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Investigating Technology Integration in a Technology Driven School: A Descriptive Research Study on Skill, Self-Efficacy, Barriers, and Integration Practices

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INVESTIGATING TECHNOLOGY INTEGRATION IN A TECHNOLOGY DRIVEN SCHOOL: A DESCRIPTIVE RESEARCH STUDY ON SKILL, SELF-EFFICACY, BARRIERS, AND INTEGRATION PRACTICES

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DEDICATION

For my children – Paul Thurston III, Anna Elizabeth, and Luke Daniel. If I can do this, you can do anything. You are braver than you think, smarter than you know, and loved more than words can ever describe. The world is yours for the taking. I promise to always be your biggest cheerleader and the home you can always return to. I will love you to my last breath.

For my parents – Daniel and Patricia Jackson. Thank you for your endless love and support no matter how misguided my path might have become. Thank you for being examples of hard work, perseverance, empathy, and success. Thank you for always demanding my best and setting the example for how I raise my children. I love you both to the moon pie and back.

For my Mema – Catherine McKinney Carroll. Every word of this was written for you. When I was little, you made me believe I could do anything I dreamed and be anything I wanted – this is me holding up my end of the bargain. I have to be the luckiest girl on earth to have been loved and cherished and valued by someone as amazing as you. I am constantly in awe at your intelligence, your selflessness, the way you can turn a history discussion into the most riveting tale, and how you face the worst of circumstances with bravery and determination. I can forever say that I have been loved unequivocally and unconditionally by you. Now you can finally say we have a doctor in the family. I love you Mema.

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ABSTRACT

Administrative observations show the use of digital technologies to facilitate learning and technology skill development are inadequate among teachers at a Science, Technology, Engineering, Arts, and Math (STEAM) accredited magnet school with International Society for Technology in Education (ISTE) based student technology guarantees. The purpose of this descriptive research study is to describe teachers' skill and confidence levels of technology use, teachers' perception of barriers to their technology integration, and levels of in-class technology integration in a STEAM accredited middle school with student Technology Guarantees in order to develop recommendations for future professional development and technology acquisition.

The research study was conducted through a series of quantitative measures including digitally administered surveys, lesson plan reviews, and classroom instructional observations. Qualitative measures include focus group interviews following the quantitative data collection phase. Participants include a purposive sample of twelve core content teachers employed full-time at the technology driven school research site.

The research study aims to answer three research questions: 1) How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?, 2) How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?, and 3) How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?

Findings indicate that teachers describe their technology skills in a mix of strengths and weakness with polarized groups of teachers having either high or low technology skills and low self-efficacy. The primary barriers perceived by teachers include access to technology resources, adequate time to plan and implement technology enhanced instructional practices, and a lack of outside support for teachers to help them connect technology with their current curriculum. The effects of these barriers are greater on teachers with lacking technology skills and lower self-efficacy. Technology integration practices at the study site occur mostly at lower replacement or amplification levels with low intentional planning. Higher levels of technology integration were observed at greater frequencies with teachers considered to be skilled and confident technology users.

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CHAPTER 1

INTRODUCTION

National Context

Traditionally, the digital divide in education referred to the gap in access to digital technologies including internet access prevalent between affluent schools and those less affluent or rural. That definition has extended to include a lack of technology proficiency that often exists even when there is access to devices (Huffman, 2018; Morley, 2013). As access has increased dramatically since that term was first coined, the digital divide has transformed to a divide in digital usage that “exists between learners who are using technology in active, creative ways to support their learning and those who predominantly use technology for passive content consumption” (U.S. Department of Education, 2017, p. 7). According to the most recent data from the National Assessment of Educational Progress’ (NAEP) Technology and Engineering Literacy assessment, only 43% of eighth grade students scored proficient in technology literacy and more than 48% of eighth grade students are not involved in any type of technology education class (National Center for Education Statistics, 2014). In addition to observations made by educational researchers, the National Education Technology Plan (NETP) describes an absence of teachers who are able to use technology to redefine the learning process noting that teachers’ primary use of technology is not for instruction (Ertmer & Ottenbreit-Leftwich, 2010; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; U.S. Department of Education, 2016). The problem is so pervasive that the consensus recommends starting the transformation process at the higher education level with teacher preparation programs for pre-service teachers leaving generations of in-service teachers teaching with inadequate technology integration and students not being taught skills needed to compete in the 21st century workplace (U.S. Department of Education, 2016). Following the most recent release of the NETP, momentum in the movement to bring our classrooms up to speed prompted the U.S. Department of Education to release smaller, yearly updates to the plan that reflect the improvements across the nation and to detail updated needs. The first plan update expands the sentiment from the NETP that pre-service teachers are starting their careers unprepared to use technology effectively in the classroom, that our testing practices fail to use technology in a manner that examines the abilities of the whole child, and our push to provide technology access to teachers and students has lacked instruction on how to use and select technology effectively (U.S. Department of Education, 2017).

The key factor to eliminating the digital use divide and increasing effective technology integration in our classrooms is examining the needs of our teachers as facilitators to this change. Often school districts will pour money into increasing student access to digital technologies but fail to determine how the teachers feel about this investment or provide adequate professional development on the purpose or integration of the devices or programs (Ertmer, Ottenbreit-Leftwich, & York, 2006; Liao, Ottenbreit-Leftwich, Karlin, Glazewski, & Brush, 2018; Ottenbreit-Leftwich et al., 2010). When professional development is provided, it becomes ineffective when it fails to take into account individual teachers' instructional needs, is not embedded in the educational process, or is not sustained long enough over a period of integration to have the maximum impact (Desimone, Porter, Garet, Yoon, & Birman, 2002; Kamalodeen, Figaro-Henry, Ramsawak-Jodha, & Dedovets, 2017; Lowther, Inan, Strahl, & Ross, 2008). Ertmer and Ottenbreit-Leftwich (2010) believe "knowing how to use technology hardware (e.g., digital camera, science probe) and software (e.g., presentation tool, social networking site) is not enough to enable teachers to use the technology effectively in the classroom" at levels beyond passive use as a substitute for non-technological tools; meaning that our technology professional development must also make the shift to more rigorous integration practices (p. 260).

Local Context

Starting in the 2018-2019 school year, teachers across South Carolina are required to integrate the new Computer Science and Digital Literacy Standards into regular classroom instructional practices. For example, students at the middle level are now required to use software to "collaborate and create authentic products," understand the function of and troubleshoot hardware, understand how data is stored and transmitted, design code and algorithms, and deeply explore digital citizenship (South Carolina Department of Education, 2017, p. 35-47). Where these skills once belonged solely in a high school level computer science course, these skills must now be embedded in all content areas and by all teachers to ensure every student is successful. In addition to the change in standards, teachers at the school research site have completed their fifth year of accreditation and are seeking reaccreditation as a science, technology, engineering, arts, and math magnet school. The school's AdvancEd STEAM accreditation and implementation of student Technology Guarantees are modeled after the International Society for Technology in Education (ISTE) standards and indicators (AdvancEd, 2018;

International Society for Technology in Education, 2016). The Technology Guarantees detail the technology affordances and competencies required for mastery by students at each grade level culminating with a digital portfolio presentation in the terminating grade level (New Ellenton Middle STEAM Magnet School, 2018).

Despite the ongoing technology focus, observations performed in my former role as a school administrator have revealed inconsistent and passive technology integration. Teachers at the school research site display varying degrees of technology proficiency and rarely seek assistance from administration to find or implement new technology practices. Core content teachers are afforded the opportunity to receive direct observations and individualized professional development from content interventionists specializing in their content area. Unfortunately, the content interventionists do not specialize in technology integration within the content and the school district does not have a technology integration specialist on staff. In the process of recertifying STEAM accreditation and incorporating the new South Carolina technology standards into instructional practices, the need for effective, targeted professional development designed to meet the needs of both individuals and groups of teachers is evident. The goal of this study is to describe those needs within the construct of current practices and make recommendations for professional development.

Statement of the Problem

The use of digital technologies to facilitate learning and technology skill development are inadequate among teachers at a Science, Technology, Engineering, Arts, and Math (STEAM) accredited magnet school with International Society for Technology in Education (ISTE) based student technology guarantees. Classroom observations performed in my former role as a school administrator have revealed that the majority of teachers use technology sparingly and often only to take the place of other less rigorous instructional practices. Other teachers will use technology on a nearly daily basis, but still only engage students with the technology in low-level replacement activities. The level of technology proficiency varies greatly from teacher to teacher, but most instructional practices lack the depth and breadth that would be expected in a school with an advertised and accredited technology focus. Ertmer and Ottenbreit-Leftwich (2010) noted the same level of technology integration on a national scale where both teachers and students are engaged in using technology more often but in practices that replace non-technological teaching practices. According to the United States Department of Education Office of Educational Technology (2017), the disparity continues to widen between students who use technology for creation and innovation and those who use technology as a substitute for non-technological tools. In order to effectively prepare students to be 21st century citizens in a technology driven world, teachers must reach an understanding of how to "use technology to facilitate meaningful learning, defined as that which enables students to construct deep and connected knowledge, which can be applied to real situations" (Ertmer & Ottenbreit-Leftwich, 2010, p. 257). "By their very nature, newer digital technologies, which are protean, unstable, and opaque, present new challenges to teachers who are struggling to use more technology in their teaching" (Koehler & Mishra, 2009, p. 61).

Purpose Statement

The purpose of this descriptive research study is to describe teachers' skill and confidence levels of technology use, teachers' perception of barriers to their technology integration, and levels of in-class technology integration in a STEAM accredited middle school with student Technology Guarantees.

Research Questions

This research study will address the following research questions:

1. How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?
2. How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?
3. How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?

Researcher Subjectivities and Positionality

Being a part of the hybrid generation where computers, software, and eventually the internet were becoming more mainstream alongside the traditional card catalogs, encyclopedias, and microfiche meant having adaptable skills that could be applied to any aspect of life and differentiated us from the generations surrounding us. As K-12 students we were excited and anxious to figure out what our MS-DOS computers could do next but were still heavily dependent on books and notecards to carry us through our studies. As college students we embraced 12-point font, double-spaced, word-processed papers and dabbled in internet research and presentation tools that would be sketchy by today’s standards. When I became a teacher nearly 20 years ago, I realized that the art teaching had changed very little even though we had entered the technology age that brought sweeping innovation to our fingertips. Unlike many places across the nation, my students have always had computer and internet access. As their teacher, I have always searched for different and unique experiences for my students to experience through technology. After ten years in the classroom and seven years as a school administrator, I see that our students are still only experiencing technology-enhanced instruction at a fraction of its potential. Many of today's teachers were educated before the extension of technology to consumers or were educated through pre-service programs that had yet to transition to high-level technology integration practices. It has always been my desire to be a facilitator for these teachers who want to have more technologically savvy classrooms but do not know where to start. My interest in helping the teachers and students use technology in creative and innovative ways to enhance the rigor and effectiveness of teaching and learning, rather than as a substitution for non-technological methods, is the motivation behind conducting this research study.

The desire to create positive change through research, study, analysis, reflection, and recommendation within my own realm of influence using best-fit research approaches resulting study-specific outcomes is reflective of my pragmatic paradigm. Approaching my research interests through a pragmatic lens allows me to choose methodologies which will best provide an understanding of the research problem whether through qualitative, quantitative, or mixed-methods approaches in addition to determining my own relationship to the research while giving a voice to the perspectives of all study participants (Creswell, 2014; Mertens, 2009). This recipe for research can and should be altered from study to study as participants, research purposes and outcomes, environments, social contexts, and constructs of the field of education change.

In alignment with pragmatic descriptive research, my positionality for this study places me as an insider taking into account my relationship to the study site and participants. My study will take place at the school in which I am a former administrator, using the teacher population as participants giving a unique perspective to the research and findings. While this positionality will require careful navigation of several ethical considerations including bias and power imbalances, it is also reflective of my values as an experienced educator who is working to provide the best education possible to more than just a single classroom of students as they strive to compete in the 21st century global market. My educational background, experiences with advancing technologies, and natural inclination toward improvement and innovation have all had a profound impact on my career and inspire my continued graduate research.

Definition of Terms

In this study the following variables are defined:

Barriers: factors that have a negative effect on a teacher's ability to successfully integrate technology into classroom instructions. Barriers are delineated by first-order barriers that are outside of the teacher (lack of technology, lack of time to plan, etc.) and second-order barriers that are internal to the teacher (self-efficacy, beliefs regarding technology, etc.) (Ertmer, 1999).

Self-Efficacy: refers to a teacher's personal belief in their ability to achieve success in technology integration (Bandura, 1997).

STEAM/STEM Accreditation: certification granted by AdvancED that signifies a school meets the standards and indicators defined by AdvancED within the science, technology, engineering, and math instructional curriculums (AdvancED, 2018).

*schools may achieve this accreditation and self-designate the addition of the arts (STEAM vs STEM)

Technology Guarantees: school specific criteria modeled after the International Society for Technology in Education (ISTE) standards and indicators that detail the technology affordances and competencies required for mastery by students at each grade level (International Society for Technology in Education, 2016).

Technology: study specific terminology includes all hardware and software (i.e. computers/laptops/tablets, interactive software, projectors, SMART boards, etc.) utilized by teachers and/or students beyond materials (i.e. textbooks, curriculum guides) provided by the state department or school district curriculum teams.

Teacher Technology Skill Self-Efficacy: self-reported efficacy and skill level in utilizing technology for personal or instructional purposes.

Technology Integration Practices and Rigor: scale designed to describe the types of technology usage, the purpose of technology usage, and the rigor level of technology integration as defined by the Looking for Technology Integration Observation Tool (LoFTI) (Friday Institute for Educational Innovation, 2015). For example, using an online textbook to replace a hardcopy textbook versus using a multimedia program to create a public service announcement regarding the spread of a mystery disease.

CHAPTER 2

A RESEARCH SYNTHESIS OF TECHNOLOGY INTEGRATION

The purpose of this descriptive research study is to describe teachers' skill and confidence levels of technology use, teachers' perception of barriers to their technology integration, and levels of in-class technology integration in a STEAM accredited middle school with student Technology Guarantees. This literature review explores existing empirical research and focuses on expanding perspectives related to the following research questions: (1) How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage? (2) How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration? And (3) How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?

The principle method for conducting this literature review involved layers of searches using academic research databases such as *Academic Search Complete*, *Education Source, JSTOR,* and *ERIC (EBSCO).* The primary search terms of technology integration and educational technology were used in conjunction with Boolean phrases and secondary search terms including barriers, benefits, pedagogy, theory, professional development, measuring, STEM, STEAM, trends, and issues. Results were typically filtered to include research in peer-reviewed content, specified reference type, with full-text affordances, in the English language, and publication dates within the last five years.

These searches resulted in many of the quality research articles presented in the literature review as well as reference lists that were mined for additional background knowledge, prior research, and research methodologies. Subordinate methods for conducting literature searches included specific searches for previously conducted research studies in dissertation format from databases such as ProQuest in addition to using Google Scholar to perform searches for literature outside of results generated from the academic research databases. In both cases, results were refined with similar parameters as with the academic database searches. Results were filtered to include recent publications, in full-text format, with the specified reference type. Some of these searches resulted in cited literature and more often the reference lists were mined for additional undiscovered literature. Results from all searches were read for content, cited research, research methodologies, results, limitations, and discussions. In some cases, research from outside the 5-year publication span was included for synthesis due to the inherent value of the information. Documentation was amassed for each piece of literature, paying special attention to topics and methodologies that mimicked the proposed research study. The organizational structure of this literature review is driven by the methodical searches of academic research described above and includes the three major themes of (a) Technology Integration, (b) STEM/STEAM, and (c) Established Research Measures.

Technology Integration

Since before the advancements achieved in the industrial revolution and the space race, educators have worked to harness every possible tool, from audio equipment and televisions to computers and virtual reality devices, to innovate the art of teaching and expand opportunities to meet the needs of students (Carver, 2016; Doshmanziari, & Mostafavi, 2017; Hew & Brush, 2007). This has required educators to reexamine educational practices and reinvent the way technology tools are used in the educational process (Birisci & Kul, 2019; Cuban, 2001; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010). In some instances, students are using technology for the creation and innovation of their own ideas while some students are using technology as a replacement for tools such as textbooks are worksheets. This spectrum is incredibly vast making the definition of technology integration difficult to nail down. Technology integration can be defined as teachers' and students' use of devices to increase productivity or replace traditional practices, the use of technology to enhance traditional instruction, or even the use of tools to fully simulate the role a student might take to complete a task or solve a problem as if they were employed to do so (Hew & Brush, 2007; Schrum, Galizio, & Ledesma, 2011).

As the first of the three major themes, technology integration is discussed across a variety of subtopics including (a) benefits and barriers, (b) making the transition to technology integration, (c) technology impact on teaching and learning, and (d) levels of technology integration. Benefits and barriers presents both the advantages and challenges, along with the big picture applications, that are present when integrating technology into educational practices. The making the transition to technology integration section takes into account effective methods of technology integration professional development methods, changing teacher mindsets and acknowledging teacher perception of technology integration and its barriers, and identifying the relationship between teacher skill level and technology integration. In the technology impact on teaching and learning subsection, the literature synthesis covers international publications, advances in mobile learning and how students integrate technology outside of school, specialized applications in content and special education areas, and pedagogical theory surrounding technology integration. The technology integration section is concluded with a synthesis of studies describing levels of technology integration present in various educational settings.

Benefits and Barriers of Technology Integration

The overarching goal of using technological advancements in instructional design is to facilitate learning, increase student engagement, and increase content mastery (Alkraiji & Eidaroos, 2016; Harper & Milman, 2016; Li, Snow, & White, 2015). With any new advancement comes the analysis of both the risks and rewards. Just as the benefits of integrating technology into educational practices are acknowledged across much of the literature, researchers are more cognizant of the barrier and contraindicators that need to be diagnosed before the true potential of the unification between technology and learning can be realized.

Benefits. The advancement of access to the Internet and increased availability of web-based resources to educational institutions has been the single most effector of change for teaching and learning since the 1990s-era recommendations that all students have computer skills before leaving high school (Alkraiji & Eidaroos, 2016; Blue, 2006; Carver, 2016; Harper & Milman, 2016; Pickett, 2009). Across all stages and forms of learning, students now have access to more educational opportunities than ever before. Advancements in instructional technologies have allowed students who live in areas where there are educational opportunity gaps, to take online courses, receive training, earn degrees, and access other educational resources through distance learning (Francom, 2016; Miller, 2017; Pickett, 2009). Teachers can connect with students through technology integration in ways that rival traditional classroom instructional methods.

Communication. The ability to communicate effectively has been a long-established favored characteristic of successful, employable citizens and facilitated communication is one of the more rudimentary benefits of technology integration (Alkraiji & Eidaroos, 2016; Arnold, 2017; Blue, 2006; Dawson; 2012; Harper & Milman, 2016). E-mail, message and discussion boards, web-based video and audio chat tools such as Skype and FaceTime, mobile texting, collaboration tools such as Google Docs, file sharing sites such as Dropbox, and social media platforms are all examples of innovations in technology that facilitate communication and can be used for educational purposes. The positive effects of uniting learners through communications technologies has been especially transforming in connecting students across the globe as collaboration has become easier and more mainstream (Alkraiji & Eidaroos, 2016; Harper & Milman, 2016).

Academic impacts. Another major benefit has been the recognition of significant student gains in academics across many areas of core content (Blue, 2006; Carver, 2016; Harper & Milman, 2016; Li, Snow, & White, 2015; Pickett, 2009). Blue (2006) found that when students interacted with technologies that included webpage development, printing and electronic imaging, and video production, academic achievement for these students in the areas of science, math, and technology proficiency improved between administered pre- and post-tests. Teachers often report that increased content mastery is one of the driving factors behind their choice to use technology during instruction, even if students are not using the technology to achieve higher-order learning (Carver, 2016). In a review of global studies, Harper and Milman (2016) determined that the implementation of 1:1 technology in low socio-economic settings and classrooms with disparages in student ability resulted in positive effects on student achievement and the reduction of achievement gaps between students of varying abilities. Li, Snow, and White's (2015) synthesis of studies indicates that there is a positive correlation between technology use and improved language skills, especially for students who are second language learners or have a low socio-economic-standing, even if that technology is limited to social media platforms.

Motivation and engagement. One of the more inherently cited benefits teachers associate with integrating technology into their teaching practices is marked increases in student motivation and engagement (Carver, 2016; Ertmer, Ottenbreit-Leftwich, & York, 2006; Harper & Milman, 2016; Muratie & Ceka, 2017; Orhan-Karsak, 2017; Pickett, 2009). In a world where students have access to entertainment and information at their fingertips both in and outside school, teaching practices would be remiss to ignore the potential gains technology integration brings to the table. "Digital technologies and social media have proven to be intrinsically attractive to youth, as shown by the time they spend in the virtual space, juggling multiple devices, and using software applications (i.e. apps)" (Li, Snow, & White, 2015. p. 143). A synthesis of research studies indicates that increased engagement and motivation as a result of expanded technology use leads to students creating content permanence, students connecting more frequently with the content both at home and at school, and even improvements in attendance and disciplinary cases for student behavior (Harper & Milman, 2016; Orhan-Karsak, 2017). In addition to bringing positive changes to how students approach learning, increased classroom technology also improves how teachers approach teaching and the overall classroom climate (Francom, 2016; Harper & Milman, 2016; Mishra & Koehler, 2006; Orhan-Karsak, 2017; Pickett, 2009). Learning experiences for students become more enriched when teachers utilize technology to facilitate learning, collaboration, and creativity. One study reviewed by Harper and Milman revealed that "students using laptops engaged in more sophisticated learning activities, including extensive written expression, creation and delivery of multimedia presentations, and data analysis" (2016, p. 134). This is a result of teachers creating more meaningful opportunities for students to learn, implementing differentiation techniques, and using best-practices for technology integration (Francom, 2016; Harper & Milman, 2016; Lowther, Inan, Ross, & Strahl, 2012; Maninger & Holden, 2009; Mishra & Koehler, 2006; Orhan-Karsak, 2017; Pickett, 2009).

Digital literacy and citizenship. Technology integration also benefits the knowledge base we have on digital literacy and citizenship (Pickett, 2009). The influx of technology in the classroom has revealed previously unknown needs for protecting students. Students are now taught not only how to work the technology, but how to manage themselves and their personal information when connected to the digital outside world. Well-trained teachers are providing instruction to students on proper digital communications, Internet safety, evaluating the value and authenticity of online information, plagiarism, and digital etiquette standards (Pickett, 2009). Digital literacy and citizenship are becoming especially valuable as technology provides students more streamlined ways of collecting data, recording information, completing assignments, and receiving feedback on devices that hold a tremendous amount of personal information.

Barriers. Ertmer (1999), Ertmer and Ottenbreit-Leftwich (2010) and Ertmer, Ottenbreit-Leftwich, and York (2006) have been cited extensively throughout the literature for their research on barriers that are encountered when integrating technology into teaching. Ertmer (1999) categorized these barriers into first-order and second-order barriers based on their external and intrinsic roots respectively. First-order barriers include outside factors that inhibit technology use such as access, training, time constraints, and conflicting rules and policies. Second-order barriers include internal factors such as teacher beliefs and perceptions of technology that continue to block technology integration even when first-order barriers have been addressed. Ertmer's second-order barriers arose out of the disproven belief that integration would happen naturally once the first-order barriers were eliminated or at least recognized. In Ertmer's (1999) research, she identified that first-order barriers could be measured, while second-order barriers had to be interpreted and it was this interpretation that told the true story of why technology was or was not integrated into instructional practices. For example, limited technology access (first-order barrier) may be overcome by the teacher's high skill level and strong value placed on technology. To the contrary, plentiful access may still not result in increased integration if the teacher does not see the value in the technology nor retain the skills needed to facility student use. To achieve high levels of integration, meaning that students are using technology tools beyond low-level replacement activities, second-order barriers must be identified for targeted professional development (Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010). Ertmer's (1999) ranking of the barriers does not suggest that they should be alleviated individually in a checklist manner, but that first- and second-order barriers are so intermingled that, once identified, should be address holistically. Teachers will often encounter multiple barriers at once when trying new technologies.

Access to technology. The very first recognized barrier to increasing technology usage is the lack of access to equipment and resources (Carver, 2016; Doshmanziari & Mostafavi, 2017; Ertmer, 1999; Francom, 2016; Heravi, 2009). As technology has advanced and become more affordably available to schools, barriers to access transitioned from computer access to information access as limitations existed in access to the Internet and web-based resources (Francom, 2016; Hughes, Read, Jones, & Mahometa, 2015; U.S. Department of Education, 2017). Since the first introduction of computers in schools, teachers have been creative with providing access to students by creating computer labs, movable carts of laptops, and collaborative grouping of students. The efforts of schools to address the barrier of access to technology has significant merit. Research shows that students perform better academically in environments that have a lower device-student ratio, specifically citing the value of a 1:1 technology environment over ones that require students to share equipment and resources (Francom, 2016; Harper & Milman, 2016; Hughes, Read, Jones, & Mahometa, 2015). Although a widely recognized barrier, research shows that even when teachers have access to technology tools, there were still several factors preventing increased student usage (George & Sanders, 2017; Harper & Milman, 2016).

Academic impacts, motivation, and engagement. As an alternative view to the cited positive impact technology integration has on student achievement, technology integration in instructional practices impacts student learning outcomes and how students are assessed (Ertmer, 1999). The types of assignments and the methods in which students receive feedback are different in a technology rich environment and teachers must take care to ensure the outcomes match instruction and the feedback is not impersonal. Often, teachers engage students with technology to promote engagement rather than increasing the instructional rigor of the lesson (Carver, 2016). Just as there is research to support technology increasing academic achievement, there are also studies whose data does not support this conclusion (Harper & Milman, 2016). Likewise, as there is plenty of evidence to suggest that technology integration increases student motivation and engagement, further research shows that students do not sustain attention on learning tasks even when technology is present and will be disinterested if the technology component becomes routine, lacks entertainment and innovation, or if the students lack self-redirection skills (Harper & Milman, 2016; Klein, 2016; Li, Snow, & White, 2015; Miller, 2017).

Teacher self-efficacy and skill levels. It is not enough for teachers to just understand how technology works. Teachers must possess a belief system that finds value in integrating technology in their instructional programs and believing that traditional teaching alone is sufficient may be a greater barrier than the others combined (Ertmer & Ottenbreit-Leftwich, 2010; Heath, 2017; Heravi, 2009; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). The barrier is magnified when educators do find value in technology tools and still do not make them a part of teaching and learning beyond most basic of functions (Carver, 2016; Orhan-Karsak, 2017; Pickett, 2009). In contrast, students' use of technology is increasing exponentially (Li, Snow, & White, 2015; Pickett, 2009). The barrier effects of poor technology perception become evident when teachers lack technology skills and/or do not have a pedagogical toolbox connected to a concrete understanding of their content leaving them unable to use technology effectively to enhance learning (Carver, 2016; Ertmer & Ottenbreit-Leftwich, 2010). Ultimately, teachers with low skill levels in using technology will only engage in low level integration practices, while teachers who have intrinsic value and whose use is facilitated through support and development will engage in higher level integration (Doshmanziari & Mostafavi, 2017; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Heravi, 2009; Pickett, 2009).

Time constraints. Effective teaching requires a significant time investment for planning, preparation, and the discovery of tools to enhance instruction. This amount of time required for planning increases exponentially when teachers are expected to incorporate new technology equipment and web resources in daily lessons; and teachers ultimately lack the time needed during working hours to effectively search for, explore, and sufficiently vet tools and software for classroom use (Ertmer, 1999, Pickett, 2009). K-12 teachers report only having minutes each day for lesson preparation while education faculty teaching online are faced with hours of preparation to create a single multimedia presentation (Carver, 2016; Miller, 2017; Pickett, 2009). In addition to overly packed curriculum expectations, teachers must meet the demands of attendance, record keeping, special education accommodations, fire drills, instructional interruptions, etc. that all detract from time dedicated to teaching and learning (Harper & Milman, 2016).

