme six is that the teacher-participants, especially Mr. Red, seemed to be blaming the students for their lack of engagement or ability to complete assigned tasks using the iPads. Mr. Red was very vocal that he believed that the students knew how to use the iPads only for games and social media and not for school-related work like creating documents or doing science research. This idea was reflected in Mr. Red's lack of observed use of the iPads in his classroom and his overreliance on 'traditional' instructional practices (mostly lecture). Fortunately, he has shown a willingness to try new things, and hopefully with more professional development and a better understanding of a constructivist learning theory, he can overcome this bias.

The present study provides a springboard for the five science teacher-participants to reflect on their own curriculum and pedagogy using the district issued iPads. Together, the teacher-participants and the participant-researcher identified strengths and areas for improvement in terms of using the iPads to engage students in science. In addition, we were able to pinpoint our own professional development needs regarding the iPads, as well as identify the challenges we face in using the devices in using the iPads to engage our students in our daily lessons. We developed the Action Plan detailed in this Chapter

in order to address these needs and concerns and to better use the devices to engage our students in science courses and STEM careers.

Key Questions

The results of the present action research study indicate a need for more professional development for incorporating iPads into science coursework for these teacher-participants at RHS despite their claim that they are well prepared to use the iPads in their science curriculum and pedagogy. Professional development must be balanced to the needs of the teachers and targeted specifically to addressing the challenges the present study identified during the data analysis process. Therefore, the following key questions were identified to be addressed in the Action Plan:

1. What additional professional development would be most beneficial to the teacher-participants in addressing the need to enhance student engagement in learning science using the iPads?

2. Is Ruraltown High School's administration aware of the concerns of the teacher-participants and are they able to provide resources to address those concerns?

3. What do the teacher-participants most need the students to be able to do with the iPads to engage them in learning science?

Action Plan

Action Researcher

I am the participant-researcher. I am a 12-year veteran teacher at Ruraltown High School. I began teaching there in January of 2005, having entered the teaching profession through the South Carolina Program for Alternative Certification of Educators (PACE). Upon earning my professional teaching credential, I expanded my certification from

Biology to all Science. In addition, I have worked to earn endorsements in advanced placement Biology and Gifted and Talented education. Due to my interest and adeptness in computers and technology, I quickly found myself as a pioneer of new technologies in this school. This led to my interest in educational technology and the focus of this action research study. The mutual respect already present between the science teacher-participants and myself enhanced the development of our new research relationship dynamic. I was viewed by the science teacher-participants as an 'expert' in using computers (and Apple iPads) to engage students in learning science and this allowed me to lead the teacher-participants in a reflective cycle of action research.

My role as an action researcher and as a participant-researcher highlighted my "insider/outsider status." As an "authority" on engaging students in learning science using one-to-one iPads, I was very much on the inside of this action research study. As a participant-researcher, however, I also had to maintain an objective viewpoint in order to effectively collect and analyze the data with the five science teacher-participants. Because of the mutual respect shared between the teacher-participants and myself, I do not feel my insider status influenced my data or the conclusions too much. In fact, this action research study has influenced the way I plan to continue my own science teaching and I think it influenced the other teacher-participants as well. Although I am not in a position of authority at my school, I do think that my findings and this Action Plan can and will influence the practices and professional development at RHS, especially within the Science Department.

Developing the Action Plan

As Mertler (2014) states, "Action research is built on the premise that some type of action will result from your action research project" (p.210). He continues, "During this phase of the action research process, the teacher-researcher is basically trying to answer the following question: Based on what I learned from my study, what should I do now?" (p. 211). The action plan was developed jointly by the teacher-participants and participant researcher and answers that question. The plan details the support that the teacher-participants and I feel that we need in order to use the iPads to more effectively engage students in learning science coursework and careers. This Action Plan will be carried out starting in the Fall semester of 2017 through the end of the school year, at which point it will be reviewed and revised if needed for the following year in a continuing cycle of reflection and improvement.

The present action research study indicated a need for specific and targeted professional development for the teacher-participants in the following areas: Constructivist learning theory and pedagogy, gender bias (especially in science), and specific apps for teaching and learning science. In addition, there are several teacher concerns that need to be addressed as well, including: students not having an iPad, students not bringing their iPad, students not charging their iPad, lack of time, and students' skills using the iPads. The steps for the action plan were developed by the teacher-participants and me during the October 26th in-service during the data analysis. As concerns and problems were identified, the teacher-participants and I suggested action steps. These are detailed below.

