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The Effect of Professional Development on Middle School Teachers' Technology Integration: An Action Research Study

Kristen Collins Tyner

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The Effect of Professional Development on Middle School Teachers' Technology
Integration: An Action Research Study

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ABSTRACT

Equipping teachers with the appropriate knowledge and skills to integrate technology effectively into their practice is a key component of school-wide technology implementation. Technology is fast becoming ubiquitous in the realm of education. Teachers and schools struggle to keep abreast of changing technologies while preparing students for a 21st century workforce. The Partnership for 21st Century Skills defined four skills critical for success in the twenty-first century: communication, collaboration, critical thinking, and creativity. School and district leaderships are tasked to provide relevant and meaningful technological professional development (PD) in order to prepare their teachers to integrate these skills into their teaching practices. Hence, quality technology professional development is essential in modern education. In this study, an instructional technology specialist examined the effects of professional development on teachers' high-level technology integration.

Keywords: technology integration, professional development, 4Cs, action research, professional learning communities, project-based learning

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LIST OF ABBREVIATIONS

4Cs	Four Cs of 21 st Century Learning
ISTE	International Society for Technology in Education
ICT	Information and Communication Technologies
ITS.....	Instructional Technology Specialist
PBL	Project-Based Learning
PD	Professional Development
PLC	Professional Learning Community
RMS	Roanoke Middle School (pseudonym)
STEAM.....	Science, Technology, Engineering, Arts, Math
STEM.....	Science, Technology, Engineering, Math

CHAPTER ONE

INTRODUCTION

Professional development (PD) is a critical and ongoing need for a school faculty. Technology is fast becoming ubiquitous in the realm of education. It is also advancing so quickly, that providing quality training on technology is a challenge for school leadership. If quality professional development is needed to improve instruction, then equipping teachers with the appropriate knowledge and skills to integrate technology effectively into their practice is a key component of school-wide technology implementation. However, in *Transforming Classroom Practice*, a PD strategies book published by the International Society for Technology in Education (ISTE), Borthwick and Pierson (2008) cite one study that found that 36 percent of participating schools provide no professional development on technology and only 29 percent provide 1-14 hours per year. Those findings seem to indicate that the majority of teachers may not be receiving adequate technology professional development.

The State of South Carolina Proviso 1A.21 requires all certified school/district staff demonstrate technology proficiency based on standards and guidelines established by district professional development policies (Certified Staff Technology Proficiency, 2016). South Carolina teachers are required to earn one hundred and twenty renewal points and thirty technology proficiency credits in a five-year period to maintain their highly qualified status (Renewal, 2016). In order to assist teachers in meeting those requirements as well as facilitate technology use at every level, the Instructional

Technology Specialist (ITS) role was created in 2006. In the initial year, only one ITS served Plymouth School District (pseudonym). In 2007, each school acquired its own ITS. Due to budget constraints over the years, ITS have been split between schools, but currently there is one ITS for every school.

The Role of the Instructional Technology Specialist

The ITS position in Plymouth School District was created to provide technical and instructional support at the school level to help teachers integrate technology into their curriculum and classroom practices. This position was created to be different from the media specialist position, which already existed in all district schools and replaced the audio-visual position. The ITS is responsible for supporting integration of computer technology into classrooms, while the media specialist is responsible for library media and providing print and media support at the school library. The responsibilities of the ITS include being the school's technology leader, professional development coordinator, and tier-one technology support. As tier-one technology support, the ITS offers assistance for basic technology problems for school personnel. Technology issues are solved by the ITS or escalated to the technician depending on the severity.

At the school level, the ITS “seeks to improve student technology use and access by managing school computer labs and offering assistive technology support” (Middle School Instructional Technology Specialist, 2016 p. 1). She is also “responsible for creating, organizing, and offering school-wide training sessions for teachers on how to use current and emerging technology ... to enhance planning, teaching, [and] assessing” (2016, p.1). Starting in the 2015-2016 school year, the focus of the Roanoke Middle School (pseudonym) ITS was to support the use of blended learning and the STEM

initiative at the school by modeling technology integration strategies. As technology proficiency in the district increases, the focus of PD has shifted to use of technology for differentiation--to improve instruction. One of the instructional goals of Roanoke Middle School (RMS) is to have every classroom utilize project-based learning principles to implement a cross-curricular STEM (science, technology, engineering, and math) framework.

Profile of a South Carolina Graduate

In February 2015, the South Carolina State Board of Education, together with the State Chamber of Commerce and the state’s Association of School Administrators, approved the *Profile of a South Carolina Graduate* as a shared framework of the knowledge, skills, and characteristics needed for students to be successful in higher learning and careers (Figure 1.1). This profile challenges schools to find innovative ways to prepare students for 21st century learning and future careers.



Figure 1.1 Profile of a South Carolina Graduate Reprinted from Profile of a South Carolina Graduate. (2016). SCASA Superintendents’ Roundtable.

The South Carolina Council on Competitiveness (2015) recommends the following practices be implemented to help achieve the goal of all South Carolina graduates being prepared to enter a global workforce or post-secondary education: “real-world learning, anytime, anywhere instruction, real-time information, and students advance when ready” ([SCCC], para 4). SCCC (2015) specifically references project-based learning as a method of real-world learning that teaches critical-thinking, problem solving, and teamwork. They also reference digital instruction and full technology integration as recommended practices. These practices imply that technology be a major component in preparing students for the global workforce. The traditional classroom model cannot provide personalized instruction or real-time feedback on progress and within the traditional classroom, students’ ability to advance when personally ready is severely limited. New digital tools allow educators to remove these limitations, so students have access to more, newer information when they are ready even if they are not sitting in a classroom. These recommendations are designed to prepare South Carolina graduate to compete in a changing world economy.

In a report for the World Bank, Abadzi (2015) found that global economies need workers that possess cognitive/problem solving, social/interpersonal, behavioral/ethical skills, and “21st century” skills. To perform the tasks needed for 21st century jobs, Abadzi states that “workers ought to possess the ‘4Cs’: creativity, critical thinking, communication, and collaboration” (2015, p. 9). The Profile of a South Carolina Graduate and ISTE Standards for Students (2016) also encourage students to develop these skills. Roanoke Middle School is located in South Carolina and as part of its STEM

initiative one of its goals is to prepare students for high school and to develop the characteristics of a South Carolina graduate.

Problem of Practice

Most of the technology integration at Roanoke Middle School focuses on teacher-centered use of the technology, simple substitution, or low-level learning such as skill practice. This is an issue for more than just RMS teachers (Hsu, 2016). Although integrating low-level technology may increase student engagement and improve classroom management, research indicates that classroom integration of technology for high-level learning eventually leads to increased student learning (Allsopp, McHatton, & Cranston-Gingras, 2009). Student use of technology for higher-level thinking, such as blended learning or collaboration, enhances students' learning experiences and intellectual growth across curricular areas rather than merely developing isolated technology skills (Hsu, 2016; Vockley, 2007). Even though teachers are proficient at using technology for personal use, it does not always translate into use instructional use (Allsopp et al., 2009; Atkinson, 2005). RMS teachers are utilizing technology in the classroom. However, it is often for basic skills practice. Although teachers may be utilizing technology in a variety of ways in the classroom, if it is at the lowest levels of integration, then students are not being prepared for their futures in a 21st century workforce (Vockley, 2007). The identified problem of practice of this action research is that RMS teachers are not trained to integrate higher-level technology methods consistently and effectively into their instruction.

Study Rationale

The NCES found in their study of educational technology that by 2008, internet access had become almost ubiquitous; 98 percent of all public schools had internet. The NCES also reported by 2005, 94 percent of instructional rooms (classrooms, computer labs, and media centers) within those public schools had internet access. The number of internet-enabled devices also increased during that time. In 2000, the student to instructional computer ratio was 6.1:1 and by 2008, that ratio was reduced to 3.1:1. (National Center for Educational Statistics [NCES], 2010).

Even though access to technology in schools has increased dramatically and it continues to progress to a 1:1 student-device ratio, technology has produced minimal effect on student achievement (Atkinson, 2005). As more technological hardware enters schools, the role of effective technology facilitator has become more of a requirement (ISTE, 2017), teachers need training on how to integrate it into instruction in meaningful ways if it is to have its intended effect (Borthwick & Pierson, 2008).

Effective technology integration enhances current instructional practices and enables new processes, so teachers can facilitate lessons that develop 21st century skills in students. ISTE standards for educators (2017) encourage teachers be designer of effective technology integrated lessons by using digital tools and resources to maximize active, deep learning and applying sound pedagogical principles to create engaging and supportive digital learning environments. The 4Cs and the ISTE standards for both students and educators provide a framework to guide the higher-level integration of digital tools.

The National Educational Technology Plan, published by the Department of Education in 2010, calls for effective teacher training that emphasizes “professional learning that is collaborative, coherent and continuous and blends more effective in-person courses and workshops with the expanded opportunities, immediacy and convenience” (as cited in Hsu, 2016, p. 30). Studies have also suggested that quality professional development has far-reaching effects on students (Borthwick & Pierson, 2008). In one school, where teachers participated in technology training and then used computers to teach higher-order skills, data showed teacher morale increased and student absenteeism decreased (Borthwick & Pierson, 2008). The same study showed that students of teachers that attended any kind of computer technology staff development within the past five years outperformed students who teachers had no educational technology training. Eighth-graders whose teachers had technology training out-scored by one-third of a grade level those whose teachers had not attended training (Borthwick & Pierson, 2008). These studies seem to indicate that technology professional development is better than no training, but there are specific factors that contribute to more effective technology development that leads to improved student outcomes.

This action research study utilizes multiple professional sessions centered on 21st century learning and embedded in a professional learning community to address barriers to successful PD. According to Roy, Vanover, and Fueyo (2012) principles of successful PD include a targeted focus on instruction, instructional improvement through awareness, planning, implementation, and reflection, shared expertise, clear expectations, collegiality, caring, and mutual respect. This study also supports a district technology goal of providing online and traditional professional development to instructional staff to

support 21st century instruction (2014-2019 Technology Plan, 2014) and a school goal of teachers using a technology-enhanced project-based learning model instruction.

Purpose Statement

At RMS, many teachers are required to use district-purchased curriculum programs in their classrooms. Students have access to digital learning every day but the majority of this digital learning is skill practice. Students passively receive content instruction from a computer instead of creating content for themselves, collaborating with peers, communicating with experts in the content, or thinking critically about the content.

In order for teachers to use higher-level technology integration as an instructional method to engage students in learning, they must receive quality professional development that focuses not only on the functionality of the tool but also spends time explaining instructional strategies that are grounded in solid pedagogy (Okojie, Olinzock, & Okojie-Boulder, 2006). The purpose of this study is to describe and interpret the impact of professional development on higher-level technology integration at Roanoke Middle School.

Research Questions

RQ1: To what extent will the implementation of technology professional development change the use of higher-level technology integration in a middle school?

RQ2: To what extent will the implementation of technology professional development change middle school teachers' perceptions and attitudes regarding higher-level technology integration?

Action Research Methodology

Action research is conducted by teacher-researchers for the purpose of solving a problem or gaining understanding to inform local practice and is generally rooted in the interests of the teacher-researchers (Fraenkel, Wallen, & Hyun, 2015). McNiff (2002) defines action research as inquiry into one's own practice. Unlike traditional forms of research, the researcher is part of the process.

This study fits the action research model because it attempted to identify which strategies and conditions can be incorporated to better support teachers' use of technology integration as an instructional practice. Further understanding of teachers' perceptions of the ITS, technology training and project-based learning and how those perceptions affect instruction and implementation can improve future endeavors.

Dana and Yendol-Hoppey (2014) outline the dichotomous views of teachers that have dominated educational research. In one view, teaching is regarded as a linear activity and teachers are viewed as technicians. In this paradigm, outside researchers conduct research and analyze data. Teachers then implement research findings of the outside researchers. Teachers are not seen as problem posers or problem solvers. Teachers are responsible for implementing with fidelity curriculum designed by those outside the classroom. In the second newer paradigm, teaching is portrayed as highly complex, context-specific, and interactive (Dana & Yendol-Hoppey, 2014). Action research, or teacher-inquiry, fits into this paradigm and gives teachers a voice to affect change in classroom practice. According to Dana & Hoppey (2014) in teacher inquiry, the teacher is the storyteller--the insider who develops a research question, which is focused on providing insight into one's own practice in an effort to make a positive

change. Teacher inquiry, a byproduct of the rationalization of the profession, is deeply rooted in best practices of teaching including progressing monitoring, data-driven instruction, and differentiation. Teachers utilizing action research may be rebelling against the perceived marginalization and de-professionalizing of teachers.

Based on the tenets of action research methodology, I examined my practice in order to improve technology professional development and improve technology integration at Roanoke Middle School. The information gained from this research was to refine technology trainings and modify the approach when delivering professional development to teachers at Roanoke Middle School on future technology initiatives. Research efforts were focused on improving the quality of the technology training at Roanoke Middle School.

Study Design

The study employed a mixed-methods research design. More specifically, it utilized a descriptive design. The purpose of this descriptive design study was to describe and interpret the impact of professional development on higher-level technology integration at Roanoke Middle School. Surveys were used to collect the quantitative data from participants; descriptive statistics were used to analyze the data.

The study employed qualitative methods and thematic analysis to develop a deeper understanding of middle school teachers' perceptions toward technology integration professional development. Teachers were asked to participate in a group interview at the end of the professional development.

Semi-structured interviews are generally formal and consist of a series of relevant questions (Fraenkel et al., 2015). Interviews were recorded to ensure accuracy of

interview transcription. Teachers assisted in reviewing the accuracy of the research report, member checking the results (2015).

This action research study aided understanding of how RMS teachers handle these new approaches in their actual teaching practice, what benefits have been observed in the classroom and in their students (for example, attitudes and learning outcomes) and what limitations have been encountered (Basilotta Gómez-Pablos, Martín del Pozo, & García-Valcárcel Muñoz-Repiso, 2017).

Limitations of the Study

This study had limitations. The action research methodology prevented generalizability because it is specific to the researcher's own practice (Mertler, 2014). Furthermore, this study had fourteen participants. The small sample size limited the assumptions that can be made about the data.

Similar to limitations of other studies of PD, this study focused on teachers' perceptions of the PD and used a survey and teacher focus groups as the data collection instruments nor did it examine the effect of the PD on student achievement (Lawless & Pellegrino, 2007).

Time constraints were another limitation of this study. This study was conducted from the end of January 2018 through early May 2018. The post survey was administered following the completion of the last PD. This short timeline may have limited teachers from implementing ideas or strategies from the professional development. In addition, during January 2018, RMS experienced a snowstorm that shut down the school for almost a full school week. When teachers returned, they were stressed about curriculum pacing. As the study concluded, the beginning of testing season was looming. These

factors may have affected teachers' willingness to integrate higher-level technology into their lessons.

Initially, the intention was to conduct whole group PD sessions. This proved to be unfeasible. Due to scheduling conflicts, sessions broke into a 6th grade session, 7th grade session during planning periods, and an after-school session for 8th grade and related arts teachers. There were several benefits of conducting PD within a PLC including collaboration, camaraderie, and cross-curricular planning. Despite having multiple sessions, one on one make-up sessions were still required because participants were absent from the sessions. Having individual make-up session lessened the ability to collaborate with peers. However, teacher collaboration could have still happened outside of the sessions or with non-participants. In fact, during the 6th grade focus group interview, participants mentioned sharing strategies and ideas with non-participants.

Finally, during the group interviews, specific questions about the researcher were asked. Because I conducted the group interviews, the likelihood of getting honest critical feedback diminished. An outside person conducting the interview may have been able to elicit responses that were more honest.

Positionality

This action research aligns with my area of specialization: technology. Reviewing, exploring, and reflecting on my practice allows me to grow as a professional educator. Making technology the area of specialization isolated the focus of the action research to an essential component of modern education. Another area of interest of mine is school leadership and administration. This action research study aligned with school leadership because understanding the needs of adult learners and collaborating with

teachers to develop organizational learning goals for the school are features of an effective leader.

Summary and Conclusion

This chapter provides an overview of the action research study. The problem of practice centers on the need for quality technology PD, not only for teachers to use technology competently, but so they may integrate student-centered, high-level technology focused on the development of 21st century skills in students. The literature review that follows this chapter covers the following topics: professional development for adult learners, technology integration, professional learning communities, and 21st century learning. Chapter Three outlines the research design and methods. Chapter Four analyzes the findings of the study. Chapter Five discusses the implications of the study results, develops an action plan, and suggests possible future research.

Glossary of Key Terms

21st century skills- Complex skills desired by the knowledge age economy characterized by the “4Cs”: creativity, critical thinking, communication, and collaboration (Abadzi, 2015).

Andragogy- “the art and science of helping adults learn” (as cited by Zmeyov, 1998, p. 104).

Higher-level Technology Integration-Active, student-centered use of technology that improves students’ digital competencies and student achievement. Quantity and quality technology integration that is beyond low-level forms of integration or teacher-centered use of technology. Research, problem solving, and collaborating on group projects are

examples of student-centered technology integration that have shown to improve student achievement (Allsopp et al., 2009; Vockley, 2007).

Instructional Technology Specialist (ITS)-provides classroom support for technology integration and technology support, data analysis, and school-wide systems management.

Professional Development (PD) - a comprehensive, sustained and intensive approach to improving teachers' and principals' effectiveness in raising student achievement”

(National Staff Development Council, n.d., p. 1).

Professional Learning Community (PLC) - an approach to professional development in which a group of community members, in this case educators, focuses on collective learning, shared vision and growth based on students’ needs (Hord, 1997).

STEM- An acronym for science, technology, engineering, and math, but also an approach to teaching that emphasizes hands-on learning.

Technology Integration- “the incorporation of technology resources and technology-based practices into the daily routines, work, and management of schools” (Lawless & Pellegrino, 2007, p. 577). “The use of hardware such as laptops, scanners, smart boards, document cameras, digital cameras,...and handheld computers, as well as related software and the Internet, in classrooms for enhancing learning” (Hsu, 2016 p. 31).

CHAPTER TWO

LITERATURE REVIEW

When developing teacher training, it is necessary to balance the needs of educators with the needs of the students. Plainly, teacher training is only effective if it contributes to student learning and achievement. Consequently, understanding how students learn is an important aspect of adequately preparing teachers. This literature review links the theory and methodology of student learning (project-based learning) and the theory and methods chosen to prepare teachers to adjust their instruction in order to implement the methodology. The literature review places the study within theoretical and historical contexts. It discusses the related research on implementation, technology integration, professional development, and professional learning communities. It also orients the reader to the historical context of the current educational climate in the knowledge age.

Historical Context

Today's global economy needs better-prepared workers. As such, education has responded with a transition from the traditional 20th century classroom to one that focuses on science, technology, engineering, and math curriculum (STEM) and emphasizes the skills of problem-solving/critical-thinking, collaboration, communication, and creativity. This section orients the reader to teachers' perceptions of their changing role in education as technology becomes increasingly ubiquitous in schools. This section of the literature

review also explores the historical undervaluing of the teaching profession and resulting teacher perceptions.

Eisner (2002) argued that traditional schooling prepares students for positions and contexts that are similar to the ones they experience in school: “hierarchical organization, one-way communication, routine” (p. 91). He further stated that 20th century schooling encouraged compliant behavior that prepared students for future jobs in factories. The model of education met the needs of the workplace at that time.

Today, the workforce rewards highly skilled and creative workers more so than compliant ones. Computers and automation are eliminating many factory jobs. Bobbitt (1918) recognized that changes in society would require changes to the educational system. He wrote that the contemporary structure of public education was constructed for simpler times and for different purposes. He believed that the system had improved incrementally, but not substantially. He argued that the educational system has been inherited from a previous time. Furthermore, he stated, “any inherited system, good for its time, when held to after its day, hampers social progress” (Bobbitt, 1918, p. 9). Made 100 years ago, this idea remains relevant. Students today are being educated in a system designed for a previous society.

Changing Societal Focus Leads to Shift in American Classrooms

By the 1980s, Americans were concerned with American schoolchildren falling behind other countries. In *A Nation at Risk*, the Reagan administration blamed public schools for the United States falling behind Japan and West Germany in the world economy (The National Commission on Excellence in Education, 1983). Schools began

to focus on educating students to be globally competitive and in order to improve the nation's standing in the world marketplace.

