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Middle School Teachers' Technology Integration

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Walden University
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Abstract

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Andrea Fox

MA, University of North Dakota, 2012

BS, Minnesota State University Moorhead, 2005

Doctoral Study Submitted in Partial Fulfillment

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Abstract

Although school districts have invested heavily in technology for teachers and students, the problem of inconsistent technology integration permeated a local school district. To create a 21st century learning environment, teachers must integrate technology with curriculum and evidence-based teaching practices. The purpose of this case study was to investigate middle school teachers' technology integration in a suburban school district in North Dakota, Midwest Public Schools (pseudonym). Technological Pedagogical Content Knowledge (TPACK) was used as a conceptual framework to guide the study. This study focused on exploration of current teacher practice in regard to technology integration and the perceived support they currently receive. A case study research design was used, and data collection included interviews and classroom observations of 10 middle school teachers to determine current technology integration practices and explore the barriers for integration and teachers' perceived support in this endeavor. Participants were chosen based on content area, grade level, and years of experience. Data was analyzed using thematic and open coding based on the TPACK framework constructs. Teachers used technology in their instruction at varying levels. Overall, the case showed a strong indication of TCK and lower results in student technology use. The results provided information for administrators in the district regarding additional training for teachers based on their current technology integration and perceived barriers of implementation in the classroom. Social change implications for this study involve an increased awareness of technology integration for teachers and administrators. Classroom teachers in this local district as well as districts across the nation could benefit from improved practice using technology to be able to learn and work in the complex school and work environments.

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Section 1: The Problem

Background

The goal of public education in the United States is to prepare students to be active and knowledgeable citizens, and while that goal has not changed, students' needs have changed since the 1990's largely because of technology (Gentry, Baker, Thomas, Whitfield, & Garcia, 2014; Kivunja, 2015). To be successful in college and careers in a global economy, students need 21st century skills, including career, innovation, and technology skills (Partnership for 21st Century Skills [P21], 2009). This has led to organizations such as P21 to identify a framework of skills students need to be successful; these skills include core subject areas of math and reading as well as additional knowledge and skills such as global awareness, innovation, and information, media, and technology skills (P21, 2011). Teachers seek to meet those needs but need support to do so. The P21 Framework for 21st Century Learning is a representation of student outcomes as well as support systems necessary for educators to make this dynamic change (P21, 2011). A local district has used the P21 framework as a basis for professional development decisions while working on the district's strategic plan. The P21 framework indicates that technology skills are an important part of 21st century education.

Student success for the future must include digital competencies because of the dynamics of the Information Age and a new learning paradigm of 21st century skills (Kivunja, 2015). If teachers want to meet the needs of their students, they must not use outdated methods as they were taught but rather digital tools embedded in the teaching

and curriculum. In using technology tools properly, students can construct academic knowledge in a way they find more natural (Kivunja, 2014b). As technology continues to change and evolve, educators acknowledge how it can transform instruction. Information and communication technology are necessary for 21st century skills and education (Voogt, Knezek, Cox, Knezek, & ten Brummelhuis, 2013). Teachers need to use technology so students will be engaged in classroom learning, critical thinkers, and ready for their future careers (Kivunja, 2014a).

To meet the increasing need of more technology in classrooms, several states have implemented 1:1 computer initiatives where each student has a computer or tablet device (Spires, Oliver, & Corn, 2011; Weston & Bain, 2010). Teachers who use technology in their classroom instruction often see the benefits for student learning. The use of technology in daily life in classrooms can support various functions of learning: knowledge construction, knowledge exploration, learning by doing, cooperative learning, and reflective learning (Xu & Chen, 2016). Students learning with technology also show greater motivation to complete tasks and express meaningful learning through real world applications (Marwan, 2015). Technology integration is crucial to middle school classrooms to provide a 21st century environment.

However, technology itself does not transform education and will not, on its own, produce the desired outcomes. Despite widespread funding for technological additions such as 1:1 initiatives, many districts across the United States did not see the desired outcome of increased student achievement; failures to meet the desired outcomes are due to the many barriers in technology integration (Gentry et al., 2014). Because of some

large-scale initiatives failing, there has been a greater focus on how districts implement such initiatives including a review of curriculum and teacher training (Blume, 2015). Perhaps the most notable of these failures is the LA County iPad debacle. One of the largest school districts in the United States, Los Angeles Unified School District, initiated 1:1 technology with iPads for every student, spending over $1 billion, but the students and teachers did not use the devices or curriculum associated with them (Blume, 2015). Spires et al. (2011) reported teacher pedagogy as the most critical component to one-to-one initiatives, and a North Carolina district saw sporadic gains in achievement because teachers integrated technology differently based on time restraints. This problem also persists abroad; large-scale computer initiatives had little influence on teacher practice (Donnelly, McGarr, & O'Reilly, 2011). It is not enough just to provide more technology to teachers and students; rather, it is necessary to help teachers understand how to implement the technology into the curriculum.

For this study, I focused on technology integration in classrooms, or the ways in which teachers embed technology in their instructional practices. Cullen and Greene (2011) defined technology integration as "the use of technology in a teacher's regular teaching and curricular plans" (p. 30). The National Center for Education Statistics (NCES, n.d.) defined and evaluated technology integration as "the incorporation of technology into instruction's major components: curriculum standards, practices, and student assessment" (para x).

The shift to a more student-centered classroom to incorporate teaching and learning of 21st century skills requires technology integration. Teacher instruction is an

important variable in order for desired outcomes to occur with technology integration (Hsu, 2010; Matherson, Wilson, & Wright, 2014). Teachers need technology integration skills, convergence of instructional strategies, and content in order to teach effectively (Matherson et al., 2014). Therefore, increasing the number of computers for student use does not necessarily change instruction if the teachers do not pair that increase in technology with a shift in pedagogical belief and practices (Ertmer, Ottenbreit-Leftwich, Sadik, Sendurur, & Sendurur, 2012). Furthermore, technology integration suggests teachers should help students use their tools within the learning process rather than students using technology to learn from as has been in the past (Wilson & Alaniz, 2015). For example, rather than simply using computers to play a game of subtraction, students can create representations of word problems and share with a teacher or a peer. Administrators and other stakeholders in education are looking to see changes in instruction because of the vast amount of time and resources they are investing in technology initiatives (Weston & Bain, 2010).

An important contribution to the study of technology integration is Ruben Puentedura's SAMR (substitution, augmentation, modification, and redefinition) model. Puentedura (2013) revealed four different levels of technology integration: substitution, augmentation, modification, and redefinition. Higher levels of technology integration, such as modification and redefinition, can produce more effective levels of engagement and student learning (Puentedura, 2013). During the substitution and augmentation phases, there is no transformation of learning; this is seen for example when students are taking notes online, or teachers are using an interactive whiteboard for a presentation.

During the modification and redefinition stages, the teacher changes the tasks and learning opportunities, so students can explore concepts in ways that they could not before. Modification means that teachers are using technology in a way that redefines the instructional task; redefinition means that students and teachers can do things with technology that were previously not possible (Puentedura, 2013). An example of modification is teachers using simulations of science concepts online. An example of redefinition is asking students to create their own video games with an app and share their creations with others. This model will give the reader insight into the local problem, as the district being studied used the SAMR model both to train teachers about technology integration and to evaluate technology integration practices through observations.

The Local Problem

The problem of inconsistent technology integration, teachers using technology strictly in a substitution phase instead of to transform students' learning experiences, permeated a local school district. School leaders consider technology use to be an essential part of modern schools and 21st century classrooms. Yet, after over more than 20 years of computer use in classrooms, many teachers still have not mastered purposeful technology integration to meet student needs (Ertmer & Ottenbreit-Leftwich, 2013). Teachers represent varying degrees of technology use in their instruction (O'Reilly, 2016), which may account for some of the disparity in student achievement results. Also, teachers' beliefs and attitudes regarding technology compound the issue of technology used in instruction, as Hampel and Stickler (2015) showed that teachers who believe in

the use of technology tend to use it more effectively than teachers who do not believe in its importance. Although there has been an increase in computer use in schools, the use is often surface level and not embedded in student learning (Webb, 2013).

Midwest Public Schools (pseudonym) is the focus of this study. Like other schools across the nation, Midwest Public Schools wanted to provide the tools that students need to be successful in a job, the military, or college; Goal 1 of the Midwest Public School District's strategic plan states the need for 21st century skills and academic proficiency. In order to meet the needs of a 21st century classroom, the school district invested in HP tablets for all sixth, seventh, and eighth grade students. The 21 with 21 initiative was intended to meet Goal 1 of the strategic plan, specifically to "create a 21st century learning experience for all students that supports their academic literacy as well as prepares them for college, career, and life". Administrators at Midwest Public Schools evaluated the problem, which was teachers using technology as mere substitution, and identified a gap in practice through a post-training survey and administrative walkthroughs for teacher evaluations. The administrators based their observations on Puentedura's SAMR model. The substitution phase of the SAMR model involves no change in pedagogy with regard to technology use and is the lowest level of technology integration according to the SAMR model. As seen in administrative observations, students and teachers were using technology as a substitute without any change in function or application, for example, students were typing documents with Microsoft Word but were not asked to do activities that could fundamentally change their learning. In order to focus on the 4 C's (collaboration, creativity, critical thinking, and

communication) and transform classroom instruction, teachers must move beyond a basic substitution model of technology integration.

After initial technology training of sixth grade teachers, the assistant superintendent of secondary schools discussed his experiences regarding conducting walkthroughs. He said the teachers are definitely using the technology provided by the district (HP laptops, Schoology learning management system, and ActivBoards) in their instruction, but the district wants them to begin to use computers to get kids to do the creative and collaborative things like creating books and videos; right now many of them are just in the substitution phase of technology integration. An assistant principal in one middle school also noted lack of proper integration with the HP tablets. He said that he saw students using computers often, but there did not seem to be a transformation of practice as he anticipated with the introduction of the 1:1 initiative. His observations were supported by the teachers' own perceptions of their technology integration.

In April 2016, Midwest Public Schools conducted a post-training survey in order to gauge teacher knowledge, use, and shift in pedagogy after one year of the 1:1 initiative. Of the 25 teachers who completed the survey, 36% believed they were still in the substitution and modification stages of technology integration, and 28% did not know. Teachers at the site of this study also administered an online survey to students in December of 2015. According to the 2016 survey from Midwest Public Schools, 82% of students said they could log in to Office 365, and 61% said they could create a Word document, but only 29% said they could collaborate with peers on classroom assignments. The survey results supported the notion that the majority of teachers and

students were using technology in a substitution phase only; their instruction had changed very little.

Rationale

The purpose of this study was to examine middle school teachers' technology integration and the barriers they may need to overcome to develop those skills. This was especially important since technology integration is an essential part of a 21st century classroom because it allows student to practice skills such as flexibility, adaptability, and multi-tasking (Kivunja, 2015), and educators seek to help their students use technology in more powerful ways to support higher-order thinking (Marcovitz & Janiszewski, 2015). Technology by itself may not increase student learning; however, when teachers and students use technology within the learning process, the classroom becomes more student-centered, with greater opportunities for collaboration, self-assessment, and self-directed learning (Tucker, 2014). There is need for increased understanding of the barriers that teachers face in their pursuit of technology integration.

While many quantitative studies have been conducted to focus on the causal relationship between technology and student achievement (see Schacter & Fagnano, 1999; Schroeder, Scott, Tolson, Huang, & Lee, 2007; Wurst, Smarkola, & Gaffney, 2008), the goal of this study was to determine the needs of middle school teachers who must change their instructional practices to include more technology integration. In this study, I explored the nuances of a particular setting and group of teachers to understand what support teachers need in order to change their pedagogy.

Definition of Terms

One-to-one (1:1) computing: The ideal ratio of technology access (computers or other devices) to students (Bebell & O'Dwer (2010).

Pedagogy: The theory of teaching, which includes theory and practice of teaching (Webb, 2013).

STEM: the collective skills of science, technology, engineering, and math (U.S. Department of Education, n.d.).

Substitution: the lowest form of technology integration according to the SAMR model; there is no change in the instructional task despite the use of technology (Puentedura, 2013).

Technology integration: The inclusion of technology into curriculum, instructional practices, and assessment (NCES, n.d.).

Significance of the Study

This study was significant to teachers and educational leaders at the local level. The results provided insight regarding teachers' current technology integration habits and perceived barriers of implementation through interviews. The results of observations and interviews indicated a need for changes in professional development opportunities and other support for teachers to improve their technology integration practices. The results were useful for district and school administrators to plan for future trainings for teachers. Because educational change is based on teacher input (Donnelly et al., 2011), the results also positively affected the culture in the two middle schools in the study. As Hampel and Stickler (2015) found, teachers' attitudes regarding technology integration in the

classroom affects their actual use. Therefore, understanding current attitudes and use provided a starting point for future conversations regarding training and support.

Research Questions

The study district has two middle school buildings which implemented a computer initiative; all students in grades six, seven, and eight received a computer for educational purposes. There are plans to move the initiative to the high schools as well. The goal of the 21 with 21 project was to create 21st century classrooms so that students are college, career, and military ready. Teachers and students received training and information regarding the initiative, and the goal of this study was to determine how teachers implemented technology in their instructional practice. I sought to understand whether teachers feel supported regarding the implementation of technology. Specifically, this study aimed to explore the following research questions:

RQ1: To what extent do teachers implement technology in the classroom?

RQ2: To what extent do teachers feel supported to implement technology in the classroom?

Review of the Literature

The purpose of this section is to provide a review of relevant literature. I divided the literature review into several sections. The first section documents changes in pedagogy to a more student-centered classroom, which has happened over the last 25 years with regard to technology integration. The second section explores instructional models for studying and applying technology integration. The third section examines current barriers to technology use in the classroom with a focus on teacher beliefs.

Finally, the fourth section incorporates current technology-centered professional development models into teacher training. A review of the literature on teacher technology integration provides insight regarding the topic and research questions for this study.

Search Strategy

I focused the literature review on technology integration and teachers' technology use in the classroom. A review of the literature was conducted using several databases, including Academic Search Complete, Education Source, Educational Resources Information Center (ERIC), Google Scholar, LearnTechLib, SAGE Journals, and Science Direct. Search terms were *technology integration, technology integration, barriers of technology integration, technology in the classroom, technology in instruction, teacher motivation, TPACK,* and *21st century classrooms*.

Conceptual Framework

Technological pedagogical content knowledge (TPCK, later changed to TPACK) is crucial to understanding technology integration and will be the conceptual framework for this study. In doing so, the authors of the theory investigated prior research of instructional practices, which focused solely on content knowledge, then moved to content knowledge (CK) and pedagogy. CK is knowledge related to the field of study, concepts, theories, and the practices and approaches necessary to teach those concepts and theories (Shulman, 1986). For example, a science teacher would have to know the scientific method and how to teach that to students. Shulman (1986) suggested that teachers could not separate the two concepts of content and pedagogy without detriment

to instruction. In other words, teachers should not teach math the same ways they teach science or social studies. Shulman (1987) identified pedagogical content knowledge as several ideas culminating into one: teaching strategies, educational principles including classroom management, content knowledge of facts, materials, texts, and how to represent concepts in visuals, and knowledge of learners. Pedagogical content knowledge (PCK) includes the conditions necessary to promote learning by using curriculum, assessment, and pedagogy; it involves making connections amongst content areas for deeper understanding and alternative ways to teach ideas (Koehler & Mishra, 2009).

Mishra and Koehler (2006) argued that new technologies have changed classroom instruction, affording new ways to represent and explain ideas. TPACK is a teacher's instruction utilizing content, teaching strategies, and technology skills all in harmony in the classroom (Mishra & Koehler, 2006). The TPACK model adds four more constructs to Shulman's ideas: technological knowledge (TK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and TPCK.

TK requires basic computer literacy but goes beyond those basics to include problem-solving, so that a person can accomplish many different tasks including communication and information processing (Koehler & Mishra, 2009). Technological content knowledge (TCK) is "understanding the impact of technology on the practices and knowledge of a given discipline" (Koehler & Mishra, 2009, p. 66). This type of knowledge is necessary to the innovation of fields, promoting new representations of ideas. Technology and content are reciprocally related, rather than technology as an add-on to instructional practice. TPK is the understanding of teaching and learning with

technology and how to use technology in a classroom setting in developmentally appropriate ways. This includes using discussion boards, communication tools, and record-keeping. TPACK or TPCK is the basis for all good teaching, as it combines content, pedagogy, and technology in a complex way, as each problem is unique in its context. As Koehler and Mishra (2009) explain, "Teaching successfully with technology requires continually creating, maintaining, and re-establishing a dynamic equilibrium between each component" (p. 68). The interaction of these ideas (Figure 1) creates effective teaching with technology.

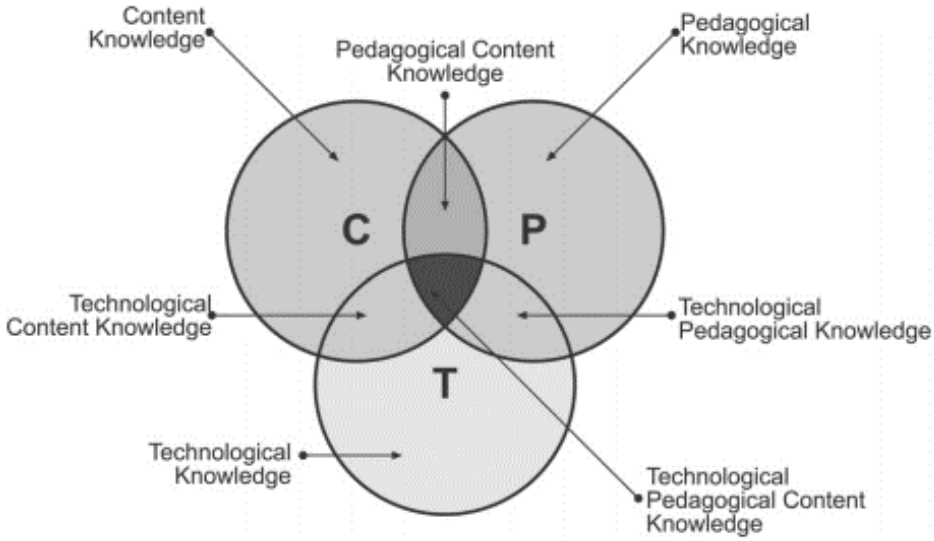

Figure 1. Pedagogical technological content knowledge. From "Tracing the Development of Teacher Knowledge in a Design Seminar: Integrating Content, Pedagogy, and Technology," by M.J. Koehler, P. Mishra, and K. Yahya, 2007, *Computers & Education, 49,* p.742. Copyright 2005 Elsevier Ltd. Reproduced with permission.

Researchers and practitioners must not view technology integration as a stand-alone element, but instead as the culmination of content, pedagogy, and technology. Koehler et al (2007) stated, "At the heart of TPACK is the dynamic, transactional relationship between content, pedagogy, and technology. Good teaching with technology requires understanding the mutually reinforcing relationships between all three elements taken together to develop appropriate, context-specific, strategies and representations" (p. 741). An example of a teacher using TPACK might be the use of an online simulation of a heart as a powerful tool to teach content, replacing a physical model or picture representation, and asking students to manipulate the blood flow or the heart's movements to analyze the results.

The four constructs of TPACK were used to analyze the results of this study. Those four constructs are: TK, TPK, TCK, and TPACK. This theory operationalizes the research questions by providing a lens through which teachers can view technology integration practices. Using the constructs, I categorized and named specific instructional practices in order to answer the research questions.

The interview questions were also guided by the elements of TPACK. For example, I asked teachers to discuss their TK and what knowledge and skills they had that enable them to use technology in the classroom. I also asked the teachers about their TPK, and how they used technology to enhance teaching strategies. Teachers discussed their TCK and knowledge and skills of using technology specific to their content area. Finally, teachers shared how they fuse technology, teaching strategies, and content to increase student learning.

Review of the Broader Problem

21st century learning. Children require different learning opportunities now than in the past because of technology; therefore, they must be taught differently (International Society for Technology in Education, n.d.; Kivunja, 2014b). Organizations such as International Society for Technology in Education (ISTE) and the NEA have noted the importance for students to experience a 21st century classroom in order to be competitive in the global market. In order to help schools and teachers meet that need, ISTE released the 2016 ISTE Standards for Students. The standards require students to use technology for their learning to seek feedback to improve learning and to curate information from a variety of sources (International Society for Technology in Education, n.d.). P21 also reported a shift in pedagogical thinking to include life and career skills, learning and innovation skills including the 4 C's, information, media, and technology skills (Kivunja, 2015).

Changes to include opportunities for the 4 C's and technology have great implications for the classroom. As pedagogy shifts, instruction becomes more student-centered, increasing chances for innovation and critical thinking (Kivunja, 2014a; Oluwatumbi, 2015). Teachers must be familiar with technology and use digital tools to help students find and evaluate information; this is a change from past models where the teacher has been the keeper of knowledge (Kivunja, 2014b). Once teachers are familiar with technology practices, they are able to create opportunities for students to use technology in authentic ways (Ertmer et al., 2012). Frequency of instructional technology and a pedagogy that aligns with 21st century learning are positively related to higher

student learning outcomes (Voogt et al., 2013). Furthermore, teachers must be reflective practitioners to determine what tools should be used given the purpose of the particular lesson; failure to do so could (Marcovitz & Janiszewski, 2015).