Action Plan in Detail

The action plan can be divided into two main components: a professional development component and a component directly addressing teacher concerns.

Professional development. In order to address the concerns identified in themes one through four of the study analysis, targeted professional development is necessary. This professional development will be designed and executed by a school-level professional development team that is already in place at Ruraltown High School. I am a member of this team that is led by the Assistant Principal for Instruction. The results of the present action research study will be used to determine the professional development targets specifically for the science teacher-participants, but other teachers will be welcome to participate as well.

Theme One: Teachers' Perceptions of Student Engagement with iPads, identified that the teacher-participants held incomplete perceptions about student engagement, especially the differences between the engagement of young men and young women. Therefore, some professional development should focus on enhancing the teacher-participants' skills at gauging student engagement using the Marzano Model (2011) which is a four-part model detailed in the Literature Review in Chapter Two of this dissertation. This will take the form of a 45 minute refresher session during the pre-service period at RHS from August 14 to August 18, 2017. This session will focus on Marzano's model of engagement and how the teacher participants can better interpret their students' engagement using the model. Teacher-participants will practice using the model by analyzing sample scenarios and answering the following questions based on the four parts of the model:

- Did students enjoy the lesson?

- Did the students think the lesson was interesting?

- Did students think the what they were learning in the lesson was important?

- Did students think that they could successfully achieve the goal of the lesson?

Practicing answering these questions based on Marzano's model will help teachers gain a better understanding of the complex nature of "student engagement" and will help them to analyze their own students' engagement and to be more fully aware of when their students are truly engaged in learning science in their classrooms.

Theme Two revealed that the teacher-participants do believe that the district issued iPads can engage students in learning science and that they are willing to try new ways to use them to engage students.

Theme Three identified two needs, one for additional professional development on a constructivist learning theory and pedagogy, and one for professional development on specific computer applications ('apps') for teaching science.

Theme Four identified that the younger teacher-participants tended to use the iPads more than the older ones, with the exception of Mrs. Blue. Several studies (Ritzhaupt, Dawson, & Cavanaugh, 2012; Rosenfeld & Martinez-Pons, 2005; Vannatta & Fordham, 2004) indicate that teachers' attitudes, experience, and education regarding technology influence their use in science classrooms, therefore providing more high-

quality professional development on the use of the iPads should work toward narrowing this gap.

The professional development regarding a constructivist learning theory and pedagogy is the largest focus for professional development in this action plan. This professional development will address concerns brought up in each of the six themes. Applefield, Huber, & Moallem (2000) state:

> Constructivism has been widely embraced by science teachers as well as teachers of mathematics. Since constructivist epistemology is entirely consistent with an inquiry approach, we see its principles manifested through investigative laboratory activities, cooperative learning, and a variety of hands on experiments combined with expert scaffolding. (p. 50)

In addition to constructivism in general, this professional development should also focus on how iPads can be used in constructivist pedagogy in science. They can be ideal tools for use with project-based learning, as they lend themselves toward student discovery, the creation of products, and personal meaning-making.

This professional development will begin during the August 14 to August 18, 2017 pre-service period at RHS. An initial 90 minute to 2 hour session will be held during this period where the teacher-participants and I will review constructivist learning theory and how to implement it into our classroom lessons using project-based learning and the iPads. This session will also give the teacher-participants time to start designing a project-based unit using the iPads for implementation during the upcoming semester.

This professional development will continue for the remainder of the school year as the teacher-participants design and implement project-based lessons in their classrooms.

Over the course of the year through this professional development, the teacher-participants will be expected to develop, implement, reflect on, and revise several project-based units using the iPads in their classes. The teacher-participants and I will meet once a month at the regularly scheduled department meeting time (the Tuesday after the first Monday of each month from 3:15 p.m. to 4:00 p.m.) to review progress, reflect on implemented units and lessons, and offer help and feedback. In addition, there are five scheduled collaborative planning days (September 20, 2017; December 6, 2017; January 24, 2018; February 28, 2018; and March 21, 2018) built into the school calendar. The students are released early at 12:30 p.m. on these days to give the teachers time to collaborate. This time will be used to review and conduct a deeper study of constructivist theory, and to determine if and what additional help each teacher-participant may need to improve their use of constructivist pedagogy (project-based learning). Teacher-participants will also be able to use this time to seek help and feedback in developing their project-based units using the iPads. In addition, I, as an instructional leader, will be available to observe and assist the teacher-participants as they implement their project-based units.

