Pairing a Learning Activity Types Short Course with Collaborative Curriculum Design: An Approach to Impact Teachers' Technological Pedagogical Content Knowledge (TPACK)

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In the last 20 years, spending on educational technology has increased a hundredfold worldwide (Lim, Zhao, Tondeur, Chai, & Tsai, 2013). Research suggests that the integration of that investment into classroom instruction is often inadequate to substantively impact student learning experiences (Ertmer & Otterbreit-Leftwich, 2010). The purpose of this study was to determine the effect of a unique approach to professional development on the participant teachers' Technological Pedagogical Content Knowledge (TPACK). TPACK is defined as "...knowledge about the complex relations among technology, pedagogy, and content that enables teachers to develop appropriate and context-specific teaching strategies" (Koehler, Mishra, Kereluik, Shin, & Graham, 2014, p. 102). The seven sixth-grade teachers at North East Middle School completed an online short course on Learning Activity Types and participated in collaborative curriculum design, during which they developed an interdisciplinary thematic unit. This study also sought to determine the contextual factors that influenced the teachers as they developed the unit, as well as their beliefs about planning and technology upon conclusion. Data was gathered during the research process through individual interviews (both at the outset of the methodology and after the teachers had completed the professional development experience), observations during the

planning process, and a focus group discussion. That data was coded and analyzed in order to answer the three research questions that guided the study.

Having teachers complete the online short course and work together to design an interdisciplinary thematic unit resulted in a positive impact on 86 percent of the participant teachers' technological pedagogical knowledge (TPK), 71 percent of the participant teachers' technological content knowledge (TCK), and 71 percent of the participant teachers' technological pedagogical content knowledge (TPACK). Contextual factors, such as access to resources and time during the day to undertake the collaborative design of instruction, were essential to this approach. The subjects shared that the collaboration with colleagues enhanced their planning and forced them reflect on how they design instruction. It also increased their awareness of technological options and improved their confidence to use technology during classroom instruction.

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Preface

On April 16, 2016 in the Petersen Event Center during a one-day orientation, our Doctor of Education cohort was challenged to begin considering problems of practice that impact education in our context. Identifying those problems and seeking solutions to them was a guiding theme throughout our coursework. In one sense, this dissertation reflects a culmination of that process as a requirement for graduation. However, I think (and hope) that it more accurately represents my continued desire to be a practitioner with the knowledge and character to lead and to serve.

Completing this dissertation was not easy. Thankfully, I benefited from the support of many individuals with whom I have worked professionally and at the University of Pittsburgh. Mr. Greg Beardsley, the principal at North East Middle School, first urged me to apply and has been a steadfast supporter ever since. He is both a mentor and an incredible friend. Dr. Richard Lansberry was the right person at the right time to help me organize my analysis and consider the implications of my research. Dr. Bill Renne and Dr. Matt Lane experienced this journey with me as fellow students and administrators in Erie County. These past three years were immensely more enjoyable with them along for the ride. I now realize how important it is to have an advisor who has high expectations and is also supportive. I had that in Dr. Longo and I thank him for everything he did to guide me in this program and towards completing this dissertation. I also thank Dr. Ziegler and Dr. Sondel for their time and feedback as members of my committee. Finally, I appreciate the support of my North East colleagues. Their encouragement was frequently what I needed to continue working and persevere.

Perhaps more than anything else, this process included near daily reminders that I am blessed to have incredible people in my life. I want to thank my parents, Joan and Alan, as well as my in-laws, Mark and Karen, for babysitting, bringing over dinner, and taking care of many other things along the way. Lastly, this simply would not have been possible without my amazing wife Kelly and my two daughters, Lilly and Clare. Kelly was unwaveringly supportive, patient, and understanding (even when I am certain it was not easy), and for that I am a lucky man. These ladies are the most important people in my life and I love them more than I can possibly describe.

1.0 Introduction

On June 21, 2018, the North East School District Board of Directors approved the final budget for the 2018-2019 school year. The budget includes the expenditure of $639,076 on educational technology including staff, hardware, software, and infrastructure (Fox, 2018; North East School District, 2018). Although the cost amounts to just 2.6 percent of the district's $24,764,569 budget, $639,076 represents the cost needed to hire six additional teachers, including salary and benefits. The amount of money allocated to educational technology in the 2018-2019 budget continues a positive trend going back at least seven years. Between the 2012-2013 school year and the 2017-2018 school year, North East School District spent $3,161,982 on technological staff, hardware, software, and infrastructure. This amount averages $526,997 per year. Although the spending trajectory is non-linear, the change between 2012-2013 and 2017-2018 represents a 28 percent increase (Fox, 2016; J. Fox, personal communication, October 4, 2018).

Clearly, the board of directors and the district's administration believe that technology plays a positive role in the educational process. Research supports this mindset. Kohler, Mishra, Kereluik, Shin, and Graham (2014) assert that technology can transform content and pedagogy. This is certainly true for a classroom of students engrossed in the digital dissection of frogs on iPads. Lim, Zhao, Tondeur, Chai, and Tsai (2013) point to the active role students can take in their own learning by using technology to gather information and publish their work. For confirmation of this benefit, look no further than students' excitement to use Google Sites, a free online webpage development tool, to share their writing with an audience beyond the school walls. These examples are indicative of wider research that validates the potential of educational technology. This

research supports the educational benefit of purchases similar to those made in the North East School District.

1.1 Statement of the Research Problem

Research shows that despite the investments and increases in computer access worldwide, many teachers are not effectively integrating technology into instruction (Ertmer & Otterbreit-Leftwich, 2010; Lim, Tondeur, Chai, & Tsai, 2013). Polly, Mims, Shepherd, and Inan (2009) define technology integration as occurrences of educational technology bolstering student learning during instruction. Furthermore, the low-level uses of technology that do occur most frequently, such as skill practice, are insufficient to prepare students for the twenty-first century workplace (Ertmer & Otterbreit-Leftwich, 2010). In many instances, teachers' insufficient Technological Pedagogical Content Knowledge (TPACK) is the reason they do not effectively integrate technology into instruction (Koehler, Mishra, Kereluik, Shin, & Graham, 2014).