The role of the teacher has changed dramatically because of technology in the last 30 years, but not all teachers have harnessed the power of technology to produce student learning (Ertmer & Ottenbreit-Leftwich, 2013). Effective teachers have changed their instruction by moving from a teacher-centered to student-centered approach, as students require a more hands-on approach to learning (Ertmer et al., 2012). Ertmer et al. (2012) evaluated classroom practices of 12 award winning teachers and their beliefs regarding student-centered instruction; they discovered that teachers' beliefs play a major role in a teacher's ability to create a student-centered classroom with technology, despite the existence of first-order barriers. However, not all teachers share this pedagogical shift. Dawson (2012) revealed in a quantitative study of 350 Florida teachers that direct instruction was the primary instructional strategy reported in classroom technology activities, and 61% of the observed activities were whole class lessons rather than small group or student-centered lessons. Dawson's (2012) study indicated the teachers' use of lower level skills (drill and practice and rote memorization) rather than high-level thinking skills, although the frequency of complex activities was greater when compared to earlier studies.

As pedagogy changes to a more student-centered approach, the physical characteristics of the classroom also change. Instead of the traditional rows of students with the teacher at the front, the physical layout is different, with teachers organizing

desks and movable furniture into pods to allow for group work and collaboration; new configurations create more quality interactions between students and teachers and promote engagement (Chen, Leger, & Riel, 2016). Hampel and Stickler (2015) noted the need for a different type of pedagogy for online classes, as they experience teachers struggling to facilitate online classes, online lectures and learning activities through YouTube and learning management systems. Two rural districts in Idaho and Pennsylvania adopted a blended learning approach where students could access homework and other materials outside of school, increasing accountability and alleviating class time spent on missed instruction; these districts found their students accessed information from many different types of devices (computers, phones, and game consoles) all outside of school (McKnight et al., 2016). It is important for researchers to take note of teachers and districts who seem to be making gains with technology integration.

Instructional models for technology integration. There are several instructional models for technology integration. Marcovitz and Janiszewski (2015) said that no model is perfect when gauging technology integration, and leaders must always consider purpose of technology use in order to evaluate technology in schools. Therefore, with the purpose of using technology in classrooms being to create 21st century classroom environments, I considered these models. In the study of high school science teachers in Ireland, Donnelly et al. (2011) evaluated teachers' technology use based on four levels of technology integration: Contented Traditionalist, Selective Adopter, Inadvertent User, and Creative Adapter. This was a variation of Sorienta and Jimoyiannis' previous work to

identify teachers' technology use by placing them in one of three categories of teaching styles: traditional, non-traditional, and undecided teachers (Donnelly et al., 2011). Some high school science teachers, who were given a new online chemistry simulator, refused to use the tool because they perceived their original methods to be adequate; these teachers were considered Contented Traditionalists (Donnelly et al., 2011). The study indicates that teachers who only adopted the new technology tool if it benefited students and themselves in some way were called Selective Adopters; while teachers who had been forced, in some way by administration or policy, to use the new technology would be called Inadvertent User. Additionally, Creative Adapters are teachers who used the online simulator because they recognized the importance of a student-centered approach and considered the effect the online tool had on their students' learning experience (Donnelly et al., 2011).

McKnight et al. identified five roles that technology plays in enhancing teaching and learning in their study of 40 teachers across seven states (2016). The five roles included communication and information management, direct instruction, access and accommodations, collaboration, research, exploration, and creativity, and assessment and feedback. Their research indicates that when teachers are initially focused on an instructional model, such as project-based learning, they are able to understand the importance of the pedagogy instead of only considering the technology (McKnight et al., 2016). Another key finding of the study was that teachers could meet all students' learning needs with greater access to learning activities and tools; for example, students with special needs used specific software (e.g., translation software) to increase

participation, and some students were challenged through enrichment activities (McKnight et al., 2016).

Beriswill, Bracey, Sherman-Morris, Huang, and Lee (2016) studied the effect that technology training would have on participating teachers' TPACK skills. Teachers participated in a four-week training with two follow-up meetings. They participated in demonstration activities that integrated subject area content, pedagogies, and technology. After the completion of the training, they produced a written lesson plan. Analysis of the pre and post survey responses indicated growth of teachers' technology integration in many areas with the greatest improvements shown in TCK, TPCK, and TPK (Beriswill et al., 2016).

Barriers of technology integration. There are many barriers teachers may face when integrating technology. Past research shows a progression from a focus on *what* is being used (resources) to a focus on *how* technology is being used (instruction). Barriers to technology integration can be divided into two categories: those outside of teachers' control (first-order), and those within teachers; control (second-order) (Holland & Piper, 2014). Teachers identified lack of resources including limited hardware, access to devices, time, and support as first-order barriers. Second-order barriers are those internal to the user and include teacher beliefs about teaching with technology, outlook on changes, and educational philosophy (Holland & Piper, 2014). This section of the literature review focused on the barriers of technology resources and support, and teacher attitudes and beliefs.

Technology Resources and Support. In the last 10 years, school districts have

invested heavily in the first-order barriers to provide better access to internet, computing devices, and teacher training, and now teachers are reporting adequate access (Ertmer & Ottenbreit-Leftwich, 2013); yet, the problem of technology integration persists (Blackwell, Lauricella, Wartella, & Schomburg, 2014). Teachers mentioned support as a major barrier to technology integration, which came in many forms: lack of support from other faculty, lack of support from administration, lack of technical support, lack of just-in-time troubleshooting support, and lack of support for students (Reid, 2014).

Teachers required more support than the simple training on the basics of technology literacy skills; they required more pedagogy and guidance on how to integrate technology into their curriculum (Voogt et al., 2013). Through an educational summit including researchers, policymakers, and practitioners across the world, Voogt et al. (2013) studied the basic conditions which need to be present for technology to have a positive influence on teaching and learning. Their proposed Call to Action revealed key indicators that must be in place for us to see benefits from technology. Teachers need support to help keep up with the ever-changing needs of technology; this may include a coordinator who can identify and support the complexities of hardware and software needs. The research also suggests that leadership should be dispersed amongst many individuals, so teachers have a system of support to keep up to date on the newest hardware and software. Furthermore, support that is specifically focused on helping teachers understand how technology can improve student learning is necessary for successful technology integration (Blackwell, Lauricella, Wartella, & Schomburg, 2014).

Absence of teacher supports creates a barrier for technology use in teachers' instructional practice.

Policy. Schools also benefit from policy frameworks, which can create a path for curriculum, instruction, and assessment as it changes to support the goals of the district (Voogt, et al., 2013). Private and public partnerships benefit schools in that business can often provide additional resources for schools. Perhaps the greatest indicator is the need for continued program evaluation. Schools must monitor the effect that integration policies and initiatives have on instruction; "there is a need to have a set of indicators to provide a better insight of the impact of ICT [Information and Communications Technology] on education" (Voogt, et al., p. 7, 2013).

Li (2016) studied over 1,000 K-12, public school teachers after their participation in a statewide professional development program. The program was created to increase teachers' technology use in the classroom as well as students' internet use as a resource. A pre-survey indicated that male participants held more positive attitudes and confidence regarding their technology use in the classroom than their female counterparts. "Lack of knowledge and experience in using technology is one of the most common reasons reported by female teachers for their negative attitudes towards technology," (Li, 2016, p. 21). After the training, the post-survey indicated that female teachers' confidence rose statistically significantly, which closed the gap between the sexes. To ensure equality and effectiveness for future PD programs, the authors suggested further study into the needs of male and female teachers.

Teacher Attitudes and Beliefs. Access to technology and support has increased

over the last 10 years in the United Stated (Ertmer & Ottenbreit-Leftwich, 2013); yet, technology integration remains to be an issue. As Kim, Kim, Lee, Spector, and DeMeester (2013) noted, TPACK on its own cannot explain why teachers who have sufficient knowledge still may not integrate technology effectively. A mixed-methods study of 42 teachers over 4 years presented this phenomenon; all participating teachers received the same technology, the same professional development, and the same support, yet their integration levels differed (Kim et al., 2013). If more individualized supports are provided to teachers according to their beliefs, their levels of technology integration could improve (Kim et al., 2013, p. 84). This has definite consequences for professional development. When districts show teachers how technology can positively affect student learning, teachers' beliefs will change, and they will engage in higher levels of technology integration (Kim et al., 2013).

In their study of teacher beliefs and technology integration practices, Ertmer, Ottenbreit-Leftwich, Sakid, Sendurur, and Sendurur (2012) found that teachers who believed strongly that technology had a positive influence on student learning, had successful technology integration practices despite barriers of technology access. Ertmer and Ottenbreit-Leftwich (2013) reported internal barriers as the lowest impact, and attitudes and beliefs of *other* teachers as the highest impact in their technology integration. Research by Blackwell, Lauricella, Wartella, Robb, & Schomburg, (2013) showed similar results indicating that teachers experiencing first-order barriers, specifically lack of access, still reported high technology use in classroom instruction. This indicated that teachers who experience barriers to technology can find ways to

integrate effectively if they believe it to be of value. Ertmer et al. (2012) suggested a focus on changing teacher beliefs and practices to a more student-centered and problem-focused instruction, and using technology to facilitate that work, is necessary in helping teachers achieve technology integration.

Motivation. Motivation is a complex idea that affects all aspects of behavior and life. This is important as district leaders plan professional development and initiatives such as 1:1 technology programs. Daniels (2017) conducted a qualitative study of 32 middle school teachers to determine how those teachers could be supported, especially important since teachers' motivation is positively correlated with student achievement. Self-determination theory (SDT) suggests that when peoples' environments meet their needs for autonomy, competence, and relatedness, they will be motivated to exert effort or participate (Daniels, 2017).

Holland and Piper (2014) sought to make sense of the role that motivation plays in teachers' technology integration as well as creating a usable model to improve and study pre-service teachers' TPACK. Their model Technology Integration Education (TIE) identified eight antecedent constructs: values, beliefs, attitude, subjective norm, perceived behavioral control, and motivation; and four moderator constructs: goals, feedback, task value, self-regulation (Holland & Piper, 2014). The purpose for the inclusion of this model is to provide a broader look at teacher motivation and how it may relate to TPACK.

According to the self-determination theory, intrinsic motivation can promote action/behavior, and in their descriptive statistical research intrinsic motivation had the

highest mean for TPACK (Holland & Piper, 2014). In further research they found values, beliefs, attitude, subjective norm, perceived behavioral control, and motivation had a predictive form on intrinsic motivation and TPACK (Holland & Piper, 2016). Of the four moderator constructs (goals, feedback, task value, self-regulation) only goals had an explanation form on intrinsic motivation and TPACK. The findings from Holland and Piper (2016) could have great implications for future work with teachers and TPACK, implying that teachers' goals could have a direct effect on how teachers implement technology. Motivation plays a major role in teachers' willingness to change, and it is important to employ the ideas of self-determination theory as district leaders consider professional development.

Professional Development. People must feel compelled to exert energy to change; motivation is required for optimal learning situations (Daniels, 2017). For professional development to be successful, teachers need autonomy in their learning, opportunities to feel competent in the learning, and relatedness to their classrooms (Deci, 2009). Teacher motivation and adult learning theory are important concepts related to professional development and technology as it is used in instruction.

Technology is unique in that it can play many roles in planning professional development. Technology can be a vehicle utilized to reach different teacher populations (different space as well as time), through virtual online sessions or asynchronous activities (Wade, Bohac, & Platt, 2013). Technology can also be the focus of professional development, since teachers must first learn how specific technology works before applying it in their classrooms. Ertmer and Ottenbreit-Leftwich (2013) argue teachers

must move beyond the basics of what technology can do to create authentic learning environments suitable for 21st century students. Using technology to meet students' needs and redefining what is possible is technology integration.

Professional development focused on technology integration skills requires specific considerations. As Yeh, Lin, Hsu, Wu, and Hwang (2014) found, teachers require training that is contextualized and dynamic to acquire skills that allow them to integrate the factors of technology, pedagogy, and content together. Matherson et al. (2014) found similar results reporting professional development which focused on technology use could increase teacher confidence; however, more professional development opportunities are needed for teachers to be able to blend content, learning strategies, and technology. Perhaps this has not been done with fidelity because of the differences among all teachers and contents.

Because teachers come to the table with a myriad of prerequisite skills and beliefs (O'Reilly, 2016), teachers need an approach that is more than one-size-fits-all professional development where technology is concerned, since technology is situated in the context of their classrooms (Angeli & Valanides, 2013). After ongoing support through various professional development opportunities, Chikasanda, Otrel-Cass, Williams, and Jones (2012) found that although teachers' technology knowledge and skills had improved, pedagogical skills still reflected a more traditional approach. Similarly, Pool, Reitsma, & Mentz (2013) found that school leaders must consider teachers' values and attitudes along with knowledge and skills in order to facilitate appropriate professional development for technology in the classroom.

Implications

In this study, I investigated middle school teachers' technology integration used for instruction; I also investigated the current barriers teachers faced and the supports and attitudes that enabled such integration to occur. This study may provide implications for this particular initiative. Results of this study may suggest changes in support and training opportunities for future iterations of this specific initiative. Although I focused on middle school teachers only, the results may also benefit other teachers in the district, as the district's strategic plan tasks all staff members to help prepare students to be college, career, and "choice ready" through 21st century teaching and learning as referred to in Midwestern School District's strategic plan. The research shared in this study can provide insight in how to use technology with instruction to promote collaboration, creativity, critical thinking, and communication

Furthermore, the results could help guide planning for professional development opportunities for all teachers in the district; they may also provide insight for future staffing decisions in the areas of technology support and instructional support. District leaders may have a better understanding of the status of their teachers' technology integration skills and the supports that are required in order to be successful. District leaders can plan professional development opportunities around necessary technology integration skills and supports. The results may also indicate the need for more staff, or better use of the current staff.

Summary

A case study was conducted to determine teachers' current technology integration and teachers' perceived level of support in that integration. I collected data from semi-structured teacher interviews and classroom observations. This provided insight into the current levels of technology integration defined by the constructs of the TPACK framework. Section 1 discussed the need for 21st century learning opportunities for students, which includes the use of technology by teachers and students. However, the local problem of teachers' lack of technology integration can be seen in districts across the world.

The literature review from Section 1 examined the complexity of technology integration. Prior research noted the necessity of technology in 21st century learning environments and the change from a teacher-centered to a more learner-centered approach. The conceptual framework of TPACK provided a lens through which researchers view teachers' technology integration to define and label the details of teachers' instructional decisions. The literature review also provided some context of possible barriers that teachers face in their use of technology and showed the importance of teachers' attitudes and beliefs in the success of an initiative.

Section 2 provides a methodology of the case study research approach. Qualitative data was gathered in the form of semi-structured interviews with teachers as well as observational data from classroom instruction. The interview questions were designed to answer the research questions with the TPACK framework as their basis. The interviews gave teacher voice to the data, as they indicated their own views and

experiences of their current technology integration and barriers for that integration. The observations served to provide authentic details of current teacher practice as it relates to technology and provided triangulation to the conclusions drawn from the interviews. This study may provide implications for the local 1:1 initiative. Results of this study may suggest necessary changes in the types or levels of support for teachers' technology integration.

Section 2: The Methodology

Research Design and Approach

The purpose of this study was to conduct an in-depth investigation of middle school teachers' use of technology within instruction in a North Dakota suburban school. The goal was to gain an understanding of teachers' current technology integration in the classroom and the barriers they face in implementation. From this information I was able to draw conclusions about characteristics of successful technology integration practices. This section outlines the purpose and rationale for the study as well as methods for data collection and analysis.

I applied a case study approach to answer the research questions leading the study:

RQ1: To what extent do teachers implement technology in the classroom?

RQ2: To what extent do teachers feel supported to implement technology in the classroom?

The nature of this research was a case study. According to Creswell (2012), a case study provides an in-depth perspective of a single issue. In this case, I will study the single issue of technology integration in a local middle school. An instrumental case "serves the purpose of illuminating a particular issue" (Creswell, 2012, p. 465), and this case study seeks to study the particular issue of teacher perceptions of current technology integration skills and support in a bounded system. The bounded system was the group of teachers and students in a suburban school district who were tasked with using technology in the classroom because of a 1:1 initiative; the community and experiences

of these teachers are unique. The context of the middle school environments and content area were important to the study, and Yin (2014) advocated for a case study methodology when one cannot separate context from the phenomenon. Stake (2000) argued that the numerous variables and the complex, holistic descriptions of a case study are imperative to study an issue such as this. The research was a single site case study of a suburban school district in the Midwest. Single case studies are useful to analyze cases that may be typical (Yin, 1981). The juxtaposition of this case being at once typical of middle schools across the nation and unique with the myriad of variables was the reason a single site case study is appropriate. This study explored the contemporary issue of teachers' technology integration strategies.

Setting

Technology integration is crucial to middle school classrooms to provide a 21st century environment. To meet Every Student Succeeds Act (ESSA) federal law, a North Dakota implemented requirements for all public school districts, which required the districts to track student skills for college, career, and military readiness (North Dakota Department of Public Instruction, 2017b). ESSA requires states to create plan to ensure all students have access to a high-quality education. To meet students' needs for a 21st century education and meet the Choice Ready requirements of the state and ESSA, the Midwestern School District implemented a 1:1 computer initiative for its middle school students. Choice Ready refers to the North Dakota's plan to ensure that students leave public schools ready for career, military, and post-secondary education (North Dakota Department of Public Instruction, 2017a).

The district is a growing suburban community with 19 schools. Two of the schools are middle level with approximately 230 teachers serving students in grades 6-8. Each of the middle schools enrolls approximately 1,200 students. According to the North Dakota Department of Public Instruction (2017), the number of secondary core courses taught by highly qualified teachers in the district was 99.5%.

In the 2015-2016 school year, the school district began the 21 with 21st initiative by providing each sixth grade student with a Hewlett Packard computer. The district added a new grade level to the initiative for the next two consecutive years so that all 6-8 grade students had access to a personal learning computer device during the 2017-2018 school year. The participants in the study are teachers in the core content areas (math, science, social studies, and English/Language Arts) from the two middle schools in the district.

Participants

The participants selected for this study were core content teachers of grades 6, 7, and 8 who were teaching in the 1:1 program in a North Dakota suburban district. The school district gave permission (see Appendix B) for this study. After receiving approval through the Walden University Institutional Review Board (IRB), I sent email invitations that were forwarded by building principals, as district procedure dictates. The invitation was specific to all core content middle school teachers teaching as part of the 1:1 computer initiative, of which there were approximately 98 teachers. The invitation included the purpose of the study, the expected time and effort expected, and confidentiality agreements.

Purposive sampling was a good fit for the study so I could deliberately choose candidates to fit the needs of the study based on a set of criteria. Criteria for selecting the participant sample included content area and grade level (6, 7, 8). I hoped to have a variety of teachers from all four content areas, different genders, and years of experience, and I was able to get a variety as desired. The volunteers were of both genders, but there was only one male participant, or 9% of cases. There were 29 male teachers representing 30% of the population so the single male participant was fewer than ideally would have represented this population. The participants included three sixth grade teachers, four seventh grade teachers, and two eighth grade teachers. Four participants taught English language arts, two taught science, three taught social studies, and two were math teachers. Teachers with a range of years of experience volunteered for the study: four teachers have taught 5 or fewer years, three were in the 5-10 year range, one who had taught for 10-20 years, and three teachers who have taught more than 20 years. This method of sampling helped me identify common patterns or themes.

Although 12 teachers volunteered, I narrowed the selection based on teacher caseloads. The outlier was a special education teacher whose students were in a self-contained environment; since the teacher's current placement did not meet the requirements for the study, the teacher was excluded from the case. I was able to gather 11 participants for the study, which was an appropriate sample for a case study. After participants read and signed the agreement for the study, they were asked for their consent and a scheduled observation time.

Participants' rights and protection of confidentiality were of utmost concern. I obtained informed consent from all participants prior to the study. All participants received written documentation of the procedures for the study and the potential risks. Participants were notified that they could opt out of the study at any time with no repercussions. Participants' names were not disclosed, and all identifying information was kept confidential. Also, I used pseudonyms to identify participants. All identifying information was kept separate from data, and the data was kept password-protected and secure. At the onset of observations and interviews, the participants were reminded of the procedures and that their participation was strictly optional. The procedure was approved by Walden University's IRB in October 2017 (IRB approval #10-24-17-0491009), and all data will be destroyed according to Walden University's research protocol.

Data Collection

The data collected was qualitative in nature. Qualitative data resulted in emerging themes that provided voice to the participants. Qualitative research studies focus on human interaction (Creswell, 2012), and in this study the purpose was to explore the decisions teachers face specifically related to their instruction with technology. I gathered data by conducting interviews with middle school teachers who were teaching within the 1:1 computer initiative.

Planned observations of the interviewees' classroom instruction were necessary for gathering data regarding teachers' instructional practice with technology. Without observations RQ1 could not be answered fully, as this requires viewing and quantifying implementation. A review of the literature provided an established observation protocol

(see Appendix C). The use of a published observational tool that was tested for validity and reliability not only provided a clear focus for the observations, it also allowed me to build on the TPACK theory and make recommendations about future practice (Miles & Huberman, 1994).

The protocol was created because of a gap in research of teachers' technology integration. The researchers created the TPACK observation protocol after noting that prior research on teachers' TPACK relied on surveys or other self-reports (Hofer et al., 2011). Such self-reporting may have indicated merely a change in confidence in technology use rather than actual practice. The researchers conducted several strategies to test the validity and reliability of the tool and found the tool to be not only valid and reliable, but also allowed researchers and practitioners to collect richer data to determine teachers' technology integration (Hofer et al., 2011). The article and observational tool are part of the Teacher Education and Professional Development Commons, and the observation tool is licensed as creative commons; this means the tool can be used with attribution if it is for non-commercial means and is not altered. I emailed the authors and received permission to use the tool in this project study. The observation protocol provided the tools to conduct observations in a formal and objective way. In conducting observations of a variety of teachers from the middle school, RQ 1 was answered (To what extent do teachers integrate technology?).