After *A Nation at Risk*, George H. W. Bush, along with a summit of the nation's governors, issued *America 2000: An Educational Strategy* (Ferneding, 2003). This plan set six goals that were to be achieved by the year 2000. It recognized a need for national performance goals and in essence, a national curriculum. In 1994, further legislation was passed, *Goals 2000: Educate America Act*, specified eight goals, including national standards, accountability, and choice, which were to be achieved by 2000 like the *America 2000* plan. This plan also highlighted a need for "educational reform within the Information Age and 'human capital' rhetoric" (Ferneding, 2003, p. 26). Two years later, the Department of Education allocated over \$2 billion in grant money to help make all U.S. children technically literate by the 21st century. Teacher training was an essential "pillar" of the plan; funds were allotted specifically for teacher training and support (Ferneding, 2003, p. 28).

In 2002, President George W. Bush signed the *No Child Left Behind* (NCLB) act, an update of the Elementary and Secondary Education Act, into law. This act vastly expanded federal oversight of education and led to an increase in high-stakes assessments.

NCLB was enacted in response to growing concern that the American education system was not adequately preparing students for the international marketplace. It sought to advance American competitiveness in the international marketplace and address scoring disparities between subgroups, (poor and minority students and students with disabilities) and their peers. In order to achieve those goals, NCLB increased school

accountability for student outcomes on state reading and math assessments for grades three through eight and three state science assessments (No Child Left Behind [NCLB], 2002). A criticism of NCLB is that it placed too much emphasis on standardized, or high-stakes, testing. As a result, there was a narrowing of the curriculum to focus almost solely on tested subjects and test preparation to the detriment of the other subjects. In practice, yearly state assessment has led to an over emphasis on tested content (reading and math) at the expense of other subjects, the decrease of interdisciplinary units that enable students to make connections.

As Pollard (2014) notes high-stakes testing tied to federal funds, created a punitive, competitive system that implied teachers needed more oversight and accountability measures to fulfill their professional responsibilities. These measures led to an increase in teacher and student anxiety over testing, influenced instructional practices, and ultimately contributed to the de-professionalization of teachers (Abrams, Pedulla, & Madaus, 2003; Pollard, 2014).

High-stakes testing affected teachers' instructional practices, specifically the amount of instructional time dedicated to test preparation (Abrams et al., 2003) or the amount of time they were willing to dedicate to trying new instructional strategies like project-based learning (Cash, 2017). Teachers felt pressure from administration to abandon teaching strategies that would enable students to have deep meaningful conversations and develop 21st century skills in order to drill the tested material. Placing pressure on teachers for student achievement on high-stakes assessments reduced opportunities for experiential, or hands-on, learning in favor of test preparation and

minimized the effect of teachers' expertise for designing appropriate learning opportunities (Abrams et al., 2003; Kellerer et al., 2014).

The Obama administration expanded federal control of education by signing *Race to the Top* legislation in 2009. One of the four educational policy goals was to “adopt standards and assessments that prepare students to succeed in college and the workplace and to compete in a global economy” (Spring, 2014, p. 445). Current school policies are discussed in a global competition context because good schools are necessary to ensure continued American power in the global marketplace. The science and technology fields feel a lack of qualified applicants for current and future jobs therefore human capital economics now dominate discussions of school reform. As mentioned previously, the South Carolina Council of Competitiveness (2015) challenges SC schools to produce graduates with 21st century skills, so the students will be equipped with requisite technology proficiency and skills to be competitive in a global marketplace.

During the past sixty years, the American manufacturing industry has been exported to foreign countries where labor costs are cheaper. This has caused a decline in the number of American citizens who work in blue-collar jobs. Fewer than 10 percent of American workers are employed in manufacturing; this is the lowest number since before the Industrial Revolution (Morley, 2006). In comparison, during the 1970s, approximately 25 percent of American workers were employed in manufacturing. From 1990 to present, manufacturing jobs have decreased every single year; since 1996, they have plummeted by almost one-fifth (Morley, 2006). This is not just an American issue. Abadzi (2015) found “the substitution of humans by technology is wiping out many

routine ‘blue-collar’ jobs in developed countries and is resulting in dramatic shifts in comparative advantage” (p. 7).

With the advances in technology, America has the opportunity to return some industry or develop different industries. In order to reclaim lost jobs or prepare students for new jobs created by advancing technology, schools are being tasked to prepare students differently. Wang (2012) recommends schools allow more flexibility in the school structure in order to respond to the rapidly changing needs of the technology-rich workplace. Career and vocational schools, STEM classes, and increased classroom technology use are intended to prepare students for the changing needs of the global marketplace.

In the 21st century, students’ ability to solve problems and think critically is more important than their ability to memorize facts. In his study, Wang (2012) reports that computers are replacing humans in low-skill tasks, which has caused a decline in the employment of unskilled or low-skill workers. At the same time, the demand for high-skilled workers is rising. The SCASA’s Profile of a South Carolina Graduate (2016) defines what 21st century employers are looking for: excellent knowledge and skills along with life and career characteristics. The ability to think critically, create, communicate effectively, and collaborate are among the necessary skills in the changing workforce (National Education Association, n.d.; Profile of a South Carolina Graduate, 2016; Wang, 2012).

Increasingly, world economies are seeking workers who possess these complex skills. Abadzi’s (2015) study found that today’s workforce requires skills that are flexible and applicable to new situations.

Workers must rapidly understand the requirements of the job, use computers fluently, know languages of international communication, and have a good understanding of mathematics. They are also expected to show initiative, creativity, critical thinking and responsibility, communicate clearly and persuasively, understand other people's communications rapidly and "read between the lines," demonstrate good manners, and seamlessly integrate into teams (Abadzi, 2015, p.7).

How can schools best prepare students for the future workplace? According to Elbow and Wager (1994), "Conventional classrooms tasks frequently lack the contextual features that support transfer from the school setting to the outside world" (p. 382). As the demand for a skilled labor force increases, schools must adjust to prepare students adequately for the global workplace. Science and technology companies are investing in schools because it is financially advantageous to begin training the necessary work force of the future. Because of the focus on preparing students to be ready for the technology-enhanced world, schools have focused on upgrading technologies and providing appropriate access for students (National Center for Education Statistics [NCES], 2000). Access to computers and the Internet has increased substantially in schools and classrooms throughout the United States. In order to support these technologies, studies and initiatives have focused on "understanding how best to use technology to improve teaching and learning and training educators to use technology effectively" (NCES, 2000, p. 22). As Reiser (2004) proposes, technology can assist in providing students with a real-world context for their learning. Technology can support the development of the 21st century skills that the global workforce demands.

New Technology Focus

As stated above, the educational system in America responded to the needs of the 19th and 20th century economy. In the 21st century, advancing technology has created a dynamic and highly competitive global economy and fundamentally has shifted the nature of work (Childress, 2017). This economic shift is happening so rapidly that education is racing to adjust. Education continues to prepare students for 20th century jobs even as it becomes evident that the workplace will require new and different skills. Disruption of this magnitude requires a monumental shift in teaching and learning. Childress (2017) argues the 21st century worker will need to be able to communicate and collaborate with diverse customers and coworkers, be adaptable to innovation and new ideas, and be problem-solvers and critical thinkers. As technology advances, more education applications are implemented. Kellerer et al., (2014) found that 90 percent of respondents, in a survey of teachers, perceived that blended learning facilitated self-paced learning better than previous methodology. Bottge, Ma, Gassaway, Toland, Butler, and Cho (2014) found that students who were taught with the blended units outscored students in traditional classes on both standardized and researcher-developed tests. However, Chatti, Jarke, & Specht (2010) found that traditional technology-enhanced learning (TEL) initiatives have failed to improve student performance. Past technology PD may have concentrated too heavily on teacher use of technology or the functionality of the program or device (Allsopp et al., 2009; Liu, 2013; National Education Association, 2008). Chatti et al. (2010) suggest rethinking how technology PD is designed in order to achieve performance improvement. They define the success factors.

Technology integration should respond to 21st century needs and be personal, self-directed, social, open, emergent, and driven by knowledge-pull (2010).

Four Cs of 21st century learning (4Cs)

As a member of the Partnership for 21st Century Skills, the National Education Association (n.d.) defines four skills critical for success in the 21st century, known as the ‘Four Cs’: critical thinking, communication, collaboration, and creativity” (p. 2). These skills, as well as the International Society for Technology in Education’s standards for teachers and students, inform this study and technology professional development (Appendices A & B). ISTE Standards for Educators (2017) encourage teachers to be designers of effective technology integrated lessons by:

[using] technology to create, adapt and personalize learning experiences that foster independent learning and accommodate learner differences and needs; design[ing] authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning; and [exploring] and apply[ing] instructional design principles to create innovative digital learning environments that engage and support learning (p. 2).

The purpose of the ISTE Standards for Educators (2017) is to guide teachers to integrate technology in meaningful ways in order to develop 21st century skills in students.

In *Maximizing the Impact: The Pivotal Role of Technology in a 21st Century Education System*, Vockley (2007) argues that all students need a different and more rigorous education than most receive today—an education that “focuses on teaching students to become critical thinkers, problem solvers and innovators; effective communicators and collaborators; and self-directed learners” (p.3). Workforce demands

have shifted from the skills suited for factory work to those of a fast-paced, dynamic, and technology-rich work environment. Society and the global workforce require students to be proficient in 21st century skills to succeed in a world that is constantly evolving. Used purposefully, technology-integrated instruction helps students develop 21st century skills (Vockley, 2007).

Technology and the Teacher's Role

When a new classroom organization is introduced, such as RMS's implementation of technology-enhanced project-based learning, there may be resistance to the change. Teachers may feel resistance to technology, and specifically blended learning and project-based learning (PBL), because a shift of the teacher role from teacher to one as a "manager" (Apple, 2013, p. 176). Apple found that many teachers he interviewed "are less than happy with the emphasis on programs which they often feel "lock us into a rigid system" (p. 176). RMS teachers may be hesitant if they perceive this change in classroom structure as a loss of autonomy and as a mandate from a largely patriarchal educational-authority. Teachers' resistance to change in teaching practices, such as technology integration or classroom organization, may be as Apple (2013) supposes, "at least partly tied to the resistance of a female workforce against external incursions into the practices they had evolved over years of labor" (p. 170-171). Historical and modern contexts affect teacher receptivity of initiatives.

Some teachers may construe the use of artificial intelligence as an instructional tool as an attempt to reduce the need for teachers (Kiesecker, 2018). Similarly, the shift of the role of the teacher in a PBL classroom places the teacher off the stage and in a more facilitator role (Ertmer & Simons, 2005; Herro & Quigley, 2017) Students are

actively working in a PBL framework instead of watching the teacher work. Although PBL teachers are busy working with students, the work looks different which may make teachers wary of this new technology-enabled approach. Project-based learning will be discussed in detail later in this chapter.

Nevertheless, Sal Kahn, founder of Kahn Academy, encourages teachers to view the new role differently, “the use of [technology] to personalize the delivery of ... learning activities will not reduce the importance of teachers, but increase it” (Tools for Real-Time Personalized Learning, 2012 p. 11). He continues that teachers in the 21st century will be “more like a coach or a mentor,” (p. 11). In this comment, he downplays the abilities, functions, and expertise of a teacher.

Bowers (2000) argues that technology proponents nor global leaders consider the downsides of rapidly expanding technologies on culture, education, and the earth. One effect of increasingly reliance in technology is the possible reduction of teaching staff. Educational technology companies and proponents argue that personalized learning software can improve productivity and change the staffing model to require fewer teachers (Kiesecker, 2018). Technology has reduced the need for workers in other industries, so it is feasible that it could happen in education. This may affect how teachers view technology integration especially for teachers already wary or insecure of their own technological skills.

Teachers’ Perception of the Their Role

In Przybyska’s (2011) study of teachers’ perception of their role, all teachers surveyed indicated that a teacher’s role was one of an educator and teacher. The third most indicated role at 80.6 percent was a “carer” (Przybyska, 2011, p. 88). However,

18.5 percent indicated that one of a teacher's roles was a master or guide which may indicate a gradual shift in perception of the teacher's role as sole arbiter of knowledge. Technology and the accessibility of information is probably a contributing factor to this shift.

The teachers in Przybylska's study (2011) were likely to categorize teaching as disseminating knowledge rather than creating possibilities to construct it. Seldom did the teachers indicate that teaching was an interactive or creative process with the aim to develop intellectual independence. More than half of the teachers identified themselves as a role model and authority. Przybylska (2011) indicated that those authoritarian roles should be gradually replaced with more collaborative roles of coach, tutor, and guide. Przybylska (2011) found that most teachers viewed teaching and their role in an "old fashioned" way (p.93). She discussed that to change this view changes to teacher education are required.

With the addition of technology-enhanced learning into pedagogy, the teacher role has become more of a facilitator role. Self-perception, as defined by Chiang & Jacobs (2009), is "an individual's understanding and perceptions of competence in specific domains" (p. 305). Although a teacher may feel competent within the traditional classroom domain, that self-perception may not transfer to technology-enhanced learning.

A RMS teacher's educational role should be one as a "coach", "designer," and "facilitator" with the teacher functioning as a curator of 21st century learning experiences for students (ISTE, 2017; Przybylska, 2011, p .90). ISTE standards for educators (2017) call for teachers to design authentic learning hands-on activities that maximize active, deep-learning and facilitate high levels of learning with technology challenging students

to use critical thinking to solve problems, and nurture creativity, communication, and collaboration. These new and demanding standards demonstrate the changing role of the teacher. Since the role of the teacher is evolving, the need for on-going quality technology PD is needed to equip teachers to be proficient technology facilitators in a modern classroom. Several studies have indicated the effect of teachers' beliefs regarding technology integration, self-perception, and self-efficacy affect the level to technology integration (Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016; Kafyulilo et al., 2015; Pryzbyska, 2011). Teachers' self-perceptions are an important factor in the success of professional development. Changing self-perception may affect teachers. Therefore, it is appropriate and relevant that this research study investigated teachers' perceptions technology integration as it relates to the changing role of the teacher.

Knowledge Age

In her book, *Learning Theory and Online Technologies*, Harasim (2012) explores the issues and challenges facing learning theory development in the 21st century. Problems with 20th century learning theory include its relation to practice, the position of adults in educational psychology, and methodology. She argues that these issues should be to be addressed by 21st century learning theory.

Harasim (2012) argues that collaboration is a fundamental characteristic of human development, reflected in all survival and cultural activities throughout history. Stages in human history have been predicated by major advancements in society, learning, technology, and knowledge (2012). As noted in her book, there have been four major paradigm shifts over the course of human history--the internet being one of those shifts.

The Internet was invented in 1990; by 2011, 2.2 billion people were online (Harasim, 2012). In a relatively short amount of time, the Internet has changed the way we view, acquire, and construct knowledge. It has revolutionized access to information and enabled the creation of a “global knowledge network” (p. 25) and created a 21st century knowledge age. Within this age, “knowledge is viewed as dynamic and evolving, not static or finite” (p. 83). Harasim (2012) writes “the Internet revolution and ensuing knowledge age emphasize, extend, and leverage our mental capabilities...the knowledge age mindset seeks the best way to solve a problem, rather than merely following instructions or replicating a textbook answer” (p. 13). The whole of human knowledge is now accessible with a wireless connection and a click of a mouse.

This new era signals the need for a revision of learning theories that emphasizes knowledge work, knowledge creation, and knowledge community. Whereas past and current learning theories and pedagogies focused on narrow individualistic tasks, rote memorization and regurgitation that groomed students to be Industrial Age workers, the knowledge age requires an education that “emphasizes creative, conceptual work, where there is no clear right or wrong answer, or where there are many right answers” (p. 83).

Educational and government agencies have responded to this paradigm shift with a call to more modern teaching methodologies that prepare students for a technology-rich work environment (Abadzi, 2015; Profile of a SC Graduate, 2016; NEA, 2008). Since students have access to so much information through technology, the role of the teacher is shifting to one of an experiential learning facilitator from a conduit of knowledge (Basilotta Gómez-Pablos et al., 2017; Przybylska, 2011; Tools for Real-Time Personalized Learning, 2012) because access to information has increased so

significantly. One current educational challenge is how teachers can bridge the gap between 21st century environments and 20th century pedagogies to engage and prepare learners, digital natives born after the Internet, for a rapidly changing world.

Theoretical Framework

This dissertation was informed by a theoretical framework regarding constructivist and adult learning theories, implementation science and technology integration research. This dissertation focused on teachers, their changing role in the classroom, and the context of school and society. Finally, teachers' needs as adult learners are also relevant to this study.

As stated above, 20th century models of instruction were predicated the teacher's authority over the student as the controller of the knowledge. The objectivist view of knowledge was that someone must impart knowledge onto an individual as seen in 20th century classrooms where students passively received knowledge from the teacher.

Contrary to the objectivist version of knowledge, constructivist epistemology informed this study. This view assumes that knowledge is constructed by the individual and not held by a higher authority. The internet and the global knowledge network accelerated this view of the nature of knowledge and learning.

Constructivism

Constructivism is both a learning theory and an epistemology of learning (Harasim, 2012). Constructivist epistemologies view knowledge as subjective, constructed from one's perceptions and generally accepted conventions. As such, learners construct new knowledge rather than acquiring it through memorization or teacher to learner transmission (Harasim, 2012). The constructivist theory of learning posits that

learners are active creators of their own knowledge. They reconcile new ideas and experiences with previous learning and they learn through experience and reflection (Jaramillo, 1996).

Most constructivist approaches fall under two broad categories: cognitive constructivism and social constructivism. The consensus of both factions is that learning is an active process of constructing rather than obtaining knowledge. Piaget (1964), a proponent of cognitive constructivism, posits that students learn through challenging experiences, the cognitive conflict those experiences create, and their (students) subsequent reflection. Piaget's constructivism focuses more on the individual than the social aspect of learning.

Vygotsky's (1978) sociocultural theory inspired social constructivism, which emphasizes the social nature of knowledge construction. Vygotsky sees learning as a social endeavor; in the classroom, students learn through interacting with their peers and teacher. The latter serves as a guide to learning experiences. Vygotsky also hypothesizes that the learner prefers "to be actively involved in hands-on learning activities that interest him and are just above his current level of competence" (Jaramillo, 1996, p. 135). In essence, students learn through guided or supported learning. Vygotsky never used the term scaffolding in his research, but it is closely tied to his theory. Constructivist classrooms utilize instructional practices that are student-centered, active, and interactive-achieved through group learning (Fusa, 2016). These principles are explored later in this chapter.

Communities of practice or professional learning communities can also trace their roots to constructivism (Cifuentes, Maxwell, & Bula, 2011). As stated at the beginning of

the literature review, the needs of students and adult learners should be recognized when developing effective training (Dewey, 2010). Both the method and the topics of the training are grounded in constructivism theory and epistemology.

Project-Based Learning

In their research, Basilotta Gómez-Pablos et al., (2017) evaluated the experience of teachers implementing project-based learning through technology integration. They found that schools should concentrate on pedagogy that supports complex differentiated activities that accepts students' interests and needs and different ability levels.

Project-based learning (PBL) is a learner-centered framework that gives students the opportunity to conduct inquiry, make decisions, and apply knowledge to solve complex problems (Savery, 2006). The methodology of PBL includes: (1) authentic context (2) teacher as facilitator, (3) explicit learning goals, (4) authentic assessment, (5) cooperative and collaborative learning (6) reflection (7) development of different skills and competencies (Basilotta Gómez-Pablos et al., 2017). Students work as a team to create a product to demonstrate their solution and knowledge gained about a driving question (Basilotta Gómez-Pablos et al., 2017).

One of the main aspects of this methodology is the need to ground learning in real-world problems. Learning is not rendered meaningless by rote classroom activities. Instead, PBL's immediate goal is to "meet students' requirements and the application of them in everyday reality and other contexts. Through projects, students make use of higher-order skills instead of memorizing information in isolated and unconnected contexts" (Basilotta Gómez-Pablos et al., 2017, p. 502). Additionally, PBL increases student motivation because activities are organized around a common interest defined by

students, and it creates a collaborative environment between the student and his peers and the teacher (Basilotta Gómez-Pablos et al., 2017). Not only does PBL affect student motivation, but also projects that emphasize students' collaborative work have the potential impact academic performance (Basilotta Gómez-Pablos et al., 2017; Raes, Schellens, De Wever, & Benoit. 2016).

Technology integration within the PBL framework. Undoubtedly, information and communication technologies (ICT) have made a crucial contribution to the field of education. ICT continues to develop solutions and tools to optimize teaching and learning in the 21st century. Technology integration can make PBL more effective by increasing student engagement through interactivity, making communication smoother, and facilitating collaboration (Basilotta Gómez-Pablos et al., 2017). Technology integration along with PBL principles provide the basis for teaching that is more focused on skills rather than facts.