1.2 Purpose of This Study

Mishra and Koehler (2006) recognize that when it comes to the impact of educational technology, "the reality has lagged far behind the vision" (p. 1018). The authors attribute this to educators' tendency to focus on the functionality of technology rather than its use to enhance instruction. This recognition led to their development of the Technological Pedagogical Content Knowledge (TPACK) framework. Chai, Koh, and Tsai (2013) define TPACK as "knowledge of

using various technologies to teach, represent, and facilitate knowledge creation of specific subject content" (p. 33). TPACK includes three domains of knowledge: technological knowledge, pedagogical knowledge, and content knowledge. Teachers must navigate the interplay of the three knowledge domains in order to design effective instruction that includes educational technology (Ronau, Rakes, & Niess, 2012). The TPACK framework has been utilized to facilitate professional development around twenty-first century skills and literacies (Harris & Hofer, 2017).

Teachers' TPACK and the methods that shape it have been the focus of a significant amount of research. Harris's 2016 article, "In-service Teachers' TPACK Development: Trends, Models, and Trajectories," includes a table listing 12 strategies and eight approaches to the development of in-service teachers' TPACK, along with sample references for each strategy and approach. Based on her analysis, she concluded that the current professional development trend tends to eschews large-group technology-centered opportunities in favor of authentic, contextual, collaborative approaches. Harris (2016) also emphasized that while researchers seem to be reaching a consensus on the qualities that typify effective professional development, some professional development opportunities that do not include those qualities still prove successful in positively influencing instruction.

This study is an investigation of the impact of Harris and Hofer's online short course, "Learning First; Tools Last: Curriculum-Based Planning with Technology," coupled with a collaborative curriculum design process, on teachers' Technological Pedagogical Content Knowledge (TPACK). Collaborative curriculum design refers to teacher teams tasked with designing lessons, units, assessments and other educational resources. Research conducted by Harris and Hofer in 2011 that involved a five-month professional development experience and

included seven social studies teachers from across the country is the model of this specific study. Harris and Hofer (2011) concluded the following based on their findings in that study:

> Regardless of preferred pedagogical approach, however, it seems clear that an instructional planning strategy that is conceptualized and organized around curriculum content, teaching/learning contexts, and pedagogy primarily, and according to the digital tools and resources that can support different types of learning secondarily, such as the activity-types-based strategy explored in this study, can help teachers diversify their instructional approaches while concurrently encouraging appropriate educational uses of technological tools and resources. (Harris & Hofer, 2011, p. 226)

In other words, teachers' lesson design benefits from professional development that emphasizes content, context, and pedagogy first, and tools such as technology second. This study seeks to determine if the results of the aforementioned investigation are replicable when the professional development is limited to a Learning Activity Types short course for experienced teachers and the planning is done among an interdisciplinary team of educators who teach in the same school. This specific study is timely and unique because it occurs as other researchers consider design-based approaches to enhancing teachers' TPACK. It also includes a short course recently released for public use by Harris and Hofer.

1.3 Research Questions

The effectiveness of collaborative curriculum design coupled with the Learning Activity Types short course will determine whether it is a worthwhile option for other practitioners who

aim to enhance in-service teachers' TPACK. A teacher's TPACK refers to her ability to synthesize technological, pedagogical, and content knowledge into the design of instruction that enhances student learning. Therefore, the questions that guide this study must be evaluative and examine both the process and its outcomes. The following three research questions guide this study:

1. What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?
2. What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?
3. How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

2.0 Review of Literature

School district administrators are required to develop an annual budget that maximizes the educational benefit of limited resources. It is notable that spending on educational technology has continued to increase annually. In fact, worldwide investment in educational technology has grown over a hundredfold in the last 20 years (Lim, Zhao, Tondeur, Chai, & Tsai, 2013). Underlying this investment is the belief that technology can improve and enhance learning. For instance, technology can provide opportunities for students to work collaboratively, solve real-world problems, and analyze information. These are examples of skills that will be required of students in the twenty-first century workplace (Koh, Chai, Benjamin, & Hong, 2015; Lim, Zhao, Tondeur, Chai, & Tsai, 2013). School districts continue to invest in educational technology in part because of its potential to improve student learning.

Many articles extol the ways technology can transform instruction and increase learning (Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Lim, Zhao, Tondeur, Chai, & Tsai, 2013). For instance, Hsu (2016) asserts, "Higher-level technology use will enhance every aspect of students' learning experiences across curricular areas, so students will grow intellectually rather than merely develop isolated technology skills" (p. 30). However, that can only occur when the technology facilitates higher-level learning for students. Examples of higher-level learning include problem solving, critically examining information, and working with other students to achieve a common goal (Lim, Zhao, Tondeur, Chai, & Tsai, 2013). Furthermore, technology can transform content and pedagogy while also impacting the representation of material (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). For instance, students studying the Great Wall of China can use Google Expeditions, an education app with virtual reality tours, to experience the location without leaving

the classroom. Teachers' ability to transform content and increase learning are two of the educational benefits possible when instruction includes technology.

The idea that technology can positively impact instruction is not new. In 1994, Peck and Dorricott wrote an article published in *Educational Leadership* on why teachers should use technology. They included a list of 10 reasons, a few of which included the individual rates at which students learn and the ability to differentiate using technology, the opportunities technology affords students to do meaningful work, and the access technology provides to information and resources outside of the school. Twenty-one years later, the Office of Educational Technology's report, *Reimagining the Role of Technology in Education* (2017), included five ways technology can enhance learning, several of which are very similar to the reasons outlined in the Peck and Dorricott article. The following list is included in the government's 2017 report on ways technology can enhance learning:

- Technology can enable personalized learning or experiences that are more engaging and relevant.
- Technology can help organize learning around real-world challenges and project-based learning – using a wide variety of digital learning devices and resources to show competency with complex concepts and content.
- Technology can help learning move beyond the classroom and take advantage of learning opportunities available in museums, libraries, and other out-of-school settings.
- Technology can help learners pursue passions and personal interests.
- Technology access when equitable can help to close the digital divide and make transformative learning opportunities available to all learners (*Reimagining the*

Role of Technology in Education: 2017 National Education Technology Plan Update, 2017, pp. 12-17).