I conducted semi-structured interviews in the teacher's home school in a conference room. I used a computer to record audio of the interview and used a transcription tool to provide voice to text. The interview questions (found in Appendix D)

were focused on providing results for the two research questions posed for this project, including teachers' current technology integration practices and their perception of the level of support they receive. The interview questions were self-created (by the sole researcher) and were piloted with a small group of teachers (2-3) to ensure the questions met the needs of the study (after receiving IRB approval through Walden University). Those responses and teachers were not used in the study sample group. I asked follow-up questions requesting more information and included probing questions as necessary. In addition, I used observational data to check and establish the validity of the results of the interview. The use of multiple sources of data was necessary for a case study to be an accurate portrayal of the case (Yin, 2014).

Researcher's Role and Potential Bias

As a technology integration specialist in the district of the case, I had a professional working relationship with all the participants in the research. For the last four years I have worked closely with members of the teaching and administrative staff in both middle school buildings. My role is non-evaluative in nature, and my main objective is to help teachers and students use technology for learning. Prior to working in technology, I was an 8th grade English Language Arts teacher in one of the middle schools presented in the case. Although I have never been in a supervisory role, I am an administrator and work closely with both building and district administration. This did not pose any conflict with participants or data collection. However, it is possible that my close working relationships with teachers affected the participants' responses if they were

concerned with damaging our relationship. My role in the district provided me with context and background of technology use and past trainings.

Data Analysis

Data analysis is an ongoing and interactive process in qualitative research (Miles & Huberman, 1994; Merriam, 2009). Throughout the case study, I used an interpretive qualitative approach to give meaning to the data. The coding process requires a conceptual and structural order to be reliable (Huberman & Miles, 1994). As stated earlier, I used TPACK to guide the study, with the observation rubric, the creation of the interview questions, and finally the codes.

Process

Several rounds of coding were conducted. Thematic coding was utilized from the constructs of the theoretical framework, followed by open coding to reveal any emerging themes (outside of the theoretical framework constructs) (Miles & Huberman, 1994). The data was then displayed in a conceptually ordered chart. This coding process occurred over the course of several weeks' time; the passage of time allowed me a fresh look at the data and helped me to see emerging themes.

The initial thematic coding was conducted utilizing the themes within the TPACK framework as described earlier. This "start list" (a priori) of codes included the following: TK (examples of technological knowledge), TPK (examples of technological pedagogical knowledge), TCK (examples of technological content knowledge), TPACK (examples of technological pedagogical content knowledge). I added additional coding (-, +) to the responses to indicate positive and negative relationships for the support (or lack of

support) from personnel. This became necessary as teachers indicated their perceived levels of support and lack of support. Next, I conducted open coding for emerging themes. When several teachers indicated ideas such as planning, engagement, and time, I knew more codes were necessary. Axial coding was then conducted to identify patterns, make comparisons, and note clustering ideas (Huberman & Miles, 1994). I used axial coding to compare teachers' years of experiences and content with their level of technology integration.

After coding the data, I identified a descriptive display to organize and continue data analysis. A conceptually-clustered matrix worked well, because it included all respondents and all responses to the research questions on one sheet (Miles & Huberman, 1994). I sorted respondents in rows and the research questions in columns to get a broad view of all responses. A thematic conceptual matrix helped me identify how the conceptual themes, rather than participants, developed across the study. I organized the observational data in this way, to draw inferences from the displayed data (Huberman & Miles, 1994).

These methods of data analysis bound together the research questions and the instruments for data collection in this case study. The research questions called for a case study, as the 1:1 initiative and technology integration are highly bound to the setting and require in-depth data from participants. The research question requires a definition for technology integration, provided by the TPACK framework. The instruments used language from and the definition of TPACK as well as current research findings regarding teacher support and teacher beliefs and values required for technology use and

integration. Finally, the data analysis methods provided a vehicle to organize the data in such a way to provide answers to the questions being sought out.

Evidence of Quality and Procedures

As indicated by Lodico, Spaulding, and Voegtle (2010) a qualitative researcher must use systematic processes when collecting and recording data. Each interview was audio recorded and transcribed immediately after. I used the same observation protocol for each observation. I used member checking and peer review to promote validity and to guard against bias. Triangulation of data amongst participants and between observations and interviews also served as safeguard for quality.

Member checking. Qualitative researchers agree that member checks are a means of ensuring that a study's data is valid (Miles & Huberman, 1994, 1994; Merriam, 2009). A member check is a way for the researcher to clarify what the respondent means and is the greatest way to avoid a misinterpretation of the data (Merriam, 2009). I conducted several member checks within the interviewing process to clarify statements and ask for more information. The more interviews I conducted, the more clarifying questions I asked because of the nature of qualitative analysis as noted above. After I performed the initial coding, I had participants review the codes with the option of providing feedback. All participants who responded to the email verified my interpretations of the data.

Peer review. Researcher subjectivity may have been a factor in limiting the results of the study. Since I am heavily invested in the topic of technology integration as part of my current position, there is sure to be bias. One way to alleviate some of the

subjectivity or bias in the results was the use of a peer review. An external researcher examined the data to determine to check that my biases have been well controlled and that the themes were appropriate given the data (Lodico et al., 2010). I chose a fellow doctoral student because was well-versed in qualitative methods who also had a background in teaching with technology. In this case study the peer reviewer challenged my assumptions of the teachers' technology integration and offered insight in the observation data. She believed my scores of the observations to be inflated based on my prior knowledge of the participants' classrooms. We agreed that it was possible this was due to my experiences with the teachers I studied and worked with, seeing how they used technology on a regular basis.

I engaged in the peer reviewing process to validate the data by incorporating credibility measures. The peer reviewer had no connections to the study or the participants apart from this reviewing process. I gave her the transcribed data from three full interviews as well as the codes used during the analysis process. The conversation that followed provided me with insight on possible codes that I missed and ways that I could have coded data differently. However, many of the reviewer's codes matched what I had indicated. I also sent the observation rubric for the scheduled observations. Both parties evaluated the rubric, and I provided the observational data so the two of us could compare evaluations of teachers' technology integration. Very quickly we realized that I had a perception of teacher technology use in instruction because of my previous work with teachers. It is likely that I have some bias towards the teachers, as I have seen several lessons prior to the case study. Initially, this knowledge may have caused me to

score the teachers' instruction higher than the peer reviewer. We had several discussions where I provided specific details from my field notes until we could come to an agreement on the assessments. Finally, I conducted a second and third analysis of the observational data with the objective of increasing credibility and decreasing personal bias.

Triangulation. Qualitative researchers often use multiple methods and multiple sources of data to improve internal validity (Lodico et al., 2010; Merriam, 2009). In this case study I engaged in triangulation of data by using two types of data (self-reporting through interviews and observational data) and multiple sources. Triangulation of two types of data was a way for me to confirm evidence of the technology integration I observed in teachers' lessons and how they reflected on their practice in the interviews. In the circumstances of discrepant evidence, I made note of them and described the differences to be used for future consideration as indicated by Merriam (2009).

Rich, thick descriptions. The use of observational protocol encourages rich, thick descriptions, as the researcher can focus on important constructs rather than broad generalizations (Lodico et al., 2010). I used a validated research protocol from Hofer et al. (2011), called the Technology Integration Observation Instrument. The instrument included key components of curriculum, instructional strategies/learning activities, and digital and non-digital technologies. The protocol included room for descriptive field notes where I wrote detailed descriptions of student and teacher actions and interactions regarding technology integration practices. This helped me through several coding cycles, so important details were not lost. I also included several direct quotes from the

interviews to provide detailed information of teachers' views of technology integration and support for their integration. The instrument also included a detailed rubric, which I used to assess the lesson based on the components of TPACK. The validated protocol aided in validity and reliability.

Qualitative Results

All participants reported use of technology within their teaching practice, although the extent to which technology was used varied across teachers. I observed the use of technology in all eleven observations, again with variance. Through observations and interviews, I noted differences in technology integration based on TPACK constructs. Participants discussed their use of technology and their perceived levels of support in semi-structured interviews. In this study, teachers' technology was evaluated by categorizing instructional activities as TK, TCK, TPK, and TPACK. The TPACK Observation Rubric (see Appendix C) assessed teachers' technology integration on a four-point scale. A score of 4 was exemplary/strongly aligned/maximally effective; 3 was appropriate/aligned/effective; 2 was marginally appropriate/partially aligned/minimally effective; 1 was inappropriate/not aligned/ineffective. The results are qualitative in nature, as the rubric scores are an evaluation of the teacher's performance and correspond to the research question to what extent do teachers integrate technology. I organized the data by participants' content area, then by their average TPACK score. Teachers' years of experience are noted, as that appeared to be a variable in their technology integration.

Technological Knowledge

The interviews and the observations indicated that ten of the eleven participants demonstrate a high level of TK. For the semi-structured interview, each participant was asked to discuss his/her technology knowledge and skills. In particular, I worded the question as such, "What knowledge and skills do you have that are specific to technology, and how did you come to learn those skills?" Although not a part of the teaching process or pedagogy, the measure of teachers' TK is important as a lack of skill can often lead to low technology integration (Ottenbreit-Leftwich, 2013). Participants talked about district-supported tools as well as tools that teachers had to learn and/or find on their own. Ten of the eleven teachers discussed a high level of comfort when using technology in the classroom.

Teachers responded that they felt comfortable using technology in their instruction. The observational data supported teachers' comments, as the "Technology Logistics" section of the rubric was a mean score of 2.81 out of a possible 4, the highest of the constructs observed from the framework. I assessed how effectively teachers were operating technologies for this section of the rubric. A score of 3 indicates teachers and/or student operate technologies well. From this information, I deduced teachers know how to use technology in their classroom and can operate the technology well.

Several themes emerged from the TK data. Firstly, I noted the need for separate assessment of teacher and student technology use in the TPACK Observational Rubric. Teachers' content knowledge did not appear to be a variable in their TK. Teachers with high TK discussed their technology skills and the training that made those skills possible. Also, participants who struggled with TK reflected on time, lack of interest, and training

opportunities. Finally, students' TK was sparse and may reflect a teachers' lack of knowledge and experience with pedagogy rather than lack of students' technology knowledge.

Teacher and student TK. For this case study, I used the Technology Observation TPACK Rubric to evaluate teacher and students' technology use. Technology Logistics coincides with the Technology Knowledge construct from TPACK. I found it difficult to provide a true rating for teacher and students together as instructed through the rubric; therefore, I found it necessary to split Technology Logistics into teacher operation and student operation scores. Table 1 is arranged by content area and then by participants' TPACK score from highest to lowest overall within the content area. I calculated the mean scores from the seven areas of the rubric. As noted in Table 1, the mean score of Technology Logistics-Teacher Use was 2.81, while Technology Logistics-Student Use was the lowest score in the observable data with a mean of 1.36. Splitting the teacher and student use allowed me to see a discrepancy between teacher technology use and student technology use. The details are also discussed in a later section for future research.

Table 1

Technology Logistics Teacher and Student Use

Participant	Content Area	Years of Experience	Total TPACK	Technology Logistics-Teacher use (TK)	Technology Logistics-Student Use (TK)
8	Math	< 5	2.86	4	1
6	Math	5-10	2.71	3	1
11	Science	20+	2.86	2	2
3	Science	20+	2	3	1

(*table continues)*

9	ELA	20+	3	2	3
7	ELA	11-20	2.14	3	2
1	ELA	< 5	2	3	1
4	ELA	5-10	1.57	2	1
2	Social Studies	< 5	2	3	1
5	Social Studies	< 5	2	3	1
10	Social Studies	5-10	2	3	1

Each score is on a four-point scale: 4= exemplary; 3= effective; 2= minimal; 1= ineffective.

Teacher TK by content area. All participants were rated as a 2 or higher in the category of Technology Logistics-Teacher Use. One lesson was scored a four to indicate teachers operating technologies very well in the observed lesson, and seven of the lessons received a score of 3 to indicate teacher operating technologies well. There were three lessons that received a score of 2 to indicate teachers adequately operating technologies. A score of 1 would indicate teachers operating technologies inadequately in the observed lesson. Although I did not see an indication that content area had affected teachers' technology knowledge, teachers discussed their TK in relation to specific tools they used for their content.

Math teachers' TK. The two participants who teach math discussed their comfort in using ActivInspire, a lesson delivery system where teachers create flipcharts. In their observed lesson, one received a score of 4 and the other a 3. Teachers projected the lesson from their computer and used an interactive whiteboard and pen to navigate the charts. Both effectively used their computers and ActivInspire to deliver the lessons. Participant 8 stated, "The online tools are easy to navigate. I use the document camera. And I also use ActivInspire." She discussed her student teaching experience as crucial to

learning those technological skills. Participant 6 said, “I've just used what we have available, like our Activboard. We had them at the STEM Center, so I used it there and then coming over here.” I asked a follow-up question because my observation of her lesson revealed that she operated technology well. When I asked her where she learned how to use it, she discussed peers and her student teaching experience. Both teachers were observed and reported operating technologies effectively, and both discussed student teaching in the district in which they currently teach as an effective means of training.

Science teachers’ TK. Participants 11 and 3 were rated as a 2, and 3 respectively in technology logistics. Participant 11 reported various technology tools. She said, “A lot of our planning and formative and summative assessments is all done on Office 365. As far as being more savvy with Microsoft Word … I'm pretty basic, but I think I can do more than the average person.” I observed her technology use in a science lesson, and I noted that she had some difficulty with her voting system, as she had to have the student re-enter their scores. The voting system interacts with the ActivInspire software; students participate by responding through a small, handheld voting device. Teachers can present quizzes or polls and download results to a spreadsheet to track responses. The teacher incorrectly started the quiz or did not download the responses correctly.

Participant 3 said she had formal training with a concentration in technology for her undergraduate work. She mentioned that technology is “constantly changing” and noted that she felt the need to seek more training when she transferred from elementary to middle school. She has taken district offered training and attended Metro Tech Camp

during the summer. Participant 3 had a TK knowledge and skills score of a 3, since she operated the document camera and her phone well during the lesson.

ELA teachers' TK. In the observed English Language Arts lessons, two teachers were assessed as a 2 and two as a 3 in technology logistics. All four ELA teachers mentioned part of the Office 365 suite in their interviews. Participant 7 acknowledged that she knows how to use technology but does not know the technical side. She said, "I do feel like I know more about Word and using the Microsoft Office technology and using different programs, but not on the fixing it side." Participant 1 also made note of the Office suite. She said, "I use the Microsoft applications sometimes. I show my students documents or PowerPoints." When asked about learning the specific Microsoft tools she replied, "Sometimes it's just easy to…tinker around. I feel like a lot of the sites that our school provides are easy to use." Office 365 was an important tool to the English teachers since it offers word processing and online collaboration activities.

Social studies teachers' TK. The three social studies teachers discussed a high level of comfort using technology, and their lessons were rated as a 3 in technology logistics. Participant 2 said, "I guess I feel very comfortable using technology, and I feel like I pick up on new technology. I seem to understand how to use pieces of technology quite easily." I observed Participant 2 operate technologies well in her lesson, moving between the CNN news online and her document camera. Participant 10 had a similar response as his peer. He said, "I kind of grew up during the big technology boom of getting computers into all of the schools…so I'd say I'm very comfortable with technology. Whenever new technology comes out, I'm always interested to see what it is

and how it can be used." He used PowerPoint, CNN news video, and a video about the Preamble of the Constitution. He operated technologies well, switching from an online video to a PowerPoint presentation, and then using his phone to pull up a website from which he read. Participant 5 had an affinity for technology. She said, "I guess I've always been into technology, so it's always just been something I've gone out on my own and tried to learn." When asked how her technology integration has evolved she stated, "I think over time I've gotten better at teaching with technology. I'm okay with it not working, and they're [students] okay with it not working sometimes. We can move on." She also mentioned her undergraduate work in technology, which I will discuss next. Participant 5 discussed PowerPoint, part of the Office suite, as a tool she used in the classroom. She said she used Google Slides, PowerPoint, WeVideo, and Schoology specifically as tools she used. Although I did not observe these tools being used, she operated the document camera effectively. The internet was down on the day that I observed her, and she was not able to use the tools she had originally planned. The social studies teachers all used technology tools for presentation well.

Technology training in pre-service work. Four participants reported technology training as part of their pre-service teacher training. The two math teachers discussed the importance of their cooperating teachers showing them technology tools for math during their student teaching internship. Two other participants mentioned formal technology training as part of their degrees. Participant 5 also discussed her formal training when asked about her technology skills. She has a certificate in STEM and a master's degree in STEM education. These four participants received a score of 3 or better in the category of

"Instructional Use", indicating effective use of technologies in the observed lesson. The other participants did not mention pre-service technology training for teaching; however, I did not specifically ask about it.

Limited TK. Only one of the eleven participants mentioned having low technology knowledge and skills to be a barrier in her technology integration. Participant 4 has between 5 and 10 years of teaching experience. She stated, "I'm not tech savvy; it doesn't interest me, so I don't spend time seeking opportunities to learn new things that could enhance my instructional time with them." Intrinsic motivation is a known factor in technology integration (Holland & Piper, 2014). Her lack of interest is a barrier to technology integration, but there appeared to be other reasons for her lack of TK as well. She stated, "I get apprehensive when I try things and they don't work for me right away." Her anxiety over troubleshooting technology issues seems to be a barrier for using technology in the classroom. She also mentioned time and lack of interest reasons for low technology integration. "I guess you could call it laziness on my part to not spend the time to figure out how to make it so it doesn't impede what I'm doing but makes it seamless and makes it helpful." The mention of time is interesting in that other participants mention time and efficiency as a reason *for* using technology. When a teacher does not feel as though he/she has enough knowledge or skills, those beliefs can be a barrier for use.

I asked two follow-up questions to garner more information regarding training for technology integration. The participant discussed several avenues she had utilized to learn: traditional professional development sessions on a district-scheduled day, mini

sessions on the district's learning management system (LMS) from a peer, and others. The participant noted that the best professional development for her was an online class on grading practices, which required her to use Schoology, the LMS the district had adopted. "The course for 15 Fixes on Schoology, that has been a good avenue for me…because I have somebody who is making me take the time to do it." When the required technology skills were embedded in an assignment for a class, the participant felt motivated to learn the skills and use the tools. She clarified, "Versus a PD day where John [pseudonym] is showing me stuff. Or, like yesterday's Tuesday Talk. . . I'm not going to take the time to do it, it just goes to the wayside." She has several different opportunities to learn new TK but is not motivated to put them into practice in her instruction. Although the participant maintained that she had high levels of support, it is evident that she requires different supports such as mentoring which could help her become motivated to use technology to help achieve her instructional goals.

TK, content area, and years of experience. I organized data by participants' content area and by composite TPACK score in the tables. There does not appear to be a connection between content area and a teacher's TK, as I saw in the other constructs. However, teachers discussed their technology tools based on their content. Teachers have a perception that their age is a variable in technology knowledge and skills. Three teachers mentioned age as a factor in teachers' T, and yet 10 of the 11 teachers reported effectively using technology in their teaching, even though they represented a range of ages. Although teachers perceived younger teachers to be more tech savvy than older teachers, my observations did not support this. There does seem to be indication that a

teachers' years of experience is a variable in Technology Logistics-Student Use. The only three teachers to have students utilize technology in the observed lessons had more than 10 years' experience. This may mean that student use has more to do with teachers' experience, classroom management and overall experience with pedagogy than age.

Students' TK. Student technology use was separated in the rubric. By evaluating students' technology use separate from teachers', I was able to focus on how those two differed. The district and building administration are looking for teachers to provide students with opportunities to use technology to create and collaborate. The observations indicate this is only happening in a few classrooms. As shown in Table 1 seven of the eleven classroom lessons observed did not have students utilizing technology at all, and they were given a rating of "1". In one of the classrooms, Participant 6 had students using technology, however the use was inadequate. The lesson was rated a 1 because only one student was asked to use the ActivBoard to graph equations while the other students looked on. The activity would have gotten a higher rating if all students were allowed to use the software along with the teacher in order to learn and practice graphing multiple equations. Two observed classroom lessons were assessed as a 2 because students were operating technologies adequately. Students were using computers to access class documents such as a rubric and using Microsoft Word to begin writing a draft in an English Language Arts class and completing formative assessments with handheld voters in a science class. Student use of technologies is significantly lower than teacher use. This is the local problem to which administrators were referring.

I observed one lesson where the teacher provided opportunities for students to operate technologies well; the TK-student use was assessed as a 3. Several indicators were present in the lesson of Participant 9, which overlap with the other constructs of TPACK. Students were given choice, as to which tools they could use and their plan for completing desired outcomes for the lesson. Some students were using a video creation tool to begin their book trailers. Other students were writing scripts using Microsoft Word. At one point all students accessed a reading website to record their progress for their literature circle book including a question for other group members to consider. Participant 9 was evaluated as a 2 in Technology Logistics-Teacher Use, because she was not utilizing technology as effectively as she could. However, students were seen operating technologies well because they were given several opportunities to do so.

As shown in Table 1 all teachers used technology in instruction. However, the degree to which they operated technology varied, and particularly the degree to which students were allowed to use technology varies greatly. The observations revealed only four lessons where students interacted with some form of technology. This is perhaps the reason administrators saw an issue with technology integration. However, it is important to note that several teachers discussed students using technology, and each participant was only observed in one lesson.