Reyes and Gabb (2005) investigated the use of information communication technology in a problem-based learning environment. Through discussion with students and teachers, Reyes and Gabb (2005) discovered that the use of technology supported the PBL process and was an integral part of the learning environment and learning activities. They also found that technology integration supports deep learning by providing a convenient means to interact and communicate ideas, which is a central component of PBL. Technology integration provides a means to obtain appropriate and timely feedback and supports active student inquiry (Reyes & Gabb, 2005). Technology integration also has the potential to empower students with more control over their own learning.

Blumenfeld, Soloway, and Marx, (1991) explored how technology supports project-based learning and project implementation. Primarily, technology makes information more accessible, allows students to construct, create, and store their own representations through several media, and structures the learning process through personalized learning platforms and learning management systems. Furthermore, Blumenfeld et al. (1991) investigated the relationship between teachers and technology in PBL environments. Technology can support teachers as they learn and implement PBL. Teachers need to know: (a) meaningful, rigorous, and engaging ways to present content, (b) PBL methodology (e.g., how to help students plan, execute, evaluate, and reflect on their work, (c) management of technology and PBL, (d) and differentiation strategies immersed within PBL (Blumenfeld et al., 1991). Professional development regarding these four components is necessary for teachers to utilize technology to support PBL.

In Herro and Quigley's (2017) study of teachers' perceptions of STEAM following professional development, they found that after professional development teachers' perceptions of STEAM teaching evolved in three key ways. Herro and Quigley used PBL as a transdisciplinary approach to achieve the goals of STEAM. STEAM and STEM are often ground in the PBL principles of cross-curricular projects, critical thinking, and collaboration; therefore, this study may provide insight into how RMS teachers may perceive PBL methods. Teachers in the study reported an increased understanding of STEAM principles within their content and beyond, they agreed collaboration was a means to achieve transdisciplinary teaching, and teachers expressed the belief that effective technology integration needed to move beyond technology for

instruction and focus on technology as a means to promote learning content (Herro & Quigley, 2017).

Teachers may struggle to employ PBL methodology in their classroom (Ertmer & Simons, 2005; Herro & Quigley, 2017). Ertmer and Simons (2005) cite a previous study that found only 5-10 percent of teachers will even try a new teaching strategy unless they are provided with an adequate support system. They acknowledge that teachers may find implementation challenging and time-consuming. PBL classrooms tend to lack the structure and traditional control that teachers are comfortable. Further challenges to implementation include incorporating technology as a cognitive tool and designing authentic assessments (Herro & Quigley, 2017). Ertmer and Simons (2005) suggest to increase the chances of a successful implementation, teachers require support “that will enable them to address the diverse challenges they are likely to encounter as they plan, implement, and evaluate the PBL process.” (p. 3). They expound that teachers need new technologies and strategies “as they adopt new roles, facilitate student inquiry, provide ongoing formative feedback, and implement new types of classroom management strategies” (p.3). The role of the instructional technology specialist (ITS) becomes essential in supporting teachers with not only implementing new technologies, but also assisting teachers in developing the strategies to manage them and facilitate PBL. Research indicates that some form of professional development is necessary to support the ongoing technology integration and PBL teaching practices at RMS (Ertmer & Simons, 2005; Herro & Quigley, 2017).

Adult Learning Theory

As society evolves in the knowledge age, education is presented with new challenges and responsibilities. There is a continuous quest for new methods and a constant struggle to determine curriculum tailored to meet the individual needs of learners. New technologies and the global information age are changing the workplace just as it is affecting schools. Adults, including teachers, need to learn. Andragogy is, as defined by Knowles, “the art and science of helping adults learn” (as cited by Zmeyov, 1998, p. 104). There are key differences between children and adult learners. Those differences demand to be acknowledged as society progresses and more adults require continuing education. One category of the adult learner is the professional, such as a teacher, attempting to improve his skill.

According to Zmeyov, (1998), “the adult learning process is characterized by the leading role of the learner...; the learner and the teacher cooperate in all stages of learning: i.e. in the planning, realization, evaluation, and correction of learning process” (p. 106). This characteristic guided this study; the participants and I collaborated within a professional learning community (PLC). Treating teachers as the adult learners and professionals from the start of the inquiry built trust between the researcher and the participants.

When professional developers create their instructional materials, they should address the needs of adult learners. Adult learners are autonomous, self-directed, goal oriented, relevancy oriented, and practical (Zmeyov, 1998; Borthwick & Pierson, 2008). They also possess a foundation of life experience and knowledge. Adult learners, such as teachers attending PD, want to be shown respect for their knowledge, abilities, and

experiences (Borthwick & Pierson, 2008). ISTE recommends that at the beginning of technology trainings, leaders acknowledge the purpose for learning and motivation of these learners (Borthwick & Pierson, 2008).

In *Transforming Classroom Practice*, editors Borthwick and Pierson (2008) reference Keagan's framework for adult education consists of three characteristics: confirmation, contradiction, and continuity. School leaders can confirm teachers' value and knowledge by involving them in the designing and planning of PD curriculum. Confirmation focuses on de-emphasizing the rigid divisions between teachers and leaders and forming cohesive units to foster a culture of support and cooperation (p. 28).

When school leaders address contradiction when developing learning opportunities for teachers, they address the "gap between the person and the world" (p. 28). Recognizing how things are and how they could be if the school could enact change is an important factor in success of adult learners. Reaching people where they are with their skills, knowledge, and experiences, allows for personal and system change.

Continuity, first introduced by Dewey, validates the needs of the learner (2010). To achieve continuity for adult learners, educators must use models for learning that support the individual's needs, the needs of others in the group, and the needs of the larger organization (Dewey, 2010). Leadership grounded by adult learning theory engages individuals and groups within schools differently.

Implementation Science

Implementation science has the potential to reduce the gap between existing research and actual practice (Olwang & Prelock, 2015). Implementation science explores "the best ways to ensure that evidence-based information is integrated into practice" (p.

S1819). It systematically addresses the factors that contribute to the research-practice gap by acknowledging the context, identifying barriers to implementation, and proposing solutions to maximize positive outcomes (Olswang & Prelock, 2015).

Nordstrum et al. (2017) assert that implementation is a collaborative effort between researchers and practitioners—both are accountable for the quality and fidelity of implementation. They highlight that the teacher has a significant effect on implementation quality, effectiveness, and overall outcomes. Further, they acknowledge intermediaries, possibly instructional coaches, as essential to ensure high quality and sustainable implementation.

In Implementation as Mutual Adaptation: Change in Classroom Organization, McLaughlin (2013) references Rand’s change agent study, which found that mere adoption of a new practice did not invariably lead to improved student outcomes. The study found that “successful implementation is characterized by a process of mutual adaptation” (2013, p. 196). Mutual adaptation requires both the design to change as well as the setting and participants throughout the implementation process. In order for these changes to occur, all stakeholders, administrators and teachers, must be willing to make changes to improve or alter their behavior in order for the innovation to have a chance to be successful.

McLaughlin (2013) focuses on classroom organization component of Rand’s change agent study. In terms of changing classroom organization, the “process” of mutual adaptation is especially important. He writes, “The amount of interest, commitment, and support evidenced by principled actors had a major influence on the prospect of successful implementation” (2013, p. 196). In classroom organization changes,

administration, district office staff, and teachers must be interested and committed to the project. Although there are no set steps to ensure teacher support of new projects (Fixsen, Naoom, Blase, Friedman, & Wallace, 2005), administrators and district office staff must gain teacher support if the innovation is to succeed. Obviously, implementation happens in the context of a community. The receptivity of that community is an important characteristic of successful implementation. It is important that the person providing training to teachers can gain teacher support for technology integration. Without such support, the implementation is likely to fail. McLaughlin (2013) also discusses the need for ongoing staff development, adaptive planning, and staff meetings as components of successful implementation. In *The State of Opportunity* study on blended learning in Ohio, respondents indicated that their top three challenges to implementing blended learning “were finding high-quality professional development (36%), getting staff buy-in (34%), and funding (32%)” (Arnett, et al., 2015, p. 6).

Technology Integration

Over the past two decades, technology integration has increasingly become a concern to schools. Many school districts have concentrated their efforts in providing students access to technology, even though significant disparities still exist (Cifuentes, Maxwell, & Bula, 2011). Research has shown that schools have not integrated high levels of effective technology (Cifuentes et al., 2011; National Education Association, 2008; Ertmer & Ottenbreit-Leftwich, 2008). However, even schools that do have a high level of access to the internet and other instructional technologies, such as computers or mobile devices, are rarely using those technologies in ways that significantly improve student learning (National Education Association, 2008). Teachers are using technology for

record-keeping, administrative tasks, communication tasks, such as corresponding with parents and colleagues (Ertmer & Ottenbreit-Leftwich, 2008). A 2008 National Education Association (NEA) report found only slightly more than half of the educators that participated in the study felt that they had adequate preparation to integrate technology into instruction. Fewer than half felt prepared to use it for individualized instruction. In the NEA report, three-fourths of teachers reported using technology daily to perform administrative tasks while less than one-half reported using technology “daily to monitor student progress, for research and information, to instruct students, and to plan and prepare instruction (40.7%, 36.8%, 32.0%, and 29.2%, respectively)” (National Education Association [NEA], 2008, p. 20). Interestingly, middle school staff seemed particularly satisfied with their technology PD. Sixty-one percent of middle school staff were satisfied with their training to integrate technology into daily instruction compared to their high school (53.7%) and elementary (54.7%) counterparts (National Education Association, 2008). The authors did not speculate as to why middle school teachers were more likely to be satisfied with their technology training, however, the level of satisfaction did not correlate to the requiring students to use technology.

The levels of student technology use were significantly lower than compared to those of teachers for administrative technology tasks (NEA, 2008). Of the teachers surveyed in the NEA study (2008), only half of them asked their students to use technology at school for individual research and problem solving. Only a few educators reported that their students use technology regularly. Approximately one-third of participants required students to use technology to research or solve problems in class at least a few times a week and less than twenty percent (18%) required students to use

technology to collaborate on projects at least a few times a week (NEA, 2008). Research, problem solving, and collaborating on group projects are examples of student-centered technology integration that have shown to improve student achievement (Allsopp et al., 2009; Vockley, 2007).

The discrepancies were even more apparent when disaggregated by school level. High school teachers were more likely than their elementary and middle counterparts were to require students to use technology for researching questions to solve problems, for group work and to complete homework (NEA, 2008). Approximately 30 percent of junior high/middle school teachers surveyed reported requiring students to use technology to research and solve problems in class. Only 13.3 percent required student use of technology to complete group projects (NEA, 2008). Integrating technologies into the curriculum appropriately is a complex task that requires sustained effort. Many teachers may find the task difficult and question whether technology has been integrated effectively.

According to Cifuentes et al., (2011) technology has been appropriately integrated in curriculum when:

1. An outside observer sees the technology activity as a seamless part of the lesson;
2. The reason for using technology is obvious to the teacher, students, and others;
3. Students are focusing on learning rather than on technology;
4. The teacher can describe how technology is helping a particular student;
5. The teacher would have difficulty accomplishing lesson objectives without technology;

6. The teacher can explain what the technology is supposed to contribute; and
7. all students are participating with technology and benefiting

When all of the above criteria are met, a teacher can have confidence that technologies are being effectively applied in his or her classroom (p. 61).

Cifuentes et al., (2011) contend that effective professional development is necessary to facilitate this level of technology integration. They continue that professional development must exceed the basic functionality and management training, but include the “application of change theory and design of student-centered instruction, adoption of project-based learning by teachers, demonstrations by school teachers who have mastered specific technologies and methods modeled for integrating technology in curriculum” (Cifuentes et al., 2011, p. 61). In order to achieve this level of effective technology integration, professional development must be a sustained, social activity involving a learning community of students, teachers, and school administrators (Cifuentes et al., 2011).

Okojie et al. (2006) found that technology should not be treated as a separate entity but should be considered as an integral part of instructional delivery. In order to accomplish this mindset shift, teachers need to be equipped with the skills to assess the appropriateness of any instructional technology in relation to specific instructional goals. Teachers should also consider how the technology supports the lesson objectives, instructional method, and assessment (Okojie et al., 2006). Technology PLCs could provide teachers the skills, time, and support to evaluate instructional technology. Okojie et al. (2006) argued that that “such considerations will provide teachers the opportunity to

reflect on their practice and reduce the tendency to integrate technology into teaching and learning in a mechanistic way” (p. 68).

School Leadership’s Effect on Technology Integration

In a study of factors that contributed to high school teachers’ technology integration, Gürfidan and Koç (2016) proposed a structural model to explain teachers’ technology integration through school culture, technology leadership, and support services. They found that school culture indirectly influenced technology integration through the mediation of technology leadership and support services. A positive school climate could be fostered by effective leadership behaviors, adequate support, and encouragement for the increased use of technology. They concluded that support services had a direct and largest total effect on teachers’ technology integration. Support services were defined as conditions that affect teachers’ perception of how easy or difficult to use technology is in their schools. Several factors contribute to high quality support services (1) convenient access to technology resources (2) one-on-one support (3) formal or informal training on educational technology integration (4) facilitating professional collaboration (Gürfidan & Koç, 2016). Several of these factors will be discussed later in this chapter.

Gürfidan and Koç (2016) defines technology leadership as a kind of leadership that endeavors to motivate, support, direct, and manage employees for efficient and effective use of technology in the institutions. They determined that support services mediated the effect of technology leadership on technology integration. This finding suggests that technology leadership first influences support services, which then directly influences teachers’ technology integration. In order for technology leadership to be

influential on technology integration school administration should “provide teachers with more overall and technical support, effective communication, and professional development, teacher will then integrate technology more widely” (Gürfidan & Koç, 2016, p. 111). School administration should be leaders and facilitators of technology vision at their schools (Gürfidan & Koç, 2016).

Technology Leadership

Grey-Bowen (2010) further clarifies technology leadership as “a combination of strategies and techniques that are common to all leadership but requires specific attention to understanding how technology can improve instructional practice and implementing strategies for helping teachers use technology in their classrooms” (p. 10). As part of an effective technology implementation plan, school leaders should develop clear educational goals for technology integration (Grey-Bowen, 2010).

Administrators can play a pivotal role as technology leaders by ensuring the technology-integrated instruction in their schools is educationally sound, well planned, and aligned with the school’s vision and goals (MCEETYA, 2006). School leadership can use the potential of information and communication technologies (ICT) and their higher-level integration to improve student outcomes by establishing school goals focused on high levels of student learning; establishing functional, viable, and rigorous learning environments; and promoting high-quality technology integration practices. ISTE standards for coaches (2011) and administrators (2009) encourage school leaders to develop and implement comprehensive plans for technology integration that promote a 21st century education for all students in all classrooms. These plans should include strategies for logistics (management of hardware and software and sustained technology

innovation within the school); professional development programs for school-wide implementation; advocacy for higher-level technology integration at local and state levels; and partnerships with teachers and community members (ISTE, 2011; ISTE, 2009).

Administration can support teacher efforts toward technology integration by allocation of funds, time, and support services (Shuldman, 2004). Principals' responsibilities tend to include creating the technology committee and budget, allocating time and money for technology planning. Both have shown to contribute to classroom technology use by teachers and students (Anderson & Dexter, 2005). Resources such as mentor teachers or technology coaches, and the time needed to plan integration may promote higher levels of technology integration within a school (Webb, 2011).

Lack of informed leadership is an impediment to successful technology integration (Grey-Bowen, 2010). Principals may lack the expertise and time needed to make informed decisions regarding technical and logistical issues (Grey-Bowen, 2010). However, it is still the responsibility of principals to make the sound decisions regarding technology acquisition, allocation, and application in their schools. Often principals rely on a shared leadership strategy to make these decisions. In a study of five schools' technology integration, Dexter (2011) stipulates "that technology leadership should be considered a school characteristic, one shared by a team of people and whose results are school resources such as technology access and support" (p.184). The majority of United States public schools have a team of people involved in the planning and support of technology use (Dexter, 2011). These teams often include the principal, a technology coordinator, and frequently teachers or media specialists. Approximately one-third of

U.S. public schools have an in-house, full-time, technical, and instructional support person and a team of two to three people that also contributes to technology support and planning (Dexter, 2011).

The vision of the school's leadership team directs the school's technology use (Dexter, 2011). She cautions that without a focused instructional vision, technology implementations can be reduced to technical or operational concerns—maintaining access and providing technical support. Dexter (2011) writes, a school's specific purpose for pursuing technology integration “reflects leaders' broader ideas about how technology can support learning and influences what structures, routines, and tools they put into place, which in turn demonstrate those leaders' conceptions of the appropriate role and involvement of technology coordinators, teachers, and students as technology consumers and leaders” (p. 185).

Instructional Technology Specialists

In a study of the role of specialists in a teamed technology leadership model, Dexter et al. (2009) observed, in regards to technology integration, substantive changes to the core teaching and learning within the schools came from a team of people. One of whom, the instructional technology specialist or other instructional technology support designee, supported the learning phases of the school improvement plan (Dexter et al., 2009). The authors concluded that ITS' effectiveness derived not from authority or power but from their expertise in the field and teachers' need to learn how to use technology effectively. Teachers viewed these support staff members as providing essential help. Dexter's et al. (2009) study demonstrated that instructional technology specialists provide more than just technical support. ITS respond to teachers' request for instructional

support, but also use their individual expertise “to proactively provide ideas, recommendations, and help to the school as a whole” (p. 462). In order for instructional technology specialists to be effective, school leadership must set the expectation that technology will be a part of instruction, and technology must be accessible and reliable (Dexter et al., 2009). When these conditions are met, the ITS and teachers can focus on instructional improvement through technology integration. Furthermore, the ITS can establish direction exert subtle pressure for instructional change within the school (Dexter et al., 2009).

Technology Professional Development

The National Education Association report, *Access, Adequacy, and Equity in Educational Technology* (2008), concluded that teachers need sustained professional development in order to integrate educational technology in the curriculum in meaningful ways. Professional development is necessary because simply using technologies in schools does not positively affect achievement (Lawless & Pellegrino, 2007). Evidence compiled by Lawless and Pellegrino (2007) suggests that educational gains are made through high-quality instruction and assessment that supports student learning. Further, Lawless and Pellegrino (2007) argued that although technology can make it more convenient and engaging to teach the same things, it has the opportunity to be a beneficial educational force. Technology also makes “it possible to adopt new and arguably better approaches to instruction and/or change the content or context of learning” (p. 581). Thus, decisions, about what, when, how, and for what purposes technology should be used in classrooms, cannot be made indiscriminately or unsystematically. Technology integration must be grounded in deeper principles and research. In its analysis of the

findings, the NEA (2008) recommends technology integration should focus creating differentiated lessons for students, development of cognitive and higher-order skills and enhancing student creativity.

Technology integration PD should focus on developing fundamental technology knowledge and skills, managing technology in the classroom (logistics), and demonstrating how technology can support content in meaningful ways (Hew & Brush, 2007). Furthermore, according to Hew & Brush (2007), PD programs should incorporate several strategies including sharing examples of teachers' successes emphasizing student outcomes, providing support for experimentation, and defining good teaching with a corollary of technology integration. Beyond training sessions, teachers must witness the impact of technology on their students' learning (Hew & Brush, 2007). When teachers witness the positive effects on student learning, they are motivated to experiment by adding more technologies to the curriculum. Focusing on helping teachers understand how student-centered practices integrated with technology can affect student outcomes (Ertmer & Ottenbreit-Leftwich, 2010).

Skill development and transfer. According to Willis, Weiser, and Smith (2016) skill development and skill transfer are critical objectives in technology training. They recommend scaffolding learning during skill acquisition because it establishes teachers' "sense of success, self-confidence, and increased interest in further skills development" (p. 5). Scaffolding requires breaking skills into small obtainable chunks as the learner, in this instance a teacher engaging in technology PD, progresses to mastery. Scaffolding helps teachers become comfortable with using technology themselves.

If used within a professional learning community, teachers may observe other teachers' struggles with technology and feel a sense of reassurance and camaraderie. They may also see teachers who have an interest or aptitude for technology; these more confident teachers become support or second teachers in the PLC. The PLC helps build trust and relationships within the group assisting in the development of technology skills.

Previously, skill development has been the focus of technology training. Most trainings focused on functionality of particular technologies. Trainers ensured teachers were able to navigate websites, login in to devices, etc. Although these are necessary skills, for technology PD to affect student achievement, training must progress beyond functionality and focus on curricular applications (Cifuentes et al., 2011).