Classroom management. Introducing technology itself may be seamless when it comes to instruction, but there will be a dynamic impact on how resources and behavior expectations are managed in the classroom (Ertmer, 1999). Traditional teaching practices that have been established may not consider concessions that must be made when technology is present. The sharing of resources, possibly technology failure, care of equipment, and collaboration expectations all need to be adjusted to reflect the differences between traditional teaching and teaching with technology. Research shows that the inclusion or removal of technology has a neutral effect on aspects of classroom management like notetaking, class attendance, and interaction with the teacher. Consequently, there is a significant impact on the quality of student work, the level of student participation, student engagement, and student perception of the course and teacher when technology is included or excluded from instructional practices (Lavin, Korte, & Davies, 2011).

Digital literacy and citizenship. In today's society, students are inundated with technology, but that does not equate to students conducting themselves as true digital natives (Harper & Milman, 2016; Heath, 2017). Students spend a lot of time on social media products and research shows their behavior opens them up to predatory attacks, less-than-credible information, theft of personal information, and ultimately the inability to manage productivity effectively (Heath, 2017; Pickett, 2009). Students today have been exposed to technology in education since before kindergarten and those students do not have the skills to troubleshoot technology or navigate new software safely without intense guidance (Heath, 2017; Klein, 2016; Muratie & Ceka, 2017).

The big picture. As researchers and educators, we must ensure we examine our school and practices holistically and not just the positive implications, perceived or realized, of technology integration. This holds especially true in areas where technology integration is new such as the rural south where technology is limited and scarce and in situations where access to computers does not match measured usage (Alkraiji &

Eidaroos, 2016; Ertmer, & Ottenbreit-Leftwich, 2006; Ertmer & Ottenbreit-Leftwich, 2010; Francom, 2016; George & Sanders, 2017; Kalonde, 2017). Making the connection between home and school technology usage, we need to take into account the side effects of promoting increased usage and our responsibility in making sure that the whole-child is addressed in policies and procedures rather than just learning or increased integration, but that achievement, engagement, and the well-being of children are equally uncompromised (Barr, Moore, Johnson, Merten, & Stewart, 2012; Harper & Milman, 2016; Heath, 2017; Li, Snow, & White, 2015; U.S. Department of Education, 2017). The studied impacts of the benefits and barriers of technology integration will always be disparate across geography and economies and research lacks empirical comparison studies that include intersection between the factors of human behavior, organizational limitations, and technological intervention (Alkraiji & Eidaroos, 2016; Francom, 2016).

Making the Technology Integration Transition

The key component of successfully introducing changes in any established program, especially when those changes include the overwhelming integration of advanced technologies, is having a clear vision of the purpose and the path that will facilitate the new expectations (Ertmer, 1999). Teachers must receive effective communication, understand the value of the path forward, and receive ample support through the transition.

Effective methods of professional development. Teachers need ample training, in a variety of formats, with a focused purpose relevant to their needs, that incorporates technical skills training, instructional practices, and pedagogical belief alignment to overcome the variety of barriers that prevent true technology integration (Clifford, 2007;

Ertmer, 1999; Harper & Milman, 2016; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). Teacher who become more comfortable with technology become better integrators who give students more authentic experiences and naturally become technology advocates who promote best-practices, rally for technology support, and mentor novice teachers (Ertmer, 1999; Ertmer-Ottenbreit-Leftwich, 2010; Pickett, 2009). Allowing teachers to collaborate, establish goals for their specific classrooms, and investigate ways technology can help apply knowledge rather than merely present content should be a focus of professional development (Ertmer & Ottenbreit-Leftwich, 2010; Miller, 2017; Pickett, 2009). The transition to technology-based approaches is best given in small, time-lapsed chunks to prevent teachers from getting overwhelmed and feeling pressed to make changes too quickly (Ertmer & Ottenbreit-Leftwich, 2010; Kamalodeen, Figaro-Henry, Ramsawak-Jodha, & Dedovets, 2017; Miller, 2017). It is important that professional development is focused on teacher and classroom needs because technology integration involves more than just using computers (Clifford, 2007).

Ertmer (1999) recommends a three-part approach to helping teachers transition technology into their classrooms, all taking place before the technology is even purchased. After establishing a clear vision and purpose for incorporating advanced technology in instructional practices, teachers need to engage in modeling, reflection, and collaboration. Observations, online or in-person, of teachers successfully utilizing best-practices for technology use and integration allow teachers to conceptualize a mental model for how they can incorporate technology themselves. Teachers then reflect on their own practices along the way as they make step-by-step technological enhancements to their instructional practices, what works and what does not, while collaborating with peers, veteran technology users, and support staff to troubleshoot, share ideas, and gain insight as technology and best-practices continue to evolve.

Changing teacher mindsets and acknowledging teacher perception. Ertmer & Ottenbreit-Leftwich (2010) suggest that a teacher's mindset for technology integration, meaning their self-efficacy and value system, may be more important than any level of technological content knowledge. "If teachers are going to adopt new beliefs about teaching and learning, they need to understand how these beliefs translate into innovative classroom practices" (Ertmer & Ottenbreit-Leftwich, 2010, p. 275). Ultimately, when a teacher's personal belief system values technology integration, classroom practices reflect those values and can, in turn, change a teacher's pedagogical approach to teaching and learning almost in a cyclical fashion (Kalonde, 2017; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). In Figure 2.1, Orhan-Karsak's (2017) research maps teacher perception of instructional technologies and how strongly perception drives instructional practices. The data shows that teachers perceive a wide variety of reasons to engage students with instructional technologies. Teachers' primary purposes for integrating technology includes keeping students active and interested, master and retention of content, increasing levels of skill and content mastery, and facilitating the learning process. Even though teachers have strong beliefs about the validity of technology integration, Figure 2.2 shows that barriers exist within teachers' own self-efficacy when it comes to technology usage (Orhan-Karsak, 2017). Of the study participants, only two perceived themselves as qualified to use technology, with the remaining 22 participants rating themselves as either insufficient or improved technology users.

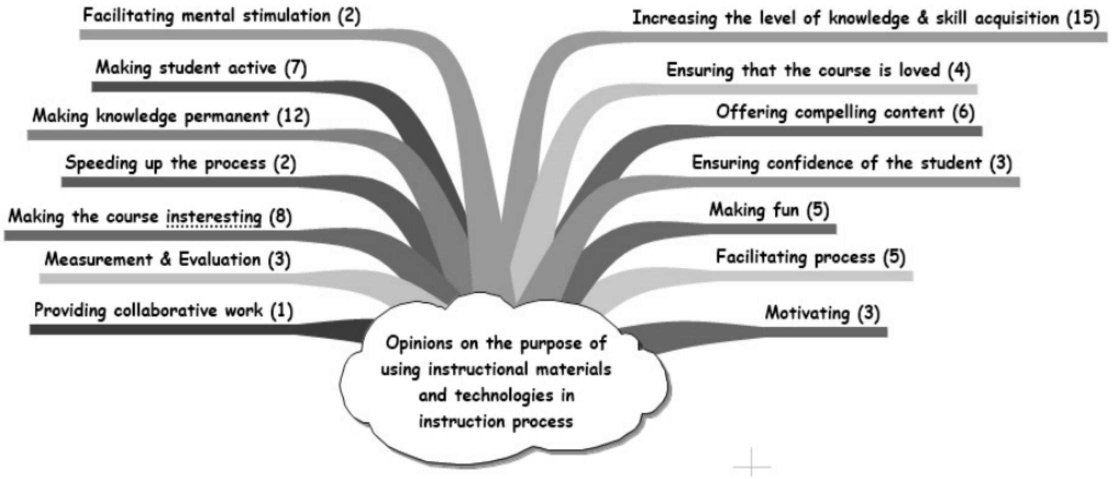


Figure 2.1. Orhan-Karsak's (2017) Opinions of the purposes of using instructional materials and technologies.

Figure 2.2. Orhan-Karsak's (2017) Opinions on self-efficacy of instructional technology usage.

Decades of research shows that access to technology does not mean integration because teachers require support from a variety of sources during their quest to become proficient with technology (Doshmanziari & Mostafavi, 2017; Ertmer, 1999; Kalonde, 2017; Pickett, 2009). A technology-positive administration and the provision of support staff with technical backgrounds are the keys to teachers feeling they are free to take technological risks and being comfortable adjusting the traditional curriculum within their own expertise (Francom, 2016; Pickett, 2009). Other studies show that while technology integration professional development is beneficial and has a positive impact on overall integration practices, teachers with less exposure have, at times, outperformed veteran teachers raising questions about other factors affecting integration (Allen, Lowther, & Strahl, 2007; Bakir, 2011).

Relationship between teacher skill level and integration practices. Teacher skill level continues to be a driving factor in how technology is used in the classroom (Doshmanziari & Mostafavi, 2017; Kretschmann, 2015; Liu, Ritzhaupt, Dawson, & Barron, 2017; Mills & Tincher, 2003; Stefl-Mabry, Radlick, & Doane, 2010). A review of the literature shows there is direct correlation between high levels of teacher technology skill and high-level integration of technology into instructional practices that engage students with interactive, innovative technology-enhance activities (Denson, 2005; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Heravi, 2009; Pickett, 2009; Willis, Lynch, Fradale, & Ueigh, 2019). Rooted in Shulman's theory that teachers have a pedagogical content knowledge (PCK) toolbox severely lacking in the technology content knowledge to integrate technology, Mishra and Koehler developed a theory for measuring teachers' capacity to integrate technology called Technology, Pedagogy, and Content Knowledge (TPACK) (Buss, Foulger, Wetzel, & Lindsey, 2018; Ertmer & Ottenbreit-Leftwich, 2010; Koehler & Mishra, 2009; Mishra & Koehler, 2006). Beyond the consideration of teachers' beliefs about technology, missing TPACK components and ineffective professional development are detrimental to levels of technology integration

(George & Sanders, 2017; Holt, 2015; Koehler & Mishra, 2009; Mishra & Koehler, 2006).

Technology Impact on Teaching and Learning

The introduction of technology into traditional teaching practices has sparked a reinvention of how teaching pedagogy and how students interact with technologically-enhanced content (Francom, 2016; Harper & Milman, 2016; Lowther, Inan, Ross, & Strahl, 2012; Maninger & Holden, 2009; Orhan-Karsak, 2017; Pickett, 2009). There are several avenues of research that discuss the impact of technology integration on pedagogical and content specific practices. First, perspectives must be considered from educators and researchers outside of the United States. Due to the diversity of our country, the barriers and implications experienced in other cultures can be applied to less-researched locations within our own geography. Second, examination of technology practices outside of school informs our approaches to educating students considering their skills, motivations, and experiences. Third, technology integration looks different in varying environments but also in varying content areas. Establishing best-practices from empirical research for each content area is key to successful integration. Finally, research theories must be identified that support the melding of technology with pedagogy.

Outside the United States. In many foreign countries, the identified benefits and barriers to technology integration in educational practices are comparable to that of the United States (Muratie & Ceka, 2017). In under-developed countries, the barriers are magnified by first-order style barriers for educational resources that have nothing to do with technology such as lacking facilities, under-educated teachers, and largely under-served students (Doshmanziari & Mostafavi, 2017; Solano, Cabrera, Ulehlova, &

Espinoza, 2017). Even if these barriers are remedied and technology is present, sufficient access to computers and technology resources along with scarce support personnel with expertise in technology remain large barriers to overcome (Alkraiji & Eidaroos, 2016; Doshmanziari & Mostafavi, 2017; Solano, Cabrera, Ulehlova, & Espinoza, 2017). Teachers are encouraged to incorporate research-based practices in their instructional routines including student-centered learning, problem-based learning, and instructional technology tools, but often teachers lack the knowledge of, and experience with, these pedagogical practices (Doshmanziari, & Mostafavi, 2017). The focus of education, and consequently the methods of technology accessed for educational purposes, in countries outside the United States can also differ based on the economic and employment needs of the country at the time (Eze, 2016; Kamalodeen, Figaro-Henry, Ramsawak-Jodha, & Dedovets, 2017; Khalif, 2018a; Subramaniam & Subramaniam, 2017).

Mobile learning and home use. Today's students come into the classroom with the expectation that their interactions with technology will be as plentiful and entertaining as it is when they are at home (Carver, 2016; Stefl-Mabry, Radlick, & Doane, 2010). Multiple studies suggest that students in rural schools have greater access to technology tools than those students in urban environments and that this phenomenon occurs even with technology access at home, leaving a large gap of students lacking skills and experience with technology (Francom, 2016; Kalonde, 2017; Li, Snow, & White, 2015). Studies show that students who use technology outside of school for academic purposes have increased academic achievement compared to those who do not; and knowing the trends and patterns of students' technology use outside of school can guide how we shape technology programs in school (Harper & Milman, 2016; Hughes, Read, Jones, &

Mahometa, 2015; U.S. Department of Education, 2017). This at-home trend of technology usage is skewed toward mobile technologies as they are more affordable and provide easier access to web-based resources especially in rural areas where students are using the technology to close their own gaps in knowledge (Kamalodeen, Figaro-Henry, Ramsawak-Jodha, & Dedovets, 2017; Khalif, 2018a; Li, Snow, & White, 2015; Stefl-Mabry, Radlick, & Doane, 2010). The regressive effects of that are being realized as students are given rigorous state and national assessments, specifically in writing, on desktop or laptop computer and most of their technology interactions are limited to mobile technologies, leaving students unable to show their level of writing mastery due to barriers created by the technology (Tate, Warschauer, & Abedi, 2016).

Content- and learner-specific technology applications. A synthesis of the literature on technology integration reveals the application and effects of integration vary across content and specialized areas of education. For example, research shows that students learning English as a second language have equal access to technology but exhibit decreased usage even though they achieve better gains when technology is incorporated into the instructional process (Andrei, 2017; Li, Snow, Jiang, & Edwards, 2015; Solano, Cabrera, Ulehlova, & Espinoza, 2017). As new web 2.0 tools including social media become mainstream, students are engaged in active language acquisition activities that allow collaborative interactions with other students and real-world application of skills (Li, Snow, Jiang, & Edwards, 2015; Li, Snow, & White, 2015; Solano, Cabrera, Ulehlova, & Espinoza, 2017). Students also receive a greater success because their learning is not based solely on the skill level of the language teacher, who is often an English-only speaker (Solano, Cabrera, Ulehlova, & Espinoza, 2017).

Often school districts implement technologies to solve a problem rather than meet a need leaving out an entire subgroup of students that have very particular educational needs. Special education students, known to benefit greatly from technological interventions and differentiation, require a very detailed needs assessment to ensure the technology component of their accommodations gives the students equal access to the curriculum (Antonenko, Dawson, & Sahay, 2017). Specifically, students exhibiting learning disabilities can use computer-based remediation software designed to address learning gaps that exist between ability and expected standards of performance. Even tools as simple as calculators allows students with processing disorders to use higher-order thinking skills in math classes by removing the barriers created by gaps in basic math skills (Patrick, 2016). Instruction for hearing impaired students typically includes a variety of technology tools giving students both visual and verbal cues and having a positive effect on both engagement and achievement (Beal-Alvarez & Cannon, 2015). Students with visual impairments struggle with content that is heavy on visual information such as science. Technology integration for these students can include haptics software that allows students to use touch-sensory tools to experience such topics as tectonic plate movement and the geography of the moon (Darrah, 2012). Special education students who may be on a non-diploma track often use technology tools to teach productivity characteristics rather than academic achievement allowing students to earn vocational and work-ready certifications (Eze, 2016).

Core and elective content areas all benefit from technology integration in different ways. With the limited available research on specific elective content like physical education, the conclusion is that there is a direct link between teachers' skill competency and classroom technology use (Kretschmann, 2015). Technology use in courses like physical education may include using video game simulations to get students moving. Art classes may include digital cameras and editing software or the creation of 3-D printed images. In math and science instruction, technology can bring students dimensional models, simulations, and visualizations once only available on paper (Sen & Ay, 2017; Smith & Mader, 2017). Similar tools are applicable in science instruction by providing students with live models of DNA, anatomical dissections, chemical simulations, and physics proofs beyond the flat diagrams and explanations found in the textbook. Furthermore, in social studies teachers can incorporate technology (e.g., virtual reality headsets) to provide students the most realistic interactions possible with the modern and historical world which might promote such 21st-century skills as innovation, creativity, and media technology skills (Farisi, 2016). In the English Language arts classroom, "there is an increasing demand for students to be competent in their ability to access, interpret, compare and contrast, synthesize, and communicate ideas electronically through the use of laptops and additional technologies" (Robinson, 2016, p. 4). One proponent of increasing student computer use is derived from the companies who produce standardized testing products making the transition to digital only testing environments and only allow paper/pencil testing for students with documented disabilities. It is imperative to prepare students for assessment and evaluation using the instruments and materials on which they will be measured. Considering all standardized testing in South Carolina is computer based, our instruction needs to reflect these digital practices (Tate, Warschauer, & Abedi, 2016; Wollscheid, Sjaastad, Tomte, & Lover, 2016).

Theory. This descriptive research study is being approached through the pragmatic paradigm meaning that value in theories is given based on their success and practical application. In the late 1900's educational technology was examined from a positivist epistemological approach meaning the development of facts related to the integration of technology into teaching came from a place of proven scientific methodology (Doshmanziari, & Mostafavi, 2017). Though not an exhaustive discussion, there are several more modernistic theoretical frameworks that are in alignment with the literature synthesized in this review. Fullan's Change Theory's success is based on the characteristics of motivation.

> Fullan's Change Theory is centered on evidence-based educational reform, which is based on seven "core premises" that embrace the theory: (a) motivation; (b) capacity building focused on results; (c) learning in context for those enacting reform; (d) capacity to change the larger context; (e) reflective action; (f) tri-level engagement; and (g) persistence and flexibility. (Icel, 2018, p. 8)

Fullan's Change Theory takes into account teachers' intrinsic belief systems (motivation), perceptions of change, and professional development preferences and needs which have all been identified as barriers to technology integration.

Established in the late 1980's, Davis's Technology Acceptance Model (TAM) and later expanded as the Technology Acceptance Model 2 (TAM2) was widely used to explain technology usage and behavior data (Khalif, 2018b; Marangunic & Granic, 2015; Venkatesh & Davis, 2000). These models were later replaced with the Unified Theory of Acceptance and Use of Technology (UTAUT) which is used to predict technology acceptance based on four constructs that include performance, effort, social influence, and facilitating conditions (Khalif, 2018b). Like Fullan's Change Theory, the UTAUT recognizes the value of addressing many of the second-order barriers discussed in this review.

Puentedura's Substitution, Augmentation, Modification, and Redefinition (SAMR) model was developed to describe the level at which technology is used when evaluating teachers' levels of integration or choosing technology for instructional purposes (Hamilton, Rosenberg & Akcaoglu, 2016). The model categorizes the usage of technology based on level of performance, that is, replacement for a non-technological object versus application for creating new knowledge similar to the descriptors of Bloom's Taxonomy (Anderson & Krathwohl, 2001). Teachers are familiar with the Bloom's Taxonomy feature of pedagogy and work with it regularly to enhance learning objectives. While the SAMR model may not be the most flexible, it can be used to evaluate learning objectives and lesson plans to identify the level at which teachers are integrating technology. Teachers can use the model to see where technology could take the place of more outdated practices to give students more exposure to higher order thinking skills using technology (Anderson & Krathwohl, 2001; Hamilton, Rosenberg & Akcaoglu, 2016).

As previously discussed, Mishra and Koehler's theory for measuring teachers' capacity to integrate technology called Technology, Pedagogy, and Content Knowledge (TPACK) is built upon Shulman's theory that educational pedagogy lacks the recognition of a vital technology component (Buss, Foulger, Wetzel, & Lindsey, 2018; Ertmer & Ottenbreit-Leftwich, 2010; Koehler & Mishra, 2009; Mishra & Koehler, 2006). This framework measures the individual constructs of mastery teachers have in technology skills, pedagogy, and specific content knowledge to determine how successfully technology can be integrated creating instructional best-practices with technology-infused planning and presentation (Buss, Wetzel, Foulger, & Lindsey, 2015; George & Sanders, 2017; Kopcha, Ottenbreit-Leftwich, Jung, & Baser, 2014; Landroth, 2014; Wetzel & Marshall, 2011). Figure 2.3 provides a visual representation of the intersections of TPACK theoretical model.

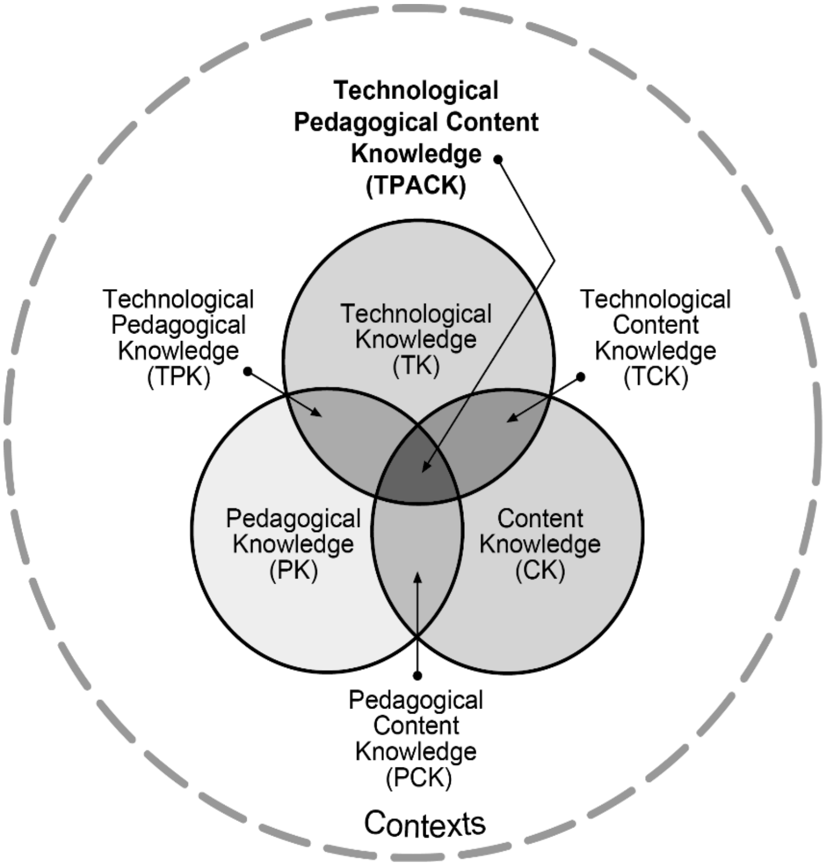


Figure 2.3. Mishra and Koehler’s Technological Pedagogical Content Knowledge (TPACK). Retrieved from http://tpack.org Reproduced by permission of the publisher, © 2012 by tpack.org

Levels of Integration

As the world becomes more technologically driven, many states have begun to include technology goals in their curriculum standards (Carver, 2016). These goals may be freestanding or may be intertwined with content area curriculum to promote TPACK-style true technology integration. A synthesis of research studies show that students often use classroom technology independently on low-level replacement activities that would traditionally take place with a textbook and paper (Harper & Milman, 2016; Orhan-Karsak, 2017). Additionally, students use technology for non-academic purposes such as playing games and personal Internet research (Orhan-Karsak, 2017). Alternately, students engage in academic technology uses to conduct research, manipulate images, create presentations, access reading materials, complete assessments, and interact with software for simulations. Scalise (2016) warns that using technology just to check a box can have negative effects on learning outcomes. She notes that when technology and content are truly integrated, students achieve higher-order outcomes for both technology and content mastery. When technology is isolated, the skills students retain are limited to the tool itself and not it's application (Scalise, 2016). This is further evident in Kalonde's (2017) research on iPad use that shows teachers used the devices most often for demonstration and presentation, and students used the devices primarily for reading and writing, all replacement devices for pencil/paper activities.

Klein (2016) found a direct correlation between levels of integration and sustained engagement. She noted that students' motivation and engagement with technology was sustained when they were applying technology to creating and innovating as compared to low-level replacement activities. As previously mentioned, teacher self-efficacy and the perception of their own technology competencies plays a large part in the level at which technology is integrated regularly into instructional practices (Brush, Glazewski, & Hew, 2008; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Holt, 2015; James, 2009; Ottenbreit-Leftwich, Glazewski, Newby, & Ertmer, 2010; Williams, 2014). Teachers often refuse to even attempt to use new technology with students until they perceive themselves to be proficient users and these same teachers use technology as a reward for students rather than instructional tools (Brush, Glazewski, & Hew, 2008). Additionally, teachers with more immersive professional development opportunities exhibit greater technology integration as compared to teachers who are tasked with self-educating (Allen, Lowther, & Strahl, 2007; Holt, 2015; Kim, Kim, Lee, Spector, & DeMeester, 2013).

STEM/STEAM

As the world innovates around us, schools are working to keep up with the production demands for 21st century thinkers by infusing concepts of STEM and STEAM into their established curriculums. STEM is defined as Science, Technology, Engineering, and Math with the A in STEAM representing the Arts. While not required to offer this blended curriculum, schools can apply for certification granted by AdvancED that signifies a school meets the standards and indicators defined by AdvancED within the science, technology, engineering, and math instructional curriculums (AdvancED, 2018). The significance of this section is to include a literature synthesis that describes the unique characteristics of the curriculum and technology expectations found in STEM/STEAM environments that are not found in traditional educational settings. The STEM/STEAM section (a) defines the concept of a Science, Technology, Engineering, Arts, and Math infused curriculum, (b) describes how STEM and STEAM concepts are integrated into curriculums and (c) describes how technology is integrated into STEM/STEAM schools.

STEM/STEAM in Curriculum

The infusion of STEM/STEAM concepts into established curriculums is changing approaches to teaching and learning while having a positive effect on student achievement (Blue, 2006; Southern Regional Education Board, 2012).

> Schools that give students access to STEM (science, technology, engineering and mathematics) studies are accomplishing several objectives: introducing students to higher-level academic and career studies, expanding project-based learning in the curriculum, enticing students to remain in school until graduation, and preparing students for challenging majors in college and modern, high-skill careers after further education and training. (Southern Regional Education Board, 2012)

The premise behind STEM/STEAM in curriculum is not to showcase each individual subject, but to integrate the design and problem-solving thinking to all subjects in a way that mimics how 21st-century innovators tackle the world's problems through communication, collaboration, and critical thinking (AdvancED, 2018; Kamalodeen, Figaro-Henry, Ramsawak-Jodha, & Dedovets, 2017; Skillen, 2016). Teachers who willingly engage in STEM/STEAM infused teaching practices display intrinsic motivation and naturally gravitate toward higher levels of technology integration as students are expected to perform at higher levels of Bloom's Taxonomy (Icel, 2018; Patrick, 2016). Incorporating STEM/STEAM concepts into an established curriculum can take large amounts of already scarce planning time. To alleviate this barrier, STEM/STEAM teachers often collaborate by taking advantages of the collective strengths and skills (Jones, 2014).