Theme Three also identified a need for professional development regarding specific apps that the teacher-participants can use in their classrooms. Providing this type of development is difficult because the teacher-participants teach different subjects. Just as students often learn a lot from each other, other teachers are often teachers' best resources. Therefore, it would be best to conduct this professional development as a

teacher-led sharing seminar that includes teachers from other schools in the district. This will be set up by the District Science Coordinator during two of the district-wide collaborative planning days; once during the Fall semester (September 20, 2017) and once during the Spring semester (February 28, 2018). During these days, 45 minutes to 1 hour of time can be devoted for each teacher-participant virtually meeting (through Google Hangouts) with teachers from other schools who teach the same or similar courses to share specific apps that they use in their classrooms.

In addition, theme five identified a clear bias toward traditional gender roles in science among the teacher-participants. Professional development on gender bias in science is also needed, especially for Mrs. White and Mr. Red. Keller (1995) expresses the basic problem associated with gender bias in science:

In this division of emotional and intellectual labor, women have been the guarantors and protectors of the personal, the emotional, the particular, whereas science – the province par excellence of the impersonal, the rational, and the general – has been the preserve of men. (p. 7)

The perpetuation of gender bias in STEM courses and careers has led to a widely acknowledged and studied gender gap in science education, especially in physics and computer science. As the AAUW (2002a) states, "This gap is a portent of the gender gap in college math and science programs, and later, in well-paying math and science careers" (p. 277). Therefore, it is morally important that the teacher-participants are receive professional development on the subject, and especially on appropriate ways in which they can reduce their own gender bias and encourage young women to pursue

potentially high-paying STEM careers. This professional development will occur in a 1 hour session during the August 14 to August 18, 2017 pre-service period. While this session will not solve the problem of the gender gap in science, making teachers aware of their own biases is a positive step toward addressing the problem. Teachers interested in further study of this problem will be directed to specific authors such as the American Association of University Women and Evelyn Fox Keller, as well as to courses they can take for graduate credit and/or certificate renewal credit. The gender gap in science at RHS is also suggested as an area for further research later in this chapter.

Addressing teacher concerns. The teacher-participants and I identified five key concerns affecting our ability to use the iPads to effectively engage students in our classrooms. The first concern is that not all students have an iPad. There are various reasons for this, the most common being that a student's parents or guardians do not want him or her to have one because they do not want the financial responsibility. Unfortunately, due to district policy we cannot force students to have an iPad with them at all times or automatically issue them a device like we do text books. The next best solution would be for each teacher to have a set of four or five iPads tied to his or her classroom as extras. There are usually only a few students in each class who do not have a device, so having them on hand would make it very easy for teachers to accommodate these students. In order for this to happen, the school administration would have to procure the additional iPads. This could become expensive and cost-prohibitive as the devices cost approximately $360 a piece according to John Smith, Ruraltown High School's computer technician (personal communication, May 8, 2017) and providing four to five extras to just the science teacher-participants and I would be around $11,000. To

provide extras for every teacher in the school would add up to around $100,000. One way to mitigate these costs is through a grant. I have experience writing a grant and can work with the administration to write a grant in order to fund the extra iPads. We might not be able to get extras for every teacher, but we could at least get some for the five science-teacher participants involved in this study and myself. During the August 14 to August 18, 2017 pre-service period, I will meet with the school administration to identify an appropriate grant (or grants) and begin the process of writing the requests. Depending on the turnaround time for the specific grant chosen, we will hopefully be able to get the extra devices for the teacher-participants to use by the beginning of the Spring semester on January 16, 2018.