One reason school districts such as North East continue to invest in educational technology is that research supports the technology's potential to improve student learning. However, in practice, many teachers struggle to overcome barriers to the integration of educational technology into instruction.

2.1 Barriers to Educational Technology Integration

The integration of technology, which includes teachers' use of hardware, software, and the internet (Hsu, 2016), into classroom instruction is generally insufficient to enhance student learning experiences (Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016; Koh, Chai, Benjamin, & Hong, 2015; Lim, Zhao, Tondeur, Chai, & Tsai, 2013). In fact, many teachers only use technology to perform low-level tasks such as drill practice and reward activities (Hsu, 2016). Reward activities refer to a teacher's use of technology as an incentive for students once they successfully complete another task. Other teachers use technology primarily for administrative responsibilities and communication, such as taking grades and sending emails. Even when technology is used during instruction, it is often to reinforce a teacher-centered learning activity such as notetaking or presenting a topic using PowerPoint. All of this is despite the exponential changes in technology that mirror the increase in spending for educational technology (Ertmer & Ottenbreit-Leftwich, 2010). Teachers in schools around the world have maintained educational activities focused on grades and standards, often absent the use of technology. These examples of technology integration will not enhance student learning outcomes (Lim, Zhao, Tondeur, Chai, & Tsai, 2013).

A significant amount of research explores why teachers have not embraced instructional technology. There are four primary factors: contextual barriers, teacher beliefs, preparation in undergraduate coursework, and professional development opportunities for in-service teachers (e.g., Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016; Koh, Chai, Benjamin, & Hong, 2015; Mishra & Koehler, 2006; Voogt, Pieters, & Handelzalts, 2016).

2.1.1 Context

A teacher's educational context refers to factors that influence his or her practice, such as the school, infrastructure, devices, culture, parents, and students (Herring, Koehler, & Mishra 2016). Several contextual barriers influence a teacher's use of technology. One is the availability of educational technology. The United States has made significant progress in addressing the first digital divide, in which marginalized students lack the same access to devices and Internet connectivity as their non-marginalized peers (*Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*, 2017). However, some teachers still do not have consistent access to technology. As a result, there is a diminishing likelihood that those teachers will incorporate technology into lesson design (Mishra & Koehler, 2006). Access to digital technology is one contextual factor that has a direct impact on a teacher's use of technology within instruction.

A second factor that adversely influences teachers' use of technology is the lack of personnel support provided in their place of practice (Hsu, 2016; Mishra & Koehler, 2006; Voogt et al., 2011). This is particularly true among teachers who work with low-income, Latino, and African-American students. Research shows that limited access to support professionals leads to a disproportionate use of ineffective instructional strategies with technology. These practices

exacerbate the existing inequalities that already impact these students. This situation has led to a second digital divide defined by students' access to achievement enhancing opportunities with technology (Kelly, 2008). It is possible that without a change, the digital divide between marginalized students and their non-marginalized peers will continue to grow even as the gap in access to technology shrinks (*Reimagining the Role of Technology in Education: 2017 National Education Technology Plan Update*, 2017). A teacher's access to personnel support when planning and implementing lessons with technology is an important factor that influences practice.

A third contextual barrier is the constantly evolving nature of educational technology (Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016). It is a challenge for teachers, who already struggle with limited time, not only to keep pace with changes but also to explore options and select methods that best complement the content being taught (Boschman, McKenney, & Voogt, 2015; Koh, Chai, Benjamin, & Hong, 2015). The availability of technology, access to personnel support, and limited time are three contextual factors that influence teachers' integration of technology.

2.1.2 Teacher Beliefs

In addition to the aforementioned contextual factors, another barrier for some teachers is their beliefs. Teachers' beliefs can influence their behavior and have a direct impact on how they incorporate technology into instruction (Boschman, McKenney, & Voogt, 2015; Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016; Lambert & Sanchez, 2007). If a teacher believes that educational technology will positively affect student learning, she will be motivated to enhance her technological knowledge and integrate what she learns into existing pedagogical and content knowledge (Ertmer & Ottenbreit-Leftwich, 2010; Lambert & Sanchez, 2007). Furthermore,

whether a teacher chooses to use an approach or tool depends on her evaluative decision regarding its efficacy (Ertmer & Ottenbreit-Leftwich, 2010). What teachers believe about educational technology, which is frequently the result of their personal experiences, impacts how it is utilized in their classrooms.

Some teachers maintain the conviction that effective teaching can occur absent twenty-first century technology. They hold to Shulman's (1987) framework that focuses on the intersection of content and pedagogy as the "sweet-spot" of instructional design. Other researchers, such as Ertmer and Ottenbreit-Leftwich (2010), believe that technology is an essential element of effective instruction. Their position is grounded in research that ties educational technology to enhanced learning in the classroom. For those teachers who resist instructional planning that includes technology, it is necessary to shift their paradigms. Those teachers must recognize that technology is a critical component of effective instruction. Teachers must not restrict access to technology in the classroom because of outdated assumptions and a resistance to change (Mishra & Koehler, 2006; Psencik, 2009). To do so would ill serve the students sitting in their classrooms. Teachers' successful attempts at integrating technology can expand their methods and choices, all while enhancing their sense of self-efficacy.