Technology in STEM/STEAM

The International Society for Technology in Education (ISTE) has worked over multiple decades to develop a series of standards frameworks geared toward students, teachers, administrators, and coaches for how students and teachers should approach the skills and knowledge needed to be successful in a 21st-century world (2016; Dondlinger, McLeod, & Vasinda, 2016; Pickett, 2009). Figure 2.4 shows the graphical connection between the seven 2016 ISTE Standards for Students. These standards are delivered in I-statement terminology to empower students to embrace their own digital literacy. Schools, especially those STEM/STEAM accredited and including the school of study, are using the ISTE Standards to help teachers integrated technology along with the STEM objectives by matching content standards with the active verbs in the standards for accreditation and technology integration resulting in the collaboration, communication, creation taking place through technology (AdvancED, 2018; New Ellenton Middle STEAM Magnet School, 2018; Dondlinger, McLeod, & Vasinda, 2016; International Society for Technology in Education, 2016; South Carolina Department of Education, 2017; South Carolina Department of Education, 2019; Southern Regional Education Board, 2012; Smith & Mader, 2017; Trust, 2018). In consideration of the drastic shift in mindset required to fully integrate STEM/STEAM technology instructional practices, ISTE provides a wealth of professional development tools and information to assist schools and teachers with integrating the standards (Ayad & Ajrami, 2017; International

Society for Technology in Education, 2009; International Society for Technology in Education, 2017).

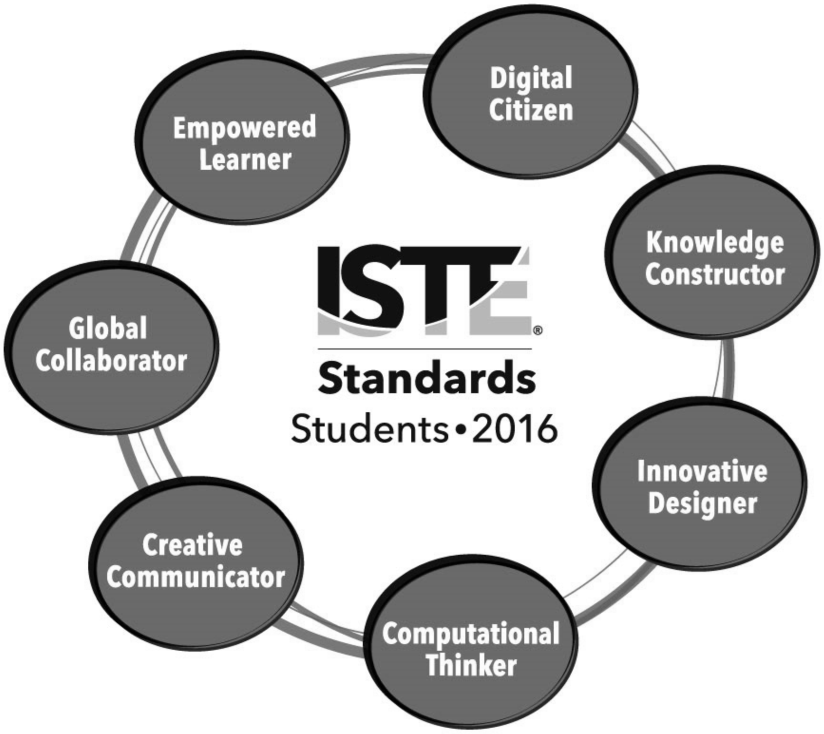


Figure 2.4. International Society for Technology in Education Standards for Students. Used with permission from www.iste.org.

Established Research Measures

Most of the synthesized literature on technology integration includes the use of research measures designed to describe, either quantitatively or qualitatively, the data collected in the research study. By examining both researcher-developed and empirically validated research measures, decisions can be made about the best tools for collecting and analyzing the data needed to answer the research questions for the proposed study. The established research measures section outlines published quantitative and qualitative measures of (a) teacher perception and skill related to technology integration and (b) levels of technology integration.

Measures of Teacher Perception and Skill

Peer-reviewed research has resulted in a variety of measures to measure teacher perception, skill levels, and self-efficacy. Many of these measures are qualitative in nature or mixed-methods with a tendency towards qualitative descriptions including TPACK scores, thematic analyses, observations, surveys, and interviews (Buss, Foulger, Wetzel, & Lindsey, 2018; Cifuentes, Maxwell, & Bulu, 2011; Hulon, 2015; Khalif, 2018a; Khalif, 2018b). One specific qualitative measure, the Determining Educational Technology and Instructional Literacy Skillsets for the 21st Century Questionnaire, ranks teacher skill level and degrees of integration as low, medium, and high (Pickett, 2009). Quantitative studies typically employed methods of treatment, rating scales, questionnaires, and inventories analyzed using measures of variance (Brush, Glazewski, & Hew, 2008; Christensen, 2002; Cifuentes, Maxwell, & Bulu, 2011; Hulon, 2015; Liu, Ritzhaupt, Dawson, & Barron, 2017). One of the few strictly quantitative measures is the Technology Skills, Beliefs, and Barriers scales used to measure teacher technology skills and experience (Brush, Glazewski, & Hew, 2008). Data collected for the Technology Skills, Beliefs, and Barriers scales originated from a survey provided to pre-service teachers over a three-year period and was able to successfully describe and predict technology integration. Other established quantitative measures include the Teacher Technology Survey (TTS) and Technology Uses and Perceptions Survey (TUPS) designed to measure levels of technology integration in the classroom in relation to teacher beliefs and perceptions of technology (Liu, Ritzhaupt, Dawson, & Barron, 2017; Ritzhaupt, Huggins-Manley, Dawson, Aglaci-Dogan, & Dogan, 2017).

Measures of Technology Integration

Due the popularity and established validity of the Technological Pedagogical Content Knowledge (TPACK) theoretical framework, several instrumentation methods have been developed to quantitatively and qualitatively measure and predict technology integration practices (Koehler & Mishra, 2009; Koehler, Shin, & Mishra, 2012; Kopcha, Ottenbreit-Leftwich, Jung, & Baser, 2014; Mishra & Koehler, 2006; Wetzel & Marshall, 2011). Schmidt, Baran, Thompson, Koehler, Mishra, and Shin (2009) developed the Survey of Preservice Teachers' Knowledge of Teaching and Technology to measure the core components of TPACK. Archambault and Crippen (2009) developed a similar un-named Likert-type scale survey instrument. In addition to surveys, instrumentation developed using the TPACK theoretical framework includes open-ended questionnaires, observation tools, interview question scripts, and performance assessments (Koehler, Shin, & Mishra, 2012). Other instrumentation developed to measure technology integration includes the Technology Integration Standards Configuration Matrix (TISCM) used in a study by Mills and Tincher (2003) and the Likert-type scale instrument developed and validated by Peeraer and Van Petegem (2012) to describe Information and Communication Technology (ICT) integration.

Chapter Summary

A synthesis of the literature reveals that technology integration is a difficult thing to define, describe, implement, and measure. The push behind increasing technology use among students is to provide them with the critical 21st-century skills valued by colleges and employers. Making technology integration a reality is so much more than increase access to computer and digital resources. The literature reveals a list of barriers that prevent true technology integration even when first-order barriers such as access and facilities are rectified. These barriers lie in the measured identification and development of teacher self-efficacy, perceived value of technology, pedagogical best-practices, content knowledge, and teacher technology skills. Teachers' beliefs about technology and instruction practices may be the most telling concept behind the success or failure of technology initiatives. In STEM/STEAM accredited schools where technology is at the forefront, it is imperative to observe current technology practices and identify second-order barriers through established research methods that may be preventing effective technology integration.

CHAPTER 3

METHODOLOGY

Research Design

This research study is designed around the tenets of traditional descriptive research with the goal of effecting change in the researcher's realm of influence. The process of descriptive research allowed methodologies specific to the participants and setting and produced results that can be applied to professional development plans and organizational-change proposals at the study location.

Dissertations in Ed.D. programs are driven by the desire for improvement in educational organizations significant to the researcher. The researcher accomplishes this by identifying problems, connecting theory with practice, proposing solutions, evaluating educational practice, and establishing plans for professional growth (Greenwood & Levin, 2007; Mertler, 2017; Mills, 2000). As a method of qualitative research, Creswell (2014) defines descriptive studies as ones that allow for research to take place in a natural setting with the researcher taking on an active role in observing and interviewing participants in the data collection process. Studies can be approached through either inductive or deductive analysis in an emergent design that possibly changes as the study dictates the need. Themes and findings result from multiple sources of data that the researcher derives meaning from rather than assigning meaning to the data.

This research study is designed to describe the level of technology integration within the study site and the teachers' self-efficacy when it comes to technology integration and encountered barriers. To achieve the intended goals, the research process included a descriptive mixed-methods design in which multiple forms of collected data were triangulated to form qualitatively described conclusions (Creswell, 2014; Ghafouri & Ofoghi, 2016; Mertler, 2017). This method was chosen because data collection methods were decided prior to the start of the study, data collection methods include both qualitative and quantitative measures, all data were compared and contrasted against each other to determine themes and common occurrences, and final results were presented in the form of a descriptive discussion implications and limitations. This research design lends itself to the formation of recommendations for educational improvement within the study site, which is characteristic of doctoral research in education and aligned with the purpose of the study.

The benefits of a mixed-methods descriptive research study are in the obvious nature of bringing the best qualities of both quantitative and qualitative designs (Ghafouri & Ofoghi, 2016; Morgan, 2014). This study relied on the objective integrity of quantitative measures for rating teacher self-efficacy and instructional observations combined with the subjective descriptions of qualitative focus group interviews to present a holistic view of technology integration. While data collection is a mixture of qualitative and quantitative measures, the study itself is rooted in a descriptive design because, instead of manipulating the study through a treatment protocol, study participants are invited to be a part of the research process through experiences and perspectives almost as if they are collaborators in the research (Rudenstam & Newton, 2007).

Setting and Participants

New Ellenton Middle STEAM Magnet School, an uncharacteristically small middle school with fewer than 300 students in a rural district in South Carolina, was the setting for this research study. While a small school, it has earned many recognitions including Advanc-Ed's Science, Technology, Engineering, Arts, and Math (STEAM) accreditation (AdvancED, 2018). This means the school has developed and implemented a plan to integrate Advanc-Ed's STEM Standards and Indicators and the ISTE Standards for Student into daily instructional practices (AdvancED, 2018; New Ellenton Middle STEAM Magnet School, 2018; International Society for Technology in Education, 2016). From these standards, the school has adopted Technology Guarantees that detail a level of technology mastery students will be able to demonstrate by the end of each academic year.

While the school does not utilize a one-to-one technology model, an ample array of technologies are available to teachers and students. Each teacher is issued a desktop computer and a personal laptop device. Each classroom has a dedicated technology cart containing a minimum of ten student laptop devices, with some teachers having up to thirty student devices. These devices connect wirelessly to the internet and to the classroom's interactive projector allowing anyone in the room to project, present, and lead discussions. In addition, the school's media center stocks technology in the form of iPads, iPods, video cameras, green screen equipment, student response systems, and Kindle e-readers. Many teachers have received grant funding for classroom technology additions such as virtual reality headsets, programmable robots, advanced calculators, and graphic design computers and plotters.

The study location itself is also unique in that it is the only school of its nature within several surrounding school districts and merits exploration into the workings of this instructional design. According to the schools instructional plan and in comparison to similar schools without STEAM accreditation or a technology focus, an instructional observer within this school should at a minimum expect to see daily STEAM connections made to content in all instructional settings, seamless technology integration, school-wide cross-curricular STEAM projects with real-world application, increased student technology mastery, as well as college and career focused study. Due to small average daily matriculation rate, the teacher allocation at the study location is also smaller than average with a total of sixteen full-time and three part-time certified teachers in the areas of Art, Music, Foreign Language, Technology, Special Education, Library Media Specialist, Math, English/Language Arts, Science, and Social Studies.

Due to the significantly smaller total teacher allocation, this research study includes a small group of purposively sampled participants who can provide the data needed to meet the defined needs of the study. The purposefully selected study location and study population are ideally aligned with the focus of this study and the research questions, as is the nature of descriptive research. Should a future study with the same purpose take place on a larger scale, multiple study locations with a similar instructional design would be recommended. This study garnered data from participants, a purposive sampling of twelve teachers from the total population of nineteen teachers, narrowed by the parameters of full-time employment, core subject (Math, English/Language Arts, Science, Social Studies) instruction, and courses with required lesson planning and assigned academic grades. It is important that study participants meet each of these parameters so the largest spectrum possible of disciplines is included and the data collected is representative of teachers who have the equal opportunities for planning and professional development, which are often sacrificed for teachers who are part-time or shared between schools. For clarification purposes, it is important to note that all STEAM certifications belong to the school and not the teachers at the school. The study participants have earned grade and content area certifications, but do not receive any special certifications from AdvancED. Of the narrowed selected participants, all twelve were solicited for participation in the research study due to the small sample size. Study participants represented demographically as 9 females, 3 males, 3 math teachers, 3 English teachers, 3 social studies teachers, 3 science teachers, and 11 of the 12 participants teach across multiple 6th, 7th, or 8th grade levels.

Data Collection Methods

While a descriptive study, a mixed methods approach using integrated qualitative and quantitative data collection methods was utilized during the research process. During the first phase of the data collection process, participants completed two quantitative surveys designed to describe and quantify self-reported levels of skill and self-efficacy regarding technology along with perceived barriers to high-level technology integration. In the second phase of data collection, the researcher engaged in a lesson plan review and observation process to quantitatively document the technology integration present during instruction and the rigor level of the integration as described by a scale developed the Friday Institute for Educational Innovation (2015). During the final phase of data collection, participants chosen for focus group participation met with the researcher to complete the qualitative interview process. Table 3.1 provides the alignment between the data collection methods and the research questions that have been addressed by the data collected.

Table 3.1 *Data Source Alignment*

Research questions	**Data collection methods**
How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?	Teacher Technology Questionnaire & Technology Skills, Beliefs, and Barriers scale Surveys Focus Group Interviews
How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?	Teacher Technology Questionnaire Technology Skills, Beliefs, and Barriers scale (survey) Focus Group Interviews
How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?	Lesson Plan Review Instructional Observations using LoFTI Observation Tool Focus Group Interviews

Quantitative Surveys

During the first phase of the data collection process, participants participated in two digital surveys designed to collect data on Research Question #1: *How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?* and Research Question #2: *How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?* The surveys contain quantitative items with the addition of demographic identifiers and have been analyzed using descriptive statistics. The surveys consist of two valid and reliable tools: the Teacher Technology Questionnaire (Lowther & Ross, 2000) and the Technology Skills, Beliefs, and Barriers scale (Brush, Glazewski, & Hew, 2008). Survey questions include approximately 70 probes and the purpose is to determine the level of technology skills acquired by participants, their self-efficacy in translating those skills into classroom instructional practices, and perceived barriers they encounter when using technology. Survey questions include types and purposes of personal and professional technology usage, familiarity with various rigor levels of technology usage, levels of skill attainment, levels of self-efficacy in usage, and teacher attitudes toward technology usage and its value in instruction. The surveys were administered to participants electronically via e-mail for convenience within a 7- to 14-day window prior to the second phase of data collection allowing for rapid data analysis (Creswell, 2014). The survey data gathered was one part of triangulated data used to describe teachers' self-efficacy and skill levels of technology use and barriers to integration.

Teacher Technology Questionnaire. The Teacher Technology Questionnaire (TTQ) is a 20-item survey originally designed to quantitatively measure teacher perceptions of technology and self-efficacy (Lowther & Ross, 2000; Lowther, Ross, & Alberg, 2000). Section one measures teacher perception of technology's impact on classroom instruction, impact on students, teacher readiness to integrate technology, overall technology support, and overall technical support. These areas are rated on a 5-point Likert-type scale ranging from Strongly Disagree to Strongly Agree. Section two measures teachers' self-rated computer ability on a 5-point Likert-type scale with a range including very good, good, moderate, poor, or no ability. Section two also covers teachers' computer use and impressions of on-site technology support. This instrument has been used across several empirical research studies and has a proven status (Lowther & Ross, 2000). "The TTQ has been validated and is commonly used in research and evaluation studies. The reliability of the TTQ was tested on 4,863 teacher participants, who has completed the instrument previously as a part of research projects for Center for Research in Educational Policy. Reliability coefficients were determined to be higher for each subscale of the instrument, ranging from .75 to .89" (Inan & Lowther, 2010).

Technology Skills, Beliefs, and Barriers scale. The Technology Skills, Beliefs, and Barriers scale was developed and tested by Brush, Glazewski, and Hew (2008) to determine its validity and reliability for measuring areas of technology integration with pre-service teachers. The survey covers three sub-sections: technology skills, beliefs, and barriers. The technology skills sub-section has 32 items that are further divided into categories: basic operation, productivity software, communication, electronic references, world wide web, and multimedia. These categories are rated on a 4-point Likert-type scale of I can't do this, I can do this with some assistance, I can do this independently, and I can teacher others how to do this. The technology beliefs sub-section contains 12 items on teachers' technology beliefs rated on a 4-point Likert-type scale of strongly disagree, disagree, agree, and strongly agree. The barriers sub-section includes a set of 10 statements rating teachers' perceived barriers on a 3-point Likert-type scale of not a barrier, minor barrier, and major barrier. "Reliability analyses for each subscale of the instrument were conducted using the Cronbach alpha coefficient in order to establish the internal consistency of the scale. In addition, correlations and Cronbach alpha coefficients were computed for each survey item in each of the three subscales (Brush, Glazewski, & Hew, 2008, p. 117). The reliability for the Technology Barriers subscale was 0.81 using the coefficient Cronbach alpha. To determine reliability of the survey, the researchers ensured the survey was based on established concepts through extensive literature review and instrument reviews with subject matter experts in K-12 instruction and instructional technology.

Lesson Plan Review

During instructional observations in the third phase of data collection, the researcher simultaneously conducted reviews of submitted lesson plans as one data collection point for Research Question #3: *How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?* The lesson plan review quantitatively measured the frequency distribution of how teachers plan for technology integration during instruction. For each week of the data collection period, the researcher reviewed lesson plans and recorded the frequency at which teachers mentioned any use of planned technology during instruction compared to the number of possible days for that week of school.

Instructional Observations

In the third phase of data collection, instructional observations took place concurrently to lesson plan reviews to collect data for Research Question #3. Instructional observations were unannounced, lasted for no less than 10 minutes of the instructional period, and included lessons with planned technology integration as well as lessons where the teacher has not planned or identified planned technology integration. Each study participant was observed a minimum of three times during this phase of data collection. Observational data was be recorded using the Looking for Technology Integration (LoFTI) observation tool developed by the Friday Institute for Educational Innovation (2015). This tool helped to measure and thoroughly describe technology use in the classroom as well as the level of rigor of technology integration. Due to the focused nature of the data collection, observations were structured in that the sole focus was to document the frequency and rigor of technology integration during the instructional period (Mertler, 2017).

Focus group interviews

Krueger (1994) describes focus group interviews by their unique insight into participant perspectives on technology usage and integration practices at the school study site. When questions are asked of multiple members in a group, a true discussion occurs when participants echo and elaborate on the responses of other participants. Analysis of this discussion reveals key information that forms the trends and patterns necessary for a thick, rich descriptive study (Krueger, 1994).

Following the first three phases of data collection and in the original proposed study design, participants were placed into focus groups based on criteria developed using the data collected in the previous phases. Focus groups were to consist of participants with similarities in technology skills and confidence or instructional technology integration practices (Krueger, 1994). Focus group interviews were to occur face-to-face using semi-structured interview protocols between the researcher and the participants and were to take place in the school chosen for the study site (Creswell, 2014). Interviews were to last less than 30 minutes, audio recorded and transcribed by the researcher, and will consist of probes that address and fill in the data collection gaps for all three research questions.

Due to effects of the COVID-19 pandemic, the planned process to conduct focus groups interviews had to be altered to accommodate the closing of schools, the availability of teachers, and the difficulties that were encountered with trying to connect digitally in ways most teachers were not previously familiar with. Teachers participated in focus group interviews on a voluntary basis resulting in two interview sessions. Groups included teachers from a variety of subject areas and levels of technology proficiency. Interviews were held over Zoom, lasted between 60 and 90 minutes, and were recorded for transcription purposes (Zoom Video Communications, Inc., 2021). Interviews were transcribed personally by the researcher ensuring the researcher was immersed in data that was an accurate reflection of both verbal and non-verbal responses from interview participants (Mertler, 2017; Morgan & Guevara, 2008; Patton, 2002).

Each focus group was asked identical open-ended questions to prompt further explanation their skills and self-efficacy with technology use and integration as well as provide background and rationale for their classroom integration practices (Krueger, 1994). Questions included “Describe for me your biggest strength when it comes to technology usage,” “Describe for me your biggest weaknesses when it comes to technology usage,” “What is the most common form of technology integration in your classroom?,” and “Tell me how you could be better supported in your technology integration goals.” Questions also referenced observations of classroom technology integration to further clarify intentions, expectations, and observed behaviors. The complete list of focus group interview questions is available in Appendix C.

As a qualitative source of research data, focus group interviews must be conducted in a manner as to reduce limitations in an otherwise subjective form of data collection (Creswell, 2014). Prior to starting interviews, the researcher discussed with participants the insider positionality and the desire to avoid any possible data distortion that may happen because of the relationship of the researcher to the study site. This established a permissive environment in which participants could speak freely without influence or judgement (Krueger, 1994). In addition, member checking and peer debriefing ensured that interview questions and response interpretations were accurate reflections of the study intent and participant contribution. Through the focus group interviews, the researcher was able to triangulate barriers to technology integration including professional development needs and barriers to access as described by the participants with the quantitative data measures.

Data Analysis

This descriptive study employs a mixed methods data analysis approach using triangulated qualitative and quantitative data sets. Data was analyzed in four phases before being triangulated to form results: a synthesis of two quantitative surveys, a quantitative lesson plan review, data derived from instructional observations, and the qualitative coding process for focus group interviews. Data collected during each phase of this research study was analyzed throughout the entire process in a manner characteristic to traditionally flexible inductive mixed-methods descriptive studies (Mertler, 2017; Liu, 2016). As shown in Table 3.2, data analysis methods are aligned with the previously discussed methods of data collection and research questions. The goal of the data analysis process was to develop thematic findings resulting in research implications and recommendations for future professional development for teachers.

Table 3.2 *Research Question, Data Collection, and Data Analysis Alignment*

Research questions	**Data collection methods**	**Data analysis methods**
How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?	Survey	Descriptive Statistics
	Focus Group Interviews	Inductive Analysis
How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?	Survey	Descriptive Statistics
	Focus Group Interviews	Inductive Analysis
How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?	Lesson Plan Review	Frequency Distribution
	Instructional Observation	Descriptive Statistics with Inductive Analysis
	Focus Group Interviews	Inductive Analysis

Teacher Technology Surveys

Data from two quantitative Likert-scale rating survey questions and responses was analyzed to address Research Question #1: *How do content teachers in a STEAM* *accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?* and Research Question #2: *How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?* Quantitative rating scales were analyzed using descriptive statistics measures of central tendency, dispersion, and relationships exemplified by the qualitative measures (Mertler, 2017; Brannen, 2005). Mixed-methods triangulation will compare the results of this data source with the other data collection sources to reveal overall findings as they relate to the research questions. Validity and reliability data on proposed surveys can be found in the Data Collection Methods section of this chapter and copies of the instruments are included in the Appendix.

Lesson Plan Review

Quantitative data collected from lesson plan reviews was analyzed to partially address Research Question #3: *How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?* Lesson plans were accessed from teachers' online class pages and/or classroom and reviewed individually for any mention of technology usage in instructional practices. Quantitative data was analyzed using a frequency distribution for planned and non-planned instructional technology usage comparing teachers with the 1:1 technology designation and those without. Any indication of technology use by the students or teacher within the written lesson plan constituted planned usage. Lesson plans with no mention of technology based instructional practices constituted non-planned usage.

Qualitative data was analyzed using inductive analysis to describe how often teachers plan for technology integration during instruction.

Instructional Observations

As outlined in Table 3.2, data collected from the LoFTI observation tool (Friday Institute for Educational Innovation, 2015) was analyzed using quantitative descriptive statistics. This tool provides checklist-style data that reflects technology usage for both teachers and students as well as the rigor level of the usage. These results were triangulated with data results from the lesson plan review and focus group interviews to provide an inductive analysis fully answering Research Question #3: *How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?*. This information is especially valuable to the study purpose in that it provides observed evidence of current practices within the school. Validity and reliability data on proposed observation tool can be found in the Data Collection Methods section of this chapter and copies of the instrument is included in the Appendix.

Focus Group Interviews

Qualitative data from focus group interviews were analyzed using inductive analysis with the CAQDAS open coding method. Transcripts were put through rounds of coding to develop categories. These steps were repeated until best-fit categories were determined that evolved into themes found within the data. Themes were then synthesized with the other data results to derive responses to the research questions and implications for research.

Procedures and Timeline

This research study was conducted over the span of nine weeks and in five phases. As outlined in Table 3.3, the procedures for identifying participants and obtaining consent took place in the first phase. The second phase included data collection through digital surveys. The third and largest phase, Phase 3, included lesson plan reviews and classroom observations. During Phase 4, focus group interviews were held and all participants were debriefed on the data collection and analyzation during Phase 5.

Table 3.3 *Study Procedures and Timeline*

Phase	Week #/Dates	Activity
Phase 1: Participant Identification & Consent	Week 1 Jan 27-31	1. Identify participants and make initial contact 2. Send and receive informed consent forms 3. Meet with teachers to discuss procedures and timeline for data collection
Phase 2: Survey Data Collection	Weeks 2-3 Feb 3-7 Feb 10-14	1. Send and receive Teacher Technology Questionnaire survey (skill level and self-efficacy) 2. Send and receive Technology Skills Assessment survey (skill level and self-efficacy) 3. Send and receive Technology Skills, Beliefs, and Barriers scale (barriers to integration)
Phase 3: Lesson Plan Review & Observations	Weeks 2-6 Feb 3-7 Feb 10-14 Feb 17-21 Feb 24-28	1. Conduct lesson plan review 2. Conduct classroom observations using ISTE Classroom Observation Tool

	March 2-6	
Phase 4: Focus Group Interviews	Weeks 7-8 March 9-13 March 16-20	1. Meet with teachers in focus groups 2. Complete transcription and coding 3. Compile rough synthesis of data to present during Phase 5
Phase 5: Participant Debriefing	Weeks 8-9 March 16-20 March 23-27	1. Meet with principal to debrief observation data 2. Meet with teachers to debrief synthesized data

Phase 1

Phase 1 of this study included the selection and identification of participants as well as the solicitation of consent or assent for study participation. In-person contact was made whole-group through a faculty meeting to all teachers as notification of the intended study. Additional contact via e-mail was made to teachers chosen as possible study participants. The process of delineating participants was described in the Settings and Participants section of this chapter. This communication outlined the purpose of the study, the procedures for data collection, and how this data will be used following the study. Selected participants were asked to consent or assent to study participation through participation in the digital survey, though consent was not required to be included in the observation and lesson plan review data collection stages. The timeline for completion of Phase 1 was one week. This timeline was acceptable considering the size of the school and the small sample size.

Phase 2

Phase 2 of this study signaled the first of the data collection phases. Study participants were provided with two different digital surveys via e-mail: the Teacher Technology Questionnaire (TTQ) and the Technology Skills, Beliefs, and Barriers scale (Allen, Lowther, Strahl, & Slawson, 2006; Brush, Glazewski, & Hew, 2008; Lowther & Ross, 2002). These surveys are designed to measure teacher technology skill level, self-efficacy regarding technology skill and usage, and any barriers teachers have identified that inhibit technology integration. Surveys were delivered digitally via e-mail to teachers who consented to be study participants and reminder emails were sent until surveys have been successfully completed. Teachers were given the option to receive paper copies of the surveys if desired. Study participants had two weeks to complete the surveys during Phase 2. Validity and reliability data on Phase 2 surveys can be found in the Data Collection Methods section of this chapter and copies of the instruments are included in the Appendix.