The second concern identified was that students who are issued iPads do not bring them every day. Having the extra iPads in each classroom would be an immediate solution to this problem for the day, but it would not address the reason why the student did not bring the iPad in the first place. In order for the students to perceive the iPads to be essential tools for learning, a fundamental shift would be required in the culture of the school. This shift would need to be led by the administration. The administration would need to clearly communicate to the students, teachers, and parents that the iPads are vital tools for education. In addition, the policies of the school must reflect this view. Therefore, administration would need to set forth a discipline plan that includes consequences for students not bringing their iPads to school, as this is essentially akin to arriving to class unprepared. The policy could include increasing levels of consequences for each instance that the student does not bring his or her iPad. For example, a first offence results in a warning, a second gets a call home, a third is a lunch detention, and

so on. This policy must then be enforced by the teachers so that students are clearly aware of the consequences for not bringing their iPad daily. The policy will be developed and communicated to the teachers during the August 14 to August 18, 2017 pre-service period, and will be communicated to the students and parents on the first day of school (August 22, 2017) to be fully implemented beginning the following Monday, August 28, 2017 for the remainder of the school year. Because all discipline referrals go through the discipline office, that office can easily track data regarding the number of students receiving disciplinary action for not bringing their iPad to school in order to determine the success of the policy. At the end of the school year, the policy will be reviewed and revised if needed.

The third concern is students not bringing their iPads to school charged. This could be mitigated by each teacher having a set of extra chargers in his or her classroom. Chargers are much cheaper compared to the iPads themselves, so each teacher can use a portion of his or her yearly supply funds provided by SC to purchase a few inexpensive chargers for student use. In addition, the school can provide inexpensive power strips for each classroom with an extension cord so that the students can plug their iPads in to charge. Teachers can purchase the chargers during the August 14 to August 18, 2017 pre-service days in order to have them ready for the first day of school on August 22, 2017.

The fourth concern identified was that the teacher-participants do not have the time to prepare lessons that use the iPads in engaging ways for students. The school administration most likely does not have extra time to give to the teachers, so it will be up to us to use our time more wisely. The schedule for professional development detailed previously provides structured time for the teacher-participants to create and develop

project-based units and lessons using the iPads during regularly scheduled departmental meeting times (each month on the Tuesday following the first Monday) and collaborative planning days (September 20, 2017; December 6, 2017; January 24, 2018; February 28, 2018; and March 21, 2018). In the past, this time has not been used in the most efficient way, so starting in the Fall of 2017, the teacher-participants and I can set the expectation that these days will be reserved for this professional development and to collaborate and share strategies, pedagogy, and apps that we are using in our classrooms to engage students in learning science. This will require the commitment of each of the teacher-participants to set the expectation that these meeting days each month are to be used to help improve iPad use in our classrooms.

The final concern identified was that students do not necessarily have the skills to use the iPads to do the work we're asking them to do. This is a false perception. Marc Prensky (2001a) calls contemporary students "Digital Natives" because "they are all 'native speakers' of the digital language of computers, video games, and the Internet" (p. 1). This means that they have the skills to use the iPads, even if they do not know how to do the specific thing we are asking them to do. Addressing this concern is going to require a shift in the teacher-participants' classroom management using the iPads, once again requiring some degree of professional development. If a student or a group of students says that they do not know how to do something, then the teacher should either provide instruction on how to do what he or she is asking, or provide resources for students to use to find out how to do something. The teacher could even direct students to look for a YouTube video that shows them how to accomplish a specific task on the iPad. This will also require a shift in classroom management practices as well. It does no good

to give all of our students an iPad, seat them in straight rows, and then sit at the front of the classroom. Simple things like rearranging the room seating and the teacher's position in the room can have a big impact. This issue and each of these suggestions will be addressed during the professional development sessions on constructivist learning theory and project-based learning, initially during the August 14 to August 17, 2017 pre-service period and consistently reiterated thereafter during the remaining professional development sessions throughout the school year. Finally, if the teacher-participants are still concerned about their students' abilities with the iPad, then I am available as an instructional leader and they can notify me for assistance.

Reflection and revision. According to Mertler (2014), action research is a cyclic and iterative process. As this action plan is part of one iteration of an action research cycle, it will be necessary for the teacher-participants and I to review and reflect on the process in order to begin a new cycle in order to continue improving our educational practice. This review and reflection will occur at the end of the school year on June 7, 2018, the last official work day for teachers. The teacher-participants and I will meet and discuss the results of this action research study and action plan, and reflect on how it has impacted our teaching for better or for worse. This will form the basis of the next iteration of the action research cycle as we identify new or continuing problems and come up with revisions to the current action plan as well as new ideas for how to address these problems.