2.1.3 Undergraduate Teacher Education Programs

In addition to contextual barriers and teacher beliefs, pre-service teachers enrolled in undergraduate teacher preparation programs are not being properly prepared to integrate technology into classroom instruction. Frequently, the training pre-service teachers do receive is limited to one stand-alone course on educational technology. During the course, pre-service teachers learn how the technology functions but not how the technology can be applied to

instructional practices about specific topics and content areas. This practice is ineffective (Ertmer & Ottenbreit-Leftwich, 2010; Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Polly, Mims, Shepherd, & Inan, 2009). Simply understanding the functionality of the technological hardware and software does not ensure that teachers will know how to use those tools to enhance content-based instruction.

Even as more pre-service teachers who are digital natives, defined as a person born during the age of digital technology, graduate college and enter the profession, proficient use of technology such as smartphones, laptops, tablets, and social media in their personal lives does not automatically equate to effective integration of technology in the classroom. Ertmer and Ottenbreit-Leftwich (2010) argue, "If technology is going to be an integral part of preservice teachers' images of good teaching, it needs to be pervasive throughout their programs" (p. 270). Because teachers often teach the way they were taught, it is imperative that colleges and universities consider incorporating technology into the education courses required of pre-service teachers. Furthermore, teachers benefit from seeing instruction with technology utilizing "best-practices" and will use technology themselves if they believe that the approach can benefit students. For this reason, it is important for students to observe teachers who integrate technology at a high level to understand what technology integration in the classroom should look like (Ertmer & Otterbreit-Leftwich, 2010). Failure to modernize instruction to include technology at the collegiate level only ensures the perpetuation of technology as a tool teachers use for low-level tasks such as grades and emails.

2.1.4 Professional Development

Professional development is a fourth aspect of education that researchers have studied in order to determine whether current practices may be compounding the problem of ineffective technology integration into instruction. Just as student learning accelerates when instruction is engaging and allows for collaboration, so too does teacher professional development (Voogt et al., 2011). Unfortunately, professional development about the use of educational technology in the classroom is often restricted to conferences and workshops, events that are passive in nature and that yield limited results (Psencik, 2009; Voogt, Pieters, & Handelzalts, 2016). Furthermore, during professional development there is an overemphasis on technology independent of content and pedagogy. An approach that does not demonstrate the integration of technology with pedagogy and content creates situations where educators know how the technology works but not how to use it in the classroom to enhance teaching. In other words, teachers have the functional skills to use the technology but lack the ability to integrate it into instruction (Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006; Polly, Mims, Shepherd, & Iana, 2009). Teachers must understand how the technology can impact student learning and help students achieve goals if any change is to be realized.

One challenge of providing professional development to teachers is that what is effective in one context may not be effective in another. Harris (2016) notes this challenge and states that the subject matter and timing of the professional development must align with the learning preferences and context of the teachers who participate. To further compound this already challenging undertaking, not all teachers are the same. Depending on the extent of teachers' technological knowledge, as well as pedagogical content knowledge, the time it takes to impact their practice varies (Ertmer & Otterbreit-Leftwich, 2010). Aligning opportunities to teachers'

needs and contexts requires the consideration of a variety of approaches to professional development. These considerations are not occurring when the primary opportunities with respect to educational technology are stand-alone trainings. Deficiencies in the professional development of in-service teachers to use technology in instruction are an area of focus for many researchers.

2.2 TPACK as a Theoretical Framework

Many of these restrictive forces result in classroom teachers who lack technological knowledge. Technological knowledge refers to knowledge of the affordances and functionality of information and communication technology during instruction (Chai, Kohn, & Tsai, 2013). Without well-developed technological knowledge, teachers are unable to integrate technology into instruction, and when they do, they employ low-level tasks (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). Mishra and Koehler (2006) recognize that technology, and specifically technological knowledge, has the power to transform instruction. For this reason, Mishra and Koehler (2006) collaborated to develop TPACK, which stands for Technological Pedagogical Content Knowledge. These three domains, which include content knowledge, pedagogical knowledge, and technological knowledge, are interconnected (Baran & Uygun, 2016). Teachers need TPACK for educational technology integrated lesson design (Koh, Chai, Benjamin, & Hong, 2015; Lambert & Sanchez, 2007). Technological knowledge is one domain of Mishra and Koehler's (2006) TPACK framework that is a weakness for many in-service teachers.

Mishra and Koehler (2006) developed the Technological Pedagogical Content Knowledge (TPACK) framework as a theoretical foundation for understanding how teachers must integrate technological knowledge into existing pedagogical and content knowledge. Their work builds on

Shulman's (1987) research, which recognized the interconnectedness of teachers' required pedagogical and content knowledge. Mishra and Koehler (2006) summarize Shulman's conceptualization of pedagogical content knowledge (PCK) as knowing how content areas are organized, adjusted, and represented within instruction. In other words, effective teachers are able to take the content they know and make it accessible to others. Although Mishra and Koehler (2006) were not the first to recognize the need to update PCK to reflect the increased presence and importance of technology, their framework provides the foundation on which a significant amount of research has occurred.

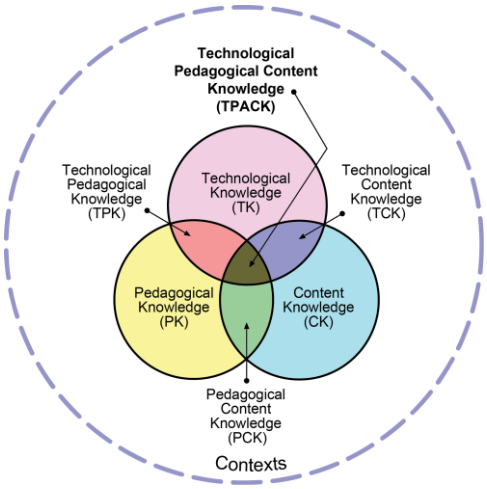


Figure 1. Technological Pedagogical Content Knowledge (TPACK) Framework. Adapted from "TPACK Explained," by M.J. Koehler, 2014, TPACK.org. Retrieved October 4, 2017, from http://matt-koehler.com/tpack2/tpack-explained/.