Another objective of technology training is the transfer of skills/knowledge related to integrating technology into curriculum (Willis et al., 2016). Technology training aligned with curriculum and relevant to what teachers do in classrooms, as in a PLC focused on PBL methodology is more beneficial to teachers and their students than training limited to basic technology skills (Willis et al., 2016) or integration that does not focus on higher-order learning. In order for technology PD to have a positive effect on teachers' technology use within the classroom, continued modeling and coaching of effective uses of technology is required. Standard PD courses, from outside the school context, focused on basic skills and application often do not enable transfer of skills from the training environment to the classroom (Willis et al., 2016). Roanoke's professional learning community with the support of the instructional technology specialist is situated to provide this continued support for teachers. As Willis et al. (2016) advise instruction must model appropriate and effective uses of technology tools for both teaching and

learning. They state, “Simply telling a teacher the capabilities of technology is not enough; teachers must envision technology as it relates to their content if they are to master ways to integrate technology effectively” (p.5).

Ertmer and Ottenbreit-Leftwich (2010) call for educators to consider technology not as a supplemental teaching tool, but as essential. Technology serves little purpose if not used as a more effective teaching tool in classrooms. In its analysis of the findings from a survey of America’s teachers on education technology, the NEA (2008) recommends expanding technology professional development with a focus on the use of technology as a classroom-learning tool. Training to use technology should go beyond the uses for administration or communications. Effective training should focus more integrating technology into curriculum to increase student achievement. Technology integration should focus creating differentiated lessons for students, development of cognitive and higher-order skills and enhancing student creativity. Schools should seek more and better ways to use technology for the greatest gain in student achievement (National Education Association, 2008).

In their study of pre-service teachers in a technology course, Brown and Warschauer (2006) suggested a more in-depth exposure to technology integration rather a focus on mastery of hardware and software functions. Furthermore, the preservice teachers’ project work did not encourage the use of technology to promote higher-order learning. Their research suggested that the promise of technology is in “their capability to enhance students’ high-order learning and problem-solving skills by using collaborative-based instruction” (p. 608). The lack of emphasis on using technology for higher-order learning activities within the technology course extended to the preservice teachers’ field

study. Approximately 10 percent of the teachers reported using technology for collaborative projects during their field study (Brown & Warschauer, 2006). This study illustrates the disconnection between effective technology integration preparation for teachers and actual classroom practice. In order for technology to be used to enhance instruction, effective technology integration professional development is needed.

Moreover, Liu (2013) advised, in qualitative study of technology professional development utilizing professional learning communities, that continuous professional development is necessary for technology integration that emphasizes student use of technology and 21st century skills. Accordingly, technology PD should be school-based. Liu (2013) argued that collaboration and experience sharing within a community could promote the technology integration and student-centered instructional practices. The participants of Liu's study initially utilized technology-enhanced lectures. However, after treatment [PD within the context of a PLC] the teachers began developing "student-based teaching methods with technology" (p. 41). The participants reported that technology PD, peer observations, collaboration, and reflection were crucial components of the subsequent change in teaching methods (Liu, 2013).

Confidence and usefulness. Technology professional development should also demonstrate usefulness of tools to promote teacher use. According to Siddiq, Scherer, and Tondeur (2016) perceived usefulness is an indicator for predicting whether teachers would integrate information and communication technology into their classrooms. Confidence is another critical factor in using technology-integrated instruction. Both teachers' confidence level and perceived usefulness of technology tools and strategies for

instructional practice are important predictors of quality and frequency of technology integration (Siddiq et al., 2016).

Professional Learning Communities

Roy et al. (2012) note that collaborative relationships between those who conduct professional development, such as ITS, and teachers are crucial to the scaling of innovative programs including technology integration initiatives. During their study of professional development support of math teachers implementing a digital unit, they learned the importance of addressing teacher behavior and knowledge in PD sessions by adjusting instruction to address misconceptions or knowledge gaps; and collaboration among teachers and those conducting the PD through shared expertise during the planning, implementation, and reflection phases. In addition, Webb (2011) noted that the more the teachers shared and supported each other, the more risks they took in integrating technology into the curriculum.

Fullan (2001) suggests that creating an atmosphere conducive to change within a traditional school is not adopting the latest trend but about fostering a culture that encourages a cyclical process of teachers seeking, critically assessing, and carefully incorporating new ideas and practices within and outside of the organization. As stated above, teacher buy-in and community receptivity to change are important factors to the success of implementation (McLaughlin, 2013; Arnett et al., 2015). The most effective environment to kindle change in schools is a professional learning community (Hord, 1997). Hord (1997) suggests that authentic learning communities require certain conditions to be successful. (1) PLCs require structural conditions to be successful including time to meet, basic electronic and paper resources, as well as access to easily

interpretable data. (2) PLCs also require the community members to be committed to the success of the group by respect for each other, interactions within the group, and conflict resolution. (3) The PLC should be grounded in a shared vision of the school's values and goals. (4) The purpose of a PLC is continued intentional learning and growth. Students' learning needs determines what the PLC will learn and how members will learn it. (5) Finally, PLCs learn from each other through peer observations and feedback to assist one another to reach their shared goal (Hord, 1997).

Furthermore, the social capital of a school plays an integral role in initiating and sustaining changes of the pedagogical use of technology (Li & Choi, 2014). The social capital of a school can be used to stimulate a culture that implements change and reinforces teachers' receptivity and responsiveness towards organizational change. As Li and Choi state (2014), "Social capital helps establish the formal and informal social support structures that provide novice teachers with necessary scaffolding and impetus to experiment with new technologies and pedagogies" (p. 13). These formal and informal social structures could be supported through the implementation of a professional learning community. Atkinson (2005) found a positive correlation that as the practice of professional learning communities increased, there was an equal implementation of technology integration. Functioning PLCs support technology infusion into student learning. Formal and informal interactions with peers and experts in the field provide the scaffolding for the use of the new technologies and their applications to support student achievement (Atkinson, 2005).

Harnisch, Comstock, and Bruce (2014) found that professional learning communities provided an informal safe space for sharing ideas and fostered communal

and mutual learning and teaching among members of the PLC. Outside of the formal classroom setting, participants met with their peers to discuss their experiences and reflect on their learning. Harnisch et al.'s study participants, in that case graduate fellows, met to share "their frustrations, insights, suggestions, and perspectives... natural leaders emerged and discouraged fellows could be motivated" (2014, p. 500). In this instance, the PLC nurtured an informality that invited narrative reflection through sharing and reflection.

During the past two decades, empirical research has demonstrated that effective PD should be on going and is best situated within a learning community and with the support of an administrator (Harnisch, et al., 2014; Cifuentes et al., 2008). Learning in context, such as PLCs focused on an organizational initiative, can engage individuals in actively working with others on challenges and goals within their professional practice (Webster-Wright, 2009). The literature on effective professional development for teachers indicates that ongoing activities in the school community context are more effective than one-time workshops (Cifuentes et al., 2008; Li & Choi, 2014). These factors contribute to teacher content knowledge and teacher satisfaction in regards to professional development (Cifuentes et al., 2008).

Conclusion

The National Education Association (2008) report found that although almost all educators in its study reported that their school district required technology training, that training appeared to be geared mostly toward administrative uses, research, and communications. Only slightly more than half of the educators felt that they had adequate preparation to integrate technology into instruction, and fewer than half felt prepared to

use it for individualized instruction. Middle school staff were more likely than high school or elementary staff to feel their technology professional development was adequate or more than adequate (National Education Association, 2008).

Ertmer and Ottenbreit-Leftwich (2010) call for educators to consider technology not as a supplemental teaching tool, but as essential. Technology serves little purpose if not used as a more effective teaching tool in classrooms. They contend that knowledge, self-efficacy, pedagogical beliefs, and culture are key characteristics that predict whether teachers will integrate technology effectively.

It is important to determine which characteristics and factors are conducive to teachers integrating technology into instruction. Kafyulilo, Fisser, and Voogt's (2015) findings regarding factors that affect teachers' continuation of technology to teach science and mathematics after pre-service technology training included professional development, personal, institutional, and technological factors. As stated by Kafyulilo et al., (2015) teachers need to perceive the PD as valuable, have access to reliable technology that is easy to use, have management support, and a supportive environment that may offer rewards and incentives to integrate technology. Teachers' personal beliefs, knowledge and skill levels, personal commitment, and engagement are also factors (Ertmer & Ottenbreit-Leftwich, 2010; Kafyulilo et al., 2015). Furthermore, Kafyulilo et al. (2015) concluded that the likelihood of technology integration was not the result of one factor but the combination of all factors. Obviously, lack of access to technology prevents teachers from integrating even when the teachers possess the knowledge and skills to integrate (Kafyulilo et al., 2015). However, having technologies did not guarantee integration. For example, even if teachers had access to technology, when

teachers lacked motivation or administrative or technical support, teachers did not integrate (Kafyulilo et al., 2015). RMS teachers have access to technology, so other factors must be contributing to the lack of high-level technology integration. One intended outcome of this study is a better understanding of how to address the other factors to support teachers' technology integration.

There are barriers to professional development in schools. Some are structural. Different bell schedules, lack of common planning among grade levels, and the amount of required paperwork make it difficult for people to work together. Other barriers are cultural. As discussed earlier, American society has historically undervalued the role education, and teachers specifically, play in society (Benton, 2014; Spring, 2014). Culturally, teachers have many roles and responsibilities hoisted upon them. Although society may laud teachers for the selflessness and commitment to students, it does not compensate them commiserate to their contribution to society. These barriers contribute to hesitance from teachers to engage in professional development adding another responsibility to their plate. Specifically reluctance to technology PD is a barrier because teachers may see it as a loss of autonomy or being replaced by a computer.

The current literature review contextualizes the importance of developing appropriate technology professional development for adult learners, so teachers can integrate technology to increase students' hands-on use of technology and 21st century skills. As it discusses, teachers' roles are shifting as technology is utilized more frequently and in more advanced ways. Thoughtful planning of technology integration is required for effectual student use of technology. As teaching changes with advancing technology, professional learning communities could be a method of addressing teacher

concerns and appropriate technology. Sustained and quality technology professional development will be required to equip teachers with the knowledge and skills necessary to integrate high-level technology appropriately and effectively. Historical, structural, and personal barriers exist that hinder teachers from technology integration. In the following chapter, the researcher defines the research methodology used in this study and describes the pedagogical foundation for the professional development.

CHAPTER THREE

METHODOLOGY

Action research has many benefits including professionalizing teaching, making progress on school-wide goals, and enhancing teacher motivation and efficacy (Sagor, 2000). Another benefit is that the researcher is able to become more reflective regarding her own practice. This study sought to determine to determine the effect of PD on teachers' high-level technology integration. Participatory action research aims to confront specific problems of practice within a classroom or school (Fraenkel et al., 2015). Its fundamental purpose is to improve short-term practice and inform larger issues at the school level. Therefore, action research methodology provides the most appropriate framework to address these research questions:

RQ1: To what extent will the implementation of technology professional development change the use of higher-level technology integration in a middle school?

RQ2: To what extent will the implementation of technology professional development change middle school teachers' perceptions and attitudes regarding higher-level technology integration?

Investigating professional development is important because its impact on classroom technology integration is essential to improve ITS practice. Examining teachers' perceptions of implementation, professional development, and technology integrations enables me, Roanoke's ITS, to improve future professional learning. An

action plan was created for expanding and improving professional development at Roanoke Middle School.

In the participatory action research, I collaborated with teachers and other stakeholders to hone research questions, gather data, and analyze results. The goal of this research study was to improve the technology integration at Roanoke, which is the best interest of all stakeholders. This chapter details the methodology utilized to address the research questions.

Positionality

In action research, the researcher is an insider because the practitioner is invested in the teaching and learning of her particular school (Mertler, 2014). This differs from traditional research, which the researcher is an outsider and distance and impartiality are valued. I am the Instructional Technology Specialist at Roanoke Middle School. As such, I am primarily responsible for the school's technology professional development. I am also responsible other forms of professional development as a part of the school leadership team.

I serve as an instructional technology specialist (ITS) at Roanoke. I have been in this position for five years and previously taught writing and reading at the same middle school. The ITS role has several functions including school technology leader; professional development coordinator, tier-one support technician; systems manager and user account manager, assistant testing coordinator, and data manager (Middle School ITS Roles and Responsibilities, 2016). My tenure at RMS has prepared me for this action research because I am acutely aware of its strengths and weaknesses.

According to Roy et al. (2012), principles of successful PD include a targeted focus on instruction, instructional improvement through awareness, planning, implementation, and reflection; shared expertise; clear expectations; and collegiality, caring, and mutual respect. My relationships with the participants in this study fostered an open and collegial collaborative environment where we could critically analyze school's technology integration.

I collaborated with teachers during and outside of formal trainings in a professional learning community. I designed instructional opportunities grounding them in research-based strategies regarding adult learning, constructivist pedagogy, and 21st century skills (Appendix E). Other participants in the study contributed ideas and feedback for professional discussion and development as is appropriate in a professional learning community. There was a combination of formal and informal interactions as practiced in PLCs and expected in action research where the researcher is an internal practitioner.

Plan for Collecting Data: Study Design

This study employed a mixed-methods research design. More specifically, it utilized a descriptive design. The purpose of descriptive design study was to describe and interpret the effect of professional development on higher-level technology integration at Roanoke Middle School. A pre- and post-survey adapted with permission from an outside instrument was used to collect the quantitative data from participants (Atkinson, 2005) (Appendix C). The study also employed qualitative methods and thematic analysis to develop a deeper understanding of middle school teachers' perceptions toward professional development and technology integration. Teachers participated in a group

interview at the end of the professional development. The open-ended response questions on the post-survey were another source of qualitative data.

The focus group interviews were semi-formal and consisted of a series of relevant questions (Appendix D). Interviews were recorded to ensure accuracy of interview transcription. Teachers assisted in reviewing the accuracy of the research report, member checking the results (Fraenkel et al., 2015).

Context

Plymouth (pseudonym) School District is a suburban district and is the one of two school districts in the county. Plymouth is ten times larger than the adjoining school district. The district serves approximately 25,000 students. The district is in a growing area of South Carolina and enrollment continues to increase every year. Plymouth School District contains fourteen elementary schools, six middle schools, and three high schools. The action research took place at one of the middle schools in the district: Roanoke Middle School.

Roanoke is a public middle school located in the Lowcountry of South Carolina. Over 1,300 students attend the school. The student demographics are as follows: 65% White, 22% African American, 6% Hispanic, and 7% Other (including two or more races, Asian, Pacific Islander, and Native American) (PowerSchool, 2016). 38.6% of Roanoke Middle School students receive free or reduced lunch (PowerSchool, 2016). The district mandates that middle school students enrolled in grade-level or gifted and talented math and language arts classes utilize the computer lab once a week. Students utilize district-mandated programs while in the computer lab. The students have access to mobile devices (HP Streams) and computers labs weekly in math and reading classes.

Students also visit the computer lab with other classes on a less frequent basis. Roanoke Middle School is implementing a project-based learning model that supports the growth of 21st century skills.

RMS conducts bi-weekly STEM PLCs in sixth and seventh grade planning periods. These sessions are led by different members of the PLC including participating teachers, the sixth-grade administrator, and the seventh-grade administrator. The sixth and seventh grade teachers participated in these meetings during the study's duration. The ITS attended sessions to assist.

There are sixty teachers, four counselors, four administrators, one media specialist and assistant, four paraprofessionals, and five adult support staff on the faculty.

Research Participants

Participants were Roanoke Middle School teachers. Participants were recruited through email and a face-to-face presentation during a grade level meeting, provided informed consent for participation, and invited to complete the survey outside of normal work hours. Participants were selected based on interest, availability to attend professional development, and a variety of grade and subject areas represented. Since the study took place during year two of a three-year implementation, participants were aware of the project-based learning initiative at RMS. Many of them had participated in PBL/STEM training within the previous two years. Two teachers were scheduled to attend PBL training the following summer after the study ended. The participants represented a cross-section of RMS teachers. Two science teachers, three English language arts, two math, two social studies, two special education (one self-contained and one resource), and three related art/elective teachers (instrumental music, business, and

pre-engineering) participated in the study. There were twelve females and two males that participated in the study. The average years of experience was 12.77 years. The group included two first year teachers and three teachers who had twenty-plus years of experience.

Treatment

For this study, the ITS led six professional development sessions. The first session was an overview of the 4Cs of 21st century learning. The following four sessions focused digital tools and technologies that supports collaboration, creativity, communication, or critical thinking. The final session was a debriefing and group interview. After the sessions are complete, a post survey was administered. Figure 3.1 provides context for other trainings that RMS teachers participated in before and during the study. It also outlines the professional development offered during the study.

RMS conducts bi-weekly STEM PLCs in sixth and seventh grade planning periods. These sessions are led by different members of the PLC including participating teachers, the sixth grade administrator, and the seventh grade administrator. The sixth and seventh grade teachers participated in these meetings during the study's duration. The ITS attended sessions to assist.

According to Roy et al. (2012), principles of successful PD include a targeted focus on instruction; instructional improvement through awareness, planning, implementation, and reflection; shared expertise; clear expectations; and collegiality, caring, and mutual respect. Participants and I formed a professional learning community within the school to conduct technology professional development and discuss student-centered higher-level technology integrated lesson ideas. As appropriate in professional

learning communities, discussion and collaboration was informal and sustained. This aligns with research recommending of allowing teachers to participate in “local material development” and acknowledging shared expertise in order to increase teacher buy-in to the innovation (McLaughlin, 2013, p. 198-199; Roy et al., 2012). Fullan (2001) agrees that that in order to foster culture that encourages instructional improvement, teachers should utilize a cyclical process of seeking, critically assessing, and carefully incorporating new ideas and practices. During the PD sessions, teachers were introduced to digital tools, ideas, and practices to incorporate into their instruction. Informally, after the PD sessions, teachers and I further discussed or collaborated on strategies and ideas for lesson planning. Teachers in the study contributed ideas and feedback for professional discussion and development as is appropriate in a professional learning community. Finally, during the sixth PD session, teachers and I discussed and reflected on the implications of 21st century skills and higher-level technology integration. My relationships with the participants in this study fostered an open and collegial collaborative environment where we could critically analyze school’s technology integration. The collaborative nature of the PD sessions reflected the shared expertise of the teachers and myself.

Session	Topic	Details
June 2017	STEM and PBL Methodology	Pre-Session 1: At the end of the 2016-2017 school year, most of the seventh grade, some fine arts teachers, new sixth grade teachers and two eighth grade teachers participated in one-day staff development on STEM teaching. This is part of RMS’s implementation plan to become a STEM school. All current sixth grade teachers participated in the training at end of the 2015-2016 school year.
August 2017	STEM Reflection	At the beginning of the 2017-2018 school year, the STEM administrator led a STEM Reflection to

		gain feedback from sixth grade teachers that implemented STEM the previous year.
Pre-Session 1	Pre-Survey was administered electronically.	
Session 1	21 st Century Learning	Introduction to the purpose of PD and 4Cs
Session 2	Collaboration	Blackboard Discussion Boards/Wikis
Session 3	Communication	Amplifying Student Voice: Skype in the Classroom and Flipgrid®
Session 4	Creativity	Presentations Tools for Students
Session 5	Critical Thinking	Digital Breakouts
Post-Session 5	Post Survey was administered electronically	
Session 6	Debriefing of PD and PLC	Discussion and survey administered
Post-Session 6		During the 2017-2018 school year, RMS implemented a STEM/PBL curriculum in seventh grade and by the 2018-2019 school year, eighth grade will be trained and STEM/PBL will be fully implemented in all grade levels and electives.

Figure 3.1 Study Timeline

Another principle of successful technology PD is a focus on curriculum not an isolated technology tool (Hsu, 2016). The targeted focus of this professional development is developing 21st century skills in students. Each PD session began with theory and support for the development of each skill (collaboration, communication, critical thinking, or creativity) then proceeded to demonstrate one or more digital tools. The digital tools demonstrated during the PD sessions were the mechanisms that assist with the development of the skills, not the primary focus on the PD. In her study of technology specialists, Dexter et al. (2009) recommended emphasizing curriculum not the technology. They found that this fostered teacher buy-in for technology integration's benefits and set the tone for technology discussions at the study school (Dexter et al., 2009).