Facilitating Educational Change

The goal of this action research study was to determine the five high school science teacher-participants' perceptions of the effects of one-to-one iPads on student

engagement, with the purpose of improving those teachers' ability to use the iPads to engage their students in learning science. Our school district has invested a lot of money on these devices, and my personal goal was to help my fellow science teachers to make better use of the iPads in their classrooms and to see them as an asset to learning instead of as a distraction. I believe that, when used properly as learning tools, iPads have the potential to greatly enhance student engagement and learning outcomes.

Change, however, is not easy. It is an unfortunate tendency for humans to resist change in favor of the status quo. Teachers especially can be resistant to change. I have been guilty of complaining and resisting changes to my classroom and instructional practices in the past. I have found, however, that when given the chance changes can be worth it.

The transition from a traditional classroom to a one-to-one iPad environment has been especially difficult for some teachers. These teachers, such as Mr. Red and Mrs. White, react by embracing the iPads much more slowly than others, Mr. Red especially. Starting this action research study, I knew I would be met with resistance of various levels from all the teacher participants, and my goal was to not give in to it. I also knew that engaging students with the iPads would require a shift in the educational practices and beliefs of the teacher-participants toward a more constructivist philosophy, and that this would be a difficult shift for some. I was able to help the teacher-participants take the first steps toward this shift by maintaining their trust and reassuring them through understanding each of their own personal beliefs, strengths, and weaknesses. Through an environment of mutual respect and trust, we were able to work together to provide each other insights about what we each do well and suggestions for improvement. Because the

shift toward constructivist learning may seem like a giant leap, we will need to proceed slowly and purposefully until we reach our goal.

Suggestions for Future Research

This action research study focused on the high school science teacher-participants' perceptions of the effects of one-to-one iPads on student engagement. As education is supposed to be first and foremost about the students, I would suggest the next logical step would be a future study that focuses on the students' perceptions of the effects of the iPads on their own engagement. Also, scheduling and timing issues restricted the courses of the teacher-participants that I was able to observe. I might have gotten a more complete picture of classroom practices and student engagement had I been able to visit all of Mr. Red's classes, for example. Another future study could expand upon this one and include teacher-participants from other disciplines outside of science. It would be interesting to see how the perceptions of math, social studies, and English teachers compare to those of the science teachers at Ruraltown High School.

Another topic that is related to the current action research study but has not been studied in depth is the effect of one-to-one devices like the iPads on student achievement. It was a difficult and time-consuming process to research and settle upon a model of student engagement for this study. Student achievement may be even more difficult because a valid and reliable measure must be identified, and there are other variables (such as SES and race) that have proven to be strongly correlated with academic achievement and may make analyzing the data problematic.

Finally, the gender gap in science and STEM at RHS could be studied further. While the existence of this gap is well documented nationally, the breadth and severity of the gap at RHS is currently unknown. An action research study of this gap could lead to identification of specific problem areas (such as physics classes), and an action plan that better addresses this problem could then be developed and implemented.

Conclusion

Even though my school district implemented one-to-one iPads for the students several years ago, I still noticed that there was a lot of inconsistency in their use by teachers throughout Ruraltown High School. I conducted this action research study to determine the effect of these one-to-one iPads on high school teachers' perceptions of student engagement in science classrooms, with the purpose of improving our practice of using the iPads to engage students in learning science. Five teacher-participants agreed to be a part of the study, each of varying ages, experience, and science subjects taught. I led these teacher-participants in an in-service professional development seminar regarding using iPads to engage students in their classrooms. I then followed this with a six-week data collection period in which I interviewed the teacher-participants about their perceptions of the iPads effect on their students' engagement and observed several of their classroom lessons. Following the data collection period, I led the teacher-participants in another in-service seminar where we analyzed the data using the coding and analysis method delineated by Mertler (2014) and developed the action plan.

Six major themes emerged from the data. Theme One was that the teacher-participants' perceptions of student engagement were often incomplete. Theme Two provided the answer to the research question; all five of the science teacher participants

believed that the iPads had the *potential* to increase student engagement in their science classrooms. Theme Three was that while the teacher-participants felt that they had enough professional development regarding the iPads, there were specific areas in which they could use more professional development. These included constructivist learning theory and pedagogy and the use of iPad apps specific to each of the courses that they teach. Theme four was that, apart from Mrs. Blue, the younger teacher-participants were more willing to use the iPads more frequently than the more experienced teacher participants. Theme five was that there was an unconscious bias among the five teacher participants toward traditional gender roles, especially regarding their perceptions of the differences in engagement with science lessons between young men and young women. Finally, theme six was that while the teacher-participants believed the iPads could enhance student engagement, there were five major obstacles they faced in using them to their full potential. These obstacles included students not having an iPad, students not bringing their iPad to school, students not charging their iPad, a lack of time for preparation to use the iPads, and student's lack of ability to use the iPads for learning.