Phase 3

Phase 3, the longest phase with a timeline of five weeks, was the most intensive of the data collection phases consisting of lesson plan reviews and classroom observations. Lesson plans for teachers participating in the study were reviewed to collect data on the frequency of technology integration in lesson activities. Instructional observations took place a minimum of three times for each study participant over the five-week window. The Looking for Technology Integration (LoFTI) observation tool (Friday Institute for Educational Innovation, 2015) was used to collect quantitative data on what technology is being used instructionally, the purpose of the technology tools, and to what level the students and teachers are using the technology in their learning. Validity and reliability data on the Phase 3 observation tool can be found in the Data Collection Methods section of this chapter and copies of the instruments are included in the Appendix.

Phase 4

The researcher virtually met with select teachers in focus groups during the two-week span that constituted Phase 4. In these focus group meetings, the researcher posed questions to the study participants to highlight and clarify data collected from surveys, lesson plan reviews, and classroom observations along with questions that specifically address the research questions. This allowed teachers to provide connecting information to the researcher as the overall picture of technology integration was developed. Transcription and coding of these focus group interviews took place immediately following the interviews. Following the focus group meetings, transcription, and coding of data, the researcher compiled data from all phases into a rough synthesis in preparation for Phase 5.

Phase 5

The final two-weeks of the data collection timeline included Phase 5 Participant Debriefing. During this phase, the researcher planned to meet with the school building principal to debrief on the overall data collected from lesson plan reviews and classroom observations. This meeting would allow the principal to gain insight into the results garnered from the LoFTI observation tool and provide any feedback to the researcher that might help in the final data analysis process (Friday Institute for Educational Innovation, 2015). The researcher also planned meet with study participants to debrief them on the overall data collection results. This would allow study participants to provide feedback to the researcher and ensure the study participants perceive they are represented accurately and fairly in the data results. Due to the effects of the COVID-18 pandemic and the closing of schools, the communication of study findings and participant debriefing took place digitally through e-mails and phone calls. The purpose of participant debriefing was achieved despite the required adjustments to the research process.

Rigor and Trustworthiness

In order to ensure credibility of the proposed research study, the researcher pursued the research using methods and procedures successfully established by other reputable researchers (Shenton, 2004). This included previously mentioned actions such as conducting the research in a site personal and familiar to the researcher, using data collection tools with high measures of validity and reliability, audits of data collection method such as interview protocols to address ethical considerations, and triangulation of multiple data sources to increase reliability of the findings (Creswell, 2014; Ghafouri & Ofoghi, 2016; Mertler, 2017; Shenton, 2004). In addition, several research alignment techniques were used to strengthen the rigor and trustworthiness of the proposed research study.

Participant Debriefing and Member Checking

As a part of the focus group interview process, participant debriefing took place immediately following the interview process to ensure all in-the-moment perspectives were documented before the data collection process concludes (Buchanan, 2004; Mertler, 2017; Shenton, 2004). This was especially important as the research purpose and questions require rich descriptions in order to make recommendations specific to the study site and participants. The COVID-19 pandemic had effects on the process of participant debriefing. As all focus group interviews were held virtually, participants were contacts during the transcription and coding phases to ensure their statements were recorded correctly and interpreted to match their intent. Participant debriefing became a cyclical process to ensure themes derived from focus group interviews valid and thoroughly encompassed participants' experiences and perceptions. Participants also engaged in member checking at the conclusion of the research study and prior to publication of the final findings. Following a debriefing with the site principal, a summation of study findings was presented to the participants digitally via e-mail as the schools were closed preventing in-person meetings. The purpose of member checking was to allow participants to review analyzed data and associated findings to ensure alignment between the research questions and their provided perspectives (Buchanan, 2004; Mertler, 2017; Shenton, 2004). Giving participants the opportunity to verify, or in some cases expand upon, their representation in the study increased the rigor and trustworthiness of the study findings (Glesne, 2006).

Peer Review

In keeping with traditional graduate research, peer review and debriefing incorporating writing groups, dissertation chair, and dissertation committee took place throughout the research process. This review process addressed all noted ethical considerations as well as further validated the methods described above designed to increase the rigor and trustworthiness of the research study. Peer review was vital to maintaining the integrity and focus of the proposed research study as critical perspectives are provided from those who are outsiders to the research itself but insiders in the research process.

Rich, Thick Descriptions

Characteristic of descriptive research, the methods designed to promote rigor and trustworthiness in this research study are all grounded in the task of providing rich, thick descriptions of the setting, participants, research purpose, study design, and findings necessary to promote systematic changes in our classroom and schools (Mertler, 2017). The depth of these findings is essential in telling the story woven by the research and for the development of research-based recommendations for educational improvement. Rich descriptions and grounded recommendations provide not only benefits to the study participants and setting, but also substantiates the original purpose for the research.

Triangulation

Triangulation of the mixed-methods data is a vital part of the data analysis process because it gives the researcher the opportunity to expand upon traditional research practices without sacrificing the validity of the study (Flick, 2018). In the research study, qualitative and quantitative findings from each phase of the study will be triangulated to determine themes for discussion and reveal any possible inconsistencies in the research methodology. Triangulation helps the research paint a thicker, more detailed picture of the study as a whole (Flick, 2018; Heale & Forbes, 2013).

Plan for Sharing & Communicating Findings

The results of this study will be used to assist school administrators and district technology coordinators in designing a targeted professional development plan for teachers to increase the effectiveness of technology integration within the school, and therefore student technology mastery as defined by the Technology Guarantees. Teachers are encouraged to use the study results to examine and improve upon their own classroom technology integration. The study findings have been translated into recommendations and have been presented as a report to the school principal and middle level executive director. Following their feedback and successful publication of the study, the report will be made available to the superintendent’s cabinet in culmination of the study approval given by the cabinet (Aiken County Public School District, 2002). Study participants, school administration, other school faculty, and district technology coordinators will be invited to participate in a school-based presentation and recommendations discussion in preparation for the professional development plan design process. Data anonymization will be used to further report findings and recommendations to ensure confidentiality of individual participant involvement and contribution.

CHAPTER 4

ANALYSIS AND FINDINGS

The research study was designed to describe the level of technology integration within the study site and the teachers' self-efficacy related to technology integration and encountered barriers using the tenets of descriptive research. The study is driven with the goal of identifying current trends and practices at the research site and the intent to produce results that can be applied to professional development plans and organizational-change proposals at the study location. Data was collected in an attempt to answer the following research questions 1) How do content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?, 2) How do content area teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?, and 3) How do content area teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?

The Analysis and Findings chapter is organized into three major sections outside of the chapter introduction and closing summary. The first section following the introduction details the Quantitative Findings for each source of quantitative data using three subheadings: Teacher Surveys, Lesson Plan Count, and LoFTI Observation Tool. Each subsection will include the method of analysis, the report of reliability, and the findings with the statement of significance for the quantitative data sources. The next section, Qualitative Findings and Interpretations, focuses on the qualitative data source and the process by which the data was analyzed. In this research study, the sole source of qualitative data was a collection of focus group interviews. This data will be described by both the source and participants that provided the data and the steps taken to code and categorize the data. The final section prior to the chapter summary titled the Presentation of Findings details the themes that emerged from the collected data and the evidence to support the researcher's assertions.

Quantitative Findings

In an attempt to answer the research questions detailed above, the research conducted quantitative data collection via three difference sources. First, teachers who consented to participation were sent a digital survey that included prompts from two separate surveys: the Technology Skills, Beliefs, and Barriers Scale (Brush, Glazewski, & Hew, 2008) and the Teacher Technology Questionnaire (TTQ) (Lowther & Ross, 2002). Following survey completion, the researcher engaged in a series of classroom observations from which two forms of data were derived. During the observation period, the researcher reviewed each teacher's lesson plans that are required to be posted in the classroom. This review searched for evidence of planned technology integration into instructional practices. Simultaneously, the researcher observed classroom instruction and documented the classroom technology integration using the Looking for Technology Integration (LoFTI) observation tool (Friday Institute for Educational Innovation, 2015). The survey results, lesson plan count, and observation tool entries combined make up the entirety of quantitative data collected during this study.

Surveys

In one of the first steps of data collection following participant identification and consent, teacher participants were sent a digital survey via email. The survey was a combination of two separate surveys, the Technology Skills, Beliefs, and Barriers Scale and the Teacher Technology Questionnaire (TTQ) (see Appendix A), that have been previously administered and validated by other researchers. The Technology Skills, Beliefs, and Barriers Scale uses a four-point Likert scale to assess skills across five sectors of technology usage, a four-point Likert scale to assess technology beliefs, and a three-point Likert scale to assess perceived technology barriers. The TTQ uses a four-point Likert scale to capture teacher perceptions across five areas of technology integration in the school setting and support for technology integration.

Technology Skills, Beliefs, and Barriers Scale Analysis and Reliability. The Technology Skills, Beliefs, and Barriers scale is divided into three sections. The technology section is categorized into five areas of measure: Basic Operations, Communications, Electronic References, World Wide Web, and Multimedia; and is rated on a four-point scale. The remaining two sections are singular categories titled Technology Beliefs and Perceived Technology Barriers. Validity and reliability information for the Technology Skills, Beliefs, and Barriers scale was detailed in Chapter 3: Methodology. For this study, the researcher used traditional descriptive statistics to develop findings from the mined data. Mean and standard deviation are provided for each question included in the survey. Data reflects responses from participants *n=10* as two teachers did not complete the survey as requested.

Technology Skills, Beliefs, and Barriers Scale Findings. The data presented in Table 4.1 is significant to the research study as it reflects technology skills and barriers to technology integration through the lens of the teachers responsible for incorporating technology into the curriculum at the study site. The data from the technology categories shows a discrepancy in confidence between basic and higher levels skills. The top three ranked skills teachers possess are printing documents, cut/paste between documents, and completing email functions. The lowest ranked skills are using spreadsheets, authoring and formatting web pages, using drawing programs, and using multimedia authoring tools.

Table 4.1 *Technology Skills, Beliefs, and Barriers Scale Findings*

Basic Operations n=10	*M*	*SD*
1. Create, save, copy, and delete files; move or copy files onto hard disks or CDs or DVDs, find files on a hard disk or a CD/DVD; create folders and move files between folders	3.5	0.527
2. Print an entire document, selected pages, and/or the current page within a document	4	0.00
3. Cut, paste, and copy information within and between documents	4	0.00
4. Use advanced features of a spreadsheet (e.g., using formulas, sorting data, and creating charts/graphs)	2.6	0.843
5. Create a presentation using predefined templates	3.6	0.699
6. Create a presentation with graphics, transitions, animation, and hyperlinks	3.6	0.699
7. Use an electronic/computer gradebook	3.6	0.516

Communications n=10	*M*	*SD*
1. Send, receive, open and read email	4	0.00
2. Use advanced email features (e.g., attachments, folder, address books, distribution lists)	3.4	0.699
3. Subscribe to and unsubscribe from a listserv	2.9	1.101

Electronic References n=10	*M*	*SD*

1. Use a search tool to perform a keyword/subject search in an electronic database (e.g., CD-ROM, library catalog)	3.5	0.527
2. Use advanced features to search for information (e.g., subject search, search strings with Boolean operators, combining searches)	3	1.054

World Wide Web n=10	*M*	*SD*
1. Navigate the web using a web browser (e.g., Internet Explorer, Firefox)	3.9	0.316
2. Use more advanced features of a web browser (e.g., creating, organizing, and using bookmarks; opening multiple windows; using reload/refresh and stop buttons)	3.7	0.675
3. Use advanced features of a web browser (e.g., install plug-ins, download files and programs, download images)	3.4	0.843
4. Use a search engine (e.g., Yahoo, Lycos, Google) to search for information on the web	3.9	0.316
5. Use a web authoring tool (e.g., FrontPage) to create basic web pages with text and images	2.6	1.174
6. Format web pages using tables, backgrounds, internal and external links	2.3	1.059
7. Use advanced features of a drawing program (e.g., layering, grouping objects, changing fill and outline colors)	2.5	1.179

Multimedia n=10	*M*	*SD*
1. Create simple shapes such as lines, circles, rectangles, and squares using a drawing program	3.2	0.789
2. Use advanced features of a drawing program (e.g., layering, grouping objects, changing fill and outline colors)	2.4	1.174
3. Create and modify a simple multimedia product using an authoring tool such as Hyperstudio	2.5	0.972
4. Import a digital image (e.g., clipart, photograph) into a document	3.7	0.483
5. Use various tools (e.g., digital camera, scanner) to capture a digital image	3.5	0.707
6. Use a photo editing tool (e.g., Photoshop) to manipulate a digital image	2.9	0.994
7. Use desktop publishing software (e.g., Publisher, PageMaker) to create a newsletter, pamphlet, or award certificate	3.3	0.949

Technology Beliefs n=10	*M*	*SD*
1. I support the use of technology in the classroom.	3.9	0.316
2. A variety of technologies are important for student learning.	3.8	0.422
3. Incorporating technology into instruction helps students learn.	3.7	0.483
4. Content knowledge should take priority over technology skills.	3.3	0.483

5. Most students have so many other needs that technology use is a low priority.	1.5	0.527
6. Student motivation increases when technology is integrated into the curriculum.	3.3	0.823
7. Teaching students how to use technology isn't my job.	1.7	0.675
8. There isn't enough time to incorporate technology into the curriculum.	1.7	0.675
9. Technology helps teachers do things with their classes that they would not be able to do without it.	3.4	0.699
10. Knowledge about technology will improve my teaching.	3.5	0.707
11. Technology might interfere with "human" interactions between teachers and students.	1.6	0.516

Perceived Technology Barriers n=10	*M*	*SD*
1. Lack of or limited access to computers in schools.	1.7	0.823
2. Not enough software available in schools.	1.9	0.876
3. Lack of knowledge about technology.	1.6	0.699
4. Lack of knowledge about ways to integrate technology into the curriculum.	1.8	0.789
5. My assignment doesn't require technology use.	1.4	0.516
6. Lack of technology available in my classes.	1.4	0.843
7. There is too much material to cover.	2.1	0.738
8. Lack of mentoring to help me increase my knowledge about technology.	1.2	0.422
9. Technology-integrated curriculum projects require too much preparation time.	1.6	0.516
10. There isn't enough time in class to implement technology-based lessons.	1.4	0.516

Teacher Technology Questionnaire Analysis and Reliability. The TTQ was designed to collect data on teacher perceptions of technology across five areas: Impact on Classroom Instruction, Impact on Students, Teacher Readiness to Integrate Technology, Support for Technology in the School, and Technical Support. When taking the survey, teachers rate statements using a five-point Likert scale rating of Strongly Disagree, Disagree, Neutral, Agree, or Strongly Agree. Validity and reliability information on the TTQ was detailed in Chapter 3: Methodology. The TTQ was analyzed using descriptive statistics. Mean and standard deviation are provided for each belief statement rated by the participants *n=10*.

Teacher Technology Questionnaire (TTQ) Findings. The data presented in Table 4.2 is significant to the research study as it reflects teacher beliefs regarding computers, the impact of technology, and technology use at the research site. These perceptions are driven by the availability, support, and use of technology within the school. For this data measure, the means calculated for the survey prompts have a narrow range and fall between 3.5 and 4.5. Therefore, the findings rely more on the analysis of each mean in relation to each standard deviation. The areas with the lowest standard deviations are aligning technology with district curriculum standards, computer skills are adequate to conduct classes with technology, and knowing how to meaningfully integrate technology into lessons. The areas with the highest standard deviations are materials for classroom use of computer are readily available, most computers are kept in good working condition, and integration of technology has positively impacted student learning and achievement.

Table 4.2 *Teacher Technology Questionnaire (TTQ) Findings*

Impact on Classroom Instruction n=10	*M*	*SD*
1. My teaching is more student-centered when technology is integrated into the lessons.	4.3	0.823
2. I routinely integrate the use of technology into my instruction.	4.4	0.699
3. Technology integration efforts have changed classroom learning activities in a very positive way.	4.4	0.699
4. My teaching is more interactive when technology is integrated into the lessons.	4.2	1.033

Impact on Students n=10	*M*	*SD*
1. The use of computers has increased the level of student interaction and/or collaboration.	4.3	0.949

2. The integration of technology has positively impacted student learning and achievement.	4	1.155
3. Most of my students can capably use computers at an age-appropriate level.	3.9	0.738
4. The use of technology has improved the quality of student work.	3.5	1.080

Teacher Readiness to Integrate Technology n=10	*M*	*SD*
1. I know how to meaningfully integrate technology into lessons.	4.2	0.632
2. I am able to align technology use with my district's standards-based curriculum.	4.2	0.422
3. I have received adequate training to incorporate technology into my instruction.	3.6	0.843
4. My computer skills are adequate to conduct classes that have students using technology.	4.4	0.516

Support for Technology in the School n=10	*M*	*SD*
1. Parents of community members support our school's emphasis on technology.	3.8	0.919
2. Teachers receive adequate administrative support to integrate technology into classroom practices.	4.5	0.707
3. Our school has a well-developed technology plan that guides all technology integration efforts.	4.1	0.568
4. Teachers in this school are generally supportive of technology integration efforts.	4.3	0.483

Technical Support n=10	*M*	*SD*
1. Most of our school computers are kept in good working condition.	4	1.155
2. I can readily obtain answers to technology-related questions.	4	0.667
3. My students have adequate access to up-to-date technology resources.	3.8	1.033
4. Materials (e.g., software, printer supplies) for classroom use of computers are readily available.	3.8	1.398

Lesson Plan Count

The purpose of the Lesson Plan Count was to evaluate the frequency at which teachers include or mention technology usage in their planned weekly lessons. Data was collected during instructional observations by evaluating each teacher's posted lesson plans for each core content course taught by the teacher.

Lesson Plan Count Analysis and Reliability. During data collection, the researcher evaluated lesson plans for each teacher based on the different core content courses taught by each teacher, not the number of sections for each course. For example, if a teacher taught three sections of Social Studies 6, one point of data collection was taken as the plans are identical for each section. If a teacher taught Social Studies 6 and Social Studies 7, two data points were collected to represent the planning technology usage for the separate courses. Lesson plans were not evaluated on the rigor or application of technology during instruction, simply any mention of planned technology usage was documented including student computers, web-based labs and resources, YouTube videos, PowerPoint presentations, digital or web-based assessments, web-based games, etc. Data was analyzed in the form of weekly frequency distributions by teacher and course as compared to the number of available instructional days that week. Reliability of data collected is found in the consistency of collecting data points for each content area for each teacher over a span of six weeks and improved by the teachers' use of a mandatory lesson plan template that prompts the teachers to include instructional technology plans for each day of a weekly lesson plan.

Lesson Plan Count Findings. The data presented in Table 4.3 is significant to the research study as it reveals teachers' direct intent to use or not use technology in their daily instructional plans. This allows the researcher to compare intent versus observed integration. Data is presented as a comparison between the number of days (opportunities) each week that teachers have to plan for technology integration and the average number of days each week where technology is mentioned in lesson plans. Averages are provided for all teachers, teachers with 1:1 ratio of computers, and teachers without 1:1 ratio of computers.

Table 4.3 *Lesson Plan Count Findings*

Week Number	**Opportunities**	**All Teachers** ***n=25*** ***M***	**1:1 Full Circle Teachers** ***n=9*** ***M***	**Non 1:1 Teachers** ***n=16*** ***M***
1	5	1.8	2.33	1.50
2	5	1.92	2.44	1.56
3	4	2.12	2.00	1.67
4	4	1.68	2.11	1.22
5	5	2.00	1.89	1.67
6	5	2.00	2.44	1.11

Looking for Technology Integration (LoFTI) Observation Tool

The LoFTI observation tool is retrieved as a PDF that can be printed and used during instructional observations (Friday Institute for Educational Innovation, 2015). The researcher digitized the observation tool into a Google Form to allow data to be collected and published in Microsoft Excel for a more streamlined analysis process. As described in the Methodology chapter, each participating teacher was observed a minimum of three times. During each observation, the LoFTI observation form was completed in full including anecdotal notes sections of the form.

LoFTI Analysis and Reliability. Data mined from the LoFTI observation tool was analyzed using the descriptive statistics that best fit the data set. Some questions are described with a frequency count (*n*) and others are described using a combination of mean (*M*), standard deviation (*SD*), lowest value (*min*), highest value (*max*), and range of values (*R*). The observation form allows for observer notes to be recorded to further describe any aspect of the observation that cannot be captured in a selected response fashion. Examples of those notes are included in findings in Appendix D. The LoFTI Observation Tool as a research instrument was discussed in Chapter 3: Methodology.

LoFTI Findings. The data derived from observations using the LoFTI Observation Tool is significant to the research study as it describes instructional practices in participants' classrooms with both standardized prompts and observer anecdotal notes. These observation descriptions include the frequency and rigor of technology integration in the classroom delineated by the behaviors of the teacher and students. Complete LoFTI data is presented in Appendix D. Table 4.4 shows the segment of LoFTI data that represents the demographic data of the observations. The data shows a total of 36 observations with 27 of those falling in the general education category and 33 observations that included technology use.

Table 4.4 *LoFTI Observations Course Demographic Data*

Grade Level	*n*
6th Grade	19
7th Grade	7
8th grade	10
Total Observations	*36*

What track is this class?	*n*
Special Education	0
Remedial	0
General Education	27
Honors	9
Advanced Placement	0
Other	0

Is technology in use?	*n*
Yes	33
No	3

Table 4.5 provides descriptive statistics for the number of students in class and the number of students using technology in the class. This data is significant because it shows the functional usage of technology within the classrooms whether whole-group, individual, or no usage at all. Specifically, students using technology reveals *M* = 9.25 and *SD* = 9.87 with the *min/max* falling between 0 and 28.

Table 4.5 *LoFTI Observations Class and Technology Usage Counts*

How many students are in class?

M	*SD*	*min*	*max*	*R*
17.69	5.99	7	28	21

How many students are using technology?

M	*SD*	*min*	*max*	*R*
9.25	9.84	0	28	28

Table 4.6 outlines how technology hardware and technology software are being used by the teacher and/or by the students and the purpose for that usage. This data is significant in that it shows trends for technology usage depending on the role of the user. For example, teachers primarily use technology for communication on desktop computer and displays using administrative, productivity and web browser software. Students primarily use technology for assessment, research, and information processing on laptop computers, using assessment and web browser software.

Table 4.6 *LoFTI Observations Technology Usage*

Technology is being used as a tool for…	Student *n*	Teacher *n*
Problem Solving (e.g. graphing, decision support, design)	2	1
Communication (e.g. document preparation, email, presentation, web development)	5	19
Information Processing (e.g. data manipulation, writing, data tables)	6	2
Research (e.g. collecting information or data)	6	0
Personal Development (e.g. e-learning, time management, calendar)	4	0
Group Productivity/Cooperative Learning (e.g. collab., planning, doc sharing)	4	1

Formative Assessment	6	1
Summative Assessment	9	0
Brainstorming	0	0
Computer-Assisted Instruction	3	0
Face to Face Classroom Discussion	0	6
Face to Face Group Instruction	1	1
Asynchronous Discussion	0	0
Drill and Practice	3	2
Generating and Testing Hypotheses	0	0
Identifying Similarities and Differences	2	1
Project-Based Learning	5	1
Recitation	0	0
Summarizing and Notetaking	2	7

Technology hardware is in use by…

Assistive Technology	0	0
Audio (e.g. speakers, microphone)	0	5
Art/Music (e.g. drawing tablet, musical keyboard)	0	0
Imaging (e.g. camcorder, film or digital camera, doc camera, scanner)	0	2
Display (e.g. digital projector, digital white board, TV, TV-link, printer)	3	30
Media Storage/Retrieval (e.g. print material, DVD, VCR, external storage devices)	0	0
Math/Science/Technical (e.g. GPS, probeware, calculator, video microscope)	6	0
Desktop Computer	0	31
Laptop Computer (including tablets)	19	2
Other	0	0

Technology software is used by…

Administrative (e.g. grading, record-keeping)	0	17
Assessment/Testing	12	5
Assistive (e.g. screen reader)	0	0
Computer Assisted-Instruction/Integrated Learning System	3	0
Thinking Tools (e.g. visual organizer, simulation, modeling, problem-solving)	8	4
Hardware-Embedded (e.g. digital white board, GPS/GIS, digital interactive response system)	0	1
Multimedia (e.g. digital video editing)	1	0
Productivity Software (e.g. database, presentation, spreadsheet, word processing)	7	22
Programming or Web Scripting (e.g. Javascript, PHO, Visual Basic)	0	0
Graphics/Publishing (e.g. page layout, drawing/painting, CAD, photo editing, web publishing)	0	1
Subject-Specific Software	8	2
Web Browser (e.g. MS Internet Explorer, Netscape, Firefox)	15	16
Web Applications		
Course Management Software (DyKnow, etc.)	0	0
Database Systems	0	0
Discussion Boards	0	0
Libraries, E-Publications	0	0

Search Engine	1	1
Video, Voice, or Real-Time Text Conference	0	0
Web Logs, Blogs	0	0
Web Mail	0	0
Wiki	0	0

Table 4.7 outlines the rigor levels of technology usage in classroom observations using a rating scale of replacement (low), amplification (middle), and transformation (high) along with observer notes regarding the instructional practices that fit into each rigor rating. This information is highly significant because it measures the depth of technology integration for the previously discussed LoFTI data features.

Table 4.7 *LoFTI Observations Technology Rigor*

How was technology used in the classroom?	*n*
Replacement	13
Observer Notes (examples):	
Instructions given on white board	
Instructions given on smart board with projector	
Maps and notetaking using digital resources	
Taking assessment on laptop	
Class agenda displayed on projector	
Notetaking/reviewing notes before assessment	
Teacher lecture using digital PowerPoint	
Teacher using document camera to show textbook on projector	
Amplification	18
Observer Notes (examples):	
Quiz on Mastery Connect (auto-graded and loaded into PowerTeacher)	
USA TestPrep Assignments	
Gizmo formative assessment	
Students projecting laptop to project to give presentations	
Students collaborating across cloud-based word processing program to complete joint writing assignment	
Students using Study Island (auto-graded)	
Students completing district CFA with document sharing and collaboration	
Students completing research for writing assignments	
Teacher presenting PowerPoint while students take digital notes on 1:1 devices and use internet to research questions raised during instruction	
YouTube videos used to enhance instruction	

Edmentum diagnostic software (adjusts to student performance)

Transformation	2

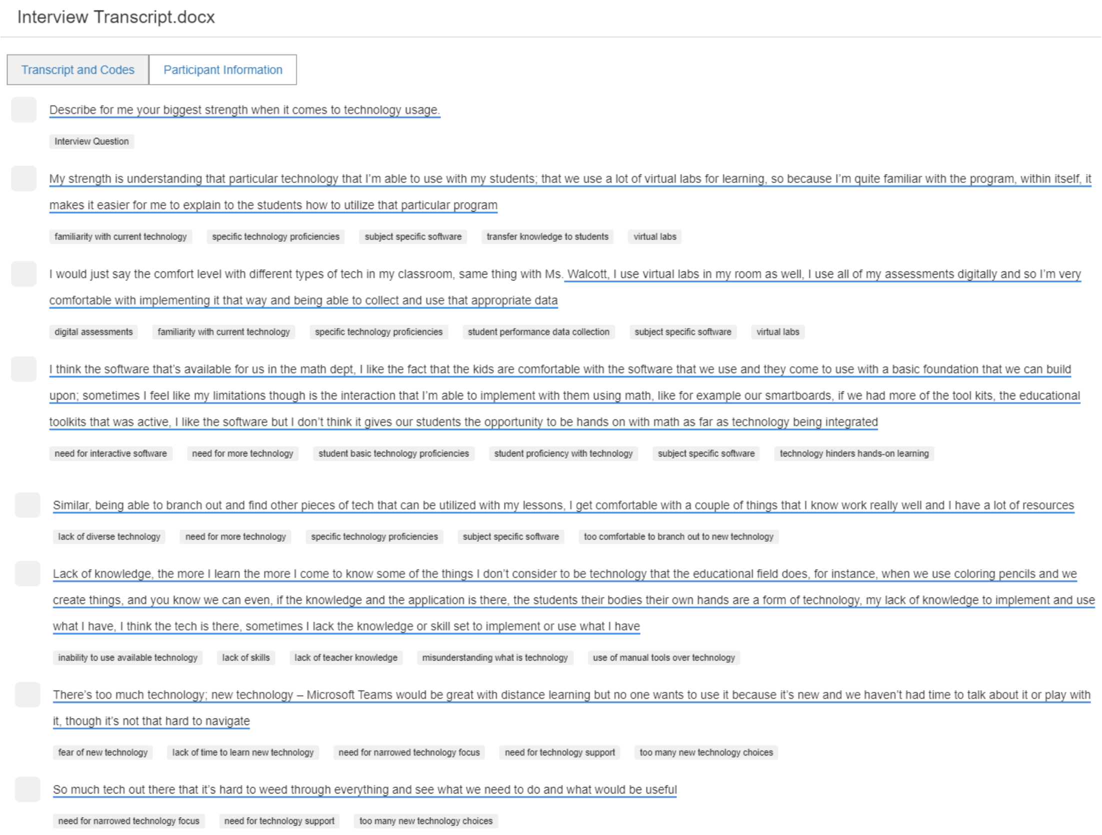
Observer Notes (examples):
Students are using laptops and internet/Office 365 to research and create lessons collaboratively that will be presented to the group
Students in pairs are writing and defending arguments using online document collaboration rather than working side by side

Qualitative Findings & Interpretations

To ensure this study provided rich, thick descriptions of the current technology integration and instructional practices at the study site, qualitative data was gathered in addition to the previously discussed quantitative data (Mertler, 2017). Qualitative data was gathered through focus group interviews that served as the final data collection point following the quantitative surveys, lesson plan count, and instructional observations. This data was collected and analyzed in holistic manner; therefore, the identities of individual participants are irrelevant. Participants of the focus group interviews are referred to as "teacher" or "teachers" in a general reference. Verbatim quotations from interview participants are credited to the participant by a given pseudonym. In this section, the qualitative focus group interview data is presented in three ways: a description of the data collected, an explanation of how the data was processed an analyzed, and figures that show the coding process.