The results of the interviews show that teachers in the case have high self-efficacy with regard to their TK, as ten of the eleven participants reported such. My observations of teacher use support their beliefs. Although three teachers were evaluated as a 2, indicating adequate use of technology, the participants discussed using technology

outside of the classroom as well. They discussed using Power Teacher for grading, Word and OneNote for collaboration, which I did not observe, as those skills were used outside of the classroom.

TCK

TCK is the use of technology within a specific content area. Schmidt-Crawford, Tai, Wang, Jin (2016) defined TCK as the ability to create new representations for content, changing the ways learners understand and practice ideas in an area such as math or science. TCK differs from TK in that, I was evaluating why teachers were using a specific technology to teach their content. All participants discussed specific ways in which they used technology to teach their content, meaning teachers in this case were aware of their content and how they used technology to meet their curricular goals. As one participant said, “I think it [technology] plays a huge role. There’s so many awesome things you can do with technology and social studies. There are so many interactive things you can do.” With an average score of 2.55, I observed classroom lessons that strongly (4), adequately (3), and partially aligned (2) to curriculum goals.

TCK was second only to teachers’ TK. However, teachers used and spoke of technology with regard to teacher instruction more than student learning. When I asked teachers why they made the technology choices they made, they discussed planning, communication, and efficiency. I observed this same trend, as teachers used technology to demonstrate and substitute in place of other modes of teaching, but in most cases, there was not a transformation of knowledge or learning. Most of the interaction happened between the teacher and technology, not the students and technology.

A teacher's content area showed to be an integral part of TCK. In this case teachers in the math and science departments were evaluated at a higher TCK (and overall TPACK) than the other two content areas. The four math and science teachers had a mean TCK score of 3, and Social studies teachers were evaluated lowest with a mean TCK of 2 (Table 2). Another theme that emerged was professional learning communities (PLC's) and planning as a support for teachers' technology integration. Teachers discussed how collaboration with peers improved their ability to effectively integrate technology. Finally, teachers discussed barriers to their technology integration as it related to their content area of instruction.

Table 2

Technological Content Knowledge by Content Area

Participant	Content Area	Years of Experience	Total TPACK	Curriculum Goals and Technologies (TCK)
8	Math	< 5	2.86	3
6	Math	5-10	2.71	3
11	Science	20+	2.71	3
3	Science	20+	2	3
9	ELA	20+	3	4
7	ELA	11-20	2.14	2
1	ELA	< 5	2	2
4	ELA	5-10	1.57	2
2	Social Studies	< 5	2	2
5	Social Studies	< 5	2	2
10	Social Studies	5-10	2	2

Teachers' TCK varied across content areas as shown in Table 2. The math teachers' TCK was evaluated as a 3 out of 4, indicating the technologies used in the

lesson were aligned with one or more goals. The science teachers' average TCK score were also 3. Both science teachers had over 20 years of experience, and they were both observed and spoke of using different types of technology. One ELA teacher scored a 4 because technology was strongly aligned to curriculum, and three of the ELA teachers scored a 2 in TCK. The social studies teachers all received a 2 in TCK. All of the participants spoke of using many different types of technology, and they discussed many different obstacles when trying to integrate technology into their lessons.

TCK in math. It is evident that the Midwest Public School District invested in math technology and training, as the two math teachers both discussed TCK and how they use technology to help students learn content. Although there were only two math teachers in the case, their interviews revealed that the math department spends a great deal of time planning lessons through ActivInspire. During PLC's they discuss upcoming lessons and make edits to their flipcharts together. This may be one of the reasons their lessons are successful when analyzing teachers' TCK, TPK, and TPACK.

I observed Participant 6 as she taught an Algebra class; her use of technology was aligned to the curriculum goals. Participant 6 stated, "That day that you were in here, I was using colors [to show graphing equations], and I think it's really helpful . . . Even the solid and dashed lines on Active Studio that are helpful for me to use to show what I need to." The observed lesson was efficient, as the teacher skillfully manipulated colors and lines, moving through each math problem using technology. It was clear that she had great knowledge and skill with both content and the technology tools. When I asked her about her skills, she responded, "In planning I feel like we have it set up so effectively.

We have specific days set aside to take notes. Planning is actually easier because we've set it up that way. We can skip examples that we know we don't need . . .We use them on our ActivBoard." The teacher discussed ways in which the math teachers collaborate to plan lessons using technology.

Another math teacher discussed her use of technology also mentioning ActivInspire as well as Schoology, both district-supported tools. She reported that she used the LMS to post materials, answer keys, and practice problems. Students also used Mathia and V-Math, online programs for math. When I asked her how she utilized the programs with students, she responded, "I see it more like a practice. I would rather work with those kids one-on-one for re-teaching. . .I don't use it for differentiation." I observed both teachers masterfully use the tools on which the district had trained them. It was evident that the teachers spent much time planning and preparing their lessons, and they were both knowledgeable in their content. Although both math teachers effectively used technology to practice math skills, there is still need for growth. Perhaps the next step would be to discuss how technology could help students understand math better, through the use of simulations and graphs, rather than to practice math problems. Students would also benefit from differentiation in their practice, which could be done through their online programs. This would require a shift in perspective, asking teachers to switch to a more student-centered approach.

TCK in science. Participants 3 and 11, who are science teachers, were evaluated with a TCK score of 3. They discussed how specific tools can help students understand scientific concepts, which may otherwise be too complex or too expensive to experience.

Participant 11 used ActivInspire to show unicellular and multicellular organisms. She has side-by-side images as well as using color to show differences. Students were engaged in the lesson because of the pace, the display of information, and the teacher's excitement for the topic. Although she had a planned lesson with objectives, the topic lends itself to real-life questions that students asked. The teacher answered some of the questions, allowed students to answer peers, and then steered the conversation back on track. In her interview she talked about making the right choices with technology. She said, "Not all concepts are better with simulations or technology. I like to have the students perform hands-on activities. We have our aquatics lab for plants, and we have a fish experiment going on right now." She also discussed a disease unit where students conducted research to determine a disease from a list of symptoms. Her ability to consider how to represent content and provide students with activities that match curriculum goals correspond to her observational TCK score of 3.

Participant 3 also received a 3 in TCK for curriculum goals and technologies. She also displayed the ability of choosing the right tools for the curricular goals. Her observed lesson was a hands-on activity where students were collecting data and observing gravity and force. She talked about her choices of technology versus paper and pencil. "I have tried to use it (technology) in a day to day situation, but I have replaced it with an interactive notebook . . . We need our whole table space for a lot of our labs and experiments." In her interview she discussed several ways in which she used technology for science. "Science and technology go well together, and I like the research side of it. I think that's a great time for students to utilize different things like presentation tools. I

also want students to be able to Skype with experts in the field." I was able to observe her using technology to share expectations and content with the students at the beginning of the lesson. She did not have students using technology during the lab. Had she asked students to record results using a spreadsheet such as Excel, students could have furthered their learning and understanding of the concept by trending their data.

TCK in ELA. The ELA teachers were the most varied in their TCK as well as their overall TPACK scores. The four ELA teachers' TCK scores ranged from a 4 to a 2. Participant 9 was evaluated as a 4 in her TCK, the highest of all the participants. Through observation I noted her students were reflecting on their literature circle books through a book website. Students were able to collaborate and interact online with their peers as they shared questions and answers, allowing everyone in the group to interact in the conversation. In her interview she discussed tools specific to her English Language Arts content. She said, "I've tried to implement new things like Noodle Tools, which is the simplest way for student to know what to put in a bibliography. It walks them through the process." She also has students use a tool called Actively Learn where they read non-fiction articles and interact with the text. She explained, "I can pull articles from all kinds of sources, add questions to them, and give students immediate feedback on their responses." Her ability to think about the purpose of her lesson, choose tools to meet the students' needs, and assess students' knowledge and skills are what made her technology integration successful.

I observed a writing lesson in the classroom or Participant 7, and she received a score of 2 on TCK. When I observed her lesson, she had students working independently

on a paragraph about Nepal. Although students could access the rubric on Schoology, the document was separate from the assignment and not interactive for either students or teacher. She said, “I use the use technology to publish all of their work for me, so especially in language arts that is crucial for us . . . One of the standards is to publish your work using some sort of technology, so we have to do that. Any written work, I usually start out with hand-writing it, and I move into the typing and publishing online in Word.” I asked Participant 7 when she felt successful in her technology. She responded with a project example in her English Language Arts classroom. She reflected, “It ended up being a great project where they really had to analyze their book to figure out what the selling points of it . . . I think they had to really think about what they were reading in order to do it.” Although I did not observe those activities in her class lesson, she discussed what technology integration looked like in her classroom. The examples she provided were evidence of her ability to use technology to enhance learning knowledge and skills for her subject/content areas.

Not all teachers used technology to effectively convey content. The ELA teachers were most varied in the TCK scores. Six of the eleven teachers were observed with a lesson where technology was partially aligned to curriculum goals and evaluated as a “2” on the TPACK rubric. All six were English Language Arts and Social Studies teachers. It is possible the teachers need support with making choices with technology for their curriculum. Like one ELA teacher said, “I sometimes struggle to figure out a way to use technology in Language Arts other than the obvious one of publishing work.”

TCK in social studies. All three social studies teachers received a 2 in their TCK

in a lesson. Participant 2 stated, “I’m on the verge; I just think I’m not quite there yet. I feel comfortable using them [technology tools]. It’s just a matter of getting beyond the content and getting to how I’m presenting the content.” Participant 10 knew he wanted to use technology in his content, but it was not observed at a high level in the lesson. He mentioned that he has not done as much as he would like with LMS to create his assignments. I asked him a follow-up question to get more information. “I think that a lot of it has to do with curriculum reasons. So, curriculum-wise our Geography curriculum was drastically shortened, and the rest of it is all new curriculum. So a lot of the project that I had done with things in Schoology, I don’t have time or scope to do anymore. And, I just haven’t gotten around to creating new ones for these yet.” He also responded that current curriculum and PLC time is being spent on a standards-based grading initiative.

Participant 10 talked about specific activities he could do with students that were related to social studies. “There’s some really cool programs that have come along that allows me . . . to actually go to a panoramic air view of the place that we were studying.” I asked him what made those experience possible. He replied, “I would say it’s a combination of the availability of technology apps and money . . . So, technology has allowed me to take them there in a way that otherwise we wouldn’t be able to.” Participant 2 also discussed possibilities of technology and her content. She said, “Webquests, maps, and our online textbooks, there’s so many different ways that it can be used in current events and in history. It can be such a great thing to use technology. I just have not delved into that quite yet.” Although the teachers seem interested in technology, these two participants have only partially aligned technology to the

curriculum goals. Their barriers were linked to time issues.

I observed Participant 5 using technology, despite the fact that her building's Wi-Fi was not working at that time. When asked about technology and social studies she said, "I think it plays a huge role. There's so many awesome things you can do with technology and social studies. I think sometimes the one thing that goes against it, is that it's hard to find some of the materials online sometimes and make sure you're getting credible sources. But, there are so many interactive things you can do." She had a TPK score of 2, showing technology minimally supporting instructional strategies. Although she was able to use some technology and was able to modify her lesson, it was evident that the outage had an impact on her intended goals for the lesson.

TPK

Technology used to enhance instructional strategies is known as TPK. From observations the average score for TPK or "instructional strategies and technologies" was 2.27. The majority, six of the eleven participants, received a score of "2" on the Technology Observation TPACK Rubric (see Table 3), meaning teachers' technology use *minimally* supports instructional strategies. In this case study participants reported and were observed using technology for assessment, student engagement, and demonstration. All participants spoke of several different components of TPK; however, the observed lessons showed a variance of skill in the area of TPK. While only one teacher was observed using technology for assessment, all participants were observed using technology for demonstration. Table 3 is organized by content and then by the teachers' total TPACK score.

Table 3

Technological Pedagogical Knowledge by Content Area

Participant	Content Area	Years of Experience	Total TPACK	Instructional Strategies and Technologies (TPK)
8	Math	< 5	2.86	3
6	Math	5-10	2.71	3
11	Science	20+	2.71	3
3	Science	20+	2	2
9	ELA	20+	3	3
7	ELA	11-20	2.14	2
1	ELA	< 5	2	2
4	ELA	5-10	1.57	1
2	Social Studies	< 5	2	2
5	Social Studies	< 5	2	2
10	Social Studies	5-10	2	2

TPK in math. Participants 6 and 8 both received a 3 in TPK. The participants discussed several factors of TPK while planning and implementing their lessons. Both teachers discussed student engagement in their interviews. I observed their use of technology to enhance student engagement as they taught math. Although neither teacher used technology for assessment in the observed lessons, they used other means and discussed assessment in the interviews. Finally, both participants focused on ActivInspire and their interactive white board as a technology tool for teaching math.

TPK and student engagement in math. I observed strong student engagement in both math lessons. The teachers used pacing, humor, and technology to promote student engagement. Participant 8 discussed her choices while planning a lesson. She said pacing and student engagement are factors when she is planning and reflecting on the day's

lesson. “I try to put things on my slide that are interactive, so I’ll reveal something after they do the problem or reveal the answer. Or, I’ll use the shades, so they can’t see, to try to keep that engagement.” I observed her TPACK skills in the lesson, and students were engaged. They wanted to see what was under the shade, and the teacher effectively used technology to hold that engagement. They wanted to check their answers, so they were paying close attention when the teacher moved the rectangle to reveal it.

TPK and assessment in math. Participant 6, a math teacher, discussed making choices based on efficiency and student engagement. She said, “I just literally searched on Quizizz for a review . . . That was a really fast and engaging way for them to review.” Participant 6 talked about Quizizz because it was easy for her as a teacher and promoted student engagement. This was the tool she used for formative assessment at the end of a unit. I was unable to observe this lesson, but I did see her use non-digital means for formative assessment. She walked around the room and used peer teaching and her ActivBoard to re-teach concepts that needed more work. Participant 8 also used non-technology means for assessment. I observed choral response and kinesthetic practice during her lesson. Technology may provide a way for these teachers to track student responses, so they can make instructional decisions based on data.

TPK and demonstration in math. I observed both math teachers use their interactive white boards in conjunction with their computers and projectors during their lessons. Participant 8 used technology to demonstrate and enhance the lesson. At one point she switched from using the ActivBoard to the document camera, so all students could see her properly using the protractor to measures the angles. I asked her why she

made that switch and if she had planned to do so, or if it was a spur-of-the-moment decision. She said, “I knew in advance that I was going to turn my doc camera on. I knew that specific page in the workbook, I knew that I had to show them with me using the tools to help them because they were going to use the tools.” This shows she is thinking about what students need in relation to her content and the goals of the lesson.

TPK in science. Both science teachers have over 20 years’ experience in teaching. I assessed Participant 3 as a 2 in TPK. Although she displayed many effective learning strategies in her lesson, technology was used minimally to support those instructional strategies. Participant 11 was the only teacher that I observed using technology for assessment purposes. She also used technology to support her instructional strategies. I assessed her lesson as a 3 in in TPK. Both teachers used technology for student engagement and demonstration purposes.

TPK and student engagement in science. Participant 3 discussed students using technology during a project, and the teacher using technology to assess student learning and engagement. She said, “When you’re just watching them [videos] just to watch them, you can really see their excitement. They talked about that project at the end of the year as one of their favorite things they did!” Participant 11 also discussed using technology to promote student engagement. She cited engagement as a reason to use the voters, while also a means of assessing student learning for the teacher. She said, “I use the voters to get them to interact and pay attention a little bit more.” Although technology was not the only means of student engagement in their lessons, both participants spoke of the importance of using technology as a way to promote student engagement.

TPK and assessment in science. Participant 11 used a voter system to check for student understanding of the science information. From those results, she was able to determine how well students learned and retained the knowledge from the previous day. She spoke of the voters twice during her interview to indicate using voters for assessment. She reported, “For example, with the carbon dioxide in photosynthesis cycle, I can see if the students really understand it. And, if they don’t, I can re-teach the content and go back and have them answer the questions again.” She also discussed the voters in the interview when asked about a time she’s felt successful and support to use technology. She reported feeling successful with the voters after having several meetings with a technology integration specialist. She said, “So when I learned how to do my assessments on the Activboard that was a good feeling because that’s pretty slick and time-saving mastering that component.” Technology provided an assessment opportunity for the lesson.

TPK and demonstration in science. The science teachers used different methods of demonstration in their lessons. Participant 3 used her document camera to clarify instructions and expectations twice during her lesson. At the beginning of the class period, she called all students to the front of the room and using the document camera she showed the lesson objectives to the students. She also placed the worksheet under the document camera to call students’ attention to a particular set of instructions for the experiment in the middle of the lesson. This procedure was less about the technology use itself and more about using technology to enhance best practices and routine.

Participant 11 also used technology for demonstration. She used different colors on her ActivInspire flipcharts to show the differences between two ideas. She reflected on this practice in her interview. “The ActiveBoard is pretty much the norm if I am lecturing or explaining something.” She used photographs and clipart as a means of demonstrating ideas. At one point, student engagement was high because she included pictures of the students, and the students were excited to see themselves and peers in the presentation.

TPK in ELA. The participants who taught ELA had the most variance in their scores. I observed the four participants’ lessons as a 3, 2, and 1 in TPK. Participant 9 allowed students to use technology for collaborative work and reading reflection. The students were also allowed to choose which technology tools would best meet their needs for their project work. In these ways she used technology to support instructional strategies. I assessed Participants 1 and 7 as a 2 in TPK, since their use of technology for demonstration minimally supported instructional strategies. I assessed Participant 4 as a 1 in TPK, since her technology use did not support her instructional strategies.

TPK and student engagement in ELA. Participant 1 spoke of making specific choices of technology in her teaching to promote engagement. She said, “I would ask myself if it will be more engaging for students. So, for instance, I played short films for the student while we talked about plot instead of just having them read articles; that’s efficiency but also because I thought they were fun and kids would be more engage in a lesson.” I was able to observe this English Language Arts lesson on plot, and students were engaged. I observed all students watching the short film and taking notes during it. The teacher could have chosen many other means for this lesson, but she chose Pixar

short films to enhance student engagement.

TPK and assessment in ELA. Participants 9 spoke of using technology for assessing student learning, but I did not observe these assessments in their classroom observation. Participant 9 said, “Through Actively Learn we’ve been talking about how to interact with a piece of non-fiction text and how to respond to questions. And, now they’re writing more because of this practice, and not just in my class but in science and social studies too!” When I asked her what made the assessments so powerful and successful, she discussed the immediate feedback and the ability for her to assess students based on standards. “What I love is that their choices are …1 2 3 4 scale for standards-based. I tell the kids that I want those proficient or those advanced answers based on that scale.” The teacher used a paper and pencil self-assessment for their speaking and listening skills. I also observed her moving about the classroom, observing students’ progress and answering questions.

TPK and demonstration in ELA. All four ELA teachers used their computers and/or their document cameras to demonstrate during their lessons, although their degree of technology use varied. Participant 1 used a document camera to project a vocabulary worksheet for students. They worked together on the vocabulary matrix to read the definition, write their own example, and draw a picture. She also played a video from her computer with the project for her lesson. Participant 7 also used the document camera to project an example of the students’ notes from their interactive notebooks. She demonstrated how to create the vocabulary flashcards, and students watched and then mimicked her work. Participant 4 used a PowerPoint to project notes on literary analysis.

The presentation lacked visual presentations for learning and cues, part of the reason the lesson was assessed as a 1 in TPK. Her technology use did not support instructional strategies.

TPK in social studies. I assessed all three participants' lessons as a 2 in TPK, technology minimally supported learning strategies. The three participants who taught social studies used similar tools for TPK. Teachers discussed demonstration tools, and I observed this use in the classroom. Lack of technology for assessment and lack of student-centered strategies were evident.

TPK and student engagement in social studies. Participant 5, a social studies teacher, stated that technology was an integral part of teaching and learning, especially when students are engaged in it. She said, "They get so excited to go online to research and then do a presentation…they were all-in. I did not need to have them do an easier version. They were five lines deep and came up with some awesome videos." Her description of a video creation project was student-centered, and she noted when student engagement was high, they worked hard to do more than the minimum requirements. Participants 2 and 10 used videos to promote student engagement. They both showed a CNN news program as part of their current events. However, Participant 2 used discussion and a reflection activity to assess students' knowledge; whereas, Participant 10 did not.

TPK and assessment in social studies. I did not observe teachers using technology for assessment in any of the social studies lessons; however, two of the three participants discussed assessment in their interviews. Participant 10 discussed the power

of technology for assessment in his interview. He said, “It makes it easier to look at trends and statistics because I can look at the averages. I can see the questions people got wrong and things like that, which is really good.” I did not observe assessment in this participant’s classroom. Participant 10 could have utilized formative assessments during his social studies lesson, which would have given him an idea of what students knew. Participant 2 talked about Actively Learn with similar comments to an ELA teacher. She said, “It’s so powerful because not only are students reading on their own, …but you cannot progress in the reading until you answer the questions. And, it’s live feedback so, I can be typing in, ‘Nope, this isn’t quite right. Give me more,’ you know, and it’s got a rubric all set in there. They’re posting questions and responding to those questions live.” This type of teacher to student and student to student feedback is an example of technology optimally supporting instructional strategies. Although I did not observe the teacher using Actively Learn in her lesson, she was using non-technological means of assessment. She could have used technology to help her evaluate students’ knowledge and skills. She discussed a back-channeling tool, which is presented in the TPACK section below.