Collaborating with the teacher-participants, we came up with an action plan to be implemented during the 2017-2018 school year that includes targeted professional development (focusing primarily on constructivist learning theory and pedagogy) that addresses the concerns identified in Themes One through Four as well as the perceived lack of student skills with the iPad in Theme Six. In addition, the action plan includes action steps to address the obstacles identified in theme five. Hopefully, with the cooperation of the teacher-participants and the school administration, we can continue to improve our practice and use the iPads more effectively to engage students in learning

science. Our success may even inspire other teachers at Ruraltown High School to follow

our example and improve their use of the iPads to engage students in their own

classrooms.

REFERENCES

American Association of University Women. (2002a). Course-taking patterns. In Bailey, S. M. *The Jossey-Bass Reader on Gender in Education* (p. 277-300). San Francisco, CA: Jossey-Bass. (Original work published 1998)

American Association of University Women. (2002b). Educational software and games: Rethinking the "Young Women' game." In Bailey, S. M. *The Jossey-Bass Reader on Gender in Education* (p. 345-360). San Francisco, CA: Jossey-Bass. (Original work published 2000)

Applefield, J. M., Huber, R., & Moallem, M. (2000). Constructivism in Theory and Practice: Toward a Better Understanding. *The High School Journal*, (2). 35.

Bobbitt, F. (2013). Scientific method in curriculum making. In Flinders, D. J., & Thornton, S. J. (Eds.). *The curriculum studies reader* (4th ed., pp. 11-18). New York, NY: Routledge. (Original work published 1918)

Byker, E. J. (2014). Sociotechnical narratives in rural, high-poverty elementary schools: Comparative findings from east Texas and south India. *International Journal of Education & Development Using Information & Communication Technology*, *10*(2), 29-40.

Conley, D. T. (2012). *A complete definition of college and career readiness*. Educational Policy Improvement Center. Retrieved from http://www.epiconline.org

Dana, N. F., & Yendol-Hoppey, D. (2014). *The reflective educator's guide to classroom research: Learning to teach and teaching to learn through practitioner inquiry* (3rd ed.). Thousand Oaks, CA: Corwin.

Dewey, J. (1897). *My pedagogic creed*. New York, NY: E.L. Kellog & Co. Retrieved from http://books.google.com

Dewey, J. (2009a). *The child and the curriculum*. Retrieved from http://www.gutenberg.org (Original work published 1902)

Dewey, J. (2009b). *Democracy and education: An introduction to the philosophy of education. Waiheke Island: The Floating Press*. Retrieved from http://www.ebscohost.com (Original work published 1916)

Doll, W. E. (2013). The four r's: An alternative to the Tyler rationale. In Flinders, D. J., & Thornton, S. J. (Eds.). *The curriculum studies reader* (4th ed., pp. 215-222). New York, NY: Routledge. (Original work published 1993)

Ertmer, P. A., & Newby, T. J. (1993). Behaviorism, Cognitivism, Constructivism: Comparing critical features from an instructional design perspective. *Performance Improvement Quarterly*, 6(4), 50-72. doi: 10.1111/j.1937-8327.1993.tb00605.x

Eskil, M., Ozgan, H., & Balkar, B. (2010). Students' opinions on using classroom technology in science and technology lessons: A case study for Turkey (Kilis City). *Turkish Online Journal of Educational Technology*, 9(1), 165-175.

Every Student Succeeds Act of 2015, 20 U.S.C. § 6301 (2015)

Festerwald, J. (December 3, 2013). *U.S. scores stagnant, other nations pass us by in latest international test*. EdSource. Retrieved from http://edsource.org.

Fink, J. W. (2015). Young women rock STEM. *Instructor*, *124*(5), 22.