Focus Group Interviews

The COVID-19 pandemic had an interesting impact on the completion of this research study. Observation data collection was completed on the final day school was in session for the 2019-2020 school year and schools were then closed for the remainder of the year. The original research goal was to include all participating teachers in the interview process, but due to the closing of schools and technology limitations, interviewees were amassed on a voluntary basis. Focus group interviews took place in two rounds, the first with four teachers and the second with three teachers. Participants represented a variety of core content disciplines and varying levels of technology skill and instructional integration. Interviews were held over recorded Zoom sessions (Zoom Video Communications, Inc., 2021) and each focus group was asked the same interview questions detailed in Appendix C. Interview recordings were then transcribed by the researcher into a single digital transcript. The transcript was cleaned up to only include responses pertinent to the interview questions (Kvale, 1996). Transcripts were then loaded into Delve, an online software program that assists with flexible, intuitive coding processes for qualitative data (Delve, 2021). Following the transcript coding in Delve, codes were exported to Microsoft Excel to facilitate further analysis and categorization (Excel version 2008). Inductive analysis, in this case through the assignment of codes, involves taking a large quantity of data and reducing it into patterns, themes, and categories with the goal of presenting findings within the data that can be used to develop vivid descriptions of research (Creswell, 2017; Mertler, 2017; Liu, 2016; Saldaña, 2016). Using inductive coding, each interview question response was evaluated line by line through eclectic coding to develop initial impressions and pull as much meaning from the participant statements as possible (see Figure 4.1) (Saldaña, 2016).



Describe for me your biggest strength when it comes to technology usage.

Interview Question

My strength is understanding that particular technology that I'm able to use with my students; that we use a lot of virtual labs for learning, so because I'm quite familiar with the program, within itself, it makes it easier for me to explain to the students how to utilize that particular program

familiarity with current technology | specific technology proficiencies | subject specific software | transfer knowledge to students | virtual labs

I would just say the comfort level with different types of tech in my classroom, same thing with Ms. Walcott, I use virtual labs in my room as well, I use all of my assessments digitally and so I'm very comfortable with implementing it that way and being able to collect and use that appropriate data

digital assessments | familiarity with current technology | specific technology proficiencies | student performance data collection | subject specific software | virtual labs

I think the software that's available for us in the math dept, I like the fact that the kids are comfortable with the software that we use and they come to use with a basic foundation that we can build upon; sometimes I feel like my limitations though is the interaction that I'm able to implement with them using math, like for example our smartboards, if we had more of the tool kits, the educational toolkits that was active, I like the software but I don't think it gives our students the opportunity to be hands on with math as far as technology being integrated

need for interactive software | need for more technology | student basic technology proficiencies | student proficiency with technology | subject specific software | technology hinders hands-on learning

Similar, being able to branch out and find other pieces of tech that can be utilized with my lessons, I get comfortable with a couple of things that I know work really well and I have a lot of resources

lack of diverse technology | need for more technology | specific technology proficiencies | subject specific software | too comfortable to branch out to new technology

Lack of knowledge, the more I learn the more I come to know some of the things I don't consider to be technology that the educational field does, for instance, when we use coloring pencils and we create things, and you know we can even, if the knowledge and the application is there, the students their bodies their own hands are a form of technology, my lack of knowledge to implement and use what I have, I think the tech is there, sometimes I lack the knowledge or skill set to implement or use what I have

inability to use available technology | lack of skills | lack of teacher knowledge | misunderstanding what is technology | use of manual tools over technology

There's too much technology; new technology – Microsoft Teams would be great with distance learning but no one wants to use it because it's new and we haven't had time to talk about it or play with it, though it's not that hard to navigate

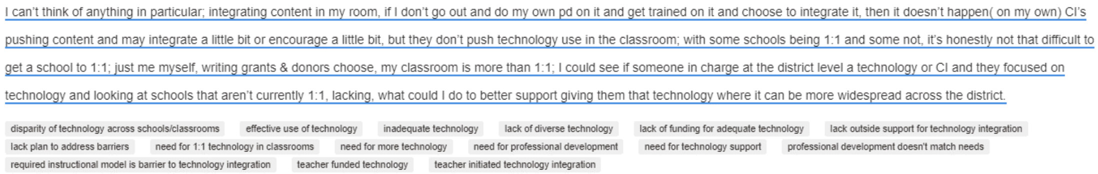
fear of new technology | lack of time to learn new technology | need for narrowed technology focus | need for technology support | too many new technology choices

So much tech out there that it's hard to weed through everything and see what we need to do and what would be useful

need for narrowed technology focus | need for technology support | too many new technology choices

Figure 4.1 Example of transcript coding using Delve software.

In many cases, multiple codes were assigned to a single statement to ensure the most detailed analysis was performed that is refered to as simultaneous coding (Elliott, 2018; Saldaña, 2016) (see Figure 4.2).

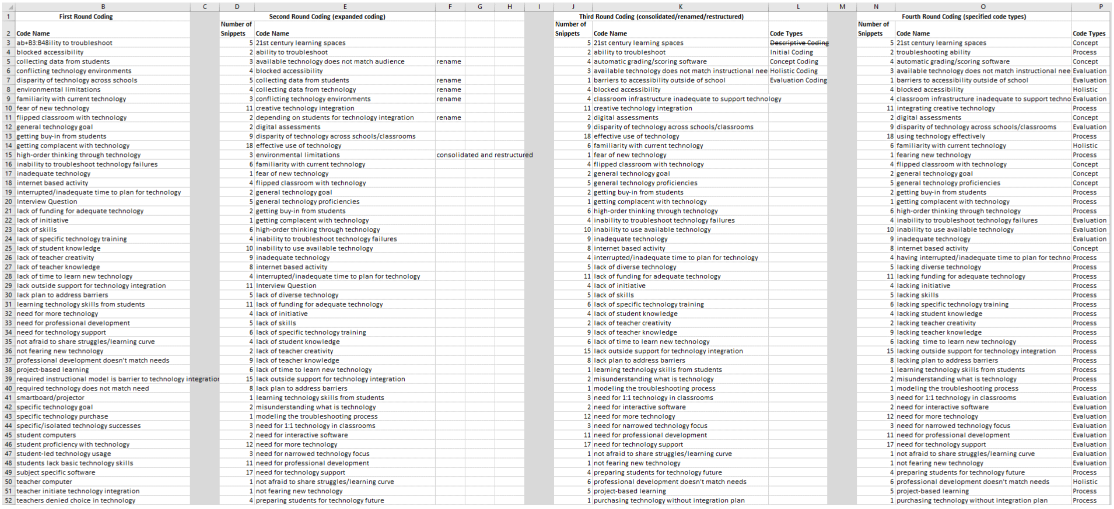


I can't think of anything in particular; integrating content in my room, if I don't go out and do my own pd on it and get trained on it and choose to integrate it, then it doesn't happen(on my own) CI's pushing content and may integrate a little bit or encourage a little bit, but they don't push technology use in the classroom; with some schools being 1:1 and some not, it's honestly not that difficult to get a school to 1:1; just me myself, writing grants & donors choose, my classroom is more than 1:1; I could see if someone in charge at the district level a technology or CI and they focused on technology and looking at schools that aren't currently 1:1, lacking, what could I do to better support giving them that technology where it can be more widespread across the district.

disparity of technology across schools/classrooms | effective use of technology | inadequate technology | lack of diverse technology | lack of funding for adequate technology | lack outside support for technology integration
lack plan to address barriers | need for 1:1 technology in classrooms | need for more technology | need for professional development | need for technology support | professional development doesn't match needs
required instructional model is barrier to technology integration | teacher funded technology | teacher initiated technology integration

Figure 4.2 Example of Simultaneous Coding

First round coding resulted in 61 codes. After peer-debriefing with Dr. Morris, a second round of eclectic coding was performed to provide a deeper evaluation each line and sentence and produced a total of 88 codes. These codes were then evaluated against the interview transcript to ensure they were a best reflection of each participant's intent and inflection within their responses (see Figure 4.3). Through the evaluation, codes were renamed, consolidated, and restructured resulting in 87 codes that fell into initial, concept, holistic, and evaluation code types (Saldaña, 2016). These code types were assigned based on the semantics of the codes and with the purpose of finding the salient features of the codes that later lead to categories and themes.



	B	C	D	E	F	G	H	I
1	First Round Coding			Second Round Coding (expanded coding)				
2	Code Name		Number of Snippets	Code Name				
3	ab+B3:B48ility to troubleshoot		5	21st century learning spaces				
4	blocked accessibility		2	ability to troubleshoot				
5	collecting data from students		3	available technology does not match audience	rename			
6	conflicting technology environments		4	blocked accessibility				
7	disparity of technology across schools		5	collecting data from students	rename			
8	environmental limitations		4	collecting data from technology	rename			
9	familiarity with current technology		3	conflicting technology environments	rename			
10	fear of new technology		11	creative technology integration				
11	flipped classroom with technology		2	depending on students for technology integration	rename			
12	general technology goal		2	digital assessments				
13	getting buy-in from students		9	disparity of technology across schools/classrooms				
14	getting complacent with technology		18	effective use of technology				
15	high-order thinking through technology		3	environmental limitations	consolidated and restructured			
16	inability to troubleshoot technology failures		6	familiarity with current technology				
17	inadequate technology		1	fear of new technology				
18	internet based activity		4	flipped classroom with technology				
19	interrupted/inadequate time to plan for technology		2	general technology goal				
20	Interview Question		5	general technology proficiencies				
21	lack of funding for adequate technology		2	getting buy-in from students				
22	lack of initiative		1	getting complacent with technology				
23	lack of skills		6	high-order thinking through technology				
24	lack of specific technology training		4	inability to troubleshoot technology failures				
25	lack of student knowledge		10	inability to use available technology				
26	lack of teacher creativity		9	inadequate technology				
27	lack of teacher knowledge		8	internet based activity				
28	lack of time to learn new technology		4	interrupted/inadequate time to plan for technology				
29	lack outside support for technology integration		11	Interview Question				
30	lack plan to address barriers		5	lack of diverse technology				
31	learning technology skills from students		11	lack of funding for adequate technology				
32	need for more technology		4	lack of initiative				
33	need for professional development		5	lack of skills				
34	need for technology support		6	lack of specific technology training				
35	not afraid to share struggles/learning curve		4	lack of student knowledge				
36	not fearing new technology		2	lack of teacher creativity				
37	professional development doesn't match needs		9	lack of teacher knowledge				
38	project-based learning		6	lack of time to learn new technology				
39	required instructional model is barrier to technology integratio		15	lack outside support for technology integration				
40	required technology does not match need		8	lack plan to address barriers				
41	smartboard/projector		1	learning technology skills from students				
42	specific technology goal		2	misunderstanding what is technology				
43	specific technology purchase		1	modeling the troubleshooting process				
44	specific/isolated technology successes		3	need for 1:1 technology in classrooms				
45	student computers		2	need for interactive software				
46	student proficiency with technology		12	need for more technology				
47	student-led technology usage		3	need for narrowed technology focus				
48	students lack basic technology skills		11	need for professional development				
49	subject specific software		17	need for technology support				
50	teacher computer		1	not afraid to share struggles/learning curve				
51	teacher initiate technology integration		1	not fearing new technology				
52	teachers denied choice in technology		4	preparing students for technology future				

	J	K	L	M	N	O	P
1		Third Round Coding (consolidated/renamed/restructured)				Fourth Round Coding (specified code types)	
2	Number of Snippets	Code Name	Code Types		Number of Snippets	Code Name	Code Types
3	5	21st century learning spaces	~~Descriptive Coding~~		5	21st century learning spaces	Concept
4	2	ability to troubleshoot	Initial Coding		2	troubleshooting ability	Process
5	4	automatic grading/scoring software	Concept Coding		4	automatic grading/scoring software	Concept
6	3	available technology does not match instructional nee	Holistic Coding		3	available technology does not match instructional nee	Evaluation
7	1	barriers to accessibility outside of school	Evaluation Coding		1	barriers to accessibility outside of school	Evaluation
8	4	blocked accessibility			4	blocked accessibility	Holistic
9	4	classroom infrastructure inadequate to support technology			4	classroom infrastructure inadequate to support techno	Evaluation
10	11	creative technology integration			11	integrating creative technology	Process
11	2	digital assessments			2	digital assessments	Concept
12	9	disparity of technology across schools/classrooms			9	disparity of technology across schools/classrooms	Evaluation
13	18	effective use of technology			18	using technology effectively	Process
14	6	familiarity with current technology			6	familiarity with current technology	Holistic
15	1	fear of new technology			1	fearing new technology	Process
16	4	flipped classroom with technology			4	flipped classroom with technology	Concept
17	2	general technology goal			2	general technology goal	Concept
18	5	general technology proficiencies			5	general technology proficiencies	Concept
19	2	getting buy-in from students			2	getting buy-in from students	Process
20	1	getting complacent with technology			1	getting complacent with technology	Process
21	6	high-order thinking through technology			6	high-order thinking through technology	Process
22	4	inability to troubleshoot technology failures			4	inability to troubleshoot technology failures	Evaluation
23	10	inability to use available technology			10	inability to use available technology	Evaluation
24	9	inadequate technology			9	inadequate technology	Evaluation
25	8	internet based activity			8	internet based activity	Concept
26	4	interrupted/inadequate time to plan for technology			4	having interrupted/inadequate time to plan for techno	Process
27	5	lack of diverse technology			5	lacking diverse technology	Process
28	11	lack of funding for adequate technology			11	lacking funding for adequate technology	Process
29	4	lack of initiative			4	lacking initiative	Process
30	5	lack of skills			5	lacking skills	Process
31	6	lack of specific technology training			6	lacking specific technology training	Process
32	4	lack of student knowledge			4	lacking student knowledge	Process
33	2	lack of teacher creativity			2	lacking teacher creativity	Process
34	9	lack of teacher knowledge			9	lacking teacher knowledge	Process
35	6	lack of time to learn new technology			6	lacking time to learn new technology	Process
36	15	lack outside support for technology integration			15	lacking outside support for technology integration	Process
37	8	lack plan to address barriers			8	lacking plan to address barriers	Process
38	1	learning technology skills from students			1	learning technology skills from students	Process
39	2	misunderstanding what is technology			2	misunderstanding what is technology	Process
40	1	modeling the troubleshooting process			1	modeling the troubleshooting process	Process
41	3	need for 1:1 technology in classrooms			3	need for 1:1 technology in classrooms	Evaluation
42	2	need for interactive software			2	need for interactive software	Evaluation
43	12	need for more technology			12	need for more technology	Evaluation
44	3	need for narrowed technology focus			3	need for narrowed technology focus	Evaluation
45	11	need for professional development			11	need for professional development	Evaluation
46	17	need for technology support			17	need for technology support	Evaluation
47	1	not afraid to share struggles/learning curve			1	not afraid to share struggles/learning curve	Evaluation
48	1	not fearing new technology			1	not fearing new technology	Evaluation
49	4	preparing students for technology future			4	preparing students for technology future	Process
50	6	professional development doesn't match needs			6	professional development doesn't match needs	Holistic
51	5	project-based learning			5	project-based learning	Process
52	1	purchasing technology without integration plan			1	purchasing technology without integration plan	Process

Figure 4.3 Example of code management and rounds of coding using Microsoft Excel

The resulting codes from round three were then grouped by content and topic resulting in categories. The first categorization round resulted in seven categories (see Figure 4.4). The codes were then mixed and regrouped under eight dissimilar categories. The goal for these categories were to then develop themes that represented the data, but

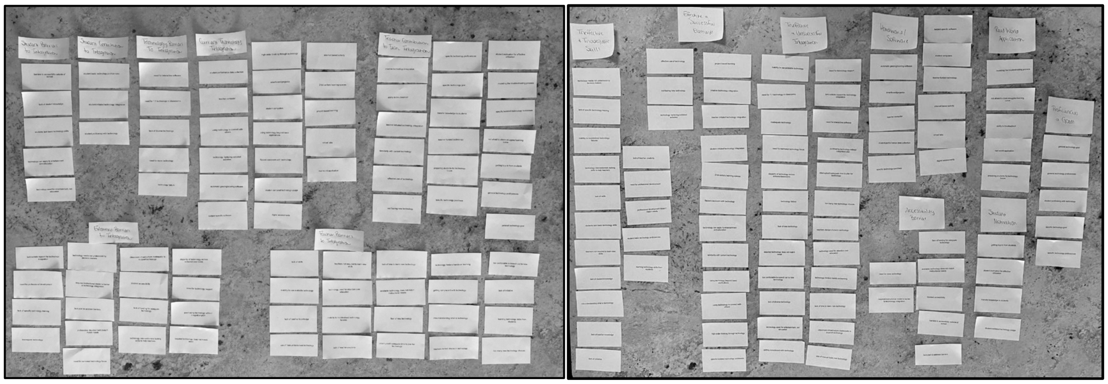


Figure 4.4 Rounds 1 and 2 of categorizing codes

the researcher was unable to choose best-fit categories from either of these rounds and the development of appropriate themes was found to be impossible. This was discussed during peer-debriefing with Dr. Morris and he suggested returning to the codes and starting again with a fresh thought process. The researcher then returned to the codes and evaluated them again against the transcript and code types, determining that both code semantics and code types were not entirely reflective of the interview responses (Auerbach & Silverstein, 2003). The 87 codes from round three were restructured to reflect the final round of code types: concept, process, holistic, and evaluation. Compared to the initial round of assigning code types, three types remained. Concept and holistic code types are both related to describing the bigger picture of what the participant is describing in their statements, whereas concept codes are applied on a line and sentence level and holistic codes are applied to a larger subset of data such as an entire discussion or response (Saldaña, 2016). The evaluation code type remained as well and was applied to participant statements that reflected their perceptions of programs and policies within the school and/or district that affected their ability to integrate technology. From the restructuring of the code semantics, the initial code type was replaced by the process code type which better represents the "conceptual or observable action" present in participant statements (Saldaña, 2016, p. 296). These codes include gerunds such as modeling, preparing, purchasing, using, and thinking. The restructured codes were put through a third round of categorization.

Following four rounds of coding and three rounds of categorization, the researcher determined there were twelve final categories that best described the codes and data provided from participants: 1) barriers external to teachers/classrooms, 2) barriers internal to teachers/classrooms, 3) current hardware integration, 4) current instructional technology integration, 5) current software integration, 6) extrinsic teacher barriers, 7) intrinsic teacher barriers, 8) student technology/integration skills, 9) student-centered barriers, 10) teacher-driven integration goals and purchases, 11) teacher-driven student-centered integration, and 12) teacher technology/integration skills. These categories were further grouped and analyzed to reveal three themes reflected in the data: 1) Teachers are using a variety of hardware, software, and instructional practices to engage students with technology and integrate technology in learning activities, 2) Current technology integration requires the utilization of skills and knowledge possessed by teachers and students as well as student motivation techniques, integration goal setting, and teacher-driven technology purchases, and 3) Enhanced technology integration is blocked by a variety of intrinsic and extrinsic barriers (see Table 4.8).

Table 4.8 *Development of Final Themes from Categories*

Categories	**Themes**
current hardware integration current instructional technology integration current software integration	Teachers are using a variety of hardware, software, and instructional practices to engage students with technology and integrate technology in learning activities.

student technology/integration skills teacher driven integration goals and purchases teacher driven student-centered integration teacher technology/integration skills	Current technology integration requires the utilization of skills and knowledge possessed by teachers and students as well as student motivation techniques, integration goal setting, and teacher-driven technology purchases.
barriers external to teachers/classrooms barriers internal to teachers/classrooms extrinsic teacher barriers intrinsic teacher barriers student-centered barriers	Enhanced technology integration is blocked by a variety of intrinsic and extrinsic barriers.

Presentation of Findings

The purpose of this descriptive research study is to describe teachers' skill and confidence levels of technology use, teachers' perception of barriers to their technology integration, and levels of in-class technology integration in a STEAM accredited middle school with student Technology Guarantees. The synthesis of qualitative data produced three overarching themes that represent this status: 1) Teachers are using a variety of hardware, software, and instructional practices to engage students with technology and integrate technology in learning activities, 2) Current technology integration requires the utilization of skills and knowledge possessed by teachers and students as well as student motivation techniques, integration goal setting, and teacher-driven technology purchases, and 3) Enhanced technology integration is blocked by a variety of intrinsic and extrinsic barriers. In this section, each theme is discussed individually along with the data evidence that drove the theme development. Theme discussions are narrowed down to include verbatim evidence that is credited to the participant by a given pseudonym as previously mentioned. The final subsection includes a discussion of incongruities found between Themes #2 and #3.

Teachers Are Using a Variety of Hardware, Software, and Instructional Practices to Engage Students with Technology and Integrate Technology in Learning Activities

The first theme states teachers are using a variety of hardware, software, and instructional practices to engage students with technology and integrate technology in learning activities. This theme originates from three categories: current hardware integration, current instructional technology integration, and current software integration. Table 4.9, *Theme #1 Categories and Codes*, details the codes that correspond with each of these categories. Examples of these codes include smartboard/projector, teacher and student computers, digital assessments, higher-order thinking through technology, project-based learning, automatic grading/scoring software, and virtual labs.

Table 4.9 *Theme #1 Categories and Codes*

Categories	Codes
current hardware integration	smartboard/projector student computers teacher computer
current instructional technology integration	21st century learning spaces digital assessments flipped classroom with technology higher-order thinking through technology project-based learning real-world application technology replacing outdated activities using technology to connect with others
current software integration	automatic grading/scoring software internet based activity student performance data collection subject specific software virtual labs

Hardware integration. In the interviews, teachers mentioned specific examples of hardware they use in their classrooms on a daily basis. Amber, Jordan, Julie, and

Christine each mentioned student use of laptop computers with Jordan specifically referencing using them on a daily basis in her 1:1 classroom.

Christine: “I use my Lenovo the most.”

Karen: “Lenovos and tablets.”

Jordan: Laptops, try to be a paperless classroom.”

Amber: “Desktops also when students don’t bring in laptops.”

Julie: “Laptops, it’s all I have and they use them independently.”

Scott mentioned “using a collection of Thinkpads, iPods, and tablets” to achieve a 1:1 ratio with his students since the district has not provided enough laptops for all students to actively manipulate the instructional tools he uses in the classroom. Multiple teachers referenced using the SmartBoard and projector in the classroom to present interactive lessons and/or information to students, which assumes the use of a teacher computer required to run the SmartBoard and input for the projector.

Karen: “The interaction I’m able to implement with them using math, like for example our SmartBoards and the educational Tool Kits.”

Scott: “The daily use of the SmartBoard to present the day’s agenda, notes for the students to record, and videos that I use to flip instruction with the students is the main source of daily hardware use.”

Amber: “I too use the SmartBoard to present whole group.”

Christine: “I display bell ringer type assignments on the board daily for students and often use the SmartBoard to allow students to present their answers by writing on a projected image of a worksheet or assignment.”

The discussion with teachers regarding current hardware use was brief, as it was mentioned by the researcher that instructional observations showed that hardware was present in each classroom, but that there was not an abundance of hardware that stood out during those observations. Teacher responses to this statement is presented with Theme #3.

Software integration. Teachers were more descriptive of their software uses over their hardware uses in the classroom.

Christine: “I use a lot of virtual labs for learning.”

Scott: “I use virtual labs in my room as well. I use all of my assessments digitally so I’m very comfortable with implementing it that way and being able to collect and use that appropriate data.”

Karen: “The software [Edmentum and Mastery Connect] that’s available for us in the math department. I like the fact that the kids are comfortable with the software.”

Amber: “Microsoft Teams for distance learning. Also the self-checkout software so the kids can get school resources they need.”

Jordan: “I use the Office 365 Suite so the kids can write and peer edit their work digitally. I also do my assessments through Schoology so the classroom is paperless. The Edmentum work required by the district.”

Scott: “Gizmos and Mastery Connect to assess the students.”

Karen: “Also USA Testprep and exploring other learning sites”

Teachers most reference high-impact examples of technology usage on an occasional basis rather than regular integration. For example, a couple of times a year Karen will use

Educreations (Educreations, Inc., 2021) she describes as a “voiceover software where students are able to do freehand illustrations…and then do a voiceover that allows them to teach a skill” they have learned. The students will use a tablet to write out and solve a math problem using the software, which then allows them to record audio that explains each step of their process. These recording can then be shared to other students or posted online for later reference. Once a year Scott uses Pen Pal Schools (2020), which connects students with PenPals across the world for educational activities such as completing projects. Scott described it as a “student-centered learning program, but the end result is up to the student. My class that used it this year went way further than they had to and Skyped with local meteorologists.” The assignment was for students to create a project on weather topics and the students used the software to connect with meteorologists who served as expert resources for their research. Other examples that occurred more frequently, but not on a daily basis, included collaborating with students at another school to complete assignments on the same novel via Skype (2021) in Jordan’s class, students creating videos for school-wide STEAM projects, and project-based learning that uses a variety of resources and presentation options for students.

Instructional practices. While often met by barriers as discussed in Theme #3, teachers use a variety of instructional practices to intentionally integrate technology into teaching and learning and have goals for greater integration practices. Amber is pushing to create a “21st century learning space” and wants to reconfigure her classroom to better suit her goal of doing “flipped classroom learning” more than just occasionally. Scott, Christine, and Jordan all previously referenced using programs such as Edmentum (2021), Mastery Connect (2019), Schoology (2020), USA Testprep (2021), and Gizmos

(2021) to provide formative and summative assessment, remediation, practice opportunities, and projects in a digital format. Jordan specifically referenced instructional practices that allow for peer collaboration on projects within the classroom and across schools. When asked about these instructional practices, Amber, Scott, and Jordan each mentioned their intent was to bring real-world application to the students in how they could expect their future endeavors to look like. Amber elaborated that within instructional practices "we need to teach them the basics and getting past the fact that a smartphone can be used as an educational device beyond entertainment. There are apps to download to read books. They can use a smartphone at home for things like USA Testprep or Schoology so we are trying to bridge that gap."