The figure above depicts the TPACK framework. It consists of three interlocking circles that create an additional four domains represented by overlapping regions. The three main circles include a teacher's pedagogical knowledge, content knowledge, and technological knowledge. Pedagogical knowledge includes the practices and methods of teaching and addresses how students learn (Mishra & Koehler, 2006). Content knowledge is knowledge of the subject matter. The addition of technological knowledge, which is a teacher's awareness of available technologies to

use in education, is unique because Mishra and Koehler made it its own realm of knowledge (Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Mishra & Koehler, 2006). A teacher with vast content knowledge that lacks pedagogical knowledge is unable to break apart and explain what he knows so that others can understand it. Similarly, a teacher with extensive pedagogical knowledge who lacks technological knowledge is unaware of what technologies exist to enhance the process of teaching and learning. An effective educator is able to integrate all three knowledge domains within the dynamic process of planning and executing instruction. Such an educator would have highly effective TPACK.

Each pair of circles overlaps to create three additional domains of knowledge. Technological pedagogical knowledge is "knowledge of the existence, components, and capabilities of various technologies as they are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies" (Mishra & Koehler, 2006, p. 1028). Technological content knowledge is the awareness of technological tools that can improve a teacher's ability to represent content in a way that helps students to learn (Mishra & Koehler, 2006). Finally, pedagogical content knowledge is when a teacher can take content knowledge and represent it in ways that that are powerful and reflective of his students and their abilities (Shulman, 1987). All of these domains are situated within a dashed circle that represents the opportunities, as well as restrictions, that are inherent in a teacher's context. Two of the three regions created by overlapping knowledge domains (technological content knowledge and technological pedagogical knowledge) are new within Mishra and Koehler's (2006) TPACK framework.

The center of the diagram represents the confluence of all three domains of knowledge: content, pedagogy, and technology (Mishra & Koehler, 2006). The practice of effective teaching

demonstrated through student comprehension requires that teachers continuously develop their own TPACK (Voogt, Fisser, Roblin, Tondeur, & Braak, 2012). When a teacher is able to utilize technology to represent a challenging concept, he is demonstrating a well-developed TPACK. Another teacher who enhances a pedagogical technique by using technology to teach the content demonstrates TPACK in action. Still another educator who can anticipate what students will find challenging about a particular topic, adjust to make it easier to learn, and correct misunderstandings with technology has well developed TPACK. Finally, a teacher who is aware of how technology can be used to build on what students already know and strengthen that knowledge, as well as develop new knowledge, has TPACK capable of designing enhanced learning opportunities (Mishra & Koehler, 2006). The ability to connect these individual domains in a way that enhances all three is indicative of well-developed TPACK, something districts must emphasize if they continue to invest significant resources into educational technology.

Each teacher's TPACK is unique and never complete. This is particularly true with respect to technology (Harris & Hofer, 2017). However, what is universal is that effective teaching requires knowledge of all three domains (Mishra & Koehler, 2006). It is the interactions among the three domains, along with the educator's understanding, that generates effective teaching (Koehler, Mishra, Kereluik, Shin, & Graham, 2014). The framework has become a method for structuring professional development and guiding observation of classroom practice (Harris & Hofer, 2017). Knowing that teachers' technological knowledge is not equipollent with the significant investment districts are making in educational technology, school leaders have a responsibility to address the discrepancy. As mentioned in the previous section, professional development is one way to enhance teachers' TPACK. There are many approaches to professional development aimed at enhancing TPACK.

2.3 Professional Development to Enhance Teachers' TPACK

The changing nature of technology requires that classroom teachers maintain a growth mindset and experience opportunities for professional development. To this point, Mishra and Koehler (2006) argue that the TPACK framework should lead to a reevaluation of how teachers are professionally developed. Many studies have examined approaches to professional development and whether they successfully developed teachers' TPACK (Ronau, Rakes, & Niess, 2012). One approach was to have college students act as technology mentors to university faculty. Another approach involved placing pre-service teachers in technology rich environments to see how that impacted their use of technology. Still another approach was to facilitate a train-the-trainer model within places of practice (Polly, Mims, Shepherd, & Inan, 2009). However, the most frequent intervention was teacher participation in the design of lessons and courses with enhanced technology (Voogt, Fisser, Roblin, Tondeur, & Braak, 2012). This approach stems from research that reinforces the belief that teachers learn best when they are able to collaborate on authentic tasks that apply directly to what is occurring in their classrooms (Binkhorst, Handelzalts, Poortman, & Van Joolingen, 2015; Hsu, 2016; Koh, Chai, Benjamin, & Hong, 2015). The design process activates participants' TPACK, changes what teachers believe constitutes good teaching, and increases teachers' confidence (Lambert & Sanchez, 2007; Voogt et al., 2011). The abundance of research dedicated to design-based professional development indicates that it is a popular approach to enhancing TPACK among pre-service and in-service teachers. Many variations have been studied, including learning-technology-by-design, integrated design-based learning, teacher design teams, and collaborative curriculum design.

2.3.1 Learning-Technology-by-Design

Mishra and Koehler (2006) advocate for an approach they term *learning-technology-by-design*. They explain, "Design experiments narrow the gap between research and practice, between theory and application" (Mishra & Koehler, 2006, p. 1019). Based on their findings and the findings of other researchers, teachers benefit from the authentic context of solving problems using technology and the act of doing (Koehler, Mishra, Kereluik, Shin, & Graham, 2014; Mishra & Koehler, 2006; Voogt, Fisser, Roblin, Tondeur, & van Braak, 2012). In other words, the teachers are actively involved in the process, not passive observers. Mishra and Koehler (2006) explain that because teachers have ownership of the process, the likelihood that they will apply what they learn in their classroom increases. The authors cite three case studies, each involving students in master's level classes. One example involved the creation of online courses. Teams included one faculty member and three or four students tasked with developing a course the faculty member would teach the following year. A forced collaboration absent a unifying context based on lived experiences is less than ideal. It fails the authors' own standard of authentic contexts. This assigned task was relevant for one group member: the professor. Without diminishing the potential of the design approach to professional development, it may be that having shared experiences and opportunities to interact professionally within a place of practice is essential to this process.