Technology training focus: 4Cs of technology integration. The goal of professional development and the creation of the professional learning community is to support educators with clear strategies and tools to migrate from the factory model of

education. The ISTE standards and the 4Cs of technology integration provide the framework for the professional development to rethink the way teachers deliver instruction—traditionally students consume content passively. The intention is to foster an environment where teachers can modify instruction, so students can become an active participant in their own learning, thereby preparing students to enter a progressively more global economy (ISTE, 2017b; Vockley, 2007).

The professional development centered on the 4Cs of technology integration: collaboration, critical thinking, communication, and creativity.

Collaboration. Collaboration is a skill listed in the Profile of a South Carolina Graduate and in the 2016 ISTE Standards for Students. To be prepared for a global economy, students need to be global communicators. Technology supports this goal by enabling students to work with others (peers, experts, and community members), that they may not have easy access to otherwise, to examine issues and problems from multiple perspectives. Teachers need to be aware and comfortable with collaboration tools in order to facilitate these interactions. Students also need to be able to “contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal explore local and global issues and use collaborative technologies to work with others to investigate solutions” (ISTE, 2016, p. 2). These standards align with the mission of RMS to become a STEM school by implementing project-based learning. This professional development instructed teachers incorporate collaborative technologies into cross-curricular projects.

Critical thinking. Critical thinking is an essential skill for any 21st century student. It is woven into all of ISTE Standards for Students (2016) (Appendix A). Critical

thinking is essential to problem-solving and project-based learning. As RMS continues to implement a STEM curriculum, teachers must adjust teaching to develop critical thinking skills in students. Technology integration that supports project-based learning is an effective measure to building students' critical thinking skills (Herro & Quigley, 2017). Students collaborate to solve a real-world problem. This type of learning is hands-on, rigorous, and relevant to students. This type of learning is also vastly different from the traditional instructional model. Teachers need training on how to effectively develop PBL lessons that foster critical thinking skills.

Communication. Students need to be effective communicators of their ideas. As such, the ISTE Standards for Students (2016) state that in order for students to be creative communicators, they should “communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats, and digital media appropriate to their goals” (p. 2). In order for students to select appropriate media platforms, create and publish original works, and communicate complex ideas, teachers need to be aware of a variety of tools and resources for students, and guide them to select the appropriate one to convey messages (ISTE, 2016). This professional development session focused on technology that can support students' ability to communicate with one another and larger communities. The ITS shared tools and strategies: skyping with experts in the STEM field, Blackboard (or another LMS platform) discussion boards.

Creativity. The International Society for Technology in Education's 2016 student standards (Appendix A) includes creativity and innovation as the first standard. This standard challenges students to demonstrate creative thinking, construct knowledge, and develop innovative products and processes using technology (ISTE, 2016). Teachers

should be designing learning opportunities that address not only content standards, but also students' future needs in the 21st century. As such, creativity is more important than rote memorization. Students should be able to:

- a. Apply existing knowledge to generate new ideas, products, or processes
- b. Create original works as a means of personal or group expression
- c. Use models and simulations to explore complex systems and issues
- d. Identify trends and forecast possibilities (ISTE, 2016)

Using technology to enhance learning experiences, putting the technology in students' hands and having students create instead of just consuming content are important differences in between past and current pedagogy.

Data Collection Instruments

Technology integration survey for teachers. This study utilized a pre- and post-survey method to obtain information regarding the use of and teachers' attitudes toward higher-level technology integration at RMS. The questionnaire was adapted with permission from a previously tested survey instrument (Atkinson, 2005) (Appendix C). In that study, "internal consistency reliability coefficient was computed using the Cronbach's Alpha formula and indicated satisfactory Cronbach's Alpha reliabilities for the full group ($n = 690$) was .94" (Atkinson, 2005, p. 66). It was designed to measure teachers' attitudes toward high-level technology integration, the frequency with which teachers integrate technology into instruction and methods, how the technology is integrated.

The Technology Integration Survey for Teachers was administered electronically through a Google Form, at the beginning of the study and at the end of the study after

professional development is administered (Appendix C). The electronic instrument was beneficial to the researcher and participants because it provided greater anonymity for the participants, which can lead to responses that are more honest. It was convenient for participants because they could complete the survey at a time chosen by them. It was time efficient for the researcher because it reduces data entry. In traditional research, disadvantages to using online surveys include a lower response rate and invalid data from careless typing or selection (Fraenkel et al., 2015). However, the action research methodology minimizes these concerns because the participants knew the researcher as a member of the community and were more likely to complete the questionnaire in a careful, timely manner than a survey from an unknown researcher.

The survey utilized close-ended and open-ended questions. For most of the close-ended questions, participants selected responses on an interval scale *strongly disagree*, *disagree*, *agree* or *strongly agree*. Other questions determined how frequently technology was integrated *daily*, *weekly*, *monthly*, *quarterly*, or *once a year/never* (Appendix C). Finally, needs areas of improvement/technical needs section asked respondents to rate their needs for technology support on an interval scale from *less urgent* to *most urgent*.

Closed-ended questions provide enhanced consistency, faster and easier data analysis and are more popular with respondents (Fraenkel et al., 2015). Although utilizing close-ended responses may limit the depth of responses in this initial round of action research, the cyclical nature of action research allows for follow-up interviews in future studies. Furthermore, the open-ended questions and subsequent group interviews provided participants opportunities to clarify and add to their responses on the survey.

Focus group interviews. Teachers also participated in a semi-structured group interview at the end of the professional development during the debriefing session listed in the study timeline. The group interviews focused on teachers' perceptions and attitudes regarding higher-level technology integration. Interviews were recorded and transcribed, so they could be thematically analyzed. Several participants assisted in reviewing the accuracy of the research report. Interview questions can be found in Appendix D.

Reflecting on the experiences of participants allowed for discussion on how PD strategies could be improved. Critical analysis aided understanding of how teachers handle these new approaches in their actual teaching practice. It helped determine what benefits have been observed in the classroom and in their students (for example, attitudes and learning outcomes) and what limitations have been encountered (Basilotta Gómez-Pablos et al., 2017).

The purpose of the analysis was to study the effect of professional development on higher-level technology integration in their classrooms. The goal was to understand the usefulness of technological tools, changes in instructional delivery, the difficulties that participants encountered, and suggestions for future improvements.

Data Analysis

The action research methodology was explanatory mixed-methods. The quantitative data were collected through a pre/posttest survey method; then the qualitative data were collected during group interviews. Descriptive statistics were used to analyze the quantitative data. Unlike traditional research where inferential statistics are used to determine if “a given statistical result can be generalized to an entire population, the action research does not require such generalizability” (Mertler, 2014, p. 174).

Content analysis was conducted of the qualitative data. Mertler (2014) describes qualitative analysis as a three-step process of organizing, describing, and interpreting. Patterns and themes were identified through code scheming. Regarding explanatory research, Mertler (2014) states the interpretation of the qualitative results focus on elaborating or clarifying the results of the quantitative analysis.

The thematic analysis focused on the overarching question regarding teachers' shifting perceptions, attempts, and plans to integrate higher-level technology integration after participating in the PD. The group interviews were coded after the administration. Once those themes were developed, I analyzed the additional comments/open-ended questions of the survey based on the themes from the survey and group interviews.

Descriptive coding was employed for the focus group interview transcriptions. Table 3.1 provides examples of the codes used in analysis. Once the transcripts were coded, I analyzed the patterns that emerged and grouped codes based on themes. For example, time and planning codes were combined along with infrastructure in an infrastructure/support theme. Several themes emerged including infrastructure/support, school leadership, specific tools, and professional development. Other codes were used to supplement the data collected from the survey. On the survey, questions were asked about teacher confidence and beliefs about high-level technology and the 4Cs. Those codes were utilized to create a richer picture of teachers' perceptions of higher-level technology integration.

Table 3.1
Examples of Codes Used in Analysis

Abbreviation	Meaning	Abbreviation	Meaning
T	Time	Infra.	Infrastructure

4C	Creativity, communication, critical thinking, or collaboration	ITS	Instructional Technology Specialist
PBL	Project-Based Learning/STEM	SE	Student engagement
I	Ideas	SHO	Student hands-on use of technology
AS	Admin support	FG, BO, PT	Specific tools mentioned Flipgrids®, breakouts, presentation tools, etc.
TC	Teacher confidence	Choice	Teacher choice/freedom

Action Research Validity

The validity of action research is measured differently than that of traditional research. Because of the nature of action research, the level of quality is assessed by rigor and authenticity.

According to Mertler (2014), rigor refers to the quality and credibility of the action research. Thorough and authentic depictions of the research context, participants and events establish credibility (McKay & Marshall, 2000). The authors summarize that “a qualitative study is credible when it presents such faithful descriptions or interpretations of a human experience that the people having that experience would immediately recognize it from those descriptions or interpretations as their own” (McKay & Marshall, 2000, p. 110). Member checking can establish the credibility of an action research inquiry. It can also increase the quality of an action research inquiry (Fraenkel et al., 2015; Mertler 2014). For this action research, participants assisted in reviewing the accuracy of the survey data, and analysis. The final report was shared with them. Participant researchers can increase the credibility of their findings through poly-

angulation, the use of multiple data sources. This research utilized a pre- and post-survey and focus group interviews as data sources. A supervising professor also provided guidance throughout the action research process, which can also increase validity of the findings of this study especially for a novice researcher (Mertler, 2014).

According to McKay and Marshall (2000), there are five lenses of authenticity: ontological, educative, catalytic, and tactical authenticity and fairness. When participants' actions, responses, and works are reported and analyzed in a balanced way, authenticity through fairness is achieved (McKay & Marshall, 2000). Because the researcher is part of the research and not an outsider, impartiality likely cannot be attained. However, fair and balanced analysis can be expected. Two of the authenticity lenses examine the participants' growth as a whole and as individuals. Educative authenticity is "the extent that shared understanding develops through the intervention" (p. 111). Since the study's participants are teachers that met to form a technology PLC, educative authenticity is likely high. The participants met and discussed a shared understanding of the goals of the technology professional development was not the development of isolated technology skills, but the eventual development of 21st century skills in students. The degree that participants grow during the research process is measured by ontological authenticity. The final two lenses of authenticity focus on the resulting action or change stimulated by the action research. Catalytic authenticity is measured by the extent that research process stimulates and facilitates participant action (McKay & Marshall, 2000). Finally, tactical authenticity is "the extent to which participants are empowered to act throughout the research process" (p. 111). The goal of this study was for participants to be equipped with the skills and tools to integrate technology at a higher level than they were using prior to

the study. If teachers do implement changes to the technology integration levels, then catalytic and tactical authenticity is achieved. I found this study to be a catalyst to implement changes in my practice and develop an action plan, which will be discussed further in Chapter Five.

Ethical Considerations

This study was conducted as RMS implemented a STEM curriculum. It was the expectation of the administration that teachers use STEM and PBL as a method of instruction. Teachers had no obligation to participate in the study; however, since it coincided with school goals teachers may have felt some pressure from administration to participate. This created an ethical consideration for the researcher because participation must be voluntary. In order to recruit participants and obtain informed consent, the research practitioner presented at three grade-level meetings to ensure that teachers had a complete understanding of the purpose and methods of the study, the risks, and any demands placed on them as a participant (Best & Kahn, 2006; Mertler, 2014).

Action research protocol relies on Institutional Review Boards to ensure the protection of participants involved. Approval for this study was granted by Plymouth School District and the University of South Carolina's Institutional Review Board. I conducted technology professional development, which was voluntary, but not outside the bounds of normal practice. RMS teachers are often asked to participate in faculty meetings and professional development during and after the school day. In adherence with the principle of accurate disclosure, informed consent forms were distributed to teachers/participants, so they could choose to be a part of the study (Mertler, 2014).

Participants were also informed that they could withdraw from the study at any time with

no penalty (Drew, Hardman, & Hosp, 2007). One participant did withdraw from the study due to scheduling conflicts. Data was formally collected by conducting a pre- and post-survey of participant and through group interviews. The researcher took steps to ensure anonymity for teachers.

Protecting participants. The most basic concern in all research is that no individual is harmed by serving as a participant. In educational research, there is rarely a chance at physical harm, but there are other concerns researchers should address. Researchers should guard against emotional and psychological harm as well.

Participants in this study face no substantial or significant risk of harm. Participants were to take a pre-assessment survey of technology integration. Then they volunteered to participate in technology professional development. Finally, in order to assess the effect of the professional development, participants completed a post-training survey.

Teachers may perceive potential harm if surveys are conducted regarding their classroom practice. In order for the research to be successful, participants must feel comfortable that their jobs or reputations will not be affected and their identities should remain private. It is my responsibility to maintain confidentiality and privacy of participants, so no harm befalls them. Pseudonyms were used in the study and identifying characteristics were obfuscated, so participants can remain anonymous and confidential—essential components of action research (Mertler, 2014).

Developing an Action Plan

After data was collected and analyzed, the next phase of the inquiry cycle was to develop an action plan. In this phase of the research, I determined what the next steps

were. This required determining specific actions and who would be responsible for those actions. Essentially, the action plan is what should happen because of the inquiry findings. However, it is important to define roles and tasks clearly in an action plan, and continued cycles of action research may be necessary based on the action plan. Within this study, the school STEM coordinator, other teacher participants, and I collaborated to create an action plan based on the results of study and as an extension of the RMS professional learning community. The action plan includes discussions of challenges encountered during implementation and recommendations for improvement for the following year. As previously stated, this study occurred during year two of a STEM implementation plan. Therefore, it is necessary to identify and address challenges that can be ameliorated prior to and during year three of implementation.

Following the development of the action plan, the next phase of action research is the reflecting phase—where the action researcher shares her findings and reflects on the inquiry process. My first responsibility is to share findings with participants. The final product can be shared informally with my school colleagues, principal, or other instructional technology specialists. At that time, feedback can be solicited. To share the results of the inquiry with a wider audience, the researcher can share at a grade-level or faculty meeting or a voluntary meeting for interested participants and non-participants. Another more public way to share work would be to submit presentation proposals to the two professional development conferences that Plymouth School District holds each year. These venues require a different format than the written paper. Presentations tools are appropriate for the faculty meetings and conferences. One alternative to the lecture format at most conferences and faculty meetings and keeping with the spirit of the

professional learning community would be to host a roundtable discussion of the findings of the study.

Conclusion

Technology has provided schools opportunities to deliver content in different formats, but many teachers struggle to keep up with the changing technologies. Research shows that quality professional development is important to any implementation (McLaughlin, 2013). Therefore, as technology becomes more prevalent in education, it is important to examine the impact of professional development and its effects on technology integration in the classroom. This action research study sought to determine if providing professional development on technology integration affected teachers' use of high-level technology integration and explore teachers' attitudes toward such integration. This chapter addressed the methods for data collection and analysis that were utilized in the study. This chapter also described the pedagogical basis for the design of the professional development, which focused on not just isolated technology skills and tools, but teachers' understanding of 21st century skills: critical thinking, collaboration, communication, and creativity. The following chapter discusses the findings of the study.

CHAPTER FOUR

FINDINGS FROM THE DATA ANALYSIS

Chapter Four presents the findings of the data collection and analysis regarding the research questions defined in Chapter One of this dissertation. Descriptive statistics describe the nature of the effect of higher-level technology professional development had on RMS teachers' technology integration practices and their attitudes toward higher-level technology integration.

Problem of Practice

Most of the technology integration at Roanoke Middle School focuses on teacher-centered use of the technology, simple substitution, or low-level learning such as skill practice. This is an issue for more than just RMS teachers (Hsu, 2016). Although integrating low-level technology may increase student engagement and improve classroom management, research indicates that classroom integration of technology for high-level learning eventually leads to increased student learning (Allsopp, et al., 2009). Student use of technology for higher-level thinking, such as blended learning or collaboration, enhances students' learning experiences and intellectual growth across curricular areas rather than merely developing isolated technology skills (Hsu, 2016; Vockley, 2007). Even though teachers are proficient at using technology for personal use, it does not always translate into application of use in the classroom (Allsopp et al., 2009; Atkinson, 2005). RMS teachers are utilizing technology in the classroom. However, it is often for basic skills practice on district-mandated programs. Although teachers may be

utilizing technology in a variety of ways in the classroom, if it is at the lowest levels of integration, then students will not be prepared for their futures in a 21st century workforce (Vockley, 2007). The identified problem of practice of this action research is that RMS teachers are not trained to integrate higher-level technology methods consistently and effectively into their instruction.

Purpose Statement

At RMS, many teachers are required to use district-purchased curriculum programs in their classrooms. Students have access to digital learning every day but the majority of this digital learning is skill practice. Students passively receive content instruction from a computer instead of creating content for themselves, collaborating with peers, communicating with experts in the content, or thinking critically about the content.

In order for teachers to use higher-level technology integration as an instructional method to engage students in learning, they must receive quality professional development that focuses not only on the functionality of the tool but also spends time explaining instructional strategies that are grounded in solid pedagogy (Hew & Brush, 2007; Okojie, Olinzock, & Okojie-Boulder, 2006).

Study Design

This research study employed a mixed-methods research design. The purpose of this descriptive design study was to describe and interpret the effect of professional development on higher-level technology integration at Roanoke Middle School. Surveys were used to collect the data from participants; descriptive statistics were used to analyze the data. The study also employed qualitative methods and thematic analysis to develop a deeper understanding of middle school teachers' perceptions toward professional

development and higher-level technology integration. Teachers participated in a group interview at the end of the professional development.

Participants

There were fourteen participants in the study— two males and twelve females. They represent a variety of contents areas. Two are science teachers, three English language arts, two math, two social studies, two special education (one self-contained and one resource), and three related art/elective teachers (instrumental music, business, and pre-engineering). The average years of experience of the group is 12.77 years. However, one participant declined to answer this question on the survey. The group included two first year teachers and three teachers who had twenty-plus years of experience. Twenty-one percent of the teachers were in the first five years of teaching. On the pre-survey, half of the respondents rated their technology ability as *beginner or intermediate*; the remaining half rated themselves *advanced*.

Procedures

Pre- and post-survey instruments were emailed to all participants with a general explanation. Hard copies were available upon request. No participant requested a hard copy. All participants completed the pre-survey prior to the start of the professional development. The post- survey was sent at the conclusion of the professional development but before the group interview. The researcher checked the response rate of post-survey and re-emailed the participants that did not complete the survey.

Each participant used a portion of their certificate number as an identifier, so the participant would remember the number and the researcher was able to match pre- and post-survey responses. After the researcher matched the data, she assigned each

participant a number one through fourteen to maintain the confidentiality of all participants. The school district, the school principal, and the Institutional Review Board all granted permission to conduct the survey.

At the end of the professional development sessions, teachers also participated in a semi-structured group interview during the debriefing session listed in the study timeline. The group interviews focused on teachers' perceptions and attitudes regarding higher-level technology integration. The interviews were recorded and transcribed to ensure accuracy.

Findings of the Study

The Technology Integration Survey for Teachers (Atkinson, 2005) served as the primary data collection instrument. It was administered prior to the start of the treatment and administered after the completion of the treatment as a pre- and post-survey. The survey consisted of four demographic questions, fifty-seven multiple-choice questions, and five open-response questions. Nine questions were not used in the data analysis because of question construction issues or they were irrelevant to study. The survey was divided into seven sections: (1) self-reflection on technology integration, (2) opinions and attitudes on technology integration, (3) student use of technology, (4) development of 21st century skills parts I and II, (5) support for technology integration, and (6) needs areas of improvement/technical needs (7) additional comments/open-ended questions. The open response questions supplemented the qualitative data collected during the focus group interviews.