TPK demonstration in social studies. All social studies participants planned to use video in their lessons. Participant 5 was unable to do so because she required internet access to stream her content. Demonstration with video is a logical way to use technology for social studies, since students can view maps, graphs, and charts in this manner. Video also lends itself to the storytelling narrative of history. In his interview he said, “Technology allows me to have more visualized scenarios of the thing that I talked

about…they get more of a visual sense of it." Two of the three social studies teachers also used the document camera to demonstrate process and materials. Participant 2 used the document camera to demonstrate Cornell note-taking strategies with students. Participant 5 used her document camera to present notes on Ancient Egypt. She used technology to help her chunk information and add visuals of tools and inventions. Although the teachers used technology to demonstrate, the technology use minimally supported instructional strategies. The lessons lacked technology use for assessment, student collaboration, and student interaction.

In summary of teachers' TPK, six participants discussed using technology to promote student engagement. Five participants discussed engagement as a reason to use technology, but I was unable to observe the particular lesson of which they spoke. Two participants cited examples of student using technology (not just teachers) as a means to promote student engagement. They believed technology and student engagement to be integral parts of their teaching. I only observed assessment practices with technology in one of eleven classrooms, a science classroom. Although six participants discussed assessment with technology, the lack of evidence leads me to believe assessing with technology is not a routine process in this case. Their current practice does not involve formative assessment practices with technology *during* the learning process. Assessment is a necessary component of teaching and learning, and technology could aid in data collection and analysis to determine students' needs.

All eleven participants used technology as a demonstration tool in their observed lessons; however, the degree in which it was used differed. Five participants used

multiple technology methods to demonstrate specific content skills. Three participants used technology to demonstrate content and also enhance students' learning experiences. Although demonstration was only a part of technological pedagogical knowledge, evaluating this part of TPK was valuable since all participants used technology for demonstration during their observed lessons.

TPACK

Teachers' TPCK varied across this case. Three items on the observation rubric were focused on technology, pedagogy, and working together. Technology Selections assessment teachers' choices of technology use based on curriculum and instruction. Fit referred to how curriculum, pedagogy, and technology all fit together in the lesson. Instructional Use referred to how effective the instruction and technology was observed in a lesson. I assessed the observed lessons for all areas of TPCK, and the mean score of all participants in each of those areas was 2.36. I also considered the participants' mean score for all areas of technology, content, and pedagogy, seven in total. The mean scores are reflective of teachers' TPACK as well; the trend of content area continue here; math teachers' TPACK scores are higher as a group, and social studies are lower as a group.

All teachers discussed multiple constructs in their interviews; however, five participants referred to all constructs together, which indicated knowledge of TPACK for those teachers. Of the eleven lessons observed, I saw three where I could not separate content, instructional strategies, or technology. Participant 8 (Math), 11 (Science), and 9 (ELA) were teaching lessons in which constructs worked seamlessly together in the lesson, and those teachers were able to reflect on the different choices they made during

their interviews. Table 4 is organized by content area and then by total TPACK scores from the rubric.

Table 4

Technological Pedagogical Content Knowledge by Participant

Participant	Content Area	Technology Selections (TPACK)	Fit (TPACK)	Instructional Use (TPACK)	Total For All Areas
8	Math	3	3	3	2.86
6	Math	3	3	3	2.71
11	Science	3	3	3	2.71
3	Science	2	2	2	2
9	ELA	3	3	3	3
7	ELA	2	2	2	2.14
1	ELA	2	2	2	2
4	ELA	2	2	2	1.57
5	Social Studies	2	2	2	2
2	Social Studies	2	2	2	2
10	Social Studies	2	2	2	2
Average		2.36	2.36	2.36	

TPACK in math. Participant 8 displayed elements of TPACK all working together in the math lesson I observed. I also observed her switch from technology to non-technology activities very quickly. She formatively assessed students with kinesthetic and choral responses in between her interactions with the Activboard. She used ActivInspire not just to show content but also to chunk information, provide multiple visual representations, and promote engagement. In the observation the teacher was using technology, and the students were practicing math problems in their workbooks, using other tools such as compasses. She reported using technology not only

to plan and collaborate but also to pace her lessons effectively. Participant 8 reported, "All my lessons are planned using that tool [ActiveInspire] …so all my instruction is implemented, not implemented but enhanced with technology." The observational data supports this statement. When I observed Participant 8, her lesson was enhanced by the technology she used. These details of technology, content, and pedagogy working together were evident not only in her interview but also in the observed lesson.

TPACK in science. Participant 11, a science teacher with more than 20 years' experience, discussed a particular tool for her content area that would provide opportunities for students to learn content in a new and engaging way. She wanted to provide students with opportunities to visualize scientific concepts through simulations which was impossible or not pragmatic prior to these types of technology. She said, "Had I been more comfortable with the technology, I probably would have implemented it and let them actually play the game." Lack of competency can affect a teachers' technology integration. However, through observation of her classroom, I assessed her knowledge and skill of TPACK through the use of other technology tools with which she was competent. She used technology to promote engagement, to assess student learning, and to represent science content. This is evidence that teachers who are competent in TPACK require ongoing support in order to continue to learn and grow, especially as new technology tools become available.

Participant 3, also a science teacher with over 20 years' experience, discussed a time when she felt successful with her technology integration. In this description of a "genius hour" project, she talked about students researching their chosen topic, choosing

a technology component for presentation, and using technology to publish the presentations. This teacher's attention to pedagogy, to content standards of science and ELA, and technology components were evidence of TPACK. The participant said she was successful in this technology integration because of collaboration and building support. "What made that experience possible was the help of others. Working together as a team with technology integration, with my instructional coach, with our art teacher." She was quick to point out that technology integration was her SMART goal for the year, because she believes in the power of technology in the classroom.

TPACK in ELA. Participant 9, an ELA teacher, discussed her instructional goals and the process of using technology to meet those goals. She said, "I think technology really lends itself to find new ways of learning and communicating. It helps them [students] practice speaking and listening standards and helps them when they are collaborating and giving each other feedback." She also talked about using technology to enhance the writing feedback so that she can give students timely feedback to improve learning. When I observed her classroom, I saw technology as a way to differentiate learning opportunities and give students tools for collaborating with peers. One group of students was using Google Translator to add elements to their video. Another group was working on their script typing on Word online. This participant has over 20 years of teaching experience, and I asked her how her technology integration had evolved. She told me she's had a shift in her mindset regarding teaching with technology. "I think part of it is that I've realized that technology is not always about doing it perfectly but doing but trying and seeing how you know each person is going to do it in a different way

through technology. They [students] are not all the same, and the uniqueness of the product/tool helps me meet the needs of students. You get that through technology." This was a different outlook than Participants 4, an English Language Arts teacher, who reported feeling like she needed to know more about technology, so she could troubleshoot. She reported this lack of knowledge and skill as a hindrance to their technology integration. Her beliefs about technology are supported by my observations, and I assessed the lesson as a "2" across the TPACK areas.

TPACK in social studies. Participant 2 discussed methods of technology, content, and pedagogy, which indicates a knowledge of TPACK. However, I did not observe these elements together in her classroom, and her interview revealed that she was not yet utilizing TPACK in her classroom but that she wanted to. Participant 2 talked about using a back-channeling tool that she would like to use with her CNN news. Students would reflect on their learning, pose and answer peers' questions, and interact with current event topics with elements of digital citizenship. She has not yet implemented these strategies in her lessons for reasons mentioned above; yet, she intends to do so. It is evident that she needs support to enhance student learning.

Years of Experience

Four participants discussed great comfort in technology use because of their age. Participants 1, 5, 8, and 10 all made mention of growing up with technology and suggested an ease of use because of this. However, the average TPACK score for those four teachers was a 2.18, indicating their technology use minimally supported their instruction as seen in Table 3. These participants also have between 1-10 years of

experience. The average TK score of those participants was a “3”, indicating they have the knowledge of skills to operate technology but may not be integrating technology into curriculum and instruction. This would suggest that technology knowledge and comfort of use does not equate to integration of technology within instructional practice.

The participants who had the most teaching experience scored higher in the seven rubric areas as seen in Table 5. The four participants with the most teaching experience (ten years or more) had an average TPACK score of 2.5. The participants with 5-10 years’ experience had the lowest TPACK score, averaging 2.0. The teachers with the least number of years’ experience had an average TPACK score of 2.2. This may indicate that teaching experience influences teachers’ ability to integrate technology.

Table 5

TPACK Scores and Years of Experience, Content, and Grade Level

Participant	Content	Grade	YOE	TOTAL TPACK
9	ELA	7	20+	3
8	Math	7	< 5	2.86
11	Science	7	20+	2.86
6	Math	8	5-10	2.71
7	ELA	6	11-20	2.14
5	Social Studies	6	< 5	2
3	Science	6	20+	2
2	Social Studies	8	< 5	2
1	ELA	6	< 5	2
10	Social Studies	7	5-10	2
4	ELA	8	5-10	1.57

Lack of Time for TPACK

Time is often listed as a barrier for technology integration. In this case, time was mentioned by six of the eleven participants; however, the meaning varied across teachers. Two participants mentioned lack of time and motivation as reasons for their lack of technology integration skill. Participant 2 stated, "There's so many wonderful things out there that I don't want to just put my time and energy into it until I can completely understand all sides. … So, I would rather implement something that I'm very comfortable with. Some of the newer pieces, I haven't had the time to understand yet." Participant 9 discussed the timing of her technology for instruction learning. She said that she may learn a tool, but it may not be at the time of need, which hindered the possibility of her using it. Participant 4 discussed the lack of time within her scope and sequence. She said, "There are things that I need to do, and sometimes we just have to get through it [curriculum]…I don't take the time to figure out the tools so that it doesn't impede our progress." This speaks to the participant's TK skills as well as a lack of knowledge of TPACK and how technology could make tasks more efficient. It is interesting that three other participants stated their reasons for using technology in their instruction was efficiency, both for students and for themselves as teachers. Two math teachers discussed using a specific tool because it saved them time from creating their own games or reviews. They specifically chose the tool for this reason.

Conclusions

Based on observations and interviews, teachers' technology use was varied, and there were several purposes for technology integration. Teachers used technology for

planning, pacing, efficiency, and organization. Teachers also used technology in their instruction to keep students engaged, to offer opportunities for research, and to present information. I observed teachers' technology integration at various levels, and they self-reported various levels of knowledge and skills through their interviews. I observed teachers' technological content knowledge (TCK) second only to TK-Teacher Use; TCK was discussed most in the interviews. TK-Student Use was the lowest of the constructs with an average score of 1.36. Teachers are using technology far more than students in this case. As teachers discussed technology use and practice, many of them talked about how they, as teachers, used the tools. Support for technology integration may be a factor in this variance. Teachers may also need training in TPACK and how technology can give students opportunities for collaboration, creativity, and choice.

Because I only observed assessment practices with technology in one of eleven classrooms, it leads me to believe teachers are not using technology for assessment routinely. Their current practice does not involve formative assessment practices with technology *during* the learning process. Students and teachers alike could benefit from ongoing assessment for setting goals and making adjustments to learning; technology tools could make the data collection easier and more efficient. Teachers may benefit from seeing a mentor teacher use technology for assessment as Participant 11 did in her observed lesson.

Support for Technology Integration

The second research question guiding this study is the following: to what extent do teachers feel supported to integrate technology? I answered the question through

investigation of the interview responses. I asked the participants how the various groups (colleagues, technology team, building administration, and district administration) supported them in their technology integration. The question of perceived support was broken down by department as a way of discussing all angles of assistance. Teachers responded with 32 specific examples of positive support and 13 examples that spoke negatively of support. I coded negative examples and comments separately with an "N" for the category, i.e. "District Support-N". The results from the interviews indicated that teachers feel supported by all the groups to use technology in their instruction. I did not find a connection between other variables such as content, grade level, or years of experience.

Support from colleagues. Participants all acknowledged that support from colleagues was positive. I coded 12 positive comments for colleague support with zero negative comments. Participants provided more positive comments for colleague support than for any other department. This indicates a great need and appreciation for collaboration, mentorship, and training with peers. Participants discussed peers as lead trainers in professional development, as mentors learning new technology tools to use in specific contents, and as technical support when technology did not go as planned. There are also some limitations to colleague support, discussed below.

Support from colleagues in professional development. Two participants discussed the importance of professional development with colleagues leading technology sessions. Participant 2 indicated that she feels a great deal of support from all colleagues in the building. She said, "I always have some sort of source to go to ask

questions. In that regard out building is such a wonderful place to try to implement something…I saw you in that PD [professional development] strand. What did you do? How are you using it?" She discussed how other teachers are using technology in the classroom. Participants also discussed support from colleagues when asked about their technological content knowledge. Specifically, I asked them how they came about TCK knowledge and skills, and participants discussed their peers as technology leaders and professional development opportunities. Participant 9 said, "I learned how to use it in PD because our district purchased a subscription to it and we had an online training with the company, and then Matt [pseudonym] helped me learn different ways to use it." Both comments speak to teachers' desires to learn how to implement or integrate technology in classroom instruction, not just to learn how to use a technology tool.

Support from colleagues as mentors. Participants 6 and 8 both maintained that their cooperating teachers during student teaching were key in learning TCK. Participant 8 said, "When I was student teaching with Diana Preston [pseudonym], that's how she planned her lessons. She had all her slides on there, and so that's how I started planning my lessons, and I thought it was a good tool and I think with time and practice and I spend a lot time making my slides and planning them out and asking other people questions." Participant 6 specifically recalled that an 8th grade math teacher was a mentor to her, and they worked together using ActivInspire to plan their lessons for Algebra and Math 8 lessons. Based on these testimonies, I believe peer collaboration and mentorship to be valuable tools for teachers' technology integration, specifically for TCK.

Technical assistance from colleagues. Another participant reported seeking

technical assistance from colleagues. Participant 3 reported, “Colleagues are great. I’ve asked my colleagues who have more experience how to do something, how to load something, how to work something. And they will help me. And then there was this golden day where I actually got to help somebody else with something. I was pretty excited about that!” Her comments are from a technical angle of how to technology works, relating to her TK.

Limitations to support from colleagues. Support of colleagues could have limitations. I asked Participant 4 to expand on her idea that she knows there are tech start but she does not always go to them for help. She reflected that she prefers to seek help and guidance from the technology department because she understands that her teacher colleagues have some many other things to do: grading papers and attending meetings. Participant 5 indicated a high level of perceived support, but also noted a divide in those teachers who excel at technology and those who do not. “My social studies team, there is a big gap between two of us and the other two of us: old school and new school. Alexa (pseudonym) and I are very techy and the other two are not as much. But, they are all for anything we suggest.” All participants reported a high level of support from colleagues, but they also acknowledged the need for other types of support for teachers’ technology integration.

Support from the technology department. Eight participants reported positive support from the technology team, and seven participants reported negative support from the technology team. This showed a need for growth. The technology team included the technicians, whose responsibility was for hardware and software management as well as

classroom and instructional support from the technology integration specialists. Support varies much in purpose, from technical support to integration support. Participants gave positive comments on technical support, and they made note of limitations for technology integration. In particular, participants said they were overwhelmed by the choices, were unsure of the vision, and did not have the technology integration support they needed.

Technical support from technology department. Response time and ability to problem solve were the main components to the technology team. Participant 1 said of support, "I feel like the IT department is definitely dependable. I wish they were open during Packer Time because that would be a perfect time for them [students] to get help, but other than that. Support is great." Participant 8 discussed the technology request system for help. She said, "The tech department is my number one favorite because every time I put in a tech request, it's answered almost immediately. If they need to come to my room or help me with something, they're there. So, I think that's the highest as far as support." Another participant discussed going to her building technician to receive technical support. When I asked what support was lacking, Participant 7 said, "I really don't feel like we are lacking. Any time that I have an idea, there has been somebody there to help me implement it and to do it. I don't feel like I've been lacking any of that support." Participant 9 discusses positive support. She said, "Well, I like that we have training through Tuesday Talks and PD. We're exposed to new technology that I wouldn't go and explore on my own. And, I've definitely had help, like when I wanted to implement a video project." Participant 5 gave a summation and said, "Colleagues, the tech department, everyone is awesome with support."

Limited support for technology integration. One participant also noted the pressure they felt regarding the fast-paced progression of technology and the constant need to learn technology. Participant 1 reflects on this when she said, “The only way I’ve ever felt not supported is sometimes I think things go so fast, and I think that any person gets really stressed out by something new in technology and not knowing what to do. So, I remember when we did our first 1:1 device training. Like, I honestly went home and cried because I was still overwhelmed by every that we learned.” This concern speaks to the lack of support by technology integration, as they planned and conducted the training.

Participant 6 also reported a need for support with technology integration. She said, “Tech department, I feel like you guys are always available. I don’t know because I’m not aware of stuff. I don’t even know what to ask because I don’t know what I’m doing that could be better, if I had to use technology. But, I know that you guys are available.” She seemed to know that the technicians will help her when she needs it, but there is a lack of coaching or mentoring. Participant 8 made a similar comment. She said, “There’s a lot of tools out there, and it’s hard to find the ones that work the best and there is almost too much sometimes. What do you want me to use? Do you want me to use OneNote or OneDrive? Schoology? There’s a lot of tools out there, and it’s tough to figure out, with time, what’s going to work the best?” This comment speaks to lack of technology integration support as well as a lack of vision for technology integration. Teachers do not know what is expected of them.

Participant 11 reflected that the technology integration specialist was often tied up in device management tasks. She used the analogy of a coach and said, “Jenna’s

(pseudonym) time is limited. She is busy managing these computers, and that's not really what her job should be. On a sports team, who manages the equipment? Not the head coach; he's busy coaching." This participant acknowledges that the district may not be using its current resources as well as it could/should be. The comment also indicates that teacher did not have support when she needed it because she perceived the integration specialist was busy with other duties.

Support from building administration. Six participants responded with positive comments about building administrative support for technology integration. Participant 2 said, "Building administration is great. I think they're always pleasantly surprised when they can come into your classroom to see the wonderful things you're doing and be supportive of the questions that you have and the time that you need to put in." Participant 5 who came from the same building as Participant 2 echoed the idea. She said, "Building admin, I think they're all in and supportive." Participant is from a different middle school building with different building administration. She too feels supported. She said, "I really feel supported by our district with that and within the district, the building, colleagues, technology department. Everybody has been fantastic about when we say, 'Hey we want to do this.' They figure out a way."

Participant 4 had a more neutral response. She said, "Current building administrators are in a similar boat that I'm in. they know that it's (technology) good for the people who really like to use it. But if they don't take the time to use because they're not in a classroom or don't really have to use it, then it's a side-cart." This may be an

indication that she believes her building administrators do not have the TK to be leaders for technology integration.

Support from district administration. Support from district administration had the fewest comments overall. Six participants discussed support from district administration, three positive and three negatives. Participant 9 reflected on district support when she said, "Yes, I think there's been a focused effort by our building and our district that we are going to get students and teachers the tools they need." Participant 4 disagreed saying, "I think the district office has the rosy-colored glasses on. They think, 'Here are all the things we're going to do and pay for,' and then they assume they're all going to work." She presented an interesting idea that the district administrative team does not have a realistic picture of what using technology looks like in the classroom. Another participant shared a negative comment overall regarding support. She said, "District admin, it's hard to tell. They do stop in and observe things. But, I wish, the only additional support, and this is more of a personal problem, but time. I wish we were given more time, because like I said, content is one piece, but technology is a whole separate piece." She believes that professional development, controlled more by district administration, does not allow her enough time to learn and collaborate. "Just to explore what other people in the building are doing. . . I wish there was something again…another gallery walk of technology pieces that we're using and how we're using them." She is seeking more flexibility in her PD time to collaborate and learn from peers.

The interview data shows that teachers in this case feel supported to integrate technology. Teachers are supported by their peers, the technology department, their

building principals, and the district administration. Although participants came from two different middle schools, I did not see that variable affect teachers' perceived level of support. Also, I did not find a correlation between teachers' perceived support and their content area. One participant reported, "I feel like we have total support in our district to implement whatever technology we see fit for a classroom. And, as long as we can justify what we're doing and how it enhances the learning and stretches the kids, I really feel supported by our district with that, within the building, colleagues, technology departments. Everybody has been fantastic about [when a teacher says] 'Hey, we want to do this'. They figure out a way." This quote seems to represent how some of the teachers feel about technology support in this case. However, other participants perceived lack of training and support. Teachers feel like they need personalized support to make good decisions about which technology they should be using and how best to make that happen. They could benefit from collaboration with peers or mentors and to work with technology integration staff to meet their instructional goals. Teacher responses also pointed to a possible lack of interest by building and district administration, or not understanding technology in a classroom. Those two groups received fewer comments than colleagues and the technology team.

Conclusion and Project Deliverable

The data is a result of studying the problem of technology integration in a North Dakota school district. Teachers are using technology in their instruction at varying levels. Overall, the case showed a strong indication of TCK but lower results for TPK. The greatest struggle for teachers seemed to be in the area of student technology use. Of

the eleven participants I only observed four classes that allowed students to use technology. One classroom asked students to use technology at levels that required all aspects of TPACK. However, through participant interviews, I discovered that teachers feel supported to use technology. This indicates there is a lack of understanding or a need for more training to help teachers use technology to its greatest purpose. Professional development training may be necessary for teachers and leaders of Midwest Public Schools. Teachers will be provided with opportunities to learn at the own pace as well as coaching support from a technology integration specialist. During the training, teachers will create a plan for ongoing support with peers, coach, or technology integration specialist through a coaching model. Administrators will receive training on the elements of TPACK, how to evaluate technology integration, and strategies on how to discuss technology use for instruction with their teachers.