Current technology Integration Requires the Utilization of Skills and Knowledge Possessed by Teachers and Students as well as Student Motivation Techniques, Integration Goal Setting, and Teacher-Driven Technology Purchases

The second theme states current technology integration requires the utilization of skills and knowledge possessed by teachers and students as well as student motivation techniques, integration goal setting, and teacher-driven technology purchases. This is a multifaceted theme that described positive reflections on the skill proficiencies, instructional practices, and planned technology integration that currently exist at the study site. Categories that drive theme development are student technology/integration skills, teacher-driven student-centered integration, teacher technology/integration skills, and teacher-driven integration goals and purchases. Table 4.10, *Theme #2 Categories and Codes*, aligns the codes that correlate with each of these categories. Examples of codes include student-centered technology usage, student-initiated technology integration, getting buy-in from students, student motivation for effective utilization, transfer knowledge to students, integrating effective technology, modeling the troubleshooting process, not fearing new technology, and teacher funded technology.

Table 4.10 *Theme #2 Categories and Codes*

Categories	Codes
student technology/integration skills	student basic technology proficiencies student centered technology usage student initiated technology integration student proficiency with technology
teacher driven student-centered integration	getting buy-in from students preparing students for technology future student motivation for effective utilization technology can apply to entertainment and education transfer knowledge to students
teacher technology/integration skills	troubleshooting ability integrating creative technology using technology effectively familiarity with current technology general technology proficiencies learning technology skills from students modeling the troubleshooting process not afraid to share struggles/learning curve not fearing new technology specific technology proficiencies specific/isolated technology successes teacher initiated technology integration using technology beyond basic applications
teacher driven integration goals and purchases	general technology goal specific technology goal specific technology purchase teacher funded technology

Student technology/integration skills. Part of successful technology integration is attributed to a generation of students who grew up with electronics and do not fear trying new things. When discussing student technology and integration skills, many teachers note that students are familiar with the technology used in the classrooms. Karen stated, “I like the fact that the kids are comfortable with the software that we use, and they come to us with a basic foundation we can build upon.” Christine echoed that sentiment and expanded with having experiences where “high level students may tap into a technology that I’m not aware of and that teaches me.” Amber referenced the high level of skill and knowledge of the students she assists with the morning news show she describes as “student produced. I do behind the scenes. The kids are actually pushing through the slides and getting [the principal] on; it’s all the kids. They are creating something new on their level.” Karen noted that even with students who may not be as proficient as others “they are always open to learning, so if I can teach it to them they do it and accept it and they give 100% to implement and try it.” Discussion of Theme #3 includes barriers that arise when students do not have basic technology skills expected of their age group.

Teacher driven student-centered integration. Teacher driven student-centered integration included discussions on how teachers are engaging, or plan to engage, students with technology on a daily basis while ultimately hoping to impact students’ futures using technology. According to Amber, “we are really behind on where we should be to prepare these kids for what they need to be prepared with.” Often, in Julie’s classroom where they have a proscribed rotational model for instruction, students have to work independently on technology using district mandated software and she has to work to “get their buy in and try to get them to work hard on it, otherwise they just click through and aren’t really utilizing the technology.” When referencing the PenPals

Schools (2020) project previously, Scott stated when students are given autonomy in how content is learned and assessed, “it was surprising to see what students would do with it when they were able to take the content and go in a direction they wanted to go.” Jordan, Karen, and Scott want to use features of global collaboration, virtual field trips, and virtual reality technology that would combine entertainment and education to bridge the gap for their students. Jordan has her students engaged in research-based writing assignments, one of which would be greatly enhanced if students had access to “explore Africa through 3-D virtual reality goggles” giving students insight into the country that no website could provide. Prior to the closing of schools, Karen planned to collaborate with Jordan, who has already successfully utilized Skype for her students to collaborate with other students outside the school, to set up connections between her students and Richland 2 school district students to discuss math skills and coping mechanisms for students with math anxiety.

Teacher technology/integration skills. Teacher technology/integrations skills is a synthesis of statements that reflect how teachers are currently using technology, the skills that make them effective users of technology, and how they approach new technologies. Multiple teachers made statements referencing that familiarity with technology is a factor that greatly effects how technology is integrated into daily instruction. Referencing virtual labs, Christine stated she is “quite familiar with the program and it makes it easier for me to explain to the students how to use that particular program.” Scott echoed that sentiment and added he also administers “all of my assessments digitally so I am very comfortable with implementing it that way and being able to collect and use that appropriate data.” Scott also said he tends to “get comfortable with a couple of things I know work really well" and implement those tools repeatedly. Multiple teachers referenced troubleshooting and vetting technology as necessary tools for technology integration.

> Amber: "My strength is not being afraid to use technology and being able to troubleshoot. In being honest about my knowledge, technology screws up so being real with the people that you are working with that we tried this and it's not working so let's try this."
>
> Julie: "The goal is to actually figure out what's going on and fixing it instead of saying 'oh it isn't working' and walking away. I'll have other teachers come to me and I help."
>
> Scott: "Making use of the data that so many programs or technology offer to make sure we are using it as best as we can and if [our instructional strategies] are making a difference."
>
> Julie: "What's hard for me is the district will tell us what we have to use we know that might now always be the best fit for our classroom. I know of some things that would be really useful and I have to try to use them on top of what I'm already using."

Discussion of Theme #3 includes barriers that arise when teachers lack technology skills or the confidence to integrate new technology.

Teacher driven integration goals and purchases. The final category, teacher-driven integration goals and purchases, was derived from codes connected to teacher statements specifically referencing their personal actions and plans for technology integration in response to a lack of technology resources and support at the district level.

"Just me writing grants and Donor's Choose, my classroom is more than 1:1" was stated by Scott when discussing the disparities across schools with the amount of district-provided technology. Scott has also garnered donations for virtual reality headsets but is "working toward a whole set to do a completely virtual lesson within the classroom." Teachers mentioned subject-specific goals, ideas about professional development, and noted their integration goals include a program to ensure students start the year with basic technology proficiencies so everyone begins on the same level when it comes to accessing hardware and software that is used regularly throughout the school.

> Scott: "Our professional development comes behind our needs. For instance, we get this training in August and throughout the year when why can't we get it through the summer to give us a chance to learn it. A lot of us will study, plan, and figure out what we are going to do with our [technology] plans. I go out on my own and do my own professional development and get trained on it and choose to integrate it."
>
> Amber: "Where my computers are is where they have to be and no one will pay to move [the ports]. I can fundraise enough to fix it."
>
> Julie: "Sitting down with the kids and going through the basics of computer usage and technology in general as no one is taking the time to teach them the basics. Technology guarantees are important, but how do we push those when they don't have the foundation?"
>
> Amber: "I would like the kids to get more proficient in using the resources within the schools. The more proficient they are in school where I can answer questions, the more likely they are to use it at home on their own."

When asked to specify their next steps for increasing integration in their own classrooms, teachers had several purchases and plans in mind.

> Jordan: “3-D goggles to experience Africa”
>
> Christine: “Virtual field trip with space unit. That would be engaging.”
>
> Scott: “Full class set of VR headsets. I already have a lot, but working toward a whole set to do a completely virtual lesson within the classroom.”
>
> Karen: “Global collaboration maybe but definitely collaboration with a teacher outside of Aiken County…for Skype sessions dealing with math anxiety and skills.”

When asked what kind of support teachers need to make their goals a reality, the overall consensus was money for additional technology and an overwhelming desire for an instructional technology support person.

> Karen: “Money. And professional development.”
>
> Christine: “Money. Someone to make sure I know how to use it so that I engage the kids, not just on the basic level but take them beyond that.”
>
> Scott: “Money. I can do my own professional development but would like time during the day and not the weekend to learn the technology and how to best utilize it.”
>
> Amber: “Taking into consideration to use what we already have and have someone come in and demonstrate how to use the SmartBoard beyond just a projector. How can I make the SmartBoard more than that?”
>
> Julie: “We need someone who can help us instructionally. We do have teachers that don’t understand technology at all, but it also needs to be good instruction.”

> Amber: “No one takes the time to fully explore brand new technology. We just get excited about it and throw it at everyone.”

Enhanced Technology Integration is Blocked by a Variety of Intrinsic and Extrinsic Barriers

The third and final theme states enhanced technology integration is blocked by a variety of intrinsic and extrinsic barriers. This theme is not only complex but was a recurring theme throughout the interview responses as teachers discussed their goals and what prevents those goals from being realized. Theme #3 was derived from five categories: barriers external to teachers/classrooms, barriers internal to teachers/classrooms, extrinsic teacher barriers, intrinsic teacher barriers, and student-centered barriers. These categories cover not only physical barriers to technology integration but also barriers that exist in teacher skill sets and/or belief systems. Table 4.11, *Theme #3 Categories and Codes*, shows the alignment between the categories and codes for Theme #3. Examples of codes include available technology does not match instructional needs, having interrupted/inadequate time to plan for technology, lacking funding for adequate technology, lacking outside support for technology integration, blocked accessibility, classroom infrastructure inadequate to support technology, technology failure, lacking specific technology training, technology used for attention over education, fearing new technology, lacking initiative, lacking skills, too comfortable to branch out to new technology, use of manual tools over technology, barriers to accessibility outside of school, and students lack basic technology skills.

Table 4.11 *Theme #3 Categories and Codes*

Categories	Codes
barriers external to teachers/classrooms	available technology does not match instructional needs
	having interrupted/inadequate time to plan for technology
	lacking funding for adequate technology
	lacking outside support for technology integration
	lacking plan to address barriers
	misunderstanding what is technology
	need for narrowed technology focus
	need for technology support
	professional development doesn't match needs
	purchasing technology without integration plan
	required instructional model is barrier to technology integration
	required technology does not match need
	teachers denied choice in technology
	technology interventionists lacking skills to help teachers
	technology needs not understood by decision makers
barriers internal to teachers/classrooms	blocked accessibility
	classroom infrastructure inadequate to support technology
	disparity of technology across schools/classrooms
	inadequate technology
	lacking diverse technology
	need for 1:1 technology in classrooms
	need for interactive software
	need for more technology
	technology failure
	too many new technology choices
extrinsic teacher barriers	inability to use available technology
	lacking specific technology training
	lacking time to learn new technology
	need for professional development
	technology used for attention over education

intrinsic teacher barriers	fearing new technology getting complacent with technology inability to troubleshoot technology failures lacking initiative lacking skills lacking teacher creativity lacking teacher knowledge teachers not required to learn new skills technology hinders hands-on learning too comfortable to branch out to new technology use of manual tools over technology
student-centered barriers	barriers to accessibility outside of school lacking student knowledge students lack basic technology skills technology used for entertainment, not education

Barriers external to teachers/classrooms. When asked about barriers to technology integration, teachers often reference barriers that originate from outside their classrooms and realms of control. Christine referenced having issues with the "internet not having the capability and even being able to connect to a website. There are certain things now that used to be available like Adobe Flash that aren't available." Scott elaborated on that statement mentioning he has had experiences with "a great website being blocked by the district. I had to go through a whole process to get it unblocked and it took a week which set me back. When I asked why it was blocked, the district didn't know. Sometimes the internet bandwidth isn't enough to implement some of the programs we are familiar with." Amber also spoke on barriers she experiences that lie in the hands of the district. "For the district to push technology the way they do," she noted having limited network connections and the inability to upgrade her equipment. Likewise, Julie discussed struggles out of her control. "The laptops they give us can't keep up. There are constant problems, so we are continuously putting in work orders rendering them useless until they are fixed."

Beyond hardware and software issues, teachers mention other factors they perceive as barriers to enhanced technology integration that come from outside their classroom walls. For example, Jordan mentioned that what little planning time they do have is often interrupted for meetings or other obligations so working with technology falls lowers on the priority list. Scott discussed the impact that district Content Interventionists, the only resource of instructional support available to teachers, have on instruction and pushing content, "but they don't push technology use in the classroom." Both Amber and Julie point out the need for a narrowed technology focus and examining where technology funds are spent in the school.

> Julie: "Technology Guarantees are important, but how do we push those when they don't have the foundation. NEMS basically doesn't look any different than any other school. Teachers don't have time to be teaching all of the technology basics, but ours is also that we don't have the resources."
>
> Amber: "Our school needs an overhaul – not enough plugs, sparking outlets. We are not set up to be a STEAM school. In another school, kids have been taught to utilize technology because it's available throughout and that's the expectation. How can we effectively integrate that technology fully if it's not even available? No one really takes the time to fully explore new technology. We just get excited and throw it at everyone."

Julie's classroom falls under a proscribed three-rotational instructional model mandated by the district. She states, "what's hard for me is the district tells us what we have to use and we know that might not always be the best fit for our classroom and not being given the ability to choose what best fits. It's a struggle because I know of things that would be really useful, but I can't use them, or I have to use them on top of what I'm already using and that's not feasible. The instructional model I have to use doesn't allow for better use of technology. Almost used as a time filler, how it feels."

Barriers internal to teachers/classrooms. In addition to struggles that originate outside the classroom, teachers perceive other barriers that are specific to their personal classrooms. For example, Amber talks about the layout of her classroom compared to her goals for instruction stating, "the room is not set up for 21st century learning at all. Where the computers are, they have to be there because there is nowhere else to put them. Then there is the cost to move them, no one is willing to pay for that." Scott said one of his limits comes with "our pacing guides with testing in place. [We are] pushing to get skills through and we can only spend a small amount of time on them. It put limits on what you can do." The teachers also engaged in a discussion on the amounts of technology available to them. Scott has used crowd funding sources to acquire a collection of devices that allows his classroom to have a 1:1 ratio meaning that students are not all using the same type of device to engage in instruction. Jordan has a district funded 1:1 ratio of laptops. Karen and Christine both have a set of ten laptops and note the struggles they experience when trying to do whole-class instruction using technology including trying to borrow devices from other teachers. As a whole, the teachers agree that inadequate hardware is a major barrier to integration, but also note that there is an abundance of tools available they are unable to access resulting in feelings of being overwhelmed. With the start of the COVD-19 pandemic, Amber explained "there's too much technology and new technology. Microsoft Teams would be great with distance learning, but no one wants to use it because it's new and we haven't had time to talk about it or play with it though it's not that hard to use." Julie said, "with so much technology out there, it's hard to weed through everything and see what we need to do and what would be useful."

Extrinsic teacher barriers. While many of the barriers mentioned previously fit into the big picture of school-wide technology integration, many of them also apply to teachers as individuals. Extrinsic teacher barriers include outside factors that teachers as individuals perceive to stand in the way of enhanced technology integration despite their own desire for growth. For example, Christine is a huge proponent of technology integration but stated her "only limit is not having enough technology in my classroom for every single student to manipulate." Karen said she is "always open to learning, but until someone comes in and shows me something," she is going to be unable to reach higher levels of technology usage. Julie stated, "I know of things that would be really useful, but I can't use them" along with not receiving professional development on the technology tools that would really be most useful for her audience. Karen further elaborated that she does not branch out the types of technology she uses because "you get comfortable with technology because it expresses the content in a way that students get it." She is concerned that changing up the way she teaches may result in lower content mastery at the student level. Every teacher involved in the focus group interviews mentioned at some point that either the professional development they receive does not meet their needs as an individual or that they are not receiving professional development at all that encompasses technology integration as it applies to their instructional requirements.

Intrinsic teacher barriers. Intrinsic teacher barriers refer to the skills and beliefs of teachers as related to technology and how it fits into their content or approach to instruction. Most of the comments received from teachers are connected to their own low self-efficacy when it comes to motivation, creativity, and overall skill levels.

> Karen: "It's a weakness on my part where I don't take an initiative to go out and learn more." Being creative is a struggle because "you get comfortable with certain technology because it expresses the content in a way that students get it."
>
> Scott: "It results in using the same resources over and over possibly missing something new and more effective as technology changes."
>
> Karen: "Lack of knowledge. Sometimes I lack the knowledge or skill set to implement what I have."

When asked about technology specifics and to expand upon her self-efficacy comments, Karen referenced struggling to use resources she is labeling as technology but is mistakenly not technology. "For instance, when we use coloring pencils and we create things the knowledge and the application is there. The students, their bodies, their own hands are a form of technology. I think the tech is there." Karen also stated she "has too many students who don't think outside the box" meaning she relies on the students to bring in new and innovative ideas to the classroom. As teachers with higher skill levels for technology integration, Julie and Amber find a lack of motivation to go up against the barriers they experience with lack of funding, inadequate and failing technology, the need for instructional technology support, etc. on top of teaching and other non-instructional obligations.

Student-centered barriers. Student-centered barriers include roadblocks that teachers encounter once the technology reaches the students.

> Amber: “We have the basic assumption that kids automatically know how to use [technology], basic information like properly shutting down [computers].”
>
> Julie: “It’s sitting down with all the kids and going through the basics of computer usage and technology in general; no one is taking the time to teach them the basics. Technology guarantees are important, but how do we push those when they don’t have the foundation?”
>
> Amber: “Outside of school, so many kids don’t have access [to technology]. There are apps to download to read books, but I don’t think kids are using them or are encouraged.”

Often kids are using technology for entertainment rather than educational purposes or may not be aware they have the capability to do both. Additionally, teachers cite student motivation as a large factor in the success of technology. Karen said she has “too many students who don’t think outside of the box” and Julie has “programs where kids have to work alone. Getting their buy in and getting them to try and work hard in it, otherwise they just click through and aren’t really utilizing the technology.”

Contradicting Statements

Theme #2, *current technology integration requires the utilization of skills and knowledge possessed by teachers and students as well as student motivation techniques, integration goal setting, and teacher-driven technology purchases*, and Theme #3, *enhanced technology integration is blocked by a variety of intrinsic and extrinsic barriers*, were derived from statements made by teachers that seem to contradict each other and these discrepancies are worth noting as findings. Verbatim quotes from teachers in the findings section for each of these themes contradict each other regarding student technology skills. For example, Christine stated that “students may tap into a technology that I’m not aware of” and use technology to create and innovate their own ideas and products indicating students have a solid grasp of how to effectively use hardware and software while Karen claimed her students “do not think outside the box” to embrace new technology. Julie and Amber note repeatedly that they encounter a huge barrier with students who do not possess the basic technology skills needed to effectively integrate technology. A deeper look indicates that teachers who have low confidence in their own technology skills view their students as more technologically competent and rely on the students’ skills to carry technology integration. The teachers who have a higher level of confidence in their own skills and incorporate technology regularly into instructional practices perceive students to be lacking the skills needed to push technology integration to a higher level. A similar contradiction was found in teachers’ perceptions of having or lacking adequate hardware and software. Teachers with a high intrinsic motivation and self-efficacy pursue avenues to supply their classrooms with technology. Other teachers limit themselves to the technology that is provided to them. In both of these instances, teacher perception of the same situation differs across a variety of factors.

Chapter Summary

The purpose of this descriptive research study is to describe teachers' skill and confidence levels of technology use, teachers' perception of barriers to their technology integration, and levels of in-class technology integration in a STEAM accredited middle school with student Technology Guarantees. To achieve this purpose, a combination of quantitative and qualitative data was gathered and analyzed through the administration of survey, lesson plan counts, instructional observations, and focus group interviews. In this chapter, each of these data points were interpreted and presented as findings. From these findings, themes have been developed that drive the discussion, implications, and limitations of the next chapter.

CHAPTER 5

DISCUSSION, IMPLICATIONS, AND LIMITATIONS

The goal of this study is to describe the current levels of technology integration at a STEAM accredited middle school in relation to the perceived barriers, skill, and self-efficacy levels of the teachers responsible for incorporating technology into their instructional practices. The purpose this chapter is to discuss the significance of the triangulated research findings in relation to the three research questions. This synthesis is then used to formulate various implications. The discussion section of this chapter is subsectioned by each of three research questions and a final summary. Next implications are discussed in relation to personal implications, recommendations for developing further technology integration, and implications for further research. The final section of this chapter discusses the limitations of this research study.

Discussion

How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage?

The first research question addressed in this study is *How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their level of skill and self-efficacy in technology usage*? This research question is addressed with triangulated data gathered from the two administered quantitative surveys and the qualitative focus group interviews. The Technology Skills, Beliefs, and

Barriers Scale (Brush, Glazewski, & Hew, 2008) measured teachers' self-efficacy and perceptions of their own skill levels across five sections: Basic Operations, Communications, Electronic References, World Wide Web, and Multimedia. Teachers ranked their skills and comfort with technology on a 4-point Likert scale. In nearly every area, teachers rated themselves as independent technology users and/or as someone who can teach others to use the specified technology (See Table 4.1). In Basic Operations, the mean fell between $M = 3.5$ and $M = 4$ for each skill except for *use advanced features of a spreadsheet* with a mean of $M = 2.6$. Communication was rated between $M = 2.9$ and $M = 4$. Electronic References skills fell between $M = 3$ and $M = 3.5$. World Wide Web skills rated between $M = 2.3$ and $M = 3.9$ and means for Multimedia skills fell between $M = 2.4$ and $M = 2.7$. Discrepancies between the mean and standard deviation were found as the topics involved increasing levels of skill or knowledge such as formatting web pages ($M = 2.3$, $SD = 1.059$), using graphics design program ($M = 2.4$, $SD = 1.174$), using photo editing tools ($M = 2.9$, $SD = 0.994$), using a web authoring tool ($M = 2.6$, $SD = 1.174$), etc. The means of these topics fell closer into the lower level ranks of "I can't do this" and/or "I can do this with some assistance" and the standard deviation calculations indicated there is a division between teachers who can effectively use such technology and those who cannot. This was echoed in the Teacher Technology Questionnaire (TTQ) (Lowther & Ross, 2002) that rated teacher beliefs on technology integration using a 5-point Likert scale (See Table 4.2). Mean and standard deviation results showed inconsistencies in teachers' perceptions on their ability to integrate technology that has a positive impact on student achievement or learning ($M = 4$, $SD = 1.155$), improves the quality of student work (*M* = 3.5, *SD* = 1.080), and results in more interactive teaching techniques (*M* = 4.2, *SD* = 1.033).

Focus group interviews confirmed the themes found in the administered surveys in that there are polarized groups of teachers that are either highly skilled in technology or are lacking the skills needed to have effective technology integration with little in between. When asked about their strengths and weaknesses, teachers with less self-efficacy regarding technology skills mentioned using a limited set of programs and technology that they are already familiar with as their regular go-to for integration. While being proficient with these forms of technology was a perceived strength, these teachers also recognized it equally as a weakness. Teachers saw their levels of technology integration in the classroom as a limitation in that they are unable to think outside the box due to their lack of knowledge.

> Christine: “A barrier is being very creative. You get comfortable with certain technology because it expresses the content in a way that students get it.”
>
> Scott: “I get comfortable with a couple of things that I know work really well.”

Contrarily, teachers who perceived themselves as having greater technology confidence spoke more about not being afraid to use technology, being willing to try new technologies, and being able to troubleshoot features and nuances of technology that comes with breaking outside of their skill set.

> Amber: “Not being afraid to use technology. Being able to troubleshoot, try something and roll with it. Being honest about my knowledge. Technology screws up, so being real with the people you are working with that we tried this, it’s not working so let’s try this.”

> Julie: “Troubleshooting when there’s a problem. Actually trying to figure out what’s going on and fixing it instead of oh it’s not working, and walk away. I’ll have other teachers come to me and I help.”

In summary, the triangulation and synthesis survey and focus group data align to answer the question of how core content teachers describe their level of skill and self-efficacy in technology usage. Focus group interviews gave a more detailed insight into the more generic survey responses in that teachers are very self-aware of their strengths and weaknesses when it comes to technology usage and integration into instructional practices. By nature, teachers with a lower skill level describe their reliance on technology as routine and basic while teachers with a higher skill level describe a higher level of integration that results from a personal investment in equipment and training. This analysis is supported by prior research where findings highlight teachers’ skill and self-efficacy as greater indicators of their ability to effectively use and integrate technology over other factors such as work experience (Ertmer & Ottenbreit-Leftwich, 2010; Kalonde, 2017; Orhan-Karsak, 2017; Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017).

How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration?

The second research question addressed in this study is *How do core content teachers in a STEAM accredited middle school with student Technology Guarantees describe their barriers to technology integration*? As with Research Question #1, this question is answered from triangulated and synthesized data from two quantitative surveys, the Technology Skills, Beliefs, and Barriers Scale (Brush, Glazewski, & Hew,

2008) and the Teacher Technology Questionnaire (TTQ) (Lowther & Ross, 2002), and qualitative focus group interviews. The Perceived Technology Barriers section of the Technology, Skills, Beliefs, and Barriers scale is ranked on a 3-point Likert scale of Not a Barrier, Minor Barrier, and Major Barrier (See Table 4.1). As with the previous research question, there are areas where teachers are in agreement on perceived barriers and areas where perceptions differ. Teacher perceptions of barriers align on topics of such as lack of outside support for technology integration and lack of time to implement enhanced technology instruction. Eighty percent of teachers rated *lack of mentoring to help me increase my knowledge about technology* as not being a barrier (*M* = 1.2, *SD* = 0.422) to technology integration. Eighty percent of teachers believe *there is too much material to cover* is a barrier to enhanced technology usage (*M* = 2.1, *SD* = 0.738) and sixty percent of teachers agree that *technology-integrated curriculum projects require too much preparation time* (*M* = 1.6, *SD* = 0.516). Teacher perceptions vary more along topics of access to hardware and software, lack of knowledge about how to effectively integrate technology, and lack of classroom specific technology tools. Fifty percent of teachers do not perceive a lack of access to computers to be a barrier in school *M* = 1.7, *SD* = 0.823), but sixty percent of teachers believe a lack of software resources to be roadblock to technology integration (*M* = 1.9, *SD* = 0.876). Teachers are split at fifty percent as to whether their lack of knowledge about technology presents a problem (*M* = 1.6, *SD* = 0.699) while sixty percent of teachers find that their lack of knowledge on how to integrate technology with their curriculum is a barrier and forty percent do not perceive it as a barrier (*M* = 1.8, *SD* = 0.789). In another area of contrast, 100% of teachers believe that content knowledge should take priority over technology skills (*M* = 3.3, *SD* = 0.483), but 100% of teachers also support the use of technology in the classroom (*M* = 3.9, *SD* = 0.316), believe that incorporating technology into instruction helps students learn (*M* = 3.7, *SD* = 0.483), and disagree that most students have so many other needs that technology use is a low priority (*M* = 1.5, *SD* = 0.527).

These divergent perceptions are echoed in the Teacher Readiness to Integrate Technology, Support for Technology in the School, and Technical Support sections of the 5-point Likert scale TTQ survey (See Figure 4.2). Teacher responses indicate a non-barrier in their ability to conduct classes using technology that meet the district's standard expectations (*M* = 4.2, *SD* = 0.422) with 100% of responses falling in the agree or strongly agree categories, but differ in barriers relating support from outside the school, support from school administrators, students having access to up-to-date technology resources, and having readily available access to materials such as software and printer supplies. Ninety percent of teachers feel supported by administration (*M* = 4.5, *SD* = 0.707) and 100% feel supported by other teachers in their technology endeavors (*M* = 4.3, *SD* = 0.483), but numbers drop to seventy percent when asked do teachers feel supported by those outside the school such as parents and community members (*M* = 3.8, *SD* = 0.919). Only thirty percent of teachers strongly agree that must of the school computers are kept in good working condition (*M* = 4, *SD* = 1.155), only twenty percent strong agree that students have access to up-to-date technology resources (*M* = 3.8, *SD* = 1.033), and only forty percent of teachers strong agree that the materials they need integrate technology are readily available (*M* = 3.8, *SD* = 1.398).