Table 4.1

RMS Teachers Responding Agree or Strongly Agree on Pre- and Post-Survey

Questions	Pre-survey	Post-Survey	Percent Change
	% Agree/ S. Agree	% Agree/ S. Agree	
SELF-REFLECTION			
I feel confident in my ability to integrate multiple technologies into my instruction.	71.4	85.7	20
I have a variety of ideas and lessons for integrating technology into my teaching.	71.4	92.9	30
Students use technology in my classroom to build 4C skills.	28.6	78.6	175
I have enough time to prepare technology-based lessons.	21.4	50	133.3
I believe that integrating technology into my curriculum is important for student success.	92.9	85.7	-7.7
Aware of resources/learning support	64.3	92.9	44
I do not have the technology skills to support the students when they use technology for a project.	0	71.4	—
I am familiar with what technology is available to my students and me in our building.	71.4	100	40
OPINIONS AND ATTITUDES ON TECH INTEGRATION			
When using the technology, students create products that show higher levels of learning.	71.4	92.9	30
When using the technology, students are more motivated.	85.7	92.9	8.33
When using the technology, students are more interested in learning when using technology to investigate an issue or solve a problem.	92.9	92.9	0

When using the technology, students go to inappropriate sites.	42.9	50	16.7
When using the technology, there is more student collaboration.	57.1	78.6*	37.5
Most technology would improve my ability to teach.	78.6	85.7	9.1
Technology has changed the way that I teach.	71.4	100	40
Technology makes my work more complicated to complete.	14.3	28.6	100
Using technology can/does help students better understand what they are learning.	85.7	92.9*	8.33
It takes a special talent to creatively facilitate and manage technology-based learning activities.	50	57.1	14.3
I feel confident in my ability to use technology for teaching and learning.	71.4	92.9	30
Creating technology-based learning activities is too time consuming compared to what is learned.	28.6	14.3	-50
The school district expects us to learn new technologies without formal training.	35.7	21.4	-40
There is a focus on technology at my PLC meetings.	71.4	71.4	0
There is a focus on technology at my grade level meetings.	64.3	78.6	22.2
There are various opportunities for technology training.	78.6**	92.9**	18.2
Technology is reliable.	74.9	71.4	66.7
DEVELOPMENT OF 21ST CENTURY SKILLS PART 1 & 2			
Does technology help students develop the 21 st century skill of...?			
a. Critical-Thinking/Problem-solving	71.4	100	40
b. Communication	78.6	92.9	18.2
c. Collaboration	92.9	100	7.7

d. Creativity	85.7	92.9	8.33
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Does the technology-integrated instruction RMS students are currently getting help develop 21st century skill of....?

a. Critical Thinking	50	92.9	85.8
b. Communication	50	64.3	28.6
c. Collaboration	64.3	78.6	22.2
d. Creativity	64.3	85.7	33.3

SUPPORT FOR TECH INTEGRATION

Principal/administration supports me when I integrate technology for student use.	92.9	100	7.7
The Instructional Technology Specialist supports me when I integrate technology for student use.	100	100	0
I have the support I need to integrate technology for student use.	100	100	0

NEEDS AREA OF IMPROVEMENT/TECHNICAL NEEDS

	More/Most Urgent Need	More/Most Urgent Need	
More time to integrate technology into my curriculum.	85.7	85.7	0
More support from administration when it comes to my technology needs	21.4	28.6	33.3
More technical support to keep computers and applications running	64.3	50	-22.2

* One participant did not respond on the post-survey

**One participant did not respond on neither the pre-nor post-survey.

Teachers also reported how often they planned student-use of technology. Overall frequency of lower-level technology integration was higher. This was expected because

of teachers' comfort level, previous training on this type of technology integration, and district required programs.

Table 4.2 answers the survey question, “How often do my students use the following for in class and/or out-of-class assignments?” Almost 80 percent of participants reported requiring students to research information using technology weekly or monthly. Approximately 29 percent of participants reported that students create presentations using technology daily or weekly. Participants were least likely to have students participate in virtual field trips. All participants reported that frequency as *never or once a year*.

Table 4.2

Percentage of RMS Teachers Self-Reporting Technology Integration on Post-Survey

	Never/ Once a Year	Quarterl y	Monthl y	Weekl y	Daily
LOWER-LEVEL TECHNOLOGY INTEGRATION	%	%	%	%	%
Word processing	14.3	42.9	14.3	21.4	7.1
Analyze data or keep records	64.3	0	0	21.4	14.3
Learn or practice new skills	21.4	0	14.3	35.7	28.6
HIGHER-LEVEL TECHNOLOGY INTEGRATION	%	%	%	%	%
Research information	7.1	14.3	28.6	50	0
Produce/create class presentations	42.9	28.6	0	14.3	14.3
Collaborate with teacher or peers on assignments	57.1	14.3	7.1	14.3	7.1
Communicate with experts, authors, or others	71.4	14.3	7.1	7.1	0
Participate in virtual field trips	100	0	0	0	0

For the qualitative data, the researcher conducted three focus group interviews and examined the open responses on the post-survey. Not all participants attended a focus

group discussion even though there were multiple opportunities to attend. Given the nature of focus group interviews, the researcher decided not to conduct individual interviews with participants that did not attend one of the group discussions. The researcher used an outside company to transcribe each focus group interviews and reviewed the transcripts to ensure accuracy. Table 4.3 describes the qualitative sources. Appendix D lists all the group interview questions. Questions included teachers' attitudes toward professional development, PLCs, 4Cs, and technology integration. Teachers were also asked how PD could be strengthened and what support they needed to integrate technology in their classrooms.

Table 4.3

<i>Description of Qualitative Data Sources</i>	
Data Source	Word Count
5.8 Discussion Transcription	3,310
6th grade Discussion Transcription	5,025
RA Discussion Transcription	5,093
Open-ended Responses on Post-Survey	780

Interpretation of Findings of the Study

Following the data collection and reporting of findings, the data were examined for themes. The survey was divided into categories prior to deployment, however, results from separate categories were analyzed together to clarify teachers' attitudes toward higher-level technology integration, RMS school leaders, and views of PD in general. The percent of participants responding agree or strongly agree on the pre-survey was compared to the percent of participants responding in the same way on the post-survey. The percent change was also calculated. The qualitative data was coded and themes emerged from that coding.

Teacher Attitudes toward Technology Integration

Teachers' attitudes and beliefs about technology integration affect the frequency technology integration (Ertmer & Ottenbreit-Leftwich, 2010). Their confidence level also contributes to their willingness to experiment with technology integration (Ertmer & Ottenbreit-Leftwich, 2010).

Confidence level. On the pre-survey, half of the respondents rated their technology ability as *beginner or intermediate*; the remaining half rated themselves *advanced*.

Fifty percent of participants rated their general technology level as *advanced* on the pre-survey. On the post survey, 35.7 percent of participants rated themselves as *advanced*. Most likely, their technology skills did not decrease, but during the professional development, they were exposed to new tools that they had yet to master, so participants may have been less confident in using these new digital tools. Even though participants rated themselves lower on their general technology ability, survey data shows that participants feel more confident in their ability to integrate multiple technologies into their instruction and their ability to use technology for teaching and learning (Table 4.4).

Table 4.4

<i>RMS Teachers' Confidence Level regarding Technology Integration</i>			
	Pre-survey	Post-Survey	
I feel confident in my ...	% Agree/ S. Agree	% Agree/ S. Agree	Percent Change
Ability to integrate multiple technologies into my instruction	71.4	85.7	20
Ability to use technology for teaching and learning	71.4	92.9	30

Twenty percent of participants felt more confident in their ability to integrate multiple technologies into instruction, and 30 percent of participants felt more confident in their ability to use technology for teaching and learning (See Table 4.4). These increases indicate that technology PD does have an effect on teachers' confidence regarding technology integration even if the teacher already felt confident in their general technology proficiency. However, this increase of teacher confidence may not lead to an immediate increase in higher-level technology integration.

Attitudes toward technology integration. The findings indicate that technology RMS teachers' overall attitudes toward technology integration are positive. Eighty-six percent of participants agreed that integrating technology into the curriculum is important for student success (See Table 4.5). However, this represents a decrease of 7.7 percent from the pre-survey. Eighty-six percent of participants also agree that most technology would improve teaching. In regards to the qualitative data, during one focus group, one participant cautioned the overuse of technology, "We have to be careful with all the screen time that the kids are getting. They stare at their phone too much already. Then they get here, and we're all under the impression that we have some sort of technology all the time going on."

All participants acknowledged that technology has changed the way they teach; however, the survey did not allow them to elaborate whether this was a positive or negative change. On the post-survey, 28.6 percent of participants felt that technology makes their work more complicated to complete. This number doubled from the pre-survey. As discussed of teachers' confidence levels, learning new teaching strategies and

digital tools that have yet to be mastered may have affected teachers' responses on this question.

Table 4.5

RMS Teachers' Attitudes of Technology Integration

	Pre-survey	Post-Survey	
	% Agree/ S. Agree	% Agree/ S. Agree	Percent Change
I believe that integrating technology into my curriculum is important for student success.	92.9	85.7	-7.7
Most technology would improve my ability to teach.	78.6	85.7	9.1
Technology has changed the way that I teach.	71.4	100	40
Technology makes my work more complicated to complete.	14.3	28.6	100

Four Cs of 21st century learning

The professional development focused on using the 4Cs as a framework to design and evaluate technology integration to support higher-level student use of technology. ISTE Standards for Educators (2017) encourage teachers to be designer of effective technology integrated lessons by “using technology to create...learning experiences that foster independent learning” for students and “use digital tools and resources to maximize active, deep learning” (p.2). The purpose of the ISTE Standards for Educators (2017) is to guide teachers to integrate technology in meaningful ways in order to develop 21st century skills in students.

Survey data indicates that prior to the professional development the majority of participants believed that technology helped develop 21st century skills in students. However, on post-survey data, there was an increase on each skill (critical thinking, communication, collaboration, and creativity) (Table 4.6). Further, greater increases were seen on the survey questions regarding the technology integrated-instruction RMS

students receive. These results demonstrate that participants believe that technology contributes to the development of 4C skills, and after the professional development, they also believe RMS students are receiving instruction that helps develop these skills.

As shown in Table 4.6, approximately 93 percent of participants agreed or strongly agreed that students are more interested in learning when using technology to investigate an issue or solve a problem. The PD for this study linked higher-level technology integration to PBL principles. This finding can be contributed to the PBL initiative at RMS and the training attended by most of the participants prior to the start of this study.

Table 4.6

<i>4Cs of 21st Century Learning</i>			
	Pre-survey	Post-Survey	
	% Agree/ S. Agree	% Agree/ S. Agree	Percent Change
Does technology help students develop the 21 st century skill of...?			
a. Critical-Thinking/Problem-solving	71.4	100	40
b. Communication	78.6	92.9	18.2
c. Collaboration	92.9	100	7.7
d. Creativity	85.7	92.9	8.33
Does the technology-integrated instruction RMS students are currently getting help develop 21 st century skill of....?			
a. Critical Thinking	50	92.9	85.8
b. Communication	50	64.3	28.6
c. Collaboration	64.3	78.6	22.2
d. Creativity	64.3	85.7	33.3
When using the technology, students create products that show higher levels of learning.	71.4	92.9	30
Students are more interested in learning when using technology to investigate an issue or solve a problem.	92.9	92.9	0
When using the technology, there is more student collaboration.	57.1	78.6	37.5

During the group interviews, participants further clarified the importance of the 4Cs for student success. A sixth-grade teacher shared that the 4Cs were “very important to all students, because as a 21st century learner if you’re not able to do those four things, you’re not [going] to succeed.” An eighth-grade teacher added the 4Cs framework helped “foster the higher learning—or, higher- level learning. More inquiry and...project-based learning. Those are skills that [the students] are [going] to need to be successful in any aspect of school at—or in life.”

These sentiments are supported by the quantitative data since the technology PD during this study used the 4Cs as a framework. Eight-five percent of participants agreed that integrating technology is important to student success (Table 4.5).

Mrs. George (pseudonym), an English teacher, expressed the need for a shift in the ELA curriculum to more inquiry-based, or student-centered. She shared that students should be “seeking out things and... learning how to use the internet as a resource and learning how to decipher resources and things like that, instead of ... just receiving.” This belief aligns with the principles of the professional development and RMS’s goal of becoming a STEM school. Teachers believed this hands-on approach to technology integration, wherein students were using the digital tools increased participation and engagement in class. Students were “actually doing” instead of “just sitting there and just passively receiving.” Teachers cited Flipgrids® and digital breakouts as examples of digital tools that increased engagement and participation. These tools will be discussed later in this chapter.

Higher-level Technology Integration

On the post-survey (78.6%) and during the focus group interviews, teachers self-reported using higher-level technology integrated instruction. Eleven respondents reported higher-level technology integration during or following the completion of the PD. This represents a 175 percent increase in participants using higher-level technology integration (Table 4.7). The small sample size limits conclusions that can be drawn from this result; however, results do indicate that higher-level technology PD has a positive effect on participants' technology integration levels. Because the sample size is so small, statistical significance cannot be calculated nor generalized to a larger population or future studies. In addition, given the scope of the study, there is no indication whether this level of technology integration will be maintained in the future.

Table 4.7

RMS Teachers' Perceptions Higher-Level Technology Integration

	Pre-survey	Post-Survey	
	% Agree/ S. Agree	% Agree/ S. Agree	Percent Change
Students use technology in my classroom to build 4C skills.	28.6	78.6	175

Previously, table 4.2 demonstrated the levels of technology integration, both lower and higher-levels, reported by teachers. Overall frequency of lower-level technology integration was higher. This was expected because of teachers' comfort level, previous training on this type of technology integration, and district required programs. Table 4.8 displays the frequency of higher-level integration reported on the post-survey. Almost 80 percent of participants reported requiring students to research information using technology weekly or monthly. Approximately 29 percent of participants reported

that students create presentations using technology daily or weekly. The majority of participants reported rarely assigning (never or once a year) students to use technology to produce class presentations (42.9%), collaborate with teachers or peers (57.1%), and communicate with experts (71.4%) Participants were least likely to have students participate in virtual field trips. Table 4.9 indicates the specific digital tools teachers reported utilizing during the study.

Table 4.8

Frequency of Higher-level Technology Integration Reported on Post-Survey

HIGHER-LEVEL TECHNOLOGY INTEGRATION	Never/ Once a Year	Quarterly	Monthly	Weekly	Daily
%	%	%	%	%	%
Research information	7.1	14.3	28.6	50	0
Produce/create class presentations	42.9	28.6	0	14.3	14.3
Collaborate with teacher or peers on assignments	57.1	14.3	7.1	14.3	7.1
Communicate with experts, authors, or others	71.4	14.3	7.1	7.1	0
Participate in virtual field trips	100	0	0	0	0

Table 4.9

Digital Tools used for Higher-level Technology Integration

Tool	Number of teachers self-reporting	%
Flipgrid	5	35.7
Digital Breakouts	2	14.3
Virtual Field Trips/Skyping with experts	1	7.1
Discussion Boards, Blogs	--	--
Presentation Tools (iPads for student speeches/reports; infographics)	2	14.3

The qualitative data sources also provided valuable information on the effect of the PD on higher-level technology integration. Ms. Shepard (pseudonym), a special education teacher, reflected that students are using more hands-on technology. She shares how higher-level technology integration can work in a special education classroom.

“Before [the PD] they would sit at an iPad and they would their [district-mandated program]. Now they’re actually going and recording themselves. Then we pull it up on the board, and we watch their answers. Then we can ... evaluate from there... Then it’s also for them—for their way to communicate in general... ‘Are you loud enough—when you’re recording yourself?’ For us, that’s a lot of social skills we can tie into it.”

During the group interviews and informal communication between participants and me, several tools/teaching strategies for higher-level technology integration were specifically reported.

Flipgrids. Flipgrid®, a communication tool where the teacher can pose a question or topic and students record and post responses, was implemented by several participants during the study and the participants shared positive reactions to it. They commented that students were engaged in the task more than they would have been if they had been given a written response assignment. The teachers also felt they received better products because the students knew that their peers would see the product. Mrs. Henson (pseudonym), a STEM teacher, shared that responses were “more thorough and thought-out when they had to sit in front of the camera.” Flipgrid® was used the most by participants because it was probably the quickest and easiest to implement. The application could be used across many types of devices and little planning time is needed

to add this technology to a lesson. Teachers reported using it as a substitution for an exit slip. The students recorded a Flipgrid® to demonstrate mastery at the end of the class. However, because of the amount of students talking at once, it was not as successful as it could have been. Participants adjusted their instruction based on these experiences and incorporated it in other ways. They also let students use devices in the hallways outside classrooms to record their videos. This sparked interest among non-participant teachers. Ms. Carson (pseudonym) mentioned teachers stopping her and the children to ask questions about Flipgrid®. Two teachers, who did not use Flipgrid® during the study, made plans to use the tool for the upcoming school year. Students will “do book promos when they come back from summer [break] to promote the books they read.” She went on “it will be a great way to incorporate technology”, assess their reading, “and sell reading to the rest of the students.”

Digital breakouts. Three participants mentioned digital breakouts, on the open-ended portion of the post survey, as a way they would like to incorporate technology in their classrooms. Digital breakouts are inspired by popular culture escape rooms. Breakouts started as physical lock boxes and students were given clues to solve in order to get the combinations to the locks. Because of financial constraints and the logistics of resetting physical locks, digital breakouts have become increasingly popular in the education field (Hampton, n.d.). Participants also mentioned interest in digital breakouts even though only two were implemented during the study. Mrs. George (pseudonym) had her advanced classes create their own digital breakouts. She commented that this assignment was an example of STEM and PBL because it mimicked the engineering and writing process because of the cyclical nature. Students had to revise their work multiple

times and ensure that each link worked before having the class participate in the student-created breakout. Following the PD, the ITS created a digital breakout for the sixth grade social studies to use during their second semester PBL project. One participant utilized it in her classroom. Other participants expressed interest in having the students participate in a digital breakout, but cited time to plan and pacing as obstacles.

Skyping with an expert. One teacher had her class video-chat with a journalist about avoiding bias in writing. I put the teacher in contact with the journalist, which is how I became aware of the technology integration. This was not reported on survey or group interview. During PD, skyping with experts was discussed but not explicitly demonstrated, which could have contributed to the lack of integration by other teachers. In addition, the study took place in a middle school, where teachers teach the same subject multiple times a day; experts are generally not available to video chat five times in one day, which seemed to discourage teachers.

Because of the time constraints of the study, several teachers indicated interest in using digital tools, but did not during the course of the study. On the post-survey open response question, several teachers expressed interest in using technology to facilitate communication, collaboration, and creativity in students. One respondent also mentioned flipped classroom. Others expressed interest in discussion boards and blogs for students to communicate and collaborate. During the PD, four teachers requested Blackboard classes to practice. The ITS created the classes for them; however, these tools were not implemented during the study.

RMS Technology Strengths

When asked what Roanoke Middle School's current technology strengths are, six respondents reported access to technology as a current strength; four participants specifically responded that having the instructional technology specialist or on-site support for instructional technology was a strength. Another mentioned that the access to various professional development is a strength. However, one teacher responded that RMS's strength is "access to different types of technology and software, but the training to use them is minimal" (Survey response, 2018). On the other hand, all participants ($n=14$) indicated on the survey that they felt the ITS supports them when they integrate technology for student use and that they had the support they needed to integrate technology for student use. As the ITS at RMS, this demonstrates that I need to be more proactive in advertising technology trainings especially with those teachers that are not required to attend weekly grade-level meetings, where I do most of my trainings.

Professional Development

During the focus group, participants were asked to share their reactions to the PD and how they thought the PD at RMS could be strengthened. Several themes emerged during these interviews: teachers prefer explicit training sessions and multiple options for tools and strategies to use. They also felt more confident about integrating technology after attending the PD.

One of Mrs. Xavier's (pseudonym) technology strengths is willingness to try new things with technology, which led her to participate in this study. She has also written several grants for classroom technology. She, underestimating her technology ability, shared "I'm not sure I would have been bold enough to have done that without having

been through [the study].” Her hesitance demonstrates the necessity for continued technology professional development and support for teachers even if they seem technology proficient.

During one focus group, teachers commented that they liked when the ITS presented the digital tools “step by step”. This was surprising because the overall technology proficiency of the group is relatively high. A sixth-grade teacher stated the benefits of explicit, hands-on technology PD, “We used it...we were so excited, we used it for math and social studies [the] same day, because we had gone step by step through it.” Others shared the preference of “step by step” PD, “when you made us sit down and get on the site and do it—it was pretty cool”, and “the getting to do it that one time, I think perks up interest.”

All focus groups shared that they appreciated the exposure to new digital tools as a benefit to professional development. Each group cited time as an obstacle to trying higher-level technology integration. This is corroborated by Mrs. Kosinski (pseudonym), a sixth grade teacher, “Just knowing what’s out there, it’s so hard to keep up with it as an educator, because they always keep throwing new, awesome things out at you. You [want] use them all, but sometimes you—you’re not even aware that they’re there”

Having a technology coach or instructional technology specialist evaluate and present the best digital tools saved time for the teachers. One teacher acknowledged the variety and how the ITS did a “great job of giving options of things to use”. Having a selection of vetted digital tools may increase the likelihood of higher-level technology integration. Ninety-three percent of participants either agreed or strongly agreed that they

had a variety of ideas and lessons for integrating technology into their teaching. See

Table 4.10 below.