Section 3: The Project

Introduction

Purpose and Goals of the Project

In this study, I explored middle school teachers' technology integration in a North Dakota school district. Low technology integration was the problem of the study. District staff trained middle school teachers in technology use with the implementation of the 1:1 computer initiative, but administrators did not see teachers and students effectively using technology. I discovered several themes as a result of interviews and observations of teachers. Teachers have various levels of knowledge and skills in terms of each of the constructs of TPACK. Teachers' TK was the highest of the constructs based on the observation rubric, and student technology use was the lowest. Teachers' TPK was also low; notable was the lack of assessment practices with technology. The purpose of the project is to address teachers' technology integration deficits by providing training to increase teachers' knowledge and skills in relation to the elements of TPACK so that they can effectively integrate technology.

The project for this doctoral study is a professional development plan for middle school teachers who teach core subjects (math, science, ELA, social studies) in grades 6-8. The plan will include all core middle school teachers and school administration from two secondary buildings. The training includes a two-day introduction, online asynchronous modules, and implementation of coaching sessions. The project will provide teachers with knowledge of the constructs of TPACK and ask teachers to self-assess their current technology integration knowledge. Teachers will collaborate with

peers to learn how to enhance their technology integration skills, specifically ways to use technology for assessment and make their classroom more student-centered. Finally, the plan will provide opportunities for teachers to receive coaching support for their technology lessons.

Rationale

Through this study, I examined teachers' technology integration skills and perceptions of support for technology integration. In the interviews, teachers indicated various levels of support from colleagues, technology staff, and building and district administration. Participants appreciated technology integration support from colleagues and technical support from the technology department. However, they acknowledged areas of weakness in training and support, particularly from technology integration staff and district administration. In particular, participants wanted time to collaborate with colleagues, and they expressed the need to learn and practice district-supported tools for their classrooms with support. My observations of the 11 participants also indicated a need for more teacher training and support. From the observations, I found the greatest need was to help teachers use technology for assessment and create a more student-centered classroom. I designed the professional development plan to meet these needs in the following ways: training for TPACK, collaboration with peers, individualized technology instruction, and coaching with technology integration. Both teachers and principals will benefit from the training to learn the complexities of teaching with technology through a TPACK lens. The training will also allow for an individualized

approach for teachers, since teachers' TPACK skills vary. The professional development training will enable teachers to use technology to create a student-centered classroom.

The training includes three different modes to support teachers. The face-to-face introduction gives teachers an overview of TPACK through a platform of desired collaboration with peers. The introductory training also creates an opportunity for teachers to hear a common message about the district's vision regarding technology use and expectations from principals and the administration. The training will include self-assessment and goal setting activities with which teachers can use to plan and guide their learning opportunities. Based on teachers' self-assessment and SMART goals, teachers will work with peers to design lessons for their current curriculum. The online asynchronous training modules will supplement teachers' knowledge and skills regarding technology tools supported by the district, such as Office 365 and Schoology. Teachers will choose videos of tools based upon their skill level and needs as identified in the assessment. The final training involves coaching and mentorship with technology integration and instructional coaching staff. Teachers will plan, implement, and reflect upon a technology lesson based on their instructional goal.

Review of the Literature

The following is a review of the scholarly literature from the last 5 years. Topics include TPACK training and support for technology integration. Using the Walden Library, I searched the following databases: Education Source, ERIC, SAGE Journals, and Computers and Applied Sciences Complete. I used the following search terms to begin the literature review: *adult learning theory*, *TPACK and training*, *evaluating*

teachers' TPACK, *instructional change and leadership*, *online professional development*, and *TPACK and design thinking*.

Adult Learning Theory

Knowles' theory of adult learning is composed of five assumptions. Adult learners are self-directed and rely on past experiences, Their readiness to learn is based on social roles, require real world applications, and are internally motivated (Knowles, 1980). Andragogy is often synonymous with adult learning (Merriam, 2001). When adults have experience and knowledge in a given area, they want to contribute to the classroom experience; adult learners also require activities for real world application, not memorization (Knowles, 1980).

Mezirow's transformative learning theory is also important to adult learning research in that it can help explain why adults reject notions that do not meet their frames of reference. For learners to undergo a paradigm shift, they must think critically about their frames of reference to be able to change their chemata, judgements, or beliefs (Mezirow, 2000). When adults are faced with contradictions to their beliefs, opportunities for learning can occur (Cox, 2015). The goal of adult education is to help people think critically about their own assumptions as well as others while engaging in discourse (Mezirow, 2000).

Narrative learning is part of the constructivist approach, allowing people to construct knowledge based on stories told of their experiences (Clark & Rossiter, 2008). Case studies, the most common mode of narrative learning, present a problem which

students must address (Clark & Rossiter, 2008). Teachers could use a case study as a valid way for adult learners to study a problem.

Approaches for Professional Development

Constructivist approach. Looi et al. (2014) and Martin (2015) noted their successful trainings for TPACK using a constructivism as a theoretical approach. Looi, et al. (2014) said,

> The PD can focus on pedagogical content knowledge, principles of technology integration, and constructivist ways of conducting activities. Thus, structured PD sessions consists of research sharing, lesson design, lesson elaboration and reflection aligns with the development and scaling up of the innovation by being responsive to the needs of the teachers. p. 113

Martin (2015) indicated that technology trainers must help build pre-teachers' confidence with technology through exposure to its use and modeling of the tools within the course is one way of doing that; when pre-service teachers had a mentor, the pre-service teachers reported higher levels of confidence with technology use. Looi et al. (2014) studied cases which paired a novice teacher and a seasoned teacher to design, implement, and reflect upon lessons using mobile technology; it was through these cases that Looi et al. (2014) saw an up-trend in student outcomes on science assessments as well as a sustainable approach to technology-supported curriculum changes. Dinse de Salas, Rohlfs, and Spannage (2016) discovered that teachers who received coaching support implemented technology more than those who did not have coaching support in their classrooms.

Koh, Chair, and Tay (2014) discussed a constructivist approach, and they said, "Teachers who had stronger beliefs about constructivist, student-centered instruction tend to have higher classroom use of computers, and constructivist beliefs positively contributed to teachers' attitudes and motivation toward ICT use which in turn motivated their classroom use of ICT," (Koh et al., 2014, p. 22). Olofson, Swallow, and Neumann (2016) showed that when teachers fail to view the teaching process through a constructivist lens, they miss opportunities for TPACK. An overall point to their research said, "We see that the independent development of technological knowledge may cause difficulties for student-centered TPACKing," (Olofson et al., 2016, p. 197). Instead, leaders should challenge teachers to consider why and how they make all pedagogical decisions, not just those related to the separate constructs. Olofson et al. (2016) stated, "If teachers are helped to self-analyze the influences on their decisions and their growing knowledge bases, they may be more deliberate about their choices to incorporate (or not to incorporate) all of these factors into the construction of their TPACK," (p. 198).

Learning by design. Niess and Gillow-Wiles (2017) provided teachers with a systems approach and recognized that teachers used technology with instructional strategies, used multiple technologies for active student engagement, and utilized a student-centered approach in their classrooms. In what they call a system of technology approach, teachers use multiple technological tools to create a 21st-century classroom where students can practice the 4 C's. When teachers engage in a systems of technology approach, they are exploring a deeper understanding of pedagogy and an advanced implementation of TPACK (Niess & Gillow-Wiles, 2017).

Preservice math teachers were given an introduction of learning technology by design, they designed with a team of math teachers, and implemented their lessons. This was effective professional development. They used a micro-teaching practice, where teams tried the lessons on their peers and made corrections when necessary. Most lessons had tasks/activities that were performed by students, so the lessons were more student-centered than teacher-centered (Agyei & Voogt, 2014). As Koehler et al. (2007) discovered, TPACK emerges when teachers engage in the design process.

Benton-Borghi (2013) recommended a training approach that infuses universally designed for learning (UDL) and TPACK, so teachers can meet the needs of all students using technology and the three UDL principles: provide multiple means of representation, provide multiple means of action and expression, and provide multiple means of engagement. Furthermore, teachers who believe in this type of approach will give students more opportunities to use technology (Benton-Borghi, 2013).

Supporting Teachers' TPACK

After studying early elementary teachers' design processes, Boschman, McKenney, and Voogt (2014b) discovered that teachers will benefit from two types of support during their collaboration for TPACK and lesson design: procedural and subject-matter support. They noted different topics for grouping details of the conversations while teachers were creating lessons for technology:

1. Practical concerns, such as their pre-existing knowledge and beliefs of technology and their experience with curriculum and instruction.

2. External priorities, such as national and state standards, building expectations, and curriculum goals
3. Existing orientations such as the amount of time available for the lessons, their students' needs, and the classroom setup (Boschman, et al., 2014b).

Koh et al. (2014) also noted a lack of focus on pedagogy and found that 55% of the teachers' comments were related to cultural/institutional factors while planning lessons. Most of the comments were logistical in nature (scheduling and organizing); the more time spent on cultural aspects, the less time spent on TPACK. Thus, teacher collaboration time must be focused on pedagogy rather than cultural/institutional factors (Koh et al., 2014). Boschman et al., (2014a) recommend chunking information into small sections during the design process and support from a researcher to help facilitate the design discussion. The authors also recommend that a content expert be present to help guide teachers to answer questions as issues of content come up. (Boschman, et al., 2014a).

Coaching and peer mentoring. As Peterson (2015) discussed, "Change in these beliefs requires a sustained relationship that can support growth through reflection and support in trying new approaches," (p. 1392). This relationship could be found within the administrative or coaching teams. Nugent, Houston, Hall, and Kunz (2014) found that coaching support was successful in helping teachers change practice; after an eight-day intensive training, coaches supported their teachers suggesting that follow-up support is necessary for change in teacher practice. Dinse de Salas et al., (2016) also noted success in coaching teachers; the coaching process was effective in changing teachers' self-efficacy and technology, attitudes towards technologies, and with teaching with

technology. Teachers received support in developing and implementing the lessons from a coach; coaches helped coaches generate knowledge using specific strategies to help the coaches overcome some of their negative feelings towards technology (Dinse de Salas et al., 2016). After interviewing and observing instructional coaches, Knight et al. (2015) discovered a simple yet effective three-step approach; teachers collaborate with an instructional coach to identify an instructional problem, learn and implement a new strategy, and reflect on the results. The authors provided a checklist for ease of use.

Teachers may also find support in their peer interactions through mentoring. Agyei and Voogt (2014) found collaborative groups of teachers learn TPACK best when they design together. Although teachers cited time as a barrier to technology integration, teachers viewed peer collaboration to mitigate that restraint (Koh et al., 2014). The collaborative culture was important, as the teachers could learn best when they formed PLC groups, and they could share knowledge and support each other (Dinse de Salas et al., 2016).

Administrative support. Administrative support is necessary for successful initiatives. Goktas, Gedik, and Baydas (2013) recommended that administrators attend training, as administrators who do not believe in the power of technology can negatively impact a technology initiative. Other research has noted the importance of building-level support from the principal. (Dinse de Salas et al., 2016). Pierson and Borthwick (2010) noted, “Successful educational technology PD initiatives are characterized by an expanded, informed, and connected view of learning on both the individual and the organizational level, (p. 128). Range, Pijanowski, Duncan, Scherz, and Hvidston (2014)

found that when administrators did not attend instructional training, it was detrimental to the coaching process and the overall initiative. Kurtz (2017) also noted the importance of administrative support, in particular for coaching where the purpose for the coaching process is school improvement.

Evaluation of Teachers' TPACK

Research indicates a conflict regarding the best ways to evaluate teachers' TPACK. Agyei and Voogt (2014) considered their participants' pre and post-surveys to determine their knowledge of TPACK; teachers' self-efficacy ratings were initially too high as indicated in interview responses that followed. Overall teachers believed they knew TPACK but could not create strong lesson plans based on TPACK (Agyei & Voogt, 2014). This coincides with past research by Lawless and Pellegrino's (2007) and Kopcha and Sullivan (2007) that noted teachers' self-efficacy with regard to technology was inflated. Not only in technology but in other pedagogical areas, "teachers may over-represent themselves when reporting on their own practices" (Kopcha, Ottenbreit-Leftwich, Jung, & Baser, 2014, p.94).

Kopcha et al. (2014) examined two popular TPACK measures that were previously established as valid and reliable. Kopcha et al. (2014) found that convergence amongst similar TPACK constructs was low/weak, and dissimilar constructs had strong correlations; the authors were concerned about the convergence across similar constructs between survey and rubric scores. This may mean the rubric is not detailed enough to determine the nuances of the construct of TPACK; this could be mitigated by giving specific examples for each leveled item in the rubric (Kopcha, et al., 2014). Shinas,

Yilmaz-Ozden, Mouza, Karchmer-Klein, and Glutting (2013) provided concurrent evidence stating teachers could not distinguish amongst the different constructs of TPACK, and further research into the rubrics and the model itself are needed. However, classroom observations and follow-up interviews can provide insight into teacher practice and teacher TPACK; the triangulation of data from multiple sources is necessary to evaluate teachers' TPACK (Schmidt-Crawford et al., 2016).

Evaluating professional development. Pierson and Borthwick (2010) argue that surveying teachers does not effectively evaluate educational technology professional development, because the surveys cannot measure if there was a change in practice or if the PD affected student learning. They offer a solution that embeds three concepts: TPACK (the what), context (the where), and practitioner research (the how). Action research can provide an evaluation of the PD by asking teachers to contemplate problems of teaching and learning within their own context, collaborate with peers to solve those problems, evaluating their results, and sharing their experiences and results with others (Pierson & Borthwick, 2010).

Project Description

Potential Resources and Existing Supports

There are several resources and existing supports in place. Staffing, training facilities, and funding are all included in the existing supports for this project. Staffing for professional development can often be a burden; however, in this case, there are several staffing supports available for the training. The Midwestern District is willing to provide compensation to instructional coaches and STEM Lead Teachers for two days of the

intended technology training. The Assistant Superintendent of Secondary Schools and building principals are also willing to be involved to support teacher training. Since teachers will already be under contract, no additional funds will be necessary.

The training requires a facility large enough to fit nearly 100 participants. The district has such facilities in each of the middle schools. They will make the rooms available for training on the designated date at no charge. This is considered part of the teachers' back to school training curriculum, and the facilities are made available for such events. The facilities include internet access, teacher laptops, a projector, and a comfortable meeting space for teachers.

The training requires very little funding aside from staffing. I have built in a Welcome breakfast and break time for both training days. I have requested and been approved for a food budget for this request. A light breakfast including coffee and cookies and gum for the break will be provided to the 96 participants. The district's food service department will make and deliver the goods, which helps keep the cost down. Any other expenses for training supplies, such as copies, will be incurred by the district's training budget. Since most of the training and materials will be delivered online, there are very few expenses of this type.

Potential Barriers

Potential barriers must be considered for the project deliverable. Time is the most significant barrier for the training. The proposed training requires two days of face-to-face contact with teachers. It is my hope that the district will allow two of the seven professional development days to be designed for technology integration training.

Without this designation, other options will need to be considered. Online training could be used. Teachers could also meet on student-contact days, which would require substitute teachers.

Another potential barrier exists if staff members are not willing to collaborate with instructional coaches and/or technology integration staff. If teachers do not see a benefit to the work or are too overwhelmed with their caseloads, they may not want to participate in the training or follow-up action research. Because the district and building administrators will be involved in the training, it is my hope that there will be little resistance. Also, the first day of the training is dedicated to talking about the importance of using technology in instruction.

Proposal for Implementation and Timetable

The following is a description and timeline of the proposed professional development project. The project includes two days of face-to-face training, divided into four parts. As the facilitator, I am responsible for the majority of the training sections. The technology training modules are online and asynchronous, so teachers can use them as they need. The final piece of training is a coaching session with an instructional coach or a technology integration specialist. The teachers will collaborate will their instructional support team to plan, implement, and reflect upon their chosen action research project. These times will vary by participant (approximately 6 hours) and may include several meetings for the coaching cycle. This is action steps are detailed in the Instructional Coaching Checklist found in Appendix E.

Objectives

- Participants will be able to identify the 7 constructs of TPACK.
- Participants will be able to describe the relationship amongst the constructs of TPACK.
- Participants will be able to differentiate the TPACK constructs when given a case study.
- Participants will be able to design a lesson using TPACK.

Activities

Participants will view PowerPoint and Sway presentations, read and annotate articles, gather materials for their lesson, plan lessons together, and reflect on their practice. Participants will also use technology tools as students; these tools include an online Venn diagram, Edge browser annotation tools, Microsoft Forms, Padlet, and Twitter. The activities are situated to give participants an experience in a TPACK environment. I chose the tools and activities because they are common to and supported by the district. These materials can be found in Appendix A. The agendas for the face-to-face activities are outlined below.

Part I

The facilitator will focus on the ISTE Standards and TPACK for the first segment of training. Participants will read and annotate several documents and participate in collaborative activities. The facilitator will use Sway, an online presentation tool, and an online Venn diagram creator. Participants will also engage in self-reflection of their TPACK skills. Table 6 (below) displays the agenda for Part 1 training.

Table 6

Agenda Part I

Activity	Specifics	Staff	Time
Introduction and Welcome	District's Vision and Mission 21st Century Learning Diagram Training Objectives	Assistant Superintendent & Facilitator	30 Minutes
Read, Annotate, and Connect	ISTE Standards for Educators	Facilitator	1 Hour
Sway Presentation Small group-Jigsaw Article	What is TPACK? History of the framework and the 7 constructs. Groups read and share information of constructs with Edge Web Notes.	Facilitator	1.5 Hours
Create a Venn Diagram	Write your own examples of the constructs and share.	Facilitator	30 Minutes
Self-reflection Four Corners	Where are your strengths? Where are your weaknesses? Share examples.	Facilitator	30 Minutes
Reflection & Evaluation	What elements of TPACK did we use? Training Evaluation	Facilitator	30 Minutes

Part II

The facilitator will review TPACK through a game and answer any follow-up questions from Part I training. Teachers will brainstorm a list of assessments with technology tools and strategies; then, volunteers will lead short, impromptu technology sessions simulating a mini technology camp. The facilitator will lead teachers through TPACK evaluation of a case study, and teachers will conduct their own evaluation of a vignette. The activities were designed to promote engagement and practice of TPACK. The agenda can be found in Table 7.

Table 7

Agenda Part II

Activity	Specifics	Staff	Time
Review TPACK Game	Review TPACK Constructs and Training Objectives Answer questions from parking lot	Facilitator	30 Minutes
Mini tech camp	Technology for Assessment	Lead Teachers	1.5 Hours
Case Studies	Discuss the context and the lesson. Evaluation of case study teacher's TPACK.	Facilitator	30 Minutes
Small group Vignettes	Choose a Vignette Read and discuss questions Post ideas to the Padlet	Facilitator	1 Hour
Discussion	Engage in online discussion through the Padlet	Facilitator	30 Minutes
Reflection & Evaluation	What elements of TPACK did we use? What did you learn? How can the training be improved?	Facilitator	30 Minutes

Part III

During Part III of training, teachers will take a self-assessment survey of their current TPACK knowledge and skills. They will use this information to create an instructional goal for the year. Instructional coaches and the facilitator will assist teachers in their goal-setting, as they create a plan for building their professional learning goal. Then, the building-level principals will discuss expectations for professional development. Part of the plan includes learning technology skills through online modules. Participants will preview the online modules, then have time to work on one of the modules. The details of the agenda for Part III training can be found in Table 8.

Table 8

Agenda Part III

Activity	Specifics	Staff	Time
Objectives	Overview of objectives	Facilitator &	30 Minutes
Self-assessment	Complete the self-assessment for technology integration (online survey).	Facilitator	30 Minutes
Presentation	Review of the elements of SMART goals	Instructional Coaches	30 Minutes
Presentation	Professional development expectations during the academic year.	Principal	30 Minutes
Exploration	Overview of the online training modules Choose and explore modules individually or in small groups.	Facilitator & Instructional Coaches	1.5 Hours
Reflection & Evaluation	What elements of TPACK did we use? What did you learn? How can the training be improved?	Facilitator	30 Minutes

Part IV

The focus of Part IV of training is on lesson creation. Teachers will engage in the design process to discuss an instructional problem. They will work collaboratively to determine a plan to address the problem. The facilitator and instructional coaches will be available to help teachers find resources/strategies and build a lesson. This lesson or strategy will be the focus of the teacher's action research for the year. They will partner with a coach or technology integration specialist to implement the lesson and reflect on the outcomes.

Table 9

Agenda Part IV

Activity	Specifics	Staff	Time
Review	Review TPACK Constructs and Training Objectives Answer questions from parking lot	Facilitator	30 Minutes
Presentation	Using the Engineering Design Process, redesign a lesson by adding elements of TPACK	Facilitator	30 Minutes
Discussion Think-Pair-Share	Brainstorm a list of instructional issues that we face in our classrooms.	Facilitator	30 minutes
Presentation & Small Group Discussion	Engage in the EDP with real classroom problems Present finished process to another group.	Facilitator, Coaches, & Curriculum	1.5 Hours
Presentation	Explore ideas and resources for action research.	Facilitator, Coaches, and Curriculum	30 Minutes
Gallery Walk & Reflection	Share findings and consider alternatives	Facilitator	30 Minutes
Reflection & Evaluation	What elements of TPACK did we use? What did you learn? How can the training be improved?	Facilitator	30 Minutes

Online Training Modules

At any time during the plan, participants may engage in online, asynchronous training modules. The modules are designed to provide teachers with the knowledge and skills for technology use to improve their TK and give them ideas about possible integration in the classroom. The modules were created by the Technology Integration

Team and are housed in the district's Schoology Resources. Participants will explore the training modules during face-to-face training to gain confidence with the process and mode of activity. There are over 24 hours of available training, and participants are required to participate in at least eight hours total or one hour per month (September-May). An example of one of the modules is presented in the training module in Appendix A. Other districts would want to find resources that would suit their own technology suites and technology tools. For example, some districts may use Google for Education resources if they are a Google campus.