2.3.2 Integrated Design-Based Learning

Utilizing integrated design-based learning (DBL) to develop teachers' TPACK is another approach that involves eight design principles outlined by Baran and Uygun (2016). The first

design principle is brainstorming as a way for teachers to consider solutions to problems related to technology integration. The second principle involves designing technology integrated materials for real classroom situations. Teachers then critically examine the design examples with a focus on how technology, pedagogy, and content blend to create effective instruction. The fourth principle is engagement with theoretical knowledge, in which teachers discuss the theoretical themes needed to incorporate technology. The next principle is investigation of ICT tools in order to identify their affordances and constraints. This approach advocates for the selection of technology to occur after making decisions related to content and pedagogy.

The sixth principle is reflection on the design experience intended to serve as an opportunity to contemplate how the process impacted teacher knowledge domains. The teachers then apply the designed lessons within their authentic contexts. The final principle occurs when teachers collaboratively reflect within design teams. This activity serves as an opportunity to communicate with other professionals on what worked and what did not. DBL is not intended to be a linear process, and the number of the principle does not reflect an order or sequence. These eight principles act as a guide to Baran and Uygun's (2016) DBL approach to developing teacher TPACK.

In theory, the design-based learning (DBL) approach to address teachers' TPACK is thorough and succinctly structured. However, based on the course (titled Research and Practice on Technology) that Baran and Uygun (2016) taught and used to conduct their research, it becomes clear that this approach is not ideally suited for the K-12 setting. Several of the eight principles are collaborative assignments, such as TECHDemos and Wikichapters in a TPACK Wikibook. The discrepancy between these assignments and the day-to-day expectations of a classroom teacher make them cumbersome to attempt. Instead, applying individual ideas from the research

may make the most sense. For instance, their use of a TPACK game, in which teachers select a random content, pedagogy, and technology and must come up with an integration of the three, is something that could serve as a quick activity at the beginning of a faculty meeting or team planning session. The DBL approach to professional development in its entirety, in which all eight principles are applied, is not conducive to developing the TPACK of in-service teachers. In the end, it takes time away from educators who already struggle with having too little time.

2.3.3 Teacher Design Teams and Collaborative Curriculum Design

Although they do not share the same name, the next two variations of the design process include many similar characteristics. One approach is teacher design teams, which involves educators working as a subgroup of a professional learning community tasked specifically with designing and implementing curriculum. The other approach is collaborative curriculum design.

A teacher's design team includes individuals tasked with collaboratively designing or redesigning curriculum materials (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015). The team sets out to generate complex curricula intended to expose students to global perspectives and make real-life connections around the responsibilities of good citizenship. The involved teachers benefit from the depths of knowledge within the group related to content and the thinking that comes from other fields (Psencik, 2009). The involvement of an instructional coach enhances this approach. The coach is frequently charged with organizing the task and managing issues that arise (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015; Psencik, 2009). The opportunity to collaborate and share knowledge within the teacher design team, including knowledge of technology, can enhance the participants' TPACK and improve student outcomes.

Teacher design teams, as an offshoot of professional learning communities, positively impact teachers' practice (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015). Many of the benefits mirror those of other design processes. One advantage of this approach is that teachers feel ownership of the designed curriculum, which increases the likelihood that teachers will utilize the resources within their classrooms. The impact on these teams increases when participants come from different schools because of their unique perspectives and experiences (Binkhorst, Handelzalts, Poortman, & van Joolingen, 2015). However, facilitating group work among teachers in different settings presents a profound challenge in practice. Finding time for teachers to collaborate in the same school is often a challenge in itself.

Collaborative curriculum design as an approach to increase teachers' TPACK yields many positive outcomes. Voogts, Pieters, and Handelzalts (2016) conducted an analysis of 14 PhD studies from various contexts, all focused on the design team process. They found that collaborative curriculum design resulted in enhanced content knowledge. Furthermore, teachers who participate in design teams strengthened their understanding of the connections between technology, pedagogy, and subject matter. The products created were superior to the lessons, units, and projects that teachers developed individually, and there was a measurable change in improved instructional practices from the design process (Voogt, Pieters, & Handelzalts, 2016). Teachers' involvement in design teams also led to changes in their beliefs about what constitutes good teaching (Voogt et al., 2011). It is difficult to argue with the benefits of collaborative curriculum design as an approach to increase teacher TPACK. However, it is important to note that there are challenges to accommodating the process in terms of time, resources, and the availability of a coach.

Voogt, Pieters, and Handelzalts (2016) explain that the benefit of collaborative curriculum design is twofold: the professional development of the participants as well as the creation of curriculum materials. They state, "Through the co-design process, teachers collaboratively generate knowledge of practice" (p. 123). During this process, teachers work together to design technology-rich units, lessons, and activities (Polly, Mims, Shepherd, & Inan, 2009; Voogt et al., 2011). By collaborating with other professionals, often including an individual who acts as a coach, teachers are exposed to new practices and actively shape their own practices (Voogt et al., 2011). Collaborative curriculum design, specifically within a middle school that has a common daily team plan time during which grade-level interdisciplinary teachers meet, holds significant promise as an approach to increase teachers' TPACK. However, without a coach present, it is possible that the process may default to practices and approaches the teachers are familiar with, which may or may not include the effective integration of educational technology.