Franco, C. S., Ott, M. G., & Robles, D. P. (2013). Lessons learned: Cultural assets inform actions. In M. Grogan (Ed). *The Jossey-Bass Reader on Educational Leadership* (3rd ed., pp 93-110.). San Francisco, CA: Jossey-Bass (Original work published 2011).

Fullan, M. (2013). Introduction: Have theory, will travel. In M. Grogan (Ed). *The Jossey-Bass Reader on Educational Leadership* (3rd ed., pp 207-219.). San Francisco, CA: Jossey-Bass (Original work published 2008).

Gorski, P. C. (2013). Building a pedagogy of engagement for students in poverty. *Phi Delta Kappan*, *95*(1), 48.

Grogan, M., & Shakeshaft, C. (2013). A new way: Diverse collective leadership. In M. Grogan (Ed). *The Jossey-Bass Reader on Educational Leadership* (3rd ed., pp 93-110.). San Francisco, CA: Jossey-Bass (Original work published 2011)

Gu, X., Zhu, Y. & Guo, X (2013). Meeting the "digital natives": Understanding the acceptance of technology in classrooms. *Educational Technology & Society*, 16 (1), 392–402.

Keller, E. F. (1995). *Reflections on Gender and Science*. New Haven: Yale University Press.

Leithwood, K., Harris, A., & Strauss, T. (2013b). How to reach high performance. In M.

Grogan (Ed). *The Jossey-Bass Reader on Educational Leadership* (3rd ed., pp

255-273.). San Francisco, CA: Jossey-Bass (Original work published 2010).

Livingstone, S. (2012). Critical reflections on the benefits of ICT in education. *Oxford

Review of Education*, 38(1), 9-24. doi:10.1080/03054985.2011.577938

Marzano, R. J. (2003). *What Works in Schools: Translating Research Into Action*.

Alexandria, VA: Association for Supervision and Curriculum Development.

Marzano, R. J., & Pickering, D. J. (2011). *The Highly Engaged Classroom*. Bloomington,

IN: Marzano Research Laboratory. Retrieved from http://www.ebrary.com

McLaughlin, M. W. (2013). Implementation as mutual adaptation: Change in classroom

organization. In Flinders, D. J., & Thornton, S. J. (Eds.). *The curriculum studies

reader* (4th ed., pp. 195-205). New York, NY: Routledge. (Original work

published 1976)

Mertler, C. A. (2014). *Action research: Improving schools and empowering teachers* (4th

ed.). Thousand Oaks, CA: SAGE Publications, Inc.

National Center for Education Statistics. (2005). *Issue Brief: Computer technology in the

public school classroom: Teacher perspectives* (NCES 2005–083). Washington,

DC: Lanahan, L., & Young Menen, J.

National Commission on Excellence in Education. (1983). *A nation at risk: The

imperative for educational reform: An open letter to the American people: A*

report to the Nation and the Secretary of Education (ERIC number: ED226006).

Retrieved from http://eric.ed.gov/

Nellie Mae Education Foundation. (2012, April). *Motivation, engagement, and student voice: A students at the center series*. Boston, MA: Toshialis, E. & Nakkula, M. J.

No Child Left Behind Act of 2001, P.L. 107-110, 20 U.S.C. § 6319 (2002).

Page, M. S. (2002). Technology-enriched classrooms: Effects on students of low socioeconomic status. *Journal of Research On Technology in Education (International Society for Technology in Education)*, *34*(4), 389.

Peterson, P. E. (May 13, 2014). *Study finds U.S. schools lag behind those in other industrialized countries*. Washington Examiner. Retrieved from http://www.washingtonexaminer.com

Prensky, M. (2001a). Digital natives, digital immigrants. Retrieved from http://www.marcprensky.com

Prensky, M. (2001b). Digital natives, digital immigrants, part II: Do they really think differently?. Retrieved from http://www.marcprensky.com

Prensky, M (September/October 2005). Engage me or enrage me: What today's learners demand. *Educause Review*, 40(5), p. 60 – 64.

Ritzhaupt, A., Dawson, K., & Cavanaugh, C. (2012). An investigation of factors influencing student use of technology in K-12 classrooms using path analysis. *Journal of Educational Computing Research*, 46(2), 229-254.

Rosenfeld, B., & Martinez-Pons, M. (2005). Promoting classroom technology use. *Quarterly Review of Distance Education*, 6(2), 145-153.