Coaching Cycle

The last module of the professional development plan requires participants to complete at least one coaching cycle for technology integration. Teachers will meet with their instructional coach or the technology integration specialist to work on their SMART goal, which is tied to their action research. The purpose of the coaching cycle is to improve teachers' TPACK by implementing a new strategy or improving upon a current strategy in their classroom. Time timing and process are included below; however, each teacher's process will vary based on their needs. Teachers will engage in the coaching cycle (Identify, Learn, Improve) outlined by Knight et al. (2015). The Instructional Coaching Checklist can be found in Appendix E.

Table 10

Coaching Process

Checklist	Teacher Role	Coaching Role	Time

(*table continues)*

Identify	Teacher records a classroom lesson and identifies a student-focused goal.	Assist teacher in identifying a goal if needed.	1-2 Hours
Learn	Teacher researches a strategy to improve practice.	Assist teacher by identifying an instructional strategy. Identify district tools of support. Model new skills as needed.	2 Hours
Improve	Implement the new strategy.	Assist teacher in the classroom as needed.	1 Hour
Improve	Gather data by videotaping or observation. Reflect upon growth and make adjustments as needed.	Review data with the teacher. Offer support and review the goals.	1-2 hours

Roles and Responsibilities of Others

There are several other staff members involved in the training, as noted by the agenda details above. The Assistant Superintendent will provide a welcome and a purpose to the training, which is related to the district's vision and mission. I have also asked building principals to attend the training in hopes that they can learn about TPACK while providing support to teachers. The principals will discuss their own expectations for teachers' technology use. Since building administration will attend the trainings, they will have a clear understanding of TPACK as well.

During Part III and IV of the training, instructional coaches and curriculum coordinators will assist in design work and planning for action research. The participants can choose to work with their PLC groups for these activities. Smaller groups may require more support, and in particular, teachers can benefit from curriculum content experts (Boschman, McKenney, & Voogt, 2014a). Participants will also attend an overview of the professional development modules. The facilitator and technology team

created the modules for just-in-time training for district-support technology tools, such as Schoology, OneNote, and Sway. Participants could choose to learn and work together or individually while they explore the online PD modules. Technology staff will be available for questions as needed.

Project Evaluation Plan

Type of Evaluation

There will be both formative and summative evaluations. The facilitator will provide opportunities for teachers to experience formative assessment with technology as students. The Venn diagram activity on Day One of training will show teachers' knowledge of the different constructs of TPACK as well as how teachers believe that context can affect technology integration. Throughout the training, participants will be encouraged to post questions in the "parking lot" using Padlet, an online bulletin board. There, they can post anonymous questions and responses as they think of questions or concerns. At the end of each block, participants will be asked to reflect upon the TPACK constructs from the training and reflect upon their own learning. I will ask the following questions to close each of the trainings:

- What elements of TPACK did we use?
- How would you rate the training?
- What did you learn?
- How can the training be improved?

I will use the formative assessments listed above to evaluate teachers' understanding of TPACK. I can vary my timing and support during the training as a result of the formative assessments.

I will evaluate the goals of the project by the action research that teachers conducted. This type of evaluation will be more time-consuming than a survey format; however, I believe it will yield the most intensive and nuanced data. I will collect feedback from the teachers as they complete their action research, so the data collection will span the academic year.

- What have you learned because of your action research?
- How has your technology integration evolved because of your work?
- Discuss how your classroom instruction has changed to become more student-centered?

Teachers will share the results of their action research in a round-table discussion on the final workshop day in January. Teachers can feel validated by sharing their results and can learn from each other as well.

Justification for Evaluation

Research has shown teachers' reflections of technology training and their self-efficacy to be inaccurate (Kopcha, et al., 2014; Pierson & Borthwick, 2010). Teachers may use their self-assessment to discuss their own growth with their instructional coach and/or administration. However, this tool was designated as a way for teachers to consider where they are starting to make a plan for professional learning and not as a part of the training evaluation. Therefore, other means are necessary. Classroom observations

and follow-up interviews have been found to be an effective evaluation of teachers' TPACK (Schmidt-Crawford et al., 2016). Throughout the coaching process, I will have a better understanding of teachers' progress. Teachers will reflect on their newly implemented strategies professional growth.

Outcomes of the Project

The purpose of the professional development project is to increase teachers' knowledge and skills of technology integration. Teachers will learn the constructs of TPACK and discuss the importance of using technology in their instruction. Teachers will explore the complexity of teaching with technology by discussing case studies. Teachers will engage in the design process to provide solutions to current instructional learning problems. In collaborative groups, participants will work together to create lessons embedded in the current curriculum for teachers to use for the upcoming school year. Teachers will choose a problem on which they can complete an action research project, research possible solutions, implement their lessons, and study the results of their labor. Ultimately, teachers will share their action research with peers to discuss successes and opportunities for learning.

Project Implications and Social Change

Local Stakeholders and Social Change

The intended training has implications for local stakeholders including teachers, students, and community members. The project is intended to help teachers use technology effectively by focusing on current classroom problems. Teachers will appreciate the time allotted for reflection and peer collaboration, so they can make better

choices in their instruction. Although the purpose of the training is not to have teachers and students use technology more, teachers who have a student-centered view often do use computers more. Because the teachers are focused on action research, they are thinking critically about the instructional choices they are making, not just using technology for technology's sake.

One of the middle schools engaged in the training has a very diverse population with almost 40% of their student body receiving free/reduced lunch; opportunities for critical thinking and collaboration are particularly important for a diverse student body to learn and understand other cultures. Students in both middle schools may have more opportunities to learn with technology, making them more marketable in the workplace. Local stakeholders will appreciate that students are using the devices that were budgeted for student use.

Large Context of Social Change

The professional development project has implications for social change. The training materials were created so nearby schools and districts can utilize them as well. As teachers engage in the design process, they are involved in reflective practices, which can have a domino effect, creating opportunities for a 21st century classroom for more and more students. The purpose of the training is to provide teachers with the tools they need to make their classrooms more student-centered using the TPACK framework. A more student-centered classroom provides students with opportunities to collaborate and communicate in ways they previously did not have. When teachers can create opportunities for collaboration, creativity, critical thinking, and communication students

learn empathy and how their actions affect the world. Teachers can create opportunities for social change when they ask their students to engage in a more democratic classroom. Because the training is available to other districts, the opportunities for a more student-centered approach can affect other schools and communities as well.

Conclusion

This section was designed to address the local problem studied in the case. A review of the academic literature provided ideas to include in the professional development plan. I included foundational aspects of adult learning theory, design thinking, and TPACK to create four blocks of face to face training. Along with this training, teachers are required to engage in the instructional coaching cycle, choosing an instructional problem on which to focus. Teachers will engage in a process of action research, collecting data and reflecting on their process. This will be the overall evaluation of teacher training. This project had both local and larger implications for social change, as students deserve a more student-centered classroom for the 21st century.

Section 4: Reflections and Conclusions

Project Strengths and Limitations

The project has both strengths and limitations. Since I created the training modules with district-supported software and tools, the project was cost-effective. District staff can easily and efficiently update and maintain the modules as the technology tools change. The district can use the modules to scaffold technology integration for new teachers as the district adds them. The plan provides teachers with opportunities to use support staff such as instructional coaches and technology staff. It also allows for differentiated professional development, since teachers can move as quickly or as slowly as they need to. The project is an attempt to use current district resources to their fullest potential, including time, staff, and technology tools.

There are limitations to the study which could hinder its effectiveness. There are many factors that contribute to low levels of technology integration, and some of the factors are out of the scope of this project. The district may not be willing to provide the allotted time for teacher training. The project is based on ESSA's requirement to create a 21st century classroom for all students; project will be limited if teachers and principals do not believe in the necessity and importance of technology integration and a 21st century classroom. Scheduling, funding, and policy are all potential factors that would hinder technology integration (Voogt et al., 2013), and they are not within the scope of this study. Also, because I have created the project plan for the Midwestern School District, districts which are different may not benefit from the plan as it is written.

Recommendations for Alternative Approaches

I have created the project to attempt to solve the problem of limited technology integration skills for teachers in a local district. There are alternatives to the approach based on audience and delivery methods that I considered. The current audience for the project is all middle school teachers in the researched site. An alternative to this requirement would be for teachers to self-select and opt into the training instead of making the training mandatory for all. This would provide teachers with more freedom to determine their own professional development needs. However, this approach may be less effective, allowing teachers who currently avoid technology to continue to do so. This approach also allows teachers to self-report incorrectly about their need to improve their technology integration knowledge and skills. The current case indicated teachers have a high self-efficacy regarding technology knowledge, and yet they are not necessarily using technology effectively in the classroom. Furthermore, teachers who are already integrating technology may not have the opportunity to improve because they may begin to focus on other district initiatives. Alternatively, principals could determine which teachers must attend technology integration training. However, this would place greater pressure on principals for their teacher evaluations.

The intended project involves a mixture of synchronous and asynchronous delivery methods, both in-person and online. I could consider a simpler training outlook for the project by focusing on only one delivery method. By doing so, the project may have a greater focus, but this would greatly hinder teachers' ability to learn the way they learn best. Allowing for multiple delivery methods would lead to reaching a greater

audience. Synchronous classes make sure teachers have dedicated time to work on technology integration. Asynchronous opportunities allow for flexibility in timing. Since time was a barrier to technology integration, both are useful options. Ultimately, the alternatives for proposed audience and delivery methods may hinder the effectiveness of the project.

Scholarship, Project Development, and Leadership and Change

A case study was the correct choice to research the local problem regarding low technology integration in two middle schools. The qualitative data gave me a detailed look into teacher practices and experiences. The classroom observations revealed a variance in TPACK levels, and I uncovered details regarding assessment with technology and students' technology use. Without this observational data, I would have relied heavily on my own perceptions of teacher technology use, including major misconceptions. Observations and interviews were necessary to answer the research question. The interviews gave me details regarding teachers' decisions regarding technology integration and their perceived levels of support. However, I would have benefited from more research and practice regarding interview question writing. If I had to go through the process again, I would change my interview questions, asking more clarifying questions, particularly about teacher support. Although I vetted the questions with a group of teachers prior to the interviews, they were not as strong as they could have been. Teachers maintained they had enough support; however, it was clear that some support was missing. I could have asked specific questions regarding technology training and training follow-up support.

Each step of the research and writing held value. Now, I have a better understanding of the process, including research and data analysis, the project study, and defending my choices during each of these stages. In the development of the proposal, I became aware of the importance of locally-situated problem that reflected the bigger picture. I practiced patience and scholarly reading and writing strategies for the literature review. I learned about myself as a scholar, practitioner, and project developer. I understand the importance of research that is timely and peer-reviewed so that I may see gaps in research and possibilities for future research. I can appreciate the data collection process and the amount of time and energy scholars must put forth as they add to the body of research. I have also come to understand the qualitative data analysis process, including finding themes across situations and participants. The process tested what I knew about myself as a writer and researcher as well as a teacher.

I have become a better practitioner of technology integration because of the entire process. I have a better understanding of the reality of teachers' technology integration in this case. I learned more about the complexity of instruction and the number of decisions educators make as they plan and implement instruction. I have a better understanding of the nuances of instruction with technology, and I have been able to share this knowledge with local stakeholders. I have learned best practices for teaching and learning with technology, including how to use these strategies in training. I can provide an academic perspective, particularly regarding evaluating teachers' technology integration, for districts and schools as the district continues to grow. I have a better understanding of

how to use research to see the broader picture of a problem, finding value not only in the research which supports my point of view but also in the research that does not.

The project development gave me opportunities to grow as a project developer as well. To work on a project from beginning to end, I understand how important it is to start with a problem, use researched strategies and best practices for adult learners, and assess the project for the best outcomes. I included several opportunities for assessment and evaluation for the project because I can adapt instruction based on my learners. I included the participants in these formative assessments, asking them to reflect on their own learning. I believe these elements will make the project successful and going through the process of creating such a project made me more aware of what details are required for professional development.

Reflection of the Importance of the Work

Scholarly work is important so that educators can make decisions that are based in research and best practices. This project is important in that aspect, especially to the local district in which it is situated. The teachers and administrators want the best for students, and they can work towards more student-centered classrooms. However, teachers need knowledge, skills, and a process to make that happen. This professional development project gives teachers and administrators the training to aid in this process. However, it is the instructional coaching process and peer mentoring that will help teachers make meaningful changes.

The project was a result of information from the data analysis. The data revealed that teachers were not asking students to use their school-issued HP tablet devices, and

most of the technology use was conducted by the teachers. The district had invested heavily in a 1:1 computer initiative to provide students with opportunities for practicing the 4 C's, but only one classroom revealed high levels of student technology use according to the TPACK rubric. Teachers were not using technology for assessments, although they spoke often of doing so. Teachers who appeared to have the most pedagogical knowledge were also the most successful in their TPACK. This meant that the project needed to consider more than technological skills to be effective.

Implications, Applications, and Directions for Future Research

This research project has several implications, especially if the evaluations prove the project to be successful. I was able to identify specific areas of weakness, and I am particularly excited to offer ideas about putting technology in the students' hands. Students will benefit from teachers' change in perspective in many ways. A student-centered classroom that provides activities for engagement has a profound effect on student achievement (Looi et al., 2014). Teachers will benefit because they will be able to use their knowledge of TPACK to create engaging and impactful lessons. The project could provide an option for similar districts who are also experiencing low technology integration.

There are several considerations for future research. The literature suggests that the TPACK framework has some weaknesses due to our inability to distinguish amongst the seven constructs (Kopcha, et al., 2014). Identifying specific examples on the rubric and implementing a norming process could provide more consistent results. Further exploration of TPACK as a tool to create rich, 21st century classrooms (Olofson et al.,

2016) and to enhance our knowledge of how teachers can transform TPACK into lessons is necessary (Koh et al., 2014). Further exploration of the results of this project study could add to that knowledge base. Another question to explore is the most effective way to evaluate teachers' TPACK.

Conclusion

This section provided me with the opportunity to reflect on the project. Through these reflections, I could evaluate the strengths and weaknesses of the project, providing a clear picture of the project's possibilities. The training was complex with its many modalities, and I considered more simplistic approaches. However, the face-to-face training coupled with online modules for personalized learning provided teachers with opportunities to collaborate as well as learn at their own pace. The instructional coaching cycle, although time-consuming, was necessary to support teachers' change in mindset.

In this section I was able to reflect upon my growth as a professional, researcher, and practitioner. Through a great deal of effort as well as support from family, colleagues, and university staff, I have made tremendous progress. I am a more well-rounded professional with knowledge of research and project development. I have a greater background of research in technology integration, which benefits teachers, students, and administrators in my district.

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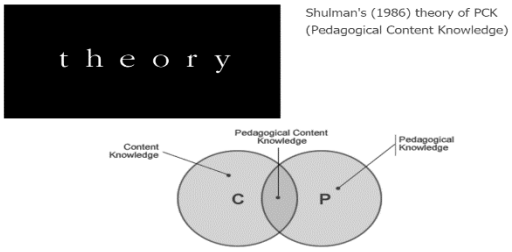
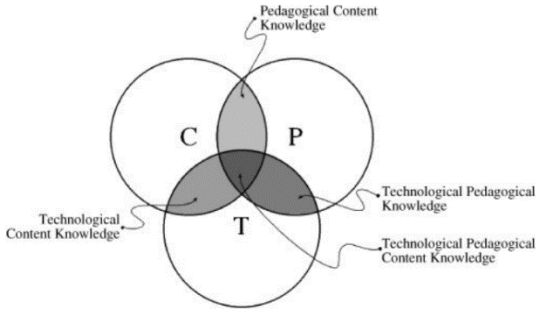
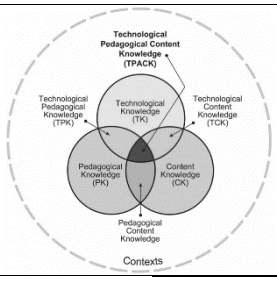
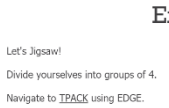
Appendix A: The Project

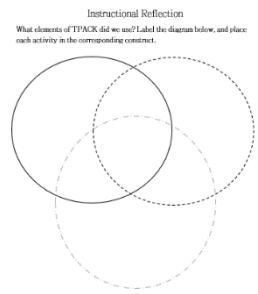
The materials below are to be used by the facilitator. Day 1 presentation is in the form of a Sway website. Each "slide" is a portion of the website. All handouts are found below the materials and are hyperlinked for ease of use.

Part I

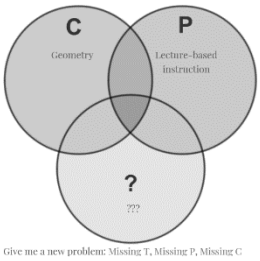
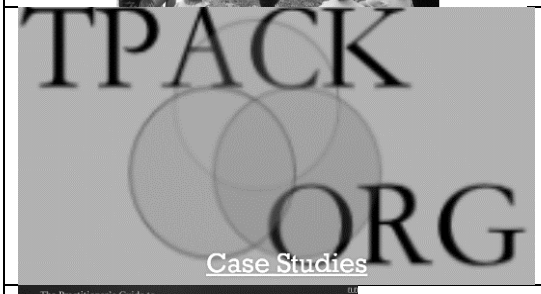
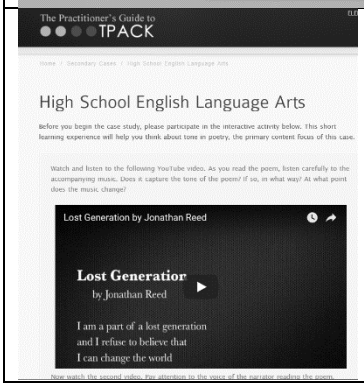
	Slide 1: introductions and welcome. Discuss your background, qualifications, and passion for teaching with technology. Write the Twitter handle on the board so people can backchannel during the training.
Who: leadership What: ISTE standards Why: our vision and mission How: TPACK	Slide 2: We are here as a team of teacher leaders hoping to collaborate and improve our practice. We will use the ISTE Standards for Educators to guide our process. We will use our district's vision and mission to drive our motivation and thinking. TPACK will be our framework for learning.
Mission Educating today's learners for tomorrow's world. **Vision** Midwest School District prepares all learners with the knowledge and skills to be compassionate, contributing citizens in a rapidly changing world. We are dedicated to continuous improvement, engaging every student to become problem solvers and lifelong learners. Excellence is achieved through practices based in research, and by aligning all resources to support learning.	Slide 3: If we want all students to be successful, we must create a 21st century classroom. All students deserve to learn and practice strategies for creativity, critical thinking, communication, and collaboration. Technology can help us achieve this.
Objectives • Participants will be able to identify the 7 constructs of TPACK. • Participants will be able to describe the relationship amongst the constructs of TPACK. • Participants will be able to differentiate the TPACK constructs when given a case study. • Participants will be able to design a lesson using TPACK.	Slide 4: Here are our objectives for our trainings. Today we will be learning about the seven constructs that makeup the TPACK framework. Learning about these constructs will help us identify strengths and weaknesses in our instruction. We will look at examples and practice some technology tools.

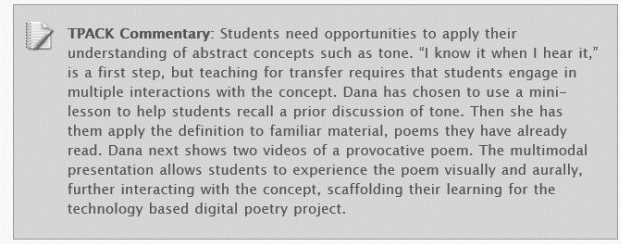
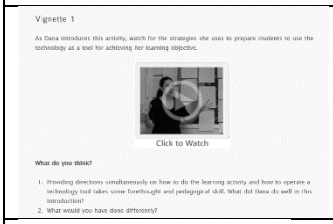
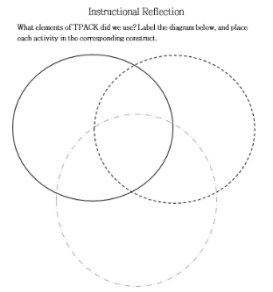
	Slide 5: Hand out ISTE's Standards for Educators. Using the printed copies, teachers will silent read the list of standards and annotate as instructed.
 Highlight/underline key phrases that resonate with you. Star your strength(s). Circle your weakness(es).	Slide 6: Teachers will highlight interesting ideas, star their personal strengths, and circle their weaknesses. Give plenty of time for teachers to read through and identify these areas. Ask teachers to share their ideas with their tables. Each table should then share their most interesting idea(s).
	Slide 7: While we are working, please use the parking lot on Padlet to post any questions or thoughts you have. https://padlet.com/afox19/i2znz9r7r2zj
	Slide 8: TPACK has a basis in Shulman's theory of Pedagogical Content Knowledge. Shulman noted that there is a sweet spot where teaching strategies and content merge. We should not teach math with the same methods we use to teach English. That is why we now have separate methods courses for subject areas. Can you think of teaching strategies that you use often, relating to your content? Share with your table.
	Slide 9: Mishra and Koehler used Shulman's theory to create TPACK. They believe that technology should be a third component, creating seven individual constructs. Let's look at these constructs carefully. Share examples as you talk about each of the areas. TK: a teacher can operate his/her Activboard with ease. TPACK: a teacher uses his/her Activboard

	to gain attention, display content with shapes and colors, and assess student knowledge using the polling system.
	Slide 10: As Mishra and Koehler have conducted more research, they have modified their theory. As you can see that this image includes the contextual elements of the classroom. Turn and talk to your neighbor, what elements of your classroom can influence instruction?
	Slide 11: If teachers have not already accessed the Sway presentations, have them do so now. Teachers will get into groups of 4, navigate to the TPACK website, and divide the paragraph. Have teachers read and annotate each of the paragraphs. Prepare to share out. Facilitator: be sure to formatively assess teachers' knowledge. Observe and listen as teachers are learning and discussing. Help clear any misunderstanding.
	Slide 12: Teachers will navigate to Read, Write, Think Venn Diagram. Facilitator will demonstrate how to create a Venn diagram with three circles, add titles, add items, and change colors. Teachers can work together to create their own examples of each of the constructs for TPACK. Share with your table. Facilitator will show teachers how to share their diagrams and discuss possible classroom uses for such a tool.
	Slide 13: Teachers will self-reflect to identify technology, pedagogy, or content knowledge as a strength. Ask them to move to a place in the room as they self-identify. Discuss what possibilities exist when this is their strength. Look at where their teaching partners are. Ask them to make connections with teachers in other groups.