2.4 Learning Activity Types

Voogt, Pieters, and Handelzalts (2016) suggest that there are three prerequisites that need to be in place for collaborative planning to succeed. The first is a culture that values professional learning. The next is time. Teachers need time to plan and time to work with a coach. The final condition is a defined structure for the work of a team. A clear structure is particularly important to the collaborative design of instructional materials when an instructional coach is not available. Such a structure must include a specific series of decisions that culminate in the selection of resources, including technology. Harris and Hofer (2009) explore an approach based on planning practices in which teachers blend technologies with teaching strategies. They refer to the product

as Learning Activity Types. Learning Activity Types are descriptors of what students are doing when engaged in the lesson. The activity types are then combined to create lessons, projects, and units. Ultimately, the selected educational technology, which is based on teachers' design decisions and the use of content specific taxonomies, is appropriate for the content goals, student learning, and context of the instruction (Harris, Hofer, Schmidt, Blanchard, & Young, 2010).

Using the Learning Activity Types model requires teachers to progress through a five-step process. At the onset of planning, teachers choose learning goals while considering contextual factors. Next, teachers make pedagogical decisions related to the eventual learning experience. Teachers then choose appropriate Learning Activity Types to combine and sequence, forming the students' learning experience. The fourth step is the selection of assessment strategies that will assist the teacher in monitoring student understanding. In the fifth and final step, the teachers select the tools and resources, including technology that will best support the prior decisions (Harris & Hofer, 2009). To assist in this process, Harris and Hofer have collaborated with teachers to develop and share Learning Activity Type taxonomies that are content and grade span specific. Providing teachers the taxonomies, in which learning activities are paired with suggested educational technologies, is an efficient way to support the process of technology integration (Harris, Hofer, Schmidt, Blanchard, & Young, 2010).

Harris and Hofer (2011) found that the combination of professionally developing teachers on their Learning Activity Types model, coupled with curricular planning, resulted in teachers making more strategic design decisions. The teachers developed lessons that were more student-centered and incorporated educational technology in a more thoughtful way. The research that led to this conclusion included professional development over a five-month period and a group of teachers comprised of only individuals who taught social studies. The design decision to include

only social studies teachers was based on research that found that learning activities are largely differentiated by content area (Harris & Hofer, 2011). From a practical standpoint, conducting a professional development opportunity over five months with a group of in-service teachers, all of whom teach in the same content area, would be challenging. As an alternative, Harris and Hofer designed a series of Learning Activity Types short courses, freely available to educators online, that guide teachers through video-based modules aimed at educating them to follow the steps outlined above as they design instructional opportunities. Harris and Hofer also offer additional resources, such as a lesson design template that teachers can utilize in their planning. The availability of the short course, lesson design materials, and taxonomies can aid the teacher design team as they make curricular decisions.

Mourlam and Bleecker (2017) conducted research on the impact of a different short course designed for preservice teachers on candidates' TPACK. Harris and Hofer also designed and offered that course. Harris recommended an article that explained how Mourlam and Bleecker situated the short course within their study (J. Harris, personal communication, July 27, 2018). Mourlam and Bleecker instructed candidates to complete the eight-module course over a three-week period. During the first week, candidates were instructed to complete modules one through three and participate in an online discussion and analysis of lesson plans regarding the extent that the plans integrated learning goals, activities, and technology. During the second week, candidates were asked to complete modules four and five and consider alternative activity types that could be utilized in various situations to facilitate higher order thinking and the incorporation of one of the four C's (communication, collaboration, creativity, or critical thinking) (National Education Association, 2012). Finally, during week three, the teacher candidates completed the short course

and designed a technology-based lesson. In-service teachers could utilize a similar design as they complete the short course for experienced teachers, which is comprised of five modules.

This approach to design does have limitations. One limitation is the constantly changing nature of technology. In order to ensure that the taxonomies do not become outdated, they would require frequent updates. Additionally, as Harris and Hofer (2011) contend, the Learning Activity Types are often content specific. This limitation, while important to note, does not preclude its inclusion as a guide during the process of collaborative curriculum design that is comprised of teachers of multiple content areas. The Learning Activity Types model does have limitations. However, in the absence of a coach, this framework provides some guidance for teachers who might otherwise revert to past practices that may or may not include technology as a tool.

2.5 Conclusion

In 2006, Mishra and Koehler emphasized the need to reevaluate the professional development of teachers based on the TPACK framework and its inclusion of technology as a knowledge domain required for effective instruction (Mishra & Koehler, 2006). Twelve years later, professional development on educational technology remains largely unchanged, with an emphasis on single offerings intended to explain the functionality of technology rather than how to use it as a tool for instruction (Ertmer & Ottenbreit-Leftwich, 2010; Mishra & Koehler, 2006; Psencik, 2009; Voogt, Pieters, & Handelzalts, 2016). The articles included in this review of literature frequently examine collaboration among teams of teachers, but not specifically of grade-level teams using the Learning Activity Types model, on the creation of interdisciplinary units with an emphasis on technology. This gap in the existing research offers an opportunity to explore

a design approach that holds the potential to improve teacher practice, create instructional resources, and benefit students.

3.0 Research Design

In 2016, Harris wrote a chapter in the *Handbook of Technological Pedagogical Content Knowledge for Educators* titled "In-service Teachers' TPACK Development: Trends, Models, and Trajectories." In it, she summarizes the various approaches and strategies found within the research intended to enhance in-service teachers' TPACK. She concludes the chapter with the following assertion:

> By purposefully choosing among and combining the strategies and approaches classified and presented here, perhaps the design and crafting of specific TPACK development efforts can become even better matched to particular teachers' professional learning needs and preferences, and the contextual realities of their workplaces. (Harris, 2016, p. 202)

This study attempts to do that by matching a variation of an approach to enhancing in-service teachers' TPACK to the contextual realities of the educators at North East Middle School. In doing so, this study adds to the possible approaches discovered in a review of the related literature. In order to determine whether this approach is worthy of further exploration for other practitioners, research questions were formulated in order to assess the impact of collaborative curriculum design using Harris and Hofer's Learning Activity Types.