Table 4.10

<i>Instructional Support</i>			
Questions	Pre-survey	Post-Survey	Percent Change
	% Agree/ S. Agree	% Agree/ S. Agree	
The Instructional Technology Specialist supports me when I integrate technology for student use into my teaching and learning activities.	100	100	0
I have a variety of ideas and lessons for integrating technology into my teaching.	71.4	92.9	30
There are various opportunities for technology training.	78.6	92.9	18.18
I am aware of the resources available by the district that can help me learn how to integrate technology.	64.3	92.9	44
I am familiar with what technology is available to my students and me in our building.	71.4	100	40

Instructional support. Several survey questions examined teachers' perceptions of technology instructional support. The greatest changes in teachers' perceptions were their awareness of district learning support (44% change) and school technology resources available to them (40 % change) (Table 4.10). This indicates that professional development has an effect on teachers' awareness of resources available to them. Moreover, professional development with a focus beyond functionality and individual digital tools seems to have an effect on the amount of ideas and lessons for integrating technology into instruction. Following the professional development, 92.9 percent of teachers responded they agreed or strongly agreed to that survey question. This demonstrates a 30 percent increase of participants. As the ITS, I am responsible for providing instructional technology support to teachers. One question on the survey instrument asked participants about the Instructional Technology Specialist. All

participants ($n=14$) indicated on the pre- and post-survey that the ITS provided support when teachers integrate technology for student use into teaching and learning activities. As mentioned above, teachers appreciated the ITS's ability to evaluate digital tools and present ideas on how to integrate them.

Support/Infrastructure

Beyond the specific support and professional development, I, as the ITS, provide RMS teachers, other forms of support and infrastructure emerged as a theme in the qualitative data. These themes were confirmed by the post-survey data.

Time. Lack of time as an obstacle to integrating higher-level technology was a theme that emerged during the focus interviews. Time was mentioned in all three focus group interviews. Eight participants mentioned time, on the open response survey questions, as an obstacle or something they needed to incorporate more hands-on student use of technology.

Moreover, on the pre-survey, only 21.4 percent of teachers responded that they had enough time to prepare-technology-based lessons. As shown in Table 4.11, this increased to 50 percent on the post-survey.

Although time was reported as a major obstacle, participants offered solutions during the group interviews. They cited the need for dedicated or additional planning time to integrate technology. One participant also suggested setting aside planning times to implement new technologies and setting a timeline for teachers to implement them with the next quarter or unit. Participants thought that might increase teacher buy-in for higher-level technology integration because "it's just amazing once you do it."

Constraints. One teacher also expressed a desire to use technology in other ways, but during computer lab time she was required to use district mandated online programs; “My hands are tied in the lab with how much time they have to be on [program]...I understand the rationale for [it]; I just wish that the curriculum was more inquiry-based.” She would like to use that time to incorporate more opportunities for critical analysis of resources and research, both higher-level hands-on student-centered use of technology. She felt “that time could be more beneficial for ELA, at least, in terms of teaching...standards.”

Administration. Several participants also voiced that administration needs to support teachers who take risks to integrate technology in new ways. They were concerned that if something with technology went wrong during a classroom observation that administrators should be supportive and understanding. One teacher expressed the relationship between administration support and being able to try new technology-integrated strategies, “It helps to have the support of the administration in the building, knowing that...sometimes what makes me uncomfortable with the technology is sometimes it being able to work, or the computer won’t turn on, or something like that.” The teachers worried about being able to troubleshoot issues, but felt supported in technology integration by the RMS administration, “Even if [the principal] comes through, I know he will support me actually trying regardless of how, what the outcome was.” Ms. Carson, agreed with other teacher, “he knows that I’ll learn from it, and I’ll do it again, and my lessons will improve because of it.”

Survey data, depicted in Table 4.11, revealed that participants felt supported by administration (100%) and had the support they needed to integrate higher-level

technology lessons (100%). However, 28.9 percent of participants reported more support from administration as an urgent need for them to integrate higher-level technology.

Table 4.11

Support for Higher-level Technology Integration

Questions	Pre-survey % Agree/ S. Agree	Post-Survey % Agree/ S. Agree	Percent Change
The school district expects us to learn new technologies without formal training.	35.7	21.4	-40
Principal/administration supports me when I integrate technology for student use into my teaching and learning activities.	92.9	100	7.7
More support from administration when it comes to my technology needs.	21.4	28.6	33.3
I have the support I need to integrate technology for student use into my teaching and learning activities.	100	100	0
There is a focus on technology at my PLC meetings.	71.4	71.4	0
There is a focus on technology at my grade level meetings.	64.3	78.6	22.2
I have enough time to prepare technology-based lessons.	21.4	50	133.3

Conclusion

The data showed that RMS teachers believe that higher-level technology integration is important for student learning. It also revealed that several teachers attempted higher-level technology integration using at least one of the tools demonstrated during the PD. Teachers cited support from the instructional technology specialist and administration as important factors in teachers' higher-level technology integration. Teachers cited time of year and time to plan as obstacles to integrating the new digital tools. Some shared plans to use the summer to practice more with the tools and develop higher-level technology integrated lessons for the next school year. The research was

conducted January through early May. The survey and group interviews were conducted following the conclusion of the PD. More participants may have attempted higher-level technology integration using one of the featured tools if there was a delay in administration of the survey or focus groups. The next chapter discusses the implications of these findings.

CHAPTER FIVE

DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

Chapter Five reviews the research questions and study design. The emphasis of the chapter is to summarize the major findings of the study, draw conclusions about the meaning of the findings, discuss the implications for my practice, and finally examine the need for future research. This chapter concludes with a discussion of the action plan that was guided by the results of the study.

Research Questions

RQ1: To what extent will the implementation of technology professional development change the use of higher-level technology integration in a middle school?

RQ2: To what extent will the implementation of technology professional development change middle school teachers' perceptions and attitudes regarding higher-level technology integration?

Summary of the Study

The study occurred during the spring semester of 2018 at a South Carolina suburban middle school. The research participants were 14 Roanoke Middle School teachers; they represented sixth through eighth grades, all core academic subjects, special education, and related arts.

This research study attempted to determine what effect technology professional development would have on the use of higher-level technology integration at RMS and

teachers' perceptions and attitudes toward higher-level technology integration. The intervention consisted of five professional development sessions: an introduction to 4Cs of 21st century learning and one session on each skill (communication, collaboration, creativity, and critical thinking). The sixth session was a debriefing and focus group interview of the professional development (Figure 5.1). Participants completed a pre- and post-survey of their attitudes towards technology integration including questions regarding support, obstacles, and the 4Cs.

Professional Development		
Session 1	21 st Century Learning	Introduction to the purpose of PD and the 4Cs
Session 2	Collaboration	Blackboard Discussion Boards
Session 3	Communication	Amplifying Student Voice Skype in the Classroom and Flipgrid®
Session 4	Creativity	Presentations Tools for Students
Session 5	Critical Thinking	Digital Breakouts
Session 6	Debriefing of PD and PLC	Discussion and group interviews

Figure 5.1. Overview of high-level technology professional development schedule

The survey results and analysis of group interview indicated that technology professional development does have a positive effect on teachers' confidence regarding technology integration even if the teacher already felt confident in their general technology proficiency. However, this increase of teacher confidence may not lead to an immediate increase in higher-level technology integration.

The findings implied that professional development does have an effect on the quantity and level of technology integration by teachers. Teachers indicated a preference for explicit instruction and hands-on time with the digital tool during the professional development. The professional development also benefited from having a common focus or theme—the 4Cs framework provided a structure that made the training more coherent

than singular training sessions. RMS teachers also believe that higher-level technology integration is important for student learning. Having an onsite Instructional Technology Specialist, or technology coach, as focused support also seems to affect the amount and quality of technology integration. Administrative support is a factor in teachers' willingness to integrate high-level technology. Administrative observations and constraints such as time and district-mandated online programs were named as concerns. Time was cited as the biggest obstacle to high-level technology integration.

Implications

It is necessary to determine which characteristics and factors affect higher-level technology integration. As stated by Kafyulilo et al., (2015) teachers need to perceive the PD as valuable, have access to reliable technology that is easy to use, have management support, and a supportive environment that may offer rewards and incentives to integrate technology. Teachers' personal beliefs, knowledge and skill levels, personal commitment, and engagement are also factors (Ertmer & Ottenbreit-Leftwich, 2010; Kafyulilo et al., 2015). Furthermore Kafyulilo et al. (2015) concluded that the likelihood of technology integration was not the result of one factor but the combination of all factors. When teachers lacked motivation or administrative or technical support, teachers did not integrate (Kafyulilo et al., 2015).

RMS teachers have access to technology. The school has three computer labs and another additional lab in the media center. There are also five mobile device cart assigned to sixth and seventh grades. There is one cart per team. Each computer lab and mobile cart has approximately thirty devices. Some computer labs have a few extra computers to accommodate larger classes. The computer lab schedule is made by me. Every English

and math teacher is required to go to the lab at least one day a week. Other content areas can request computer lab time; science teachers request time most often. For the mobile carts, a sign-out system is in place. There is a checkout calendar for each grade, and teachers sign up for the carts on an as needed basis. When a device is not working, teachers submit a work order to the school's technician. The device is then evaluated and fixed if possible. While the device is being fixed, there are no replacement devices to complete the set of 30. If the device is permanently broken, it is not replaced.

Although RMS teachers have access to technology, as Kafyulilo et al. (2015) asserted the technology must be easy to use. Ease of use is determined by how comfortable teachers feel with the devices and digital resources they are using. Ease of use comes from quality professional development and continued support for technology integration. The findings of this study demonstrate that RMS teachers possess general technology ability and beliefs that support technology integration. Most of the teachers possessed confidence in their ability to integrate technology into their instruction. One outcome of this study was a better understanding of how to address the other factors (access to technology, management support, supportive environment) to support teachers' technology integration.

Higher-Level Technology Integration

Overall frequency of lower-level technology integration was greater than higher-level technology integration. This was expected because of teachers' comfort level, previous training on this type of technology integration, and district required programs. In regards to higher-level integration, students using online resources to research

information was most frequently reported. Teachers reported assigning it monthly (28.6%) or weekly (50%).

There was a dichotomy of teachers reporting students creating presentations. Approximately 29 percent of participants reported that students create presentations using technology daily or weekly. A larger portion of teachers reported rarely assigning (never or once a year) students to use technology to produce class presentations (42.9%). A majority of participants reported rarely having students use technology to collaborate with teachers or peers (57.1%). Approximately 71 percent of teachers of teachers reported rarely or never having students communicate with experts. Participants were least likely to have students participate in virtual field trips.

The teachers that participated in this study represented multiple content areas including all core academic subjects, special education, and fine arts; however, examining technology use by subject area was determined inappropriate because of the small sample size. Any differences could have been contributed to individual teachers and could not be generalized to subject areas. However, it would be helpful to determine which content areas assigned technology integration and which kinds of higher-level technology integration most frequently, so the ITS could differentiate PD opportunities for specific content areas. One limitation of this study was time of year and the timeframe of the study. The study took place during the second semester of the school year, so teachers may have been responding on levels of technology integration over the course of the year, half of which was prior to the beginning of the study. Nevertheless, teachers reported utilizing specific digital tools and strategies featured during the PD (Table 4.9). It will be worthwhile to see if increased levels of technology integration are sustained

during the following school year. Also the ITS should focus on increasing incremental use of higher-level technology integration, encouraging teachers who currently use higher-level digital tools or strategies once a year to quarterly or from quarterly to monthly. The ITS could encourage this by offering systematic, explicit, and hands-on PD more frequently. This will be discussed further in the action plan.

School Technology Leadership

Ertmer and Ottenbreit-Leftwich (2010) suggest that schools have not integrated high levels of effective technology. They call for educators to consider technology not as a supplemental teaching tool but as essential. Technology has the ability to affect student learning, however it is not being used to its fullest potential in most classrooms (Vockley, 2007). In order to make school-wide increases to the level and quality of technology integration, teachers must have support from administration and other support staff like an instructional technology specialist. RMS administration facilitates the integration of technology and its appropriate use by allocating time and money for professional development and purchasing mobile devices to support the STEM initiative. RMS teachers confirmed that they felt supported by administration regards to higher-level technology integration and that support has an effect on the amount to technology integration they do. However, more could be done to alleviate teachers' concerns about technology integration affecting evaluations and providing more flexibility to integrate different digital tools or strategies in lieu of district-mandated programs.

Having an onsite Instructional Technology Specialist, or technology coach, as focused support also seems to affect the amount and quality of technology integration. The ITS should focus on providing systematic technology integration professional

development on specific tools and instructional strategies. The PD should also include follow-up support. Another suggestion would be for the ITS to advertise professional development to teachers that do not attend weekly planning and grade level meetings. The related arts and special education teachers were less likely to be aware of what training the ITS was offering because they did not attend these meetings.

Beyond training sessions, teachers must witness the impact of technology on their students' learning (Hew & Brush, 2007). When teachers witness the positive effects on student learning, they are motivated to experiment by adding more technologies to the curriculum. If the ITS attended content planning periods, she could help teachers understand how student-centered practices integrated with technology can affect student outcomes (Ertmer & Ottenbreit-Leftwich, 2010). Teachers could share within content and grade-level PLCs their success and challenges with higher-level technology integration, so other teachers could see the impact of technology on student learning.

Professional Development

This study specifically examined teachers' beliefs and confidence about higher-level technology and professional development. When developing ways to alter teachers' technology integration practices, I must consider the factors that affect high-level technology integration. Hew and Brush (2007) concluded that technology integration PD should focus on basic skills, management strategies, and curriculum support. This study supported that conclusion; even teachers who were confident with technology preferred systematic technology training that included explicit instruction on functionality, hands-on learning of the tool and instructional strategies. Hew and Brush (2007) proposed professional development programs that incorporate several strategies including sharing

examples of teachers' successes emphasizing student outcomes, providing support for experimentation, and defining good teaching with a corollary of technology integration. The professional development of this study was grounded in the 4Cs of 21st century learning. These skills can be taught without technology, however, are enhanced through technology integration. The focus on the 4Cs instead of solely on low-level technology skills and usage addressed the need for teachers to increase the quality of technology integration and active, hands-on student technology use.

Providing effective professional development is important to affecting teachers' pedagogical approach. RMS's current professional development is focused on increasing the use of PBL methodology throughout the school. Teachers need effective professional development to transition from teacher-led instruction to technology-enhanced student-centered learning outcomes. The PD offered during this study focused on building 21st century skills in students through student-centered use of technology. By focusing on content and pedagogy during technology PD and not just specific digital tools, teachers had a better understanding of the purpose of high-level technology integration. Providing teachers with baseline knowledge, specific examples of technology-rich lessons, and creating a culture that embraces higher-level technology integration should be the goal of any technology coach. Conducting technology training within the context of a PLC to discuss teachers' experiences, student learning, and ideas for improvement is essential to changing teaching practices to incorporate meaningful higher-level technology integration. Incorporating technology training in PLCs aligns PD with school goals and allows technology support, reflection, and discussion among colleagues.

21st Century Learning

The professional development within this study used the 4Cs as a framework to design and evaluate technology integration to support higher-level student use of technology. This framework aligns to the Profile of a South Carolina Graduate's (2016) world-class skills and RMS's STEM/PBL initiative. Teachers responded positively to the 4Cs. They agreed in their necessity for students' futures and were interested in learning strategies to support them in their classrooms. The PD benefited from focusing the purpose of higher-level technology integration on the development of these skills and as a means to promote learning content not just integrating technology for technology's sake (Herro & Quigley, 2017). From a training perspective, the professional development also benefited from having a purpose and vision for the technology training. Each tool corresponded with a "C". This prevented the training from appearing disjointed or unrelated. Future professional development could benefit from a common theme, so teachers can easily see the relevance and purpose of technology trainings.

Limitations of the Study

The study had limitations. The action research methodology of this study prevented generalizability because action research was specific to my own practice (Mertler, 2014). Furthermore, this study had fourteen participants. The small sample size limited the assumptions that can be made about the data.

Similar to limitations of other studies of professional development, this study focused on teachers' perceptions of the professional development and used a survey and teacher group interviews as the data collection instruments (Lawless & Pellegrino, 2007). Nor did it examine the effect of the professional development on student achievement.

Time constraints were another limitation of this study. This study was conducted from the end of January 2018 through March 2018. The post survey was administered following the completion of the last PD. This short timeline may have limited teachers from implementing ideas or strategies from the professional development. In addition, during January 2018, RMS experienced a snowstorm that shut down the school for almost a full school week. When teachers returned, they were stressed about curriculum pacing. As the study concluded, the beginning of testing season was looming. These factors may have affected teachers' willingness to integrate higher-level technology into their lessons.

Initially, I intended to conduct whole group PD sessions. This proved to be unfeasible. Due to scheduling conflicts, sessions broke into a 6th grade session, 7th grade session during planning periods, and an after-school session for 8th grade and related arts teachers. There were several benefits of conducting PD within a PLC including collaboration, camaraderie, and cross-curricular planning. The benefits of a PLC were experienced by the smaller groups but not by the whole group. Despite having multiple sessions, one on one make-up sessions were still required because participants were absent from the sessions. Having individual make-up session lessened the ability to collaborate with peers. However, teacher collaboration could have still happened outside of the sessions or with non-participants. In fact, during the 6th grade focus group interview, participants mentioned sharing strategies and ideas with non-participants.

Finally, during the group interviews, specific questions about the researcher were asked. Because I conducted the group interviews, the likelihood of getting honest critical

feedback diminished. An outside person conducting the interviews may have been able to elicit responses that are more honest.

Suggestions for Future Research

The findings of this study suggested areas for further study to add to the knowledge base on technology integration and professional development. First, resurvey past participants at the end of the first semester of the following school year to see if there is a longer-term effect of the professional development. Also re-conducting the experiment with new participants lengthening the time between treatment and survey to see if technology integration increased compared to original study. This adjustment would address the time constraint limitation discussed earlier.

As mentioned by a participant about higher-level technology integration, “it’s just amazing once you do it.” One adjustment to the future research would be to require an authentic assessment/homework during the treatment. If teachers are required to implement strategies at least once, they may be more likely to integrate higher-order technology within the classroom after the study’s completion.

Siddiq et al. (2016) found in their study of teachers’ emphasis on student development of digital information and communication skills that language, humanities, and arts teachers were more likely to integrate ICT. However, their literature review revealed that mathematics and science teachers were more likely to emphasize technology integration. This study did not analyze technology integration by subject area because of the small sample size. However, it would be beneficial to those who plan school-wide PD opportunities to determine which content areas assigned technology-integrated activities most frequently and which kinds of higher-level activities were

assigned, so PD opportunities could be differentiated for different content areas. Subject area differences may be an avenue for future research. This avenue also lends itself to the study of PD within dedicated content planning time because PD could be easily personalized to that content area.

Beyond this study, further research on the integration of technology professional development embedded within dedicated content planning time may be informative. In addition, research on how the role of the instructional technology specialist can better support teachers' attempts at higher-level technology integration could be beneficial to ITS or technology coaches. One possibility would include how co-teaching with the ITS could affect higher-level technology integration at RMS.

One surprising finding of the study was teachers' concern over poor performance reviews, even though it is a small portion of an overall evaluation tool. Further study on the effect evaluation tools have on teachers implementing higher-level technology could clarify steps school leadership could do to lesson this concern. Also exploring how school leadership can provide teachers more support and flexibility to integrate different digital tools or strategies in lieu of mandated online programs. Furthermore, administration support was determined to have an effect on the teachers' higher-level technology integration, so the effects of school technology leadership on technology integration should be investigated.

Action Plan

This study was designed to support technology integration at RMS. This study was conducted during year two of a STEM initiative at RMS. The action plan outlines steps that are based on conclusions drawn by this study to further higher-level technology

integration at RMS. See Figure 5.2. The action plan will be implemented during year three, presumably the final year of implementation. Eighth-grade teachers and teachers new to RMS will receive STEM training during the summer to prepare to teach using a PBL methodology during the upcoming school year.