As with the previous research question, the focus group interviews confirmed the results of the quantitative surveys and gave further insight into the perceived barriers teachers encounter when integrating technology. Teachers specifically stated that major barriers to technology instruction originate from source outside of their classrooms and control. For example, Scott stated, “a great website was blocked by the district” and the process to grant access to that website took weeks of instructional time away from the teacher. Teachers are also provided professional development after pacing guides and testing schedules have been dictated leaving them without the time needed to invest in learning new technology.

> Julie: “So much tech out there that it’s hard to weed through everything and see what we need to do and what would be useful. Our pacing guides with testing in place, pushing to get skills through and we can only spend [so much time] and it limits what you can do.”
>
> Amber: “There’s too much technology; new technology. Microsoft Teams would be great with distance learning, but no one wants to use it because it’s new and we haven’t had time to talk about it or play with it, though it’s not that hard to navigate. How are we supposed to expect the kids to solve problems when we as teachers don’t even have the ability to do so.”

Echoing from Julie and Amber, Scott stated, “we get this training in August and throughout the year when why can’t we get it through the summer to give us a chance to learn it.” It is noted in the limitations section that the impacts of the COVID-19 pandemic affected the participation in focus group interviews and resulted in a more narrowed description of barriers as compared to the surveys that included full participation.

Extensive prior research supports the research findings in that a multitude of barriers exist between the current status and true, effective technology integration such as access to technology, lack of effective training, time constraints for both planning and execution, technology use for entertainment over education, and a lack of clear policy and procedure (Carver, 2016; Doshmanziari & Mostafavi, 2017; Ertmer, 1999; Ertmer & Ottenbreit-Leftwich, 2010; Francom, 2016; Heravi, 2009).

How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?

The final research questions *How do core content teachers in a STEAM accredited middle school with student Technology Guarantees integrate technology for instructional purposes?* is answered through triangulated and synthesized data collected from three sources: lesson plan reviews, instructional observations, and focus group interviews. Lesson plan reviews show that teachers intentionally plan for technology integration in their classrooms less than half their allotted instructional days, an average of 1.92 days per week out of a possible 4.67 instructional days. Teachers with district funded 1:1 technology in their classrooms include intentional instructional plans for technology ($M = 2.204$) at nearly twice the rate as teachers without district funded 1:1 technology ($M = 1.454$), but still not above 50% of their allotted instructional time ($M = 4.67$). It should be noted that while lesson plan reviews document intentional technology planning at an average of 1.92 days per week, when compared to instructional observations the researcher noted there were often instances of technology integration present during instructional activities that were not noted on lesson plans. Technology usage was observed at a 100% rate with teachers that had district funded 1:1 technology, but these teachers did not include it as a tool identified in their instructional plans at that same rate averaging 2.20 days per week.

In alignment with the lesson plan reviews, the LoFTI Observation Tool (Friday Institute for Educational Innovation, 2015) data reveals similar fluctuations in frequency and rigor of instructional technology integration. Teachers used technology for a variety of instructional purposes and often used the same technology to achieve multiple goals. The most common purposes were activating prior knowledge, assessment (specifically using selected response software), advanced organizers, facilitation and/or lecture, reinforcement, and setting objectives. Teachers by far were more consistent in how and why they used technology compared to students. Teachers were observed 70 times using technology such as desktop computers, digital projectors, productivity software, and web browsers to perform tasks such as grading, record keeping, communication, email, and document preparation/presentation. While students also consistently used laptop computers and web browsers to complete digital assessments, they also used technology for a wide variety of learning activities. For example, students were observed 58 times using technology as a tool for problem solving, communication, data manipulation, research, e-learning, project collaboration, both formative and summative assessments, and project-based learning.

Student engagement ratings and rigor levels of technology usage included in the LoFTI Observation Tool (Friday Institute for Educational Innovation, 2015) provide for a more subjective description of instructional practices. These rating indicate an overall above average level of student engagement with outlying instances of low engagement and low instructional rigor and technology integration that falls into more replacement and amplification level practices over technology being used as a transformation tool in learning. Replacement activities were noted in 36% (*n*=13) observations and include using technology to give instructions, notetaking, displaying agendas, and using document cameras or PowerPoint during lectures. Amplification activities were noted in 50% (*n*=18) observations and primarily include the use of technology to administer assessments that are self-grading and therefore streamline the data collection process for teachers. Other instances of amplification include technology-enhanced research, collaboration via digital documents rather than paper exchange, and YouTube videos added to enrich lessons. Transformation actives were only recorded in 6% (*n*=2) of observations, both belonging to the same teacher who has district-funded 1:1 student laptop computers. In one observation, students were using the internet and Office 365 to research and create presentations that would be presented to the class through digital projection from the students' individual computers. The second observation noted students writing arguments, getting peer feedback, and debating those arguments using online document collaboration with students across the classroom. No transformation activities were observed in other classroom.

Researcher notes during observations further confirm the themes developed from data triangulation in that there are divisions among teachers when it comes to technology skills and levels of integration. While most teachers displayed innovation and confidence in their daily instructional practices, other teachers struggled with troubleshooting technology, maintaining classroom management with or without technology, and displaying confidence with technology practices the teacher has had multiple opportunities to master prior to the observation period.

In focus group interviews, teachers verbalized the same types of technology integration described through the previously discussed data points. Of the seven focus group participants, 100% referenced regularly using hardware and software that is already present in their classrooms to enhance teaching and learning such as virtual labs, laptops, and digital projectors. Shining moments in technology integration happen sparingly and depend greatly on the skills and confidence of the teacher utilizing the technology. For example, Karen, who struggles with technology integration, described her most rigorous technology integration at the replacement level through software such as Educreations (Educreations, Inc., 2021). She stated, "[It's a] voiceover where students are able to do freehand illustrations or from the web or images from safe sites and then do a voice layover. I allow them to use it to teach a skill." Christine cited having students engage in online research and using word processing programs to do project-based learning. Teachers such as Scott, Amber, Julie, and Jordan, with greater perceptions of their own skills and confidence with technology, plan and implement long-term, technology-enhanced instructional practices that involve collaboration across schools, live interactions with subject-specific experts, using technology to make cross-curricular connections, and producing school-wide live streamed presentations.

> Scott: "We use Pen Pal Schools which is a student-centered learning program, but the end result is up to the student. My class that used it this year went way further than they had to and Skyped with local meteorologists."
>
> Amber: "The morning show, I do behind the scenes. The kids are actually pushing through the slides and getting [the principal] on; it's all the kids. They are creating something new on their level."

Julie: “Students create videos for school-wide STEAM projects. They do everything from planning to filming to editing. These videos are shown across the school and take several versions of technology to accomplish.”

Jordan: “My students read a novel over several weeks and have multiple Skype sessions with students from another school. They analyze the book and work together on a digital project.”

Summary

The process of answering each of the three research questions paints a picture of technology practices at the study site and provides a basis for understanding what may be preventing greater levels of instructional technology integration. Most teachers perceive their technology skills and confidence as adequate, but with the potential to be greater. The difference lies in that teachers with higher levels of technology skills and confidence are constantly looking for more knowledge and new technology to bring into the classroom while teachers will lower levels of skill and confidence are looking to just achieve mastery in the technology already present in their classrooms. Findings from the two surveys and focus group interviews show teachers agree that their greatest barriers to enhancing technology integration include disparity in access to hardware and software, limited time to learn and implement new technologies, and a lack of support from technology specialists that can not only help teach new technologies but support teachers instructionally using technology enhanced practices. Again, the effects of these barriers are greater on teachers with lower skills and confidence as their more skilled counterparts take the initiative to break down these barriers find solutions that benefit teaching and learning. These descriptions are further validated by observations and reviews of lesson plans that show an almost polarization of teachers who plan for, regularly integrate, and search for new technology to enhance classroom instructional practices and those who use and lean on technology but only at lower rigor levels and within their comfort zones.

Implications

Following successful data collection and analysis of findings, research questions have been answered and thick, rich descriptions of technology integration at the study site have evolved. The next step is to explore the implications of the research findings and identify their importance in the researcher's realm of influence. In this section, implications are addressed in three phases: personal implications, recommendations for further developing technology integration, and implications for future research.

Personal Implications

In the proposal stages of this study, my researcher positionality was one of an insider as I was employed as the assistant principal in the school I intended to study. During the data collection and analysis phases, I changed employment outside the school district but continued to take the positionality of an insider due to the deep connections from the prior employment and treated the process as if I was still a true insider. From this positionality, the personal implications discovered in this process are vital in driving my own future professional development. Teachers repeatedly stated in survey and interview responses that they are in dire need of technology support that will address their specific weaknesses and goals for integration. For example, Karen stated she needs "someone to make sure that I know how to use it so that I engage the kids; not just on the basic level, but take them beyond that" and Christine echoed, "use what we have and have someone come in and demonstrate how to use it." Julie said, "we need someone to help us instructionally." This study confirms my belief that the greatest support teachers have to grow their instructional practices, specifically in terms of technology integration and enhanced learning opportunities, must come from the direct administrators as sources of guidance, evaluation, and development. This belief is also backed in research that states providing technology hardware and software to teachers will not alone result in increased integration because teachers require support from those that are rich in knowledge and capable of connecting technology resources with established curriculum content (Doshmanziari & Mostafavi, 2017; Ertmer, 1999; Francom, 2016; Kalonde, 2017; Pickett, 2009). If I were to return to an administrative position, it would be imperative to gain insight into the technology situation at the school as I have with this research study in order to provide support and development for teachers as they work to increase usage and rigor in their classrooms. My current position as an instructional technologist and digital training developer requires that I evaluate curriculums against audiences to determine the most effective methods of instruction and assessment, primarily using technology to facilitate content mastery. The personal implications of this study dictate that my beliefs about my role in supporting instruction, and therefore instructors and teachers, are valid and require that I maintain competency in both current technology trends and instructional best practices to be successful in that role.

Recommendations for Further Developing Technology Integration

Recommendations for developing technology integration practices at the study site are rooted in both prior research and current findings. These recommendations include discussion of the importance of software and hardware access along with the support opportunities teachers need to turn that access into instructional practices. First, teachers identified through survey and interview responses that there is a disparity in technological resources when comparing classrooms. Some classrooms have district funded 1:1 devices, some classrooms have a menagerie of devices funded through grants sought by the teacher, and some classrooms have ten laptops that must be shared across up to thirty students. This was expected as it is one of the most widely identified barriers to technology integration, though most certainly not the only barrier (Carver, 2016; Doshmanziari & Mostafavi, 2017; Ertmer, 1999; Francom, 2016; George & Sanders, 2017; Harper & Milman, 2016; Heravi, 2009). Prior research indicates that students perform better when there is a lower ratio of computers to students and findings from this study indicate there is greater technology usage, both planned and unplanned, in 1:1 technology classrooms (Francom, 2016; Harper & Milman, 2016; Hughes, Read, Jones, & Mahometa, 2015). The first recommendation to the current administration at the study site is to complete an evaluation into the quantities, types, and conditions of technologies available to teachers. Providing a minimum of 1:1 laptop devices in each classroom will at least ensure teachers can plan to use technology on a daily basis, even at lower rigor levels. Once teachers have access to reliable basics, newer and innovative technologies can be attained to supplement where they fit in the curriculum. In addition, targeted professional development can be planned under the assumption that teachers will have the ability to return to the classroom and have the tools needed to implement the skills learned.

Second, findings indicated that there are significant time restraints that prevent teachers from pursuing professional development opportunities or completing proper planning to incorporate technology at more rigorous levels during instruction. Teachers at the study site have one hour of planning daily that is often consumed with meetings, phone calls, and tutoring leaving teachers to grade and plan upcoming lessons outside of work hours. As identified in previous research, teachers lack the time needed properly find, explore, and plan for new technology integration (Ertmer, 1999, Pickett, 2009). The same applies to teachers at the study site. It is recommended that administration create dedicated planning opportunities to address deficiencies in teacher technology skills and enhance current instructional practices. Ideally this planning time would take place during work hours and during teachers' contracted workdays, possibly on already scheduled professional development days in place of generic, district-wide activities. This planning time should be targeted to individuals and groups of teachers to ensure teachers with low skill levels are able to master current accessible technology and teachers with higher skill levels are able to connect with new and innovative technology that can enhance their specific curriculum.

Finally, data analysis indicates that teachers need support that helps them connect technology with curriculum and works to improve teachers' perceptions of technology in relation to their own self-efficacy. Teachers may be experts in their curriculum, but they identify a significant barrier in sorting through the massive amounts of technology available to find what works best with their curriculum and their students. Prior research indicates that teachers who receive varied, recurring professional development focusing on pedagogical practices that include authentic technology integration, rather than isolated hardware or software presentations, become advocates of technology integration and experience natural increases in self-efficacy and skill development (Clifford, 2007; Ertmer, 1999; Ertmer-Ottenbreit-Leftwich, 2010; Harper & Milman, 2016; Pickett, 2009;

Tondeur, van Braak, Ertmer, & Ottenbreit-Leftwich, 2017). The ideal approach to this recommendation would be a dedicated curriculum and technology coach that, based on observable and measurable data, could offer targeted professional development and support to teachers as they integrate technology this is a best-fit for the content and the audience (Ertmer 1999).

Implications for Future Research

The motivation behind this research study came from the assumption that a school with a technology focus and a Science, Technology, Engineering, Arts, and Math (STEAM) magnet school designation would have a magnitude of available technology and a more rigorous approach to technology integration as compared to a school without such designations; yet during administrative instructional observations there appeared to be no differentiation in practices. The implications of this research study are important as they lend themselves to expanding the research base beyond describing one school of study to include true comparisons between schools characterized as technology-focused and schools without such designation. The school district has an opportunity to established mass data collection practices through already-occurring administrative observations to compare technology accessibility and integration in all school across the district. This data can be used to ensure instructional and technological equality for all students and teachers through funding allocations and targeted planning of professional development activities. On a smaller and more localized scale, the study site could use a similar research approach to test the effectiveness of targeted support and professional development provided to teachers based on the findings of this study and to requisition for additional technology resources needed to enhance integration practices.

Limitations

As with all research, there are limitations present in this research study that affect the research process and reduce the ability to generalize the findings to a broader audience. The primary limitations noted in this study is the use of a single study site and small number of study participants. The use of a single study site prevents further generalization of findings outside of a rare school with a similar population and STEAM designation. Due to the small size of the school population and small purposively selected sample, the number of study participants is considered a limitation even though every available teacher that fit the study parameters contributed to the research process (Creswell, 2014). The size of the study along with the nature of descriptive research creates a limitation in that the study cannot be generalized.

Researcher bias and positionality are both limitations that exist within this research study. Due to the insider positionality and former supervisory role of the researcher, the potential exists for the researcher to have undue influence on the survey and focus group responses. In the same manner, the nature of a qualitative descriptive study lends to a more subjective evaluation and interpretation of the data and is considered a limitation when compared to the objective nature of strictly quantitative study.

Another limitation that should be noted is the effect the COVID-19 pandemic had on the data gathering process. All surveys were completed as planned and the final day of scheduled lesson plan reviews and instructional observations were concluded on the very last day schools were in session for the 2019-2020 school year. The scheduled timeframe for focus group interviews fell during remote learning and had to be scheduled with teachers over Zoom on a volunteer basis. Remote learning and access to technology prevented the original plan for focus group interviews to take place which included all participants. Instead, there were two volunteer groups that consisted of 7 participants total representing a variety of subject areas. By the nature of needing volunteers rather than a full panel representing all participants, the focus group interviews included two fairly polarized groups of teachers that fell into either the technologically savvy end of the spectrum or the opposite with little to no representation of the median. In addition, the participating members of the focus groups are not an adequate representation of the study participants. While they represent the context of the discussion well, they are unable to voice the perspectives of all teachers, subject areas, skill levels, and perceived barriers. Therefore, data gathered in focus group interviews represents a limitation. This data being the only source of qualitative data presents yet another limitation as multiple sources of data are strengthen the validity of study findings (Creswell, 2014).

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APPENDIX A

SURVEY QUESTIONS

Table A.1 Technology Skills, Beliefs, and Barriers Scale

Basic Operations	I can't do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
1. Create, save, copy, and delete files; move or copy files onto hard disks or CDs or DVDs, find files on a hard disk or a CD/DVD; create folders and move files between folders				
2. Print an entire document, selected pages, and/or the current page within a document				
3. Cut, paste, and copy information within and between documents				
4. Use advanced features of a spreadsheet (e.g., using formulas, sorting data, and creating charts/graphs)				
5. Create a presentation using predefined templates				
6. Create a presentation with graphics, transitions, animation, and hyperlinks				

7. Use an electronic/computer gradebook				
Communications	I can't do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
1. Send, receive, open and read email				
2. Use advanced email features (e.g., attachments, folder, address books, distribution lists)				
3. Subscribe to and unsubscribe from a listserv				
Electronic References	I can't do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
1. Use a search tool to perform a keyword/subject search in an electronic database (e.g., CD-ROM, library catalog)				
2. Use advanced features to search for information (e.g., subject search, search strings with Boolean operators, combining searches)				
World Wide Web	I can't do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
1. Navigate the web using a web browser (e.g., Internet Explorer, Firefox)				

2. Use more advanced features of a web browser (e.g., creating, organizing, and using bookmarks; opening multiple windows; using reload/refresh and stop buttons)				
3. Use advanced features of a web browser (e.g., install plug-ins, download files and programs, download images)				
4. Use a search engine (e.g., Yahoo, Lycos, Google) to search for information on the web				
5. Use a web authoring tool (e.g., FrontPage) to create basic web pages with text and images				
6. Format web pages using tables, backgrounds, internal and external links				
7. Use advanced features of a drawing program (e.g., layering, grouping objects, changing fill and outline colors)				
Multimedia	I can't do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
1. Create simple shapes such as lines, circles, rectangles, and squares using a drawing program				
2. Use advanced features of a drawing program (e.g., layering, grouping objects, changing fill and outline colors)				
3. Create and modify a simple multimedia product using an				

authoring tool such as Hyperstudio				
4. Import a digital image (e.g., clipart, photograph) into a document				
5. Use various tools (e.g., digital camera, scanner) to capture a digital image				
6. Use a photo editing tool (e.g., Photoshop) to manipulate a digital image				
7. Use desktop publishing software (e.g., Publisher, PageMaker) to create a newsletter, pamphlet, or award certificate				
Technology Beliefs	I can't do this	I can do this with some assistance	I can do this independently	I can teach others how to do this
1. I support the use of technology in the classroom.				
2. A variety of technologies are important for student learning.				
3. Incorporating technology into instruction helps students learn.				
4. Content knowledge should take priority over technology skills.				
5. Most students have so many other needs that technology use is a low priority.				
6. Student motivation increases when technology is integrated into the curriculum.				
7. Teaching students how to use technology isn't my job.				

8. There isn’t enough time to incorporate technology into the curriculum.				
9. Technology helps teachers do things with their classes that they would not be able to do without it.				
10. Knowledge about technology will improve my teaching.				
11. Technology might interfere with “human” interactions between teachers and students.				

Perceived Technology Barriers	Not a Barrier	Minor Barrier	Major Barrier
1. Lack of or limited access to computers in schools.			
2. Not enough software available in schools.			
3. Lack of knowledge about technology.			
4. Lack of knowledge about ways to integrate technology into the curriculum.			
5. My assignment doesn’t require technology use.			
6. Lack of technology available in my classes.			
7. There is too much material to cover.			
8. Lack of mentoring to help me increase my knowledge about technology.			
9. Technology-integrated curriculum projects require too much preparation time.			
10. There isn’t enough time in class to implement technology-based lessons.			

Table A.2 Teacher Technology Questionnaire (TTQ)

Impact on Classroom Instruction	Strongly Disagree	Disagree	Agree	Strongly Agree
1. My teaching is more student-centered when technology is integrated into the lessons.				
2. I routinely integrate the use of technology into my instruction.				
3. Technology integration efforts have changed classroom learning activities in a very positive way.				
4. My teaching is more interactive when technology is integrated into the lessons.				
Impact on Students				
1. The use of computers has increased the level of student interaction and/or collaboration.				
2. The integration of technology has positively impacted student learning and achievement.				
3. Most of my students can capably use computers at an age-appropriate level.				
4. The use of technology has improved the quality of student work.				
Teacher Readiness to Integrate Technology				
1. I know how to meaningfully integrate technology into lessons.				
2. I am able to align technology use with my district’s standards-based curriculum.				
3. I have received adequate training to incorporate technology into my instruction.				

4. My computer skills are adequate to conduct classes that have students using technology.				
Support for Technology in the School				
1. Parents of community members support our school's emphasis on technology.				
2. Teachers receive adequate administrative support to integrate technology into classroom practices.				
3. Our school has a well-developed technology plan that guides all technology integration efforts.				
4. Teachers in this school are generally supportive of technology integration efforts.				
Technical Support				
1. Most of our school computers are kept in good working condition.				
2. I can readily obtain answers to technology-related questions.				
3. My students have adequate access to up-to-date technology resources.				
4. Materials (e.g., software, printer supplies) for classroom use of computers are readily available.				

APPENDIX B

CLASSROOM OBSERVATION TOOL

Looking for Technology Integration (LoFTI)

Purpose: LoFTI is a tool to aid in the observation of technology integration into teaching and learning. The data gathered through the use of this instrument should be helpful in building-level staff members as they plan and/or provide professional development in instructional technology.

1. Please enter the date and time:

   Date (mm/dd/yyyy):

   Time (hh:mm):

2. Observer Name:
3. Which school is being observed?
4. Teacher Name:

For all items, check any and all which apply to the activities being observed.

5. Grade level:

   __ Pre-K

   __ Kindergarten

   __ 1

   __ 2

   __ 3

   __ 4

   __ 5

   __ 6

   __ 7

   __ 8

   __ 9

   __ 10

   __ 11

   __ 12

   __ 13

6. What track is this class?

   __ Special Education

   __ Remedial

   __ General Education

   __ Honors

   __ Advanced Placement

   __ Other (please specify: ________________)

7. Is technology in use?

__ Yes

__ No

8. How many students are:

In class? _________

Using technology? __________

Comments: ____

____

9. Student Arrangement

__ Tables, Centers, Pods

__ Circle or U

__ Cubicles

__ Rows

__ Other (please specify: _____________________________)

10. Learning Environment:

__ Auditorium

__ Cafeteria

__ Classroom

__ Gymnasium

__ Lab

__ Media Center

__ Multipurpose Room

__ Outside

__ Virtual Environment

__ Other (please specify: _________________)

11. Student Grouping:

__ Independent Work

__ Learning Center

__ Pairs

__ Small Groups

__ Whole Groups

__ Workshops

__ Other (please specify: _________________)

12. Instructional Collaborators:

__ Administrator
__ Assistant
__ Curriculum Specialist
__ Media Coordinator
__ Other Teacher
__ Outside Consultant
__ Special Education Teacher
__ Student
__ Technology Facilitator/Coach
__ Volunteer
__ None
__ Other please specify: _________________)

13. Core Subject:

__ Arts
__ Career/Technical
__ Computer/Technology Skills
__ English/Language Arts
__ ESOL
__ Guidance
__ Health
__ Physical Education
__ Library/Media Skills
__ Mathematics
__ Foreign Languages
__ Science
__ Social Studies
__ Other (please specify: _________________)

Technology includes such things as computers, laptops, software, iPods, iPads, interactive whiteboards, digital cameras, document cameras, video cameras, the Internet, clickers, 3D virtual space, etc.

14. Teacher Activities: (*check only if technology is being used for…)*

__ Activating Prior Knowledge
__ Assessments
__ Reinforcing/Recognition
__ Demonstration
__ Differentiated Instruction
__ Facilitation (guiding)
__ Lecture
__ Providing Feedback
__ Questioning
__ Cues, Questions, and Advance Organizers
__ Scaffolding
__ Setting Objectives
__ Summarizing
__ Other (please specify: _________________)

15. Assessment Methods: *(check only if technology is being used for…)*

__ Oral Response

__ Written Response

__ Selected Response

__ Product (e.g. project with rubric)

__ Performance (e.g. presentation, demonstration)

__ Other (please specify: _________________)

16. Technology is being used as a tool for… *(check either Students or Teacher or both)*

	Teacher	Student
Problem Solving (e.g., graphing, decision support, design)	_______	_______
Communication (e.g., doc prep, email, presentation)	_______	_______
Information Processing (e.g., data manip, writing, tables)	_______	_______
Research (e.g., collecting information or data)	_______	_______
Personal Development (e.g., e-learning, time mgmt.)	_______	_______
Group Productivity/Cooperative Learning	_______	_______
Formative Assessment	_______	_______
Summative Assessment	_______	_______
Brainstorming	_______	_______
Computer-Assisted Instruction	_______	_______
Face to Face Classroom Discussion	_______	_______
Face to Face Group Discussion	_______	_______
Asynchronous Discussion	_______	_______
Drill and Practice	_______	_______
Generating and Testing Hypotheses	_______	_______
Identifying Similarities and Differences	_______	_______
Project-Based Activities	_______	_______
Recitation	_______	_______

Summarizing and Note Taking	________	________

17. Technology hardware is in use by… *(check either Students or Teacher or both)*

	Teacher	Student
Assistive Technology	________	________
Audio (e.g., speakers, microphone)	________	________
Art/Music (e.g., drawing tablet, musical keyboard)	________	________
Imaging (e.g., camcorder, film or digital camera)	________	________
Display (e.g., digital projector, digital white board, tv)	________	________
Media Storage/Retrieval (e.g, print, DVD)	________	________
Math/Science/Technical (e.g., GPS, calculator)	________	________
Desktop Computer	________	________
Laptop Computer (including laptops)	________	________
Other (please specify:____________________)	________	________

18. Technology software is in use by… *(check either Students or Teacher or both)*

	Teacher	Student
Administrative (e.g., grading, record keeping)	________	________
Assessment/Testing	________	________
Assistive (e.g., screen reader)	________	________
Computer Assisted Instruction	________	________
Thinking Tools (e.g., graphic organizers)	________	________
Hardware-Embedded (e.g., digital white board)	________	________
Multimedia (e.g., digital video editing)	________	________
Productivity Software (e.g., database, word processing)	________	________
Programming or Web Scripting	________	________
Graphics/Publishing	________	________

Subject-Specific Software ________ ________

Web Browser ________ ________

Web Applications

Course Management ________ ________

Database Systems ________ ________

Discussion Boards ________ ________

Libraries, E-Publications ________ ________

Search Engine ________ ________

Video, Voice, or Text Conference ________ ________

Web Logs, Blogs ________ ________

Web Mail ________ ________

Wiki ________ ________

Other (please specify: ________________) ________ ________

For the following items, please indicate the percentage of students in the classroom showing positive student engagement.