Ryan, J. (December 3, 2013). *American schools vs. the world: Expensive, unequal, bad at math: What the latest results of an international test tell us about education in the United States*. The Atlantic. Retrieved from http://www.theatlantic.com

The Schlechty Center. (2014). Introduction to the Schlechty Center. Retrieved from http://www.schlechtycenter.org/tools/

Skinner, E., Furrer, C., Marchand, G., & Kindermann, T. (2008). Engagement and disaffection in the classroom: Part of a larger motivational dynamic?. *Journal Of Educational Psychology*, *100*(4), 765-781. doi:10.1037/a0012840

Snyder, K. (2013). Why g quotient leadership works. In M. Grogan (Ed). *The Jossey-Bass Reader on Educational Leadership* (3rd ed., pp 131-147.). San Francisco, CA: Jossey-Bass (Original work published 2006).

Solomon, G., & Shrum, L. (2010). *Web 2.0: How-to for educators*. Eugene, OR: International Society for Technology in Education.

South Carolina Department of Education. (2015). *Read to succeed (R2S)*. Retrieved from https://ed.sc.gov/agency/ie/School-Transformation/Read-to-Succeed/

South Carolina Read to Succeed Act, S.C. Code of Laws § 59-155-110-210 (2014).

Spring, J. (2014). *The American school: A global context: From the Puritans to the Obama administration* (9th ed.). New York, NY: McGraw-Hill Education.

Tyler, R. (1949). *Basic principles of curriculum and instruction* [PDF]. Chicago:

 University of Chicago Press.

Vannatta, R. A., & Fordham, N. (2004). Teacher dispositions as predictors of classroom

 technology use. *Journal of Research on Technology in Education*, 36(3), 253-271.

Waddington, D. I. (2015). Dewey and video games: From education through occupations

 to education through simulations. *Educational Theory*, *65*(1), 1-20.

APPENDIX A

TEACHER PARTICIPATION LETTER

Dear Teachers,

I am currently a student in a Doctoral program at University of South Carolina under the supervision of Dr. Kenneth Vogler. As part of my Doctoral program, I must complete original research for my dissertation. This research is called "action research" and is designed to address a specific instructional problem in order to improve teaching practices. My dissertation is entitled *The Effects of One-to-one Computing Devices and Curriculum on Student Engagement*. I would like for you and your students to be a part of this study.

Your participation would involve answering questions on a survey about how you use the one-to-one iPads in your classroom during your third block class. Your personally identifiable information will be kept strictly confidential and separate from your survey responses. This information will not be shared with anyone else. Your information and survey responses will be used to categorize the level of iPad integration in your classroom so that I can compare the engagement of student groups. Once student surveys have been collected, your personally identifiable information will be destroyed. Information about the level of technology integration and subject area for each classroom will be retained.

In order to disrupt classes as little as possible, your students will be surveyed a week later during third block panther time regarding their level of engagement in class, based on a model of engagement by Marzano. Students will fill out the surveys anonymously and only with parental consent. There are no risks to students involved in the study, and very little risk involved for you.

Should you wish to decline participation in this study, you may do so at any time for any reason with no penalty or ill effects for you or your students. Your participation is completely voluntary. If you wish to decline to participate in this study, please let me know and I will expunge your name and information from the study.

At the conclusion of the study, I will share my results with you, the school, and the district, and the results will be published as part of my dissertation. Hopefully, this will provide us with valuable information about the effects the iPads are having on our students.

Sincerely,

Herb Bocchino

APPENDIX B

TEACHER INTERVIEW QUESTIONS

1. How did your classes go this week?

2. Were your students engaged in your class this week?

    a. What did you do that engaged them?

        i.   Did the students enjoy the activity/lesson?

        ii. Were the students interested in the content of the activity/lesson?

        iii. Did the students think that what they were learning was important?

        iv. Did the students believe that they could be successful at what you

             were asking them to do/learn?

    b. How do you think you could engage them better next time?

    c. (if iPads were not used) Do you think the iPads could have made the

        activity more engaging?

3. Did you use the iPads?

    a. How did you use them?

    b. Was this successful?

    c. Do you think your students were engaged?

    d. What would you change about what you did in the future?

    e. What support do you need to better use the iPads to engage your students?

4. Did you notice any differences between the engagement of the Young Men and

    Young Women in your classroom?