The action plan steps will support high-level technology integration and align with RMS's overall STEM goals. (1) The ITS will continue to offer technology tips and strategies at grade-level and STEM meetings. The featured strategies, tips, and tools will highlight one 21st century skill at a time. The designated "Tech Time" at meetings will be used to support the current PBL projects in each grade level. (2) The ITS will offer and advertise longer more in-depth training afterschool to accommodate teacher preference of explicit technology professional development. (3) The ITS will create and circulate a monthly calendar of technology trainings to meet the needs and schedules of related arts and special education teachers who do not attend STEM or grade-level meetings regularly. (4) The ITS will attend content plannings to assist teachers in integrating high-level technology. I will rotate content areas in order to meet with each team at least quarterly. This time can be used to differentiate professional development based on the needs of specific content areas. (5) During content plannings, the ITS can suggest and encourage more co-teaching to facilitate higher-level technology integration. (6) I will discuss with administration what high-level technology integration looks like, so they can recognize and encourage during observations and subsequent feedback. Furthermore, it is necessary to share teacher concerns regarding poor observations when technology malfunctions and allowing more flexibility from district required online programs. Discussing strategies with administration team on how to foster a safe, supportive

environment that is conducive to high-level technology integration is imperative for teachers to feel comfortable integrating technology.

Action Steps	Person(s) responsible	Frequency	Timeline
(1) Continue to offer technology tips and strategies at grade-level and STEM meetings.	ITS	Bi-weekly	2018-2019 school year
(2) Offer and advertise longer more in-depth training afterschool to accommodate teacher preference of explicit technology professional development.	ITS	Monthly	2018-2019 school year
(3) Create and circulate a monthly calendar of technology trainings.	ITS	Monthly	2018-2019 school year
(4) Attend content plannings to assist teachers in integrating higher-level technology and encourage more co-teaching.	ITS and Teachers	1-2 per week	2018-2019 school year
(5) Train administration to recognize higher-level technology integration during observations and walkthroughs. <ul style="list-style-type: none"> ▪ Share teacher concerns 	ITS and Administration	Once	August-September 2018

Figure 5.2. Action Plan Timeline

Conclusion

This study investigated the effect the professional development had on higher-level technology integration at a middle school. Professional development that addressed higher-level technology strategies and digital tools appeared to have a positive effect on higher-level technology integration of participants. Teachers reported utilizing specific digital tools and strategies featured during the PD. However, teachers most frequently reported assigning students higher-level technology integrated assignments never or once a year. It is relevant to continue monitoring levels of technology integration to see if they are sustained during the following school year. Also the ITS should focus on increasing

incremental use of higher-level technology integration, encouraging teachers who currently use higher-level digital tools or strategies once a year to quarterly or from quarterly to monthly. The ITS can encourage this by offering and advertising systematic, explicit, and hands-on PD more frequently.

The PD focused on building 4C skills in students by utilizing higher-level technology integration. The participants (n=14) agreed that 21st century skills of collaboration, communication, critical thinking, and creativity are a necessity for students' futures. They were interested in learning strategies to support the development of those skills in their classrooms. From a training perspective, the professional development benefited from having a purpose and vision, the 4Cs, for the technology training. This purpose provided focus and made the trainings more coherent. The focus also provided a clear connection to content and pedagogy instead of singular technological skill development. Systematic professional development is still the preferred method of PD.

When teachers are confident in their technology ability and interested in doing so, time is cited as a common obstacle toward integration. Finally, instructional, administrative, and structural supports are factors that contribute to teachers' higher-level technology integration. Teachers require support from administration and ideally an instructional technology specialist in order to attempt technology integration. Structural support such as time for planning and more freedom of teacher choice in technology integration also contribute to teachers' higher-level technology integration.

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APPENDIX A

ISTE STANDARDS FOR STUDENTS (ISTE, 2016)

2016

ISTE STANDARDS FOR STUDENTS

1. Empowered Learner

Students leverage technology to take an active role in choosing, achieving and demonstrating competency in their learning goals, informed by the learning sciences. Students:

- articulate and set personal learning goals, develop strategies leveraging technology to achieve them and reflect on the learning process itself to improve learning outcomes.
- build networks and customize their learning environments in ways that support the learning process.
- use technology to seek feedback that informs and improves their practice and to demonstrate their learning in a variety of ways.
- understand the fundamental concepts of technology operations, demonstrate the ability to choose, use and troubleshoot current technologies and are able to transfer their knowledge to explore emerging technologies.

2. Digital Citizen

Students recognize the rights, responsibilities and opportunities of living, learning and working in an interconnected digital world, and they act and model in ways that are safe, legal and ethical. Students:

- cultivate and manage their digital identity and reputation and are aware of the permanence of their actions in the digital world.
- engage in positive, safe, legal and ethical behavior when using technology, including social interactions online or when using networked devices.
- demonstrate an understanding of and respect for the rights and obligations of using and sharing intellectual property.
- manage their personal data to maintain digital privacy and security and are aware of data-collection technology used to track their navigation online.

3. Knowledge Constructor

Students critically curate a variety of resources using digital tools to construct knowledge, produce creative artifacts and make meaningful learning experiences for themselves and others. Students:

- plan and employ effective research strategies to locate information and other resources for their intellectual or creative pursuits.
- evaluate the accuracy, perspective, credibility and relevance of information, media, data or other resources.
- curate information from digital resources using a variety of tools and methods to create collections of artifacts that demonstrate meaningful connections or conclusions.
- build knowledge by actively exploring real-world issues and problems, developing ideas and theories and pursuing answers and solutions.



4. Innovative Designer

Students use a variety of technologies within a design process to identify and solve problems by creating new, useful or imaginative solutions. Students:

- a. know and use a deliberate design process for generating ideas, testing theories, creating innovative artifacts or solving authentic problems.
- b. select and use digital tools to plan and manage a design process that considers design constraints and calculated risks.
- c. develop, test and refine prototypes as part of a cyclical design process.
- d. exhibit a tolerance for ambiguity, perseverance and the capacity to work with open-ended problems.

5. Computational Thinker

Students develop and employ strategies for understanding and solving problems in ways that leverage the power of technological methods to develop and test solutions. Students:

- a. formulate problem definitions suited for technology-assisted methods such as data analysis, abstract models and algorithmic thinking in exploring and finding solutions.
- b. collect data or identify relevant data sets, use digital tools to analyze them, and represent data in various ways to facilitate problem-solving and decision-making.
- c. break problems into component parts, extract key information, and develop descriptive models to understand complex systems or facilitate problem-solving.
- d. understand how automation works and use algorithmic thinking to develop a sequence of steps to create and test automated solutions.

6. Creative Communicator

Students communicate clearly and express themselves creatively for a variety of purposes using the platforms, tools, styles, formats and digital media appropriate to their goals. Students:

- a. choose the appropriate platforms and tools for meeting the desired objectives of their creation or communication.
- b. create original works or responsibly repurpose or remix digital resources into new creations.
- c. communicate complex ideas clearly and effectively by creating or using a variety of digital objects such as visualizations, models or simulations.
- d. publish or present content that customizes the message and medium for their intended audiences.

7. Global Collaborator

Students use digital tools to broaden their perspectives and enrich their learning by collaborating with others and working effectively in teams locally and globally. Students:

- a. use digital tools to connect with learners from a variety of backgrounds and cultures, engaging with them in ways that broaden mutual understanding and learning.
- b. use collaborative technologies to work with others, including peers, experts or community members, to examine issues and problems from multiple viewpoints.
- c. contribute constructively to project teams, assuming various roles and responsibilities to work effectively toward a common goal.
- d. explore local and global issues and use collaborative technologies to work with others to investigate solutions.

APPENDIX B

ISTE STANDARDS FOR EDUCATORS (ISTE, 2017)

ISTE STANDARDS FOR EDUCATORS

Empowered Professional

1. Learner

Educators continually improve their practice by learning from and with others and exploring proven and promising practices that leverage technology to improve student learning. Educators:

- Set professional learning goals to explore and apply pedagogical approaches made possible by technology and reflect on their effectiveness.
- Pursue professional interests by creating and actively participating in local and global learning networks.
- Stay current with research that supports improved student learning outcomes, including findings from the learning sciences.

2. Leader

Educators seek out opportunities for leadership to support student empowerment and success and to improve teaching and learning. Educators:

- Shape, advance and accelerate a shared vision for empowered learning with technology by engaging with education stakeholders.
- Advocate for equitable access to educational technology, digital content and learning opportunities to meet the diverse needs of all students.
- Model for colleagues the identification, exploration, evaluation, curation and adoption of new digital resources and tools for learning.

3. Citizen

Educators inspire students to positively contribute to and responsibly participate in the digital world. Educators:

- Create experiences for learners to make positive, socially responsible contributions and exhibit empathetic behavior online that build relationships and community.
- Establish a learning culture that promotes curiosity and critical examination of online resources and fosters digital literacy and media fluency.
- Mentor students in the safe, legal and ethical practices with digital tools and the protection of intellectual rights and property.
- Model and promote management of personal data and digital identity and protect student data privacy.



Learning Catalyst

4. Collaborator

Educators dedicate time to collaborate with both colleagues and students to improve practice, discover and share resources and ideas, and solve problems. Educators:

- a. Dedicate planning time to collaborate with colleagues to create authentic learning experiences that leverage technology.
- b. Collaborate and co-learn with students to discover and use new digital resources and diagnose and troubleshoot technology issues.
- c. Use collaborative tools to expand students' authentic, real-world learning experiences by engaging virtually with experts, teams and students, locally and globally.
- d. Demonstrate cultural competency when communicating with students, parents and colleagues and interact with them as co-collaborators in student learning.

5. Designer

Educators design authentic, learner-driven activities and environments that recognize and accommodate learner variability. Educators:

- a. Use technology to create, adapt and personalize learning experiences that foster independent learning and accommodate learner differences and needs.
- b. Design authentic learning activities that align with content area standards and use digital tools and resources to maximize active, deep learning.
- c. Explore and apply instructional design principles to create innovative digital learning environments that engage and support learning.

6. Facilitator

Educators facilitate learning with technology to support student achievement of the 2016 ISTE Standards for Students. Educators:

- a. Foster a culture where students take ownership of their learning goals and outcomes in both independent and group settings.
- b. Manage the use of technology and student learning strategies in digital platforms, virtual environments, hands-on makerspaces or in the field.
- c. Create learning opportunities that challenge students to use a design process and computational thinking to innovate and solve problems.
- d. Model and nurture creativity and creative expression to communicate ideas, knowledge or connections.

7. Analyst

Educators understand and use data to drive their instruction and support students in achieving their learning goals. Educators:

- a. Provide alternative ways for students to demonstrate competency and reflect on their learning using technology.
- b. Use technology to design and implement a variety of formative and summative assessments that accommodate learner needs, provide timely feedback to students and inform instruction.
- c. Use assessment data to guide progress and communicate with students, parents and education stakeholders to build student self-direction.

For more information, contact standards@iste.org. ISTE Standards for Educators, ©2017, ISTE® (International Society for Technology in Education), iste.org. All rights reserved.



iste.org/standards

APPENDIX C

TECHNOLOGY INTEGRATION SURVEY FOR TEACHERS

Last 4 digits of your teaching certificate:	Gender:
Grade(s) you Teach:	Subject(s):
Years Employed as a Teacher:	Years Employed at RMS:

1. My general technology expertise level:	Beginner		Intermediate	Advanced	Expert
I use a computer mostly for:	Never	Rarely	Monthly	Weekly	Daily
Personal purposes	1	2	3	4	5
Classroom instruction presentations i.e. PowerPoint, SMART Notebook	1	2	3	4	5
Email	1	2	3	4	5

SELF-REFLECTION ON TECHNOLOGY IN INSTRUCTION				
	Strongly Disagree	Disagree	Agree	Strongly Agree
I feel confident in my ability to integrate multiple technologies into my instruction.				
I have a variety of ideas and lessons for integrating technology into my teaching.				
Students use technology in my classroom to build critical thinking skills, creativity, collaboration, and communication skills.				
I have enough time to prepare technology- based lessons.				

I believe that integrating technology into my curriculum is important for student success.				
I am aware of the resources available by the district that can help me learn how to integrate technology.				
I do not have the technology skills to support the students when they use technology for a project.				
I am familiar with what technology is available to my students and me in our building.				

OPINIONS AND ATTITUDES ON TECHNOLOGY INTEGRATION

	Strongly Disagree	Disagree	Agree	Strongly Agree
When using the technology....				
Student create products that show higher levels of learning				
Students are more motivated				
Students are more interested in learning when using technology to investigate an issue or solve a problem.				
Students go to inappropriate sites				
There is more student collaboration.				
I think...				
Most technology would improve my ability to teach				
Technology has changed the way that I teach				
Technology makes my work more complicated to complete.				

Using technology can/does help students better understand what they are learning.				
I am confident in my ability to use technology for teaching and learning				
Creating technology-based learning activities is too time consuming compared to what is learned.				
Students are more knowledgeable than I am when it comes to technology				
The school district expects us to learn new technologies without formal training				
There is a focus on technology at my PLC meetings.				
There is a focus on technology at my grade level meetings.				
There are various opportunities for technology training.				
Technology is a good tool for collaboration with other teachers when building unit plans				
Technology is reliable.				

STUDENT USE OF TECHNOLOGY					
How often do my STUDENTS use the following for in class and/or out-of-class assignments?	Never/Once a Year	Quarterly	Monthly	Weekly	Daily
Computer applications to prepare assignments/papers (e.g., word processing)					
Computer or web-based applications to produce class presentations					

The internet or other software to <u>research information</u> or find materials for assignments					
Software to learn or practice new skills					
Computer communications to collaborate on assignments (e.g., email, web-based communication)					
Computer communications to correspond with experts, authors, or others (e.g., email, web-based communication)					
The internet to participate in virtual field trips.					
Other: _____					

DEVELOPMENT OF TWENTY-FIRST CENTURY SKILLS Part I

Does technology help students develop the 21 st century skill of...?	Strongly Disagree	Disagree	Agree	Strongly Agree
a. Critical-Thinking/Problem-solving				
b. Communication				
c. Collaboration				
d. Creativity				

DEVELOPMENT OF TWENTY-FIRST CENTURY SKILLS Part II

Does the technology-integrated instruction RMS students are currently getting help develop 21 st century skill of...?	Strongly Disagree	Disagree	Agree	Strongly Agree
a. Critical-Thinking/Problem-solving				
b. Communication				
c. Collaboration				
d. Creativity				

SUPPORT FOR TECHNOLOGY INTEGRATION				
_____ supports me when I integrate technology for student use into my teaching and learning activities.	Strongly Disagree	Disagree	Agree	Strongly Agree
Principal/administration				
Other teachers at my school				
Instruction Technology Specialist				
Others: _____				
I have the support I need to integrate technology for student use into my teaching and learning activities.				

NEEDS AREAS OF IMPROVEMENT / TECHNICAL NEEDS				
I need...	Less Urgent			Most Urgent
More time to integrate technology into my curriculum	1	2	3	4
More support from administration when it comes to my technology needs	1	2	3	4
More technical support to keep computers and applications running	1	2	3	4
More access to technology tools to integrate in my classroom instruction	1	2	3	4
Faster access to the internet	1	2	3	4

ADDITIONAL COMMENTS	
What are <i>Roanoke Middle School's</i> current technology strengths? Please provide examples.	
What are my current technology strengths? Please provide examples.	
In what ways would I like to use technology in my classroom? Please provide examples:	
What obstacles do I need to overcome in order to use	

technology in my teaching practices? Please explain.	
Additional comments:	

(Atkinson, 2005)

APPENDIX D

GROUP INTERVIEW QUESTIONS

Participants Present for PD/PLC Debriefing:

PD Reflection:

1. Tell me about your experiences with project-based learning in your classroom?
 - a. How effective was the technology training you received?
 - b. How helpful were the PLC meetings?
2. What are your perceptions of 4Cs of 21st century learning?
3. How comfortable do you feel with technology? Did the PD affect your comfort level?
4. Do students use more technology in your classroom? (direct hands-on use of technology)
5. In your experience/opinion, how do students feel about the technology used in your classroom?
6. Based on the data and discussions, what actions should be taken to strengthen instruction? (increase the use of hands-on technology use)
 - Teacher-
 - ITS-
 - Administrators-
7. What are teacher needs / concerns?

Based on the experience/opinion, what actions should be taken to strengthen professional development?

APPENDIX E

STUDY TIMELINE

Session	Topic	Details
June 2017	STEM and PBL Methodology	Pre-Session 1: At the end of the 2016-2017 school year, most of the seventh grade, some fine arts teachers, new sixth grade teachers and two eighth grade teachers participated in one-day staff development on STEM teaching. This is part of RMS's implementation plan to become a STEM school. All current sixth grade teachers participated in the training at end of the 2015-2016 school year.
August 2017	STEM Reflection	At the beginning of the 2017-2018 school year, the STEM administrator led a STEM Reflection to gain feedback from sixth grade teachers that implemented STEM the previous year.
Pre-Session 1	Pre-Survey was administered electronically.	
Session 1	21 st Century Learning	Introduction to the purpose of PD and the 4Cs
Session 2	Collaboration	Blackboard discussion boards
Session 3	Communication	Amplifying Student Voice Skype in the Classroom (skyping with experts, virtual field trips) Flipgrid®
Session 4	Creativity	Presentations Tools for Students
Session 5	Critical Thinking	Digital Breakouts
Post-Session 5	Post Survey was administered electronically	
Session 6	Debriefing of PD and PLC	Discussion and survey administered
Post-Session 6		During the 2017-2018 school year, RMS implemented a STEM/PBL curriculum in seventh grade and by the 2018-2019 school year, eighth grade will be trained and STEM/PBL will be fully implemented in all grade levels and electives.

APPENDIX F

PERMISSION TO USE SURVEY INSTRUMENT



Mon 5/21/2018 11:42 AM

Atkinson, Linda K. <latkinson@ou.edu>

RE: Permission to use survey instrument

To tyner, kristen (DMS Teacher)

Hi Kristen,

Your research sounds very interesting. You have permission to use the survey and modify as needed for your study. We would be very interested in your results.

Sincerely,

Linda

From: tyner, kristen (DMS Teacher) <kcollins@dorchester2.k12.sc.us>

Sent: Sunday, May 20, 2018 4:05 PM

To: Atkinson, Linda K. <latkinson@ou.edu>

Subject: Permission to use survey instrument

Hello Dr. Atkinson,

My name is Kristen Collins Tyner. I am a doctoral candidate in the Education Department at the University of South Carolina. I am conducting an action research study on technology integration at my school. I have used your work as a resource in my literature review. The purpose of my study is to determine what effect professional development has on teachers' use of technology integration as a higher-level instructional method. I am the instructional technology specialist at a middle school in Summerville, SC, so this study is intended to be a deep analysis and reflection of my personal practice.

I would like to request permission to use questions from your survey instrument from your dissertation *Schools as Learning Organizations: Relationships between Professional Learning Communities and Technology-Enriched Learning Environments*. I do not plan to use your survey instrument in its entirety, but only certain questions and adding my own questions to create a similar one.

I appreciate your consideration for granting permission to use your survey instrument. I would be happy to answer any questions you have. You may contact me at 843 323-1475 or ktyner@dorchester2.k12.sc.us.

Thank you for your time and consideration,

Kristen Collins Tyner, M.S.

APPENDIX G

INVITATION LETTER

Dear Potential Participant,

My name is Kristen Collins Tyner. I am a doctoral candidate in the Education Department at the University of South Carolina. I am conducting a research study as part of the requirements of my degree in Curriculum Studies, and I would like to invite you to participate.

I am studying the effect of professional development on technology integration. If you decide to participate, you will be asked to participate in several professional development sessions, complete a pre- and post-survey and participate in a group discussion about professional development within a professional learning community. You may feel uncomfortable answering some of the questions. You do not have to answer any questions that you do not wish. The focus group will take place at a mutually agreed upon time and place, and should last about 45 minutes. The focus group will be audio or videotaped, so that I can accurately reflect on what is discussed. The tapes will only be reviewed by members of the research team who will transcribe and analyze them. They will then be destroyed.

Study information will be kept in a secure location. The results of the study may be published or presented at professional meetings, but your identity will not be revealed.

During the focus group, others in the group will hear what you say, and it is possible that they could tell someone else. Because we will be talking in a group, we

cannot promise that what you say will remain completely private, but we will ask that you and all other group members respect the privacy of everyone in the group.

Taking part in the study is your decision. You do not have to be in this study if you do not want. You may also quit being in the study at any time or decide not to answer any question you are not comfortable answering.

We will be happy to answer any questions you have about the study. You may contact me at ktyner@dorchester2.k12.sc.us or my faculty advisor, Dr. Nathaniel Bryan, bryann@mailbox.sc.edu if you have study related questions or problems. If you have any questions about your rights as a research participant, you may contact the Office of Research Compliance at the University of South Carolina at 803-777-7095.

Thank you for your consideration. If you would like to participate, please contact me at the email listed below to discuss participating.

With kind regards,

Kristen Collins Tyner