19. Student engagement is shown by…

Positive indicator of engagement	*Circle your best estimate of the percentage of students showing each positive indicator of engagement.*	*The opposite is disaffection*
Sustained behavioral involvement	100% 80% 60% 40% 20% 0%	Tendency to give up easily in the face of challenges
Positive emotional tone – cheerful, calm, and communicative	100% 80% 60% 40% 20% 0%	Negative emotional tone – boredom, depression, anxiety, anger, withdrawal, or rebellion
Selection of tasks at the border of their competencies	100% 80% 60% 40% 20% 0%	Selection of tasks well within their comfort zone
Initiation of action when given the opportunity	100% 80% 60% 40% 20% 0%	Passivity, lack of initiative
Exertion of effort and concentration	100% 80% 60% 40% 20% 0%	Laziness, distraction

20. **How was technology used in this classroom?** (RAT framework; Hughes, et al., 2006; Adapted from Wilder Research's Technology Integration Observation Protocol, Maxfield, Huynh, & Mueller, 2011)

(CHECK ALL THAT APPLY and type a brief description in the corresponding text box)

__ **Replacement.** "Technology used to replace and in no way change established instructional practices, student learning processes, or content goals. The technology serves merely as a different means to the same instructional end. Most of the learning activities might be done as well or better without technology." (*Example:* Using an interactive whiteboard for the same purposes as a chalkboard)

Notes:

__ **Amplification.** "Technology used to amplify current instructional practices, student learning, or content goals, oftentimes resulting in increased efficiency and productivity. The focus is effectiveness or streamlining, not fundamental change." (*Example:* Using a word processor rather than written materials for instructional preparation)

Notes:

__ **Transformation.** "Technology used to transform the instructional method, the students' learning processes, and/or the actual subject matter. Technology is not merely a tool, but rather an instrument of mentality. The focus is fundamental change, redefining the possibilities of education. Most technology uses represent learning activities that could not otherwise be easily done." (*Example:* Using Google drive or any cloud based applications for student collaboration on a project.)

Notes:

21. Classroom Agenda:

22. Other comments regarding teacher (e.g., demeanor, comfort with technology, interactions with students):

23. Other comments regarding students (e.g., comfort with technology, peer interactions):

24. Other comments regarding learning environment:

APPENDIX C

FOCUS GROUP QUESTIONS

The following list of questions was used as an outline for the focus group questions. Where appropriate, the interviewees may be asked to expand upon their answers.

1. Describe for me your biggest weakness when it comes to technology usage.
2. Describe for me your biggest weakness when it comes to technology usage.
3. How do your strengths and weaknesses affect technology integration in your classroom?
4. What is one technology related skill you wish you were more proficient at?
5. What barriers do you experience that prevent you from integrating technology more rigorously?
6. What has been done to address these barriers?
7. How do these barriers interfere with your ability to integrate technology and has anything been done to address the barriers?
8. Tell me about a shining moment in your classroom with your students involving technology.
9. What is your goal or next steps for increasing technology integration in your classroom?
10. What kind of support would you like to have to make these goals a reality?
11. What technology do you lean on the most?

Questions will also reference observations of classroom technology integration to further clarify intentions, expectations, and observed behaviors.

APPENDIX D

LOOKING FOR TECHNOLOGY INTEGRATION

Table D.1 LoFTI Observation Data

LoFTI Observation Tool				
Grade Level				***n***
6th Grade				19
7th Grade				7
8th grade				10
Total Observations				*36*
What track is this class?				***n***
Special Education				0
Remedial				0
General Education				27
Honors				9
Advanced Placement				0
Other				0
Is technology in use?				***n***
Yes				33
No				3
How many students are in class?				
M	*SD*	*min*	*max*	*R*
17.69	5.99	7	28	21
How many students are using technology?				
M	*SD*	*min*	*max*	*R*
9.25	9.84	0	28	28
Student Arrangement:				***n***
Tables/Centers/Pods				24
Circle or U				0
Cubicles				0
Rows				12
Other				0
Learning Environment				***n***
Auditorium				0

Cafeteria	0
Classroom	36
Gymnasium	0
Lab	0
Media Center	0
Multi-Purpose Room	0
Outside	0
Virtual Environment	0
Other	0
Student Grouping	***n***
Independent Work	20
Learning Center	0
Pairs	4
Small Groups	1
Whole Groups	9
Workshops	1
Other	1
Instructional Collaborators	***n***
Administrator	0
Assistant	0
Curriculum Specialist	0
Medial Coordinator	0
Other Teacher	1
Outside Consultant	0
Special Education Teacher	0
Student	0
Technology Facilitator/Coach	0
Volunteer	0
None	35
Other	0
Core Subject	***n***
Arts	0
Career/Technical	0
Computer/Technology Skills	0
English/Language Arts	9
English as Second Language	0
Guidance	0
Health	0

Physical Education	0
Library/Media Skills	0
Mathematics	9
Foreign Languages	0
Science	6
Social Studies	12
Other	0
Technology Activities (Teacher)	***n***
Activating Prior Knowledge	7
Assessments	11
Cues, Questions, and Advanced Organizers	16
Demonstration	4
Differentiated Instruction	0
Facilitation (guidance)	8
Lecture	8
Providing Feedback	4
Questioning	4
Reinforcing/Recognition	7
Scaffolding	2
Setting Objectives	5
Summarizing	0
Other	5
Assessment Methods	***n***
Oral Response	1
Product (e.g. project with rubric)	2
Performance (e.g. presentation, demonstration)	2
Selected Response	14
Written Response	6
Other	16

Technology is being used as a tool for…	**Student** ***n***	**Teacher** ***n***
Problem Solving (e.g. graphing, decision support, design)	2	1
Communication (e.g. document preparation, email, presentation, web development)	5	19
Information Processing (e.g. data manipulation, writing, data tables)	6	2
Research (e.g. collecting information or data)	6	0
Personal Development (e.g. e-learning, time management, calendar)	4	0
Group Productivity/Cooperative Learning (e.g. collab., planning, doc sharing)	4	1
Formative Assessment	6	1

Summative Assessment	9	0
Brainstorming	0	0
Computer-Assisted Instruction	3	0
Face to Face Classroom Discussion	0	6
Face to Face Group Instruction	1	1
Asynchronous Discussion	0	0
Drill and Practice	3	2
Generating and Testing Hypotheses	0	0
Identifying Similarities and Differences	2	1
Project-Based Learning	5	1
Recitation	0	0
Summarizing and Notetaking	2	7
Technology hardware is in use by…	**Student** ***n***	**Teacher** ***n***
Assistive Technology	0	0
Audio (e.g. speakers, microphone)	0	5
Art/Music (e.g. drawing tablet, musical keyboard)	0	0
Imaging (e.g. camcorder, film or digital camera, doc camera, scanner)	0	2
Display (e.g. digital projector, digital white board, TV, TV-link, printer)	3	30
Media Storage/Retrieval (e.g. print material, DVD, VCR, external storage devices)	0	0
Math/Science/Technical (e.g. GPS, probeware, calculator, video microscope)	6	0
Desktop Computer	0	31
Laptop Computer (including tablets)	19	2
Other	0	0
Technology software is used by…	**Student** ***n***	**Teacher** ***n***
Administrative (e.g. grading, record-keeping)	0	17
Assessment/Testing	12	5
Assistive (e.g. screen reader)	0	0
Computer Assisted-Instruction/Integrated Learning System	3	0
Thinking Tools (e.g. visual organizer, simulation, modeling, problem-solving)	8	4
Hardware-Embedded (e.g. digital white board, GPS/GIS, digital interactive response system)	0	1
Multimedia (e.g. digital video editing)	1	0
Productivity Software (e.g. database, presentation, spreadsheet, word processing)	7	22
Programming or Web Scripting (e.g. Javascript, PHO, Visual Basic)	0	0
Graphics/Publishing (e.g. page layout, drawing/painting, CAD, photo editing, web publishing)	0	1
Subject-Specific Software	8	2

Web Browser (e.g. MS Internet Explorer, Netscape, Firefox)	15	16
Web Applications		
Course Management Software (DyKnow, etc.)	0	0
Database Systems	0	0
Discussion Boards	0	0
Libraries, E-Publications	0	0
Search Engine	1	1
Video, Voice, or Real-Time Text Conference	0	0
Web Logs, Blogs	0	0
Web Mail	0	0
Wiki	0	0

Student engagement is shown by… (percentage)				
Sustained behavioral involvement				
M	*SD*	*min*	*max*	*R*
88	0.22	20	100	80
Positive emotional tone – cheerful, calm communicative				
M	*SD*	*min*	*max*	*R*
91	0.17	40	100	60
Selection of tasks at the border of their competencies				
M	*SD*	*min*	*max*	*R*
84	0.27	20	100	80
Initiation of action when given the opportunity				
M	*SD*	*min*	*max*	*R*
83	0.27	20	100	80
Exertion of effort and concentration				
M	*SD*	*min*	*max*	*R*
84	0.26	20	100	80

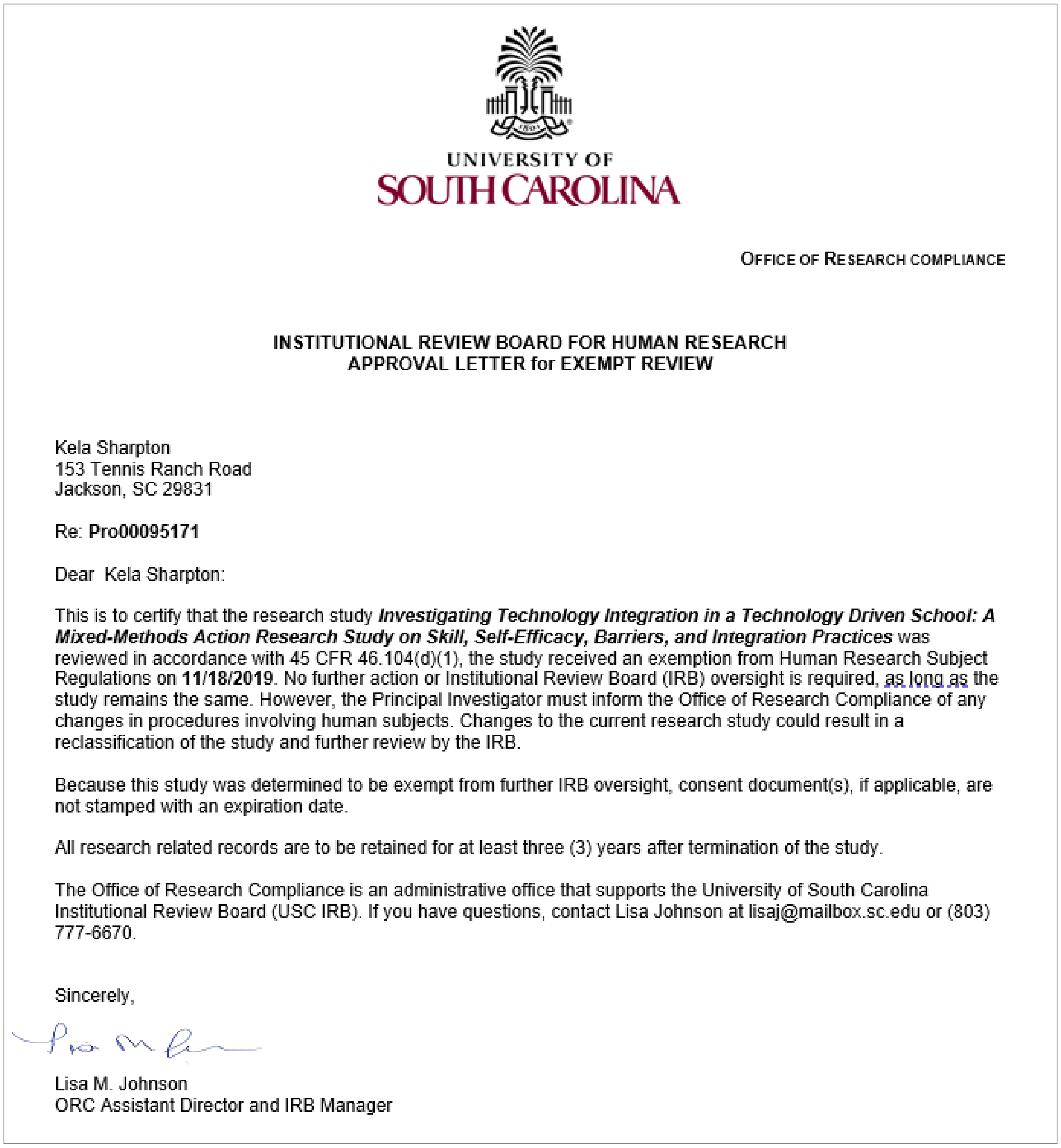
How was technology used in the classroom?	***n***
Replacement	13
Observer Notes (examples): Instructions given on white board Instructions given on smart board with projector Maps and notetaking using digital resources Taking assessment on laptop Class agenda displayed on projector Notetaking/reviewing notes before assessment Teacher lecture using digital PowerPoint Teacher using document camera to show textbook on projector	
Amplification	18

Observer Notes (examples): Quiz on Mastery Connect (auto-graded and loaded into PowerTeacher) USA TestPrep Assignments Gizmo formative assessment Students projecting laptop to project to give presentations Students collaborating across cloud-based word processing program to complete joint writing assignment Students using Study Island (auto-graded) Students completing district CFA with document sharing and collaboration Students completing research for writing assignments Teacher presenting PowerPoint while students take digital notes on 1:1 devices and use internet to research questions raised during instruction YouTube videos used to enhance instruction Edmentum diagnostic software (adjusts to student performance)	
Transformation	2
Observer Notes (examples): Students are using laptops and internet/Office 365 to research and create lessons collaboratively that will be presented to the group Students in pairs are writing and defending arguments using online document collaboration rather than working side by side	
Classroom Agenda	
Observer Notes (examples): Worksheets and workbooks Teacher prepping students before written exam Independent reading Notetaking, lecture Computer based summative assessment Student created content lessons Drill and practice worksheets Youtube video and then using playdoh to make 3D shapes than be cut along lines Intermittent internet outages during lessons Research for writing projects PowerPoint lecture with student-created foldables	
Other comments regarding teacher **(e.g. demeanor, comfort with technology, interactions with students)**	
Observer Notes (examples): Teacher comfortable with technology/software Teacher skill with minimum like word document is limited Teacher well-versed in Mastery Connect Teacher comfortable with 1:1 and providing 100% digital instruction Teacher innovative in continuing lesson without internet	

Teacher well-planned collaborative activities and is comfortable with paperless classroom
Teacher’s use of technology shows limited skill level
Teacher uncomfortable with and level of technology and dealing with barriers
Teacher does not have a backup when technology fails
Teacher comfortable with 1:1 but integration is at low level
Teacher demonstrated well planned lesson enhanced by technology
Teacher has developed several examples of transformation technology usage, more so than other teachers
Teacher has zero confidence with technology for CFAs even though there have been multiple administrations and require the use of two applications the teacher should be able to experience success with
Teacher seems to miss opportunities to add in tech transformation with the tech available in the classroom
Teacher has mastered the use of online assessments to streamline grading

APPENDIX E

IRB AND DISTRICT APPROVALS



UNIVERSITY OF
SOUTH CAROLINA

OFFICE OF RESEARCH COMPLIANCE

**INSTITUTIONAL REVIEW BOARD FOR HUMAN RESEARCH
APPROVAL LETTER for EXEMPT REVIEW**

Kela Sharpton
153 Tennis Ranch Road
Jackson, SC 29831

Re: **Pro00095171**

Dear Kela Sharpton:

This is to certify that the research study ***Investigating Technology Integration in a Technology Driven School: A Mixed-Methods Action Research Study on Skill, Self-Efficacy, Barriers, and Integration Practices*** was reviewed in accordance with 45 CFR 46.104(d)(1), the study received an exemption from Human Research Subject Regulations on **11/18/2019**. No further action or Institutional Review Board (IRB) oversight is required, as long as the study remains the same. However, the Principal Investigator must inform the Office of Research Compliance of any changes in procedures involving human subjects. Changes to the current research study could result in a reclassification of the study and further review by the IRB.

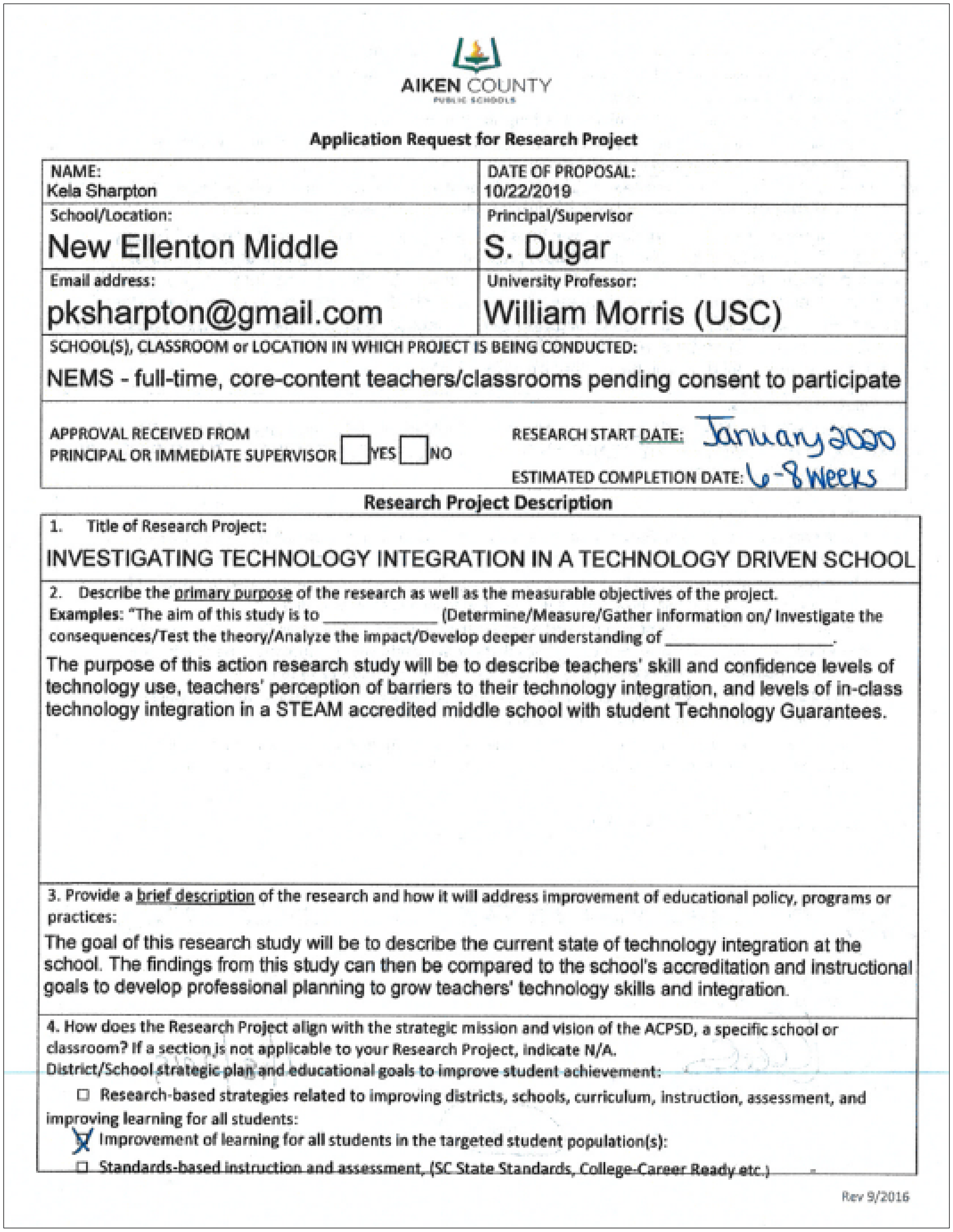
Because this study was determined to be exempt from further IRB oversight, consent document(s), if applicable, are not stamped with an expiration date.

All research related records are to be retained for at least three (3) years after termination of the study.

The Office of Research Compliance is an administrative office that supports the University of South Carolina Institutional Review Board (USC IRB). If you have questions, contact Lisa Johnson at lisaj@mailbox.sc.edu or (803) 777-6670.

Sincerely,

Lisa M. Johnson
ORC Assistant Director and IRB Manager



AIKEN COUNTY
PUBLIC SCHOOLS

Application Request for Research Project

NAME:
Kela Sharpton

DATE OF PROPOSAL:
10/22/2019

School/Location:
New Ellenton Middle

Principal/Supervisor
S. Dugar

Email address:
pksharpton@gmail.com

University Professor:
William Morris (USC)

SCHOOL(S), CLASSROOM or LOCATION IN WHICH PROJECT IS BEING CONDUCTED:
NEMS - full-time, core-content teachers/classrooms pending consent to participate

APPROVAL RECEIVED FROM PRINCIPAL OR IMMEDIATE SUPERVISOR ☐ YES ☐ NO

RESEARCH START DATE: January 2020

ESTIMATED COMPLETION DATE: 6-8 weeks

Research Project Description

1. Title of Research Project:

INVESTIGATING TECHNOLOGY INTEGRATION IN A TECHNOLOGY DRIVEN SCHOOL

2. Describe the primary purpose of the research as well as the measurable objectives of the project.
Examples: "The aim of this study is to ____________ (Determine/Measure/Gather information on/ Investigate the consequences/Test the theory/Analyze the impact/Develop deeper understanding of ________________.

The purpose of this action research study will be to describe teachers' skill and confidence levels of technology use, teachers' perception of barriers to their technology integration, and levels of in-class technology integration in a STEAM accredited middle school with student Technology Guarantees.

3. Provide a brief description of the research and how it will address improvement of educational policy, programs or practices:

The goal of this research study will be to describe the current state of technology integration at the school. The findings from this study can then be compared to the school's accreditation and instructional goals to develop professional planning to grow teachers' technology skills and integration.

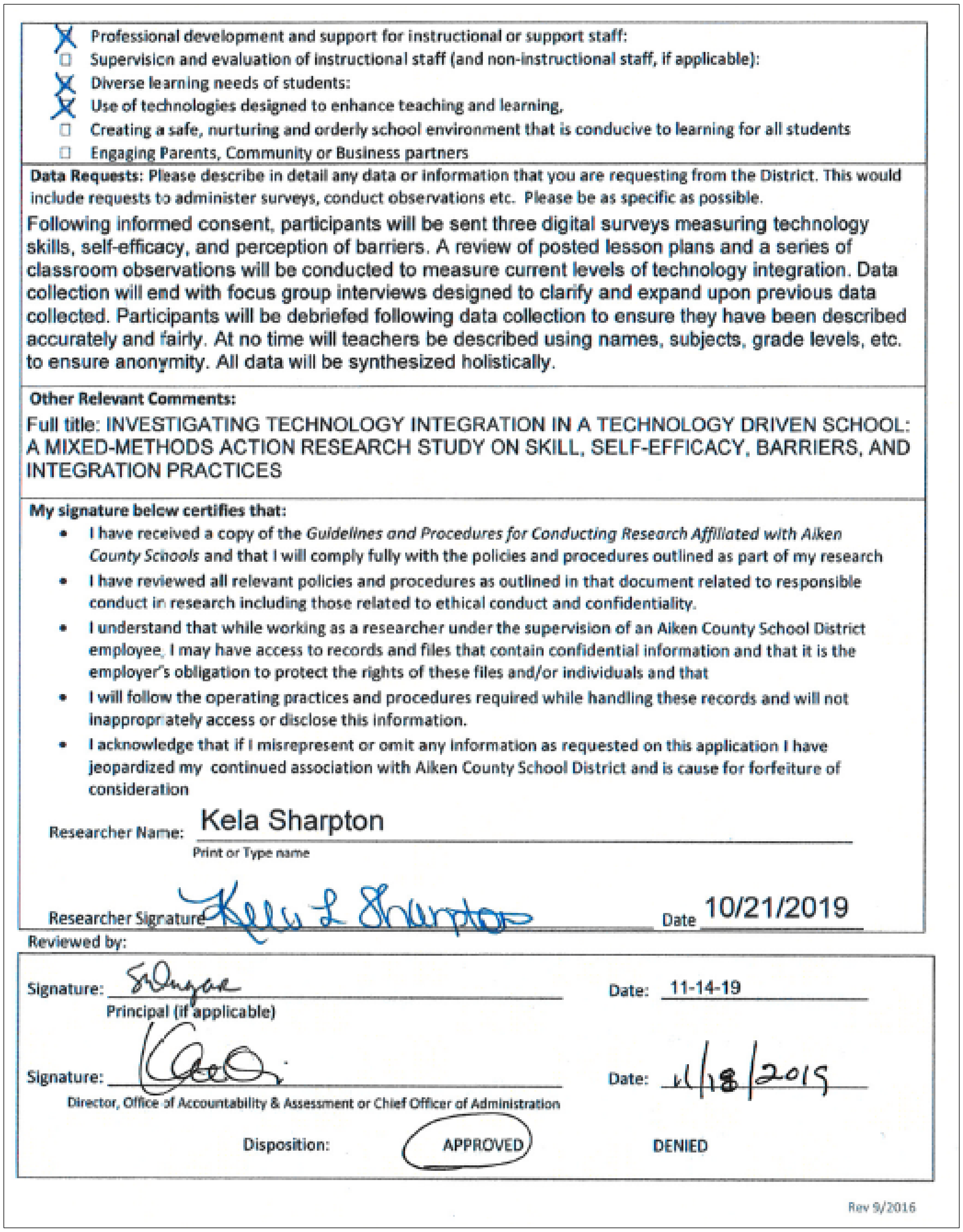
4. How does the Research Project align with the strategic mission and vision of the ACPSD, a specific school or classroom? If a section is not applicable to your Research Project, indicate N/A.
District/School strategic plan and educational goals to improve student achievement:

☐ Research-based strategies related to improving districts, schools, curriculum, instruction, assessment, and improving learning for all students:

☒ Improvement of learning for all students in the targeted student population(s):

☐ Standards-based instruction and assessment, (SC State Standards, College-Career Ready etc.)

Rev 9/2016



- ☒ Professional development and support for instructional or support staff:
- ☐ Supervision and evaluation of instructional staff (and non-instructional staff, if applicable):
- ☒ Diverse learning needs of students:
- ☒ Use of technologies designed to enhance teaching and learning,
- ☐ Creating a safe, nurturing and orderly school environment that is conducive to learning for all students
- ☐ Engaging Parents, Community or Business partners

Data Requests: Please describe in detail any data or information that you are requesting from the District. This would include requests to administer surveys, conduct observations etc. Please be as specific as possible.

Following informed consent, participants will be sent three digital surveys measuring technology skills, self-efficacy, and perception of barriers. A review of posted lesson plans and a series of classroom observations will be conducted to measure current levels of technology integration. Data collection will end with focus group interviews designed to clarify and expand upon previous data collected. Participants will be debriefed following data collection to ensure they have been described accurately and fairly. At no time will teachers be described using names, subjects, grade levels, etc. to ensure anonymity. All data will be synthesized holistically.

Other Relevant Comments:

Full title: INVESTIGATING TECHNOLOGY INTEGRATION IN A TECHNOLOGY DRIVEN SCHOOL: A MIXED-METHODS ACTION RESEARCH STUDY ON SKILL, SELF-EFFICACY, BARRIERS, AND INTEGRATION PRACTICES

My signature below certifies that:

- I have received a copy of the *Guidelines and Procedures for Conducting Research Affiliated with Aiken County Schools* and that I will comply fully with the policies and procedures outlined as part of my research
- I have reviewed all relevant policies and procedures as outlined in that document related to responsible conduct in research including those related to ethical conduct and confidentiality.
- I understand that while working as a researcher under the supervision of an Aiken County School District employee, I may have access to records and files that contain confidential information and that it is the employer's obligation to protect the rights of these files and/or individuals and that
- I will follow the operating practices and procedures required while handling these records and will not inappropriately access or disclose this information.
- I acknowledge that if I misrepresent or omit any information as requested on this application I have jeopardized my continued association with Aiken County School District and is cause for forfeiture of consideration

Researcher Name: Kela Sharpton
Print or Type name

Researcher Signature Kela L Sharpton Date 10/21/2019

Reviewed by:

Signature: Date: 11-14-19
Principal (if applicable)

Signature: Date: 11/18/2019
Director, Office of Accountability & Assessment or Chief Officer of Administration

Disposition: [✓ APPROVED] DENIED

Rev 9/2016