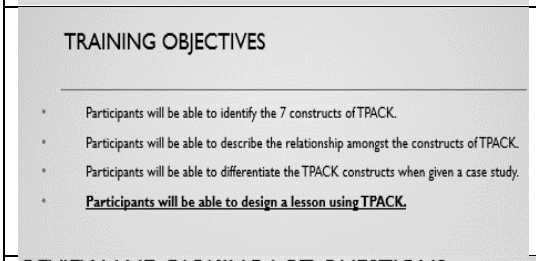
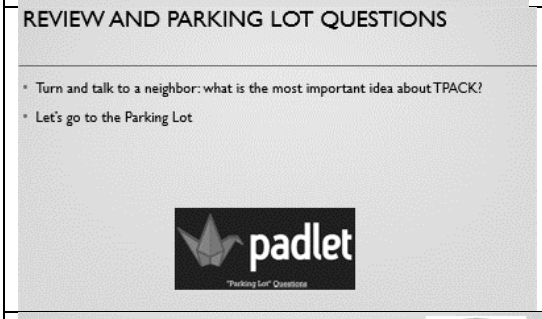
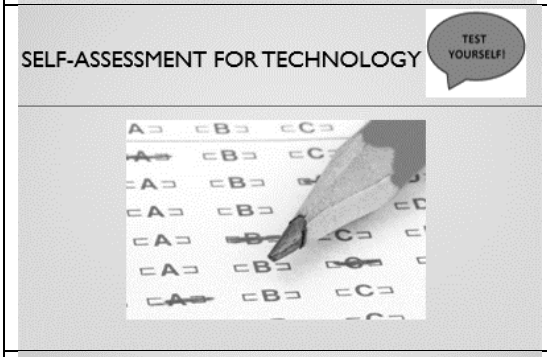
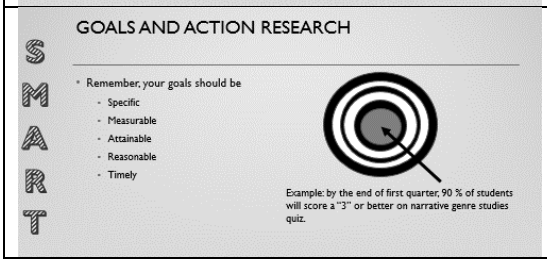
	Slide 14: Repeat the “4 Corners” activity with teacher weaknesses. Ask teachers to self-reflect on how they can improve.
	Slide 15: Use the Instructional Reflection worksheet. Ask teachers to identify the various strategies we used today. Where would you place them on the TPACK diagram? What would I use in my classroom? What would I like to learn more about?
Form	Slide 16: Complete the Microsoft Form before leaving.

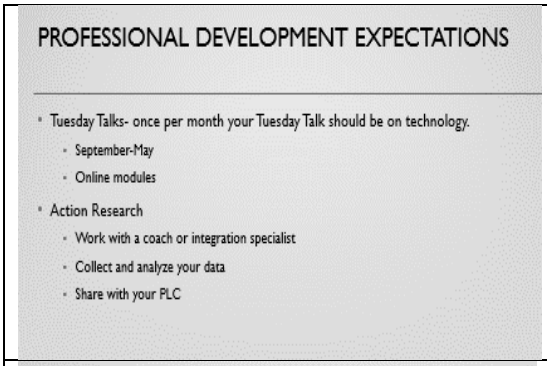
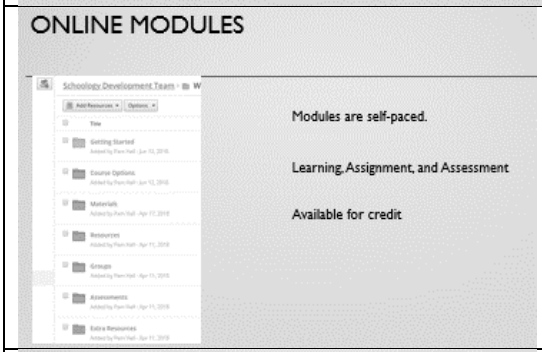
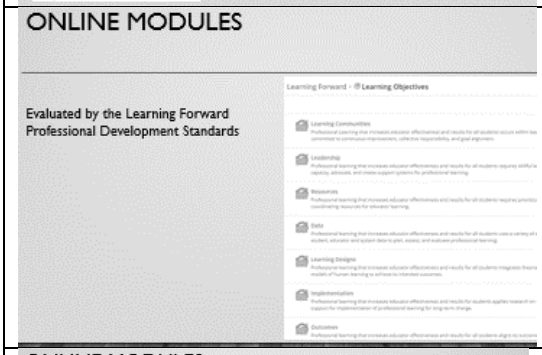
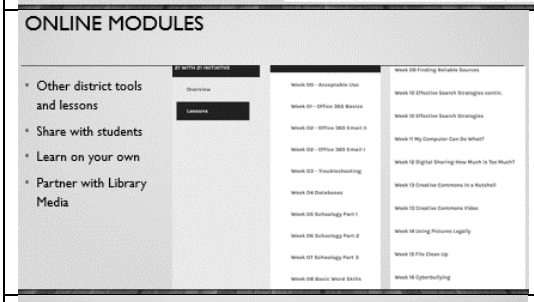
Part II Training Notes

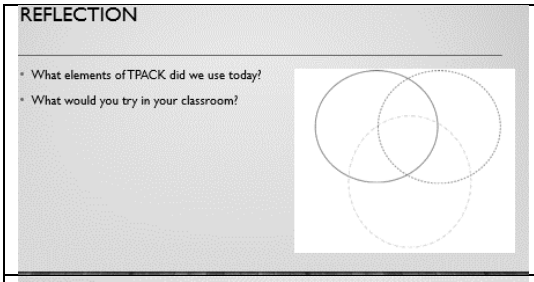
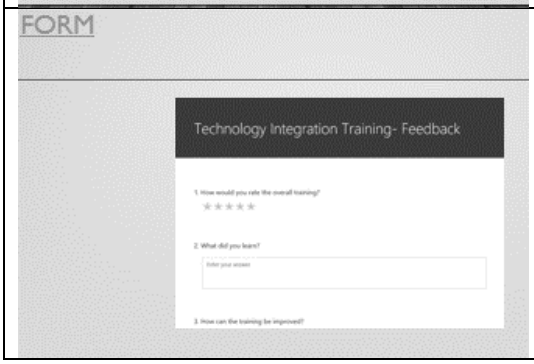
Objectives and Questions 	Slide 1: Review the objectives for the training. Today we will focus again on TPACK. First, we will review with the TPACK Game, and then we will consider some classroom cases. Let's look at the Padlet to see what questions we have from last time.
	Slide 2: Navigate to TPACK.org. Click on "Library" at the top of the page. Scroll down to find TPACK Game. Ask teachers to consider each of the scenarios at their tables. Now, have teachers create their own example of a missing TPACK. Do a share-out of the best creations.
	Slide 3: Technology and assessment. This will be a mini-tech camp. We will brainstorm a list of assessment tools. Teachers will volunteer to share what they know. We will need at least one teacher per table. All other teachers will choose a tool to learn. Rotate with extra time.
	Slide 4: Help teachers navigate to the case studies on the TPACK.org website. Go to "Library" at the top, "TPACK Cases", and "Secondary Cases".
	Slide 14: Highlight the scenario and teacher in this case. Ask teachers to read Activity 1.

	Slide 15: Focus discussion on the TPACK commentary. Have teachers collaborate to read Activity 2 and discuss the TPACK Commentary together. Complete Activity 3 with remaining time.
	Slide 16: Choose a vignette. Watch the video and answer questions with a partner.
	Slide 17: Use the Instructional Reflection worksheet. Ask teachers to identify the various strategies we used today. Where would you place them on the TPACK diagram? What would I use in my classroom? What would I like to learn more about?

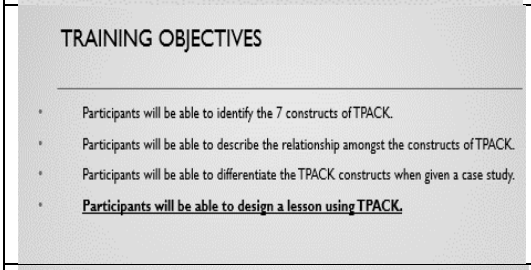
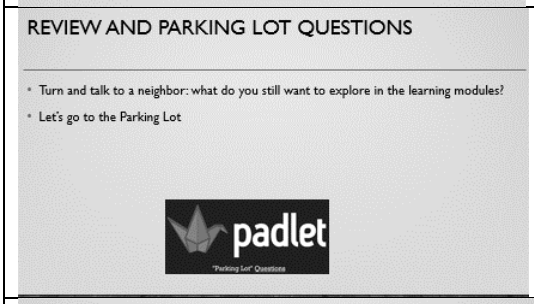
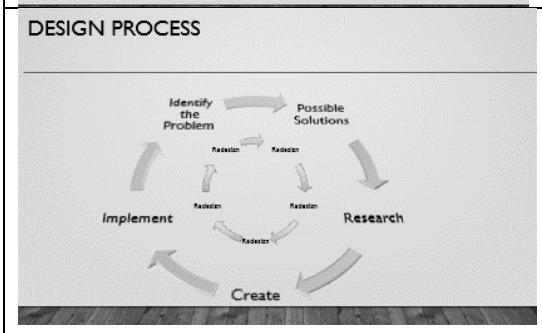
Part III Training Notes

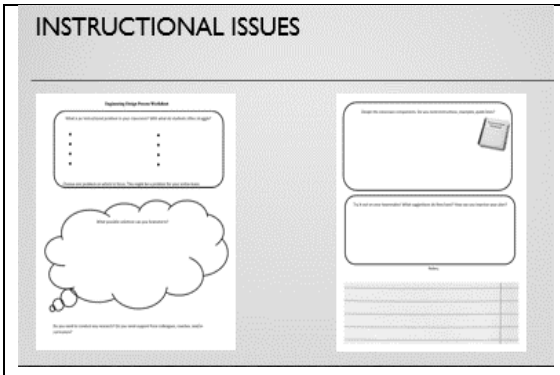
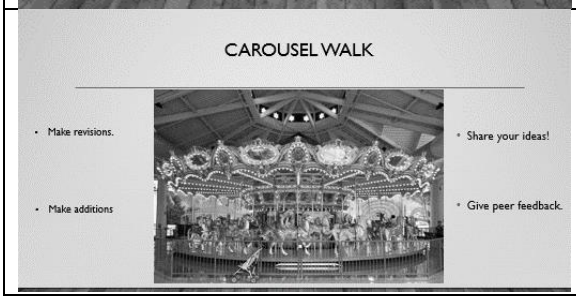
	Slide 1: Welcome back
	Slide 2: Today, our focus will be on building technology skills and exploring resources you have at your disposal.
	Slide 3: Review parking lot questions.
	Slide 4: Participants will take a self-assessment for technology. The timing will vary. Participants can take a break when they have completed the survey. Some participants may take up to 30 minutes to read and answer the questions.
	Slide 5: Review the parts of a smart goal. Teachers will write their own SMART goal, keeping in mind the self-assessment they just took. The facilitator should provide support as teachers are working on their goals.

	Slide 6: The principals of both middle school buildings will present this year's professional development expectations. Each teacher attends PD training for one hour each Tuesday. One of the Tuesdays will be designated for technology, and teachers are expected to work at their own pace in a training module of their choice.
	Slide 7: The facilitator will show teachers the online modules in Schoology. Teachers may opt to skip the first lessons if they are already proficient.
	Slide 8: All Schoology training modules utilize the Learning Forward professional development standards. We are modeling expected use by attaching standards to each of our activities. In doing so, teachers can get a student view of "Mastery" and learning objectives.
	Slide 9: We have videos and lessons on other district-supported tools. These videos can be used in classrooms for student learning as well as for professional learning.
	Slide 10: Teachers should take some time to explore the learning tools. Give at least an hour for teachers to learn and share.

	Slide 11: Have teachers discuss the various elements of TPACK at work today. Example: flipping classroom instruction, giving choice.
	Slide 12: Please fill out the feedback form before leaving. You should also make sure you post your questions to the Padlet.

Part IV Training Notes

	Slide 1: Welcome back! This is the final session in our face-to-face trainings.
	Slide 2: Our focus today will be on creating a lesson for classroom use. We will be using the design process to consider contemporary instructional problems, researching possible solutions, and deciding on a plan for implementation.
	Slide 3: Let us review any questions from our online parking lot. Make sure to praise any teachers who have already created responses to their peers.
	Slide 4: We will review the Engineering by Design process that many of you are using with your STEM units. Remember, you may need to redesign during different stages, so you will want to reflect often. Ask teachers to discuss at their tables: Why is the design process so important for reflective practitioners? How often do you engage in the design process on your own? What value can your PLC team bring to the process?

	Slide 5: Hand out the Engineering Design Process worksheet. Begin by brainstorming possible instructional issues. Ask instructional coaches to have 2 examples ready in case teachers need help. Teachers should discuss in small groups. Then, have the PLC teams choose one problem. Brainstorm possible solutions. Before allowing for work time, remind teachers of the district resources available to them. Curriculum team will be available to answer curriculum questions. Allow the majority of this time to be work time for teachers. They may even choose to work in a new location. Ask them to come back together in the final 30 minutes.
	Slide 6: During the design process, the facilitator should be a resource to teachers. Make sure to circulate the room and provide just in time re-teaching as necessary. Teachers will have questions on curriculum, design, and technology.
	Slide 7: As teachers complete their plans, encourage them to walk the room to engage in peer reflection. This carousel walk will allow them to make revisions on their own work, help peers revise their work/plan, share new ideas, and make additions.

	Slide 8: Thank you for your work and your willingness to change your practice. Your work for our students is valued.

Appendix B: Local District Permission

RESEARCH STUDY REQUEST

I hereby request permission to conduct a research study in the West Fargo Public School District during the period from September 2017 to January 2019.

TOPIC: middle school teachers' technology integration
To what extent do teacher implement technology in the classroom? To what extent do teacher feel supported to implement technology?

If this request is granted, I agree to abide by Administrative Policy 4800: refer to the Administrative policies in each building Administrator's office or in the Human Resources office.

Signature of Researcher: [signature]

Institution of Higher Education: Walden University

Signature of Graduate Advisor: [signature]

Date: 8-1-17

In addition to completing the Research Study Request Form, a copy of the following items are attached for review:

1. Abstract of the project
2. Questionnaire(s) to be used
3. Consent letter to be sent to parents

Endorsement: This request is ✓ approved _____ disapproved

Administrator: Carol Zent

Date: 08-07-2016

A copy of the approval form must be presented to the school building principal before conducting any survey. The principal has the final approval to conduct a survey in a school building.

Please print your name and the mailing address where you want this form returned:

Name: Andrea Fox
Street Address: 825 17th Avenue East
City, State, & Zip: West Fargo, ND, 58078

Appendix C: Observation Protocol

Technology Integration Observation Instrument

Observer _____ Teacher _____ Date_____

Grade Level(s) _____ Subject Area(s) _____

Primary Learning Goals _____

Directions:
We have tried to key the components of this instrument to different aspects of teachers' knowledge for technology integration. Please note, however, that the instrument is *not designed to assess this knowledge directly*. It is designed to focus upon the use of technology integration knowledge in observable teaching. Please record the *key curriculum topics addressed*, *instructional strategies/learning activities observed*, and *digital and non-digital technologies used* by the teacher and/or students in the lesson.

Curriculum Topic	Key Instructional Strategies/Learning Activities	Digital[1] & Non-Digital[2] Technologies

What, if anything, do you know about influences upon what you have observed in this lesson? Examples might include students' learning needs, preferences, and challenges; access to technologies; cultural, language and/or socioeconomic factors.

Technology Integration Observation Instrument[3i]

Directions: Referring to the notes you made on the previous page, including your responses to the question about influences, please complete the following rubric, considering the lesson as a whole.

	4	3	2	1
Curriculum Goals & Technologies (Matching technology to curriculum)	Technologies used in the lesson are strongly aligned with one or more curriculum goals.	Technologies used in the lesson are aligned with one or more curriculum goals.	Technologies used in the lesson are partially aligned with one or more curriculum goals.	Technologies used in the lesson are not aligned with one or more curriculum goals.
Instructional Strategies & Technologies (Matching technology to instructional strategies)	Technology use optimally supports instructional strategies.	Technology use supports instructional strategies.	Technology use minimally supports instructional strategies.	Technology use does not support instructional strategies.
Technology Selection(s) (Matching technology to both curriculum and instructional strategies)	Technology selection(s) are exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are appropriate, but not exemplary, given curriculum goal(s) and instructional strategies.	Technology selection(s) are marginally appropriate, given curriculum goal(s) and instructional strategies.	Technology selection(s) are inappropriate, given curriculum goal(s) and instructional strategies.
"Fit" (Considering curriculum, pedagogy and technology all together)	Curriculum, instructional strategies and technology fit together strongly within the lesson.	Curriculum, instructional strategies and technology fit together within the lesson.	Curriculum, instructional strategies and technology fit together somewhat within the lesson.	Curriculum, instructional strategies and technology do not fit together within the lesson.

(over, please)

[3]Adapted from:
Harris, J., Grandgenett, N., & Hofer, M. (2010). Testing a TPACK-based technology integration assessment instrument. In C. D. Maddux, D. Gibson, & B. Dodge (Eds.). *Research highlights in technology and teacher education 2010* (pp. 323-331). Chesapeake, VA: Society for Information Technology and Teacher Education (SITE).

	4	3	2	1
Instructional Use (Using technologies effectively for instruction)	Instructional use of technologies is maximally effective in the observed lesson.	Instructional use of technologies is effective in the observed lesson.	Instructional use of technologies is minimally effective in the observed lesson.	Instructional use of technologies is ineffective in the observed lesson.
Technology Logistics (Operating technologies effectively)	Teachers and/or students operate technologies very well in the observed lesson.	Teachers and/or students operate technologies well in the observed lesson.	Teachers and/or students operate technologies adequately in the observed lesson.	Teachers and/or students operate technologies inadequately in the observed lesson.

Comments:

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[i] "Technology Integration Observation Instrument" by Judi Harris, Neal Grandgenett & Mark Hofer is licensed under a Creative Commons Attribution-Noncommercial-No Derivative Works 3.0 United States License.

(http://creativecommons.org/licenses/by-nc-nd/3.0/us/)

Appendix D: Semi-structured Interview Protocol

The interview questions are listed here:

1. Can you give me some examples of how you typically implement technology in your classroom? By implementation, I mean, how do you use technology to enhance student learning?
2. In your day-to-day instruction, what role does technology play?
3. What knowledge and skills do you have that are specific to technology? How did you come to learn them? (TK)
4. Discuss how pedagogy (instructional strategies) plays a role in your use of technology and planning (TPK).
5. Discuss how your content plays a role in your use/lack of use of technology.
    a. What specific considerations must be made for technology use in your content area (TCK)?
6. Think of a time when you have felt successful in your technology integration (TPACK). Describe the lesson.
    a. What made that experience possible? In what ways do you believe your technology integration has evolved?
7. To what extent do you feel supported to implement technology?
    a. By the district office administration?
    b. By your building administrators?
    c. By your colleagues?
    d. By the technology department?

8. What support do you feel is lacking?

Appendix E: Instructional Coaching Checklist

INSTRUCTIONAL COACHING CHECKLIST

COACHING BEHAVIOR	OBSERVATION
IDENTIFY	
Teacher gets a clear picture of current reality by watching a video of their lesson or by reviewing observation data. (Video is best.)	
Coach asks the identify questions with the teacher to identify a goal.	
Teacher identifies a student-focused goal.	
Teacher identifies a teaching strategy to use to hit the goal.	
LEARN	
Coach shares a checklist for the chosen teaching strategy.	
Coach prompts the teacher to modify the practice if he or she wishes.	
Teacher chooses an approach to modeling that he or she would like to observe and identifies a time to watch modeling.	
Coach provides modeling in one or more formats.	
Teacher sets a time to implement the practice.	
IMPROVE	
Teacher implements the practice.	
Data is gathered (by teacher or coach, in class or while viewing video) on student progress toward to the goal.	
Data is gathered (by teacher or coach, in class or while viewing video) on teacher's implementation of the practice (usually on the previously viewed checklist).	
Coach and teacher meet to discuss implementation and progress toward the goal.	
Teacher makes modifications until the goal is met.	