3.1 Importance of the Study

An in-depth review of the literature revealed that technology use in the classroom is generally inadequate to positively enhance student learning opportunities (Ertmer & Ottenbreit-Leftwich, 2010; Hsu, 2016; Koh, Chai, Benjamin, & Hong, 2015; Lim, Zhao, Tondeur, Chai, & Tsai, 2013). Also revealed was the exponential increase in spending dedicated to educational technology over the last 20 years (Lim, Zhao, Tondeur, Chai, & Tsai, 2013). In other words, school districts continue to invest in educational technology even though many classroom teachers lack the Technological Pedagogical Content Knowledge necessary to design lessons that incorporate technology and will enhance student learning. Attempting to bridge this divide is what makes this research important.

3.2 Research Questions

The purpose of this study is to determine the degree to which collaborate curriculum design using Harris and Hofer's Learning Activity Types impacts an individual teacher's TPACK, thereby enhancing student learning opportunities. The following questions guide the research:

1. What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?
2. What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?

3. How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

3.3 Methods

During the fall of 2018, a select group of teachers at North East Middle School participated in a professional development study aimed at enhancing experienced teachers' TPACK. They were asked to complete an asynchronous online course designed and narrated by Judith Harris and Mark Hofer, "Learning First; Tools Last: Curriculum-Based Planning with Technology" (http://plp.thinkific.com/courses/learning-first-tools-last). Upon successful completion of the course, the group developed an interdisciplinary unit using Learning Activity Types, which is the approach prescribed in the course. The teachers' TPACK was assessed before and after the process through a structured interview as it related to their design of instruction. The final interview also included questions to assess each teacher's beliefs about his or her ability to utilize technology as an instructional tool. Additionally, a focus group interview of the entire team occurred after completing the unit in order to evaluate the contextual factors that influenced this process from the teachers' perspectives.

Figure 2. Progression of experiences for participants involved in this study

3.3.1 Participants

A convenience sample was chosen to ensure better access to the participants, which yielded superior data (Balbach, 1999). Seven teachers at North East Middle School work exclusively with sixth-grade students. Those teachers were chosen to participate in this study. The table below includes each teacher's subject, gender, number of years teaching, and number of years in his or her current position.

Table 1. Sixth-Grade Teachers at North East Middle School

Subject	Gender	Years Teaching (Total)	Years in Current Position
Math 1	Female	9	4
Math 2	Male	32	13
English Language Arts 1	Female	12	3
English Language Arts 2	Female	22	6
Science	Male	17	7
Social Studies	Female	31	6
Learning Support	Female	10	5
Totals (N = 7)			

The individuals on this team have all worked together in their current positions for the last three years. This group of teachers was selected primarily because of the convenience of their shared plan time for the principal researcher.

Although the focus of this study was intentionally detached from student achievement as it is it measured on high-stakes tests, the students in sixth-grade at North East Middle School are commonly high-performing in this respect. For example, on the 2017 Pennsylvania System of School Assessment (PSSA), 81.5 percent of the sixth-grade students scored proficient or advanced in English Language Arts, and 71.2 percent of the sixth-grade students scored proficient or advanced in math ("2017 PSSA School Level Data", 2017). Across the entire state, 63.6 percent and 40.2 percent were proficient or advanced in English Language Arts and math, respectively

("2017 PSSA State Level Data", 2017). Sixth-grade students in North East exceeded the state average by 17.9 percent and 31 percent in English Language Arts and math, respectively. Furthermore, the sixth-grade students' growth average in both English Language Arts and math, as calculated within the Pennsylvania Value-Added Assessment System (PVAAS), indicates "significant evidence that the school exceeded the standard for Pennsylvania academic growth" ("PVAAS", 2018). These standardized test results may reflect the effectiveness of instruction in sixth-grade at North East Middle School.

3.3.2 Inquiry Setting

This study occurred at North East Middle School, located in northwestern Pennsylvania in the northeast corner of Erie County. Roughly 400 students in grades six, seven, and eight attend the middle school. Of those students, 48 percent are economically disadvantaged, and 93 percent are white. ("Performance Profile", 2017). Until this year, the building had carts of devices, including iPads, Chromebooks, and laptops, that were signed out by teachers on an as-needed basis. Additionally, the middle school had two stationary computer labs, each equipped with 30 desktop computers. The availability of devices changed this year when the Board of Directors approved the first year of a ten-year technology plan. Beginning this school year, each student in the middle school was provided with a Chromebook that he or she carries throughout the day to each class. As part of a concurrent renovation project, the stationary labs have been permanently removed to create two additional classrooms. The iPads and other laptops have been reallocated to other buildings until they are scheduled for replacement. If the plan continues to be implemented, all students in grades three through 12 will have their own Chromebooks beginning in the 2021-2022 school year. Presently, students do not take the Chromebooks home at night.

Additional digital technology in the middle school includes a SMART Board in each classroom, a desktop lab in the technology education classroom, and Windows laptops for each teacher. Although many districts preceded North East in a transition to one-to-one computing, wherein every student is given a device by the district, this was a time of significant technological change in the North East Middle School.

North East Middle School operates on a block schedule. This allows each grade level team of teachers to share a common planning period. For instance, every day from 9:30 to 10:12, the sixth-grade teachers meet. A common grade-level planning time is not unique to North East Middle School. *This We Believe: Keys to Educating Young Adolescents*, a seminal study of the middle school model of schooling, advocates for a common team planning time for teachers apart from their personal planning time. It is during common planning time that teachers are often grouped by grade-level teams that include teachers of multiple disciplines (National Middle School Association, 2003). This time provides a framework during which a collaborative curriculum design approach to professional development is ideally suited. Other middle schools that operate on a similar schedule utilizing a team approach to student grouping may be able to apply the results of this study to their context.

3.3.3 Data Collection

3.3.3.1 Interviews

Teacher participants were interviewed twice: once at the onset of the study and again after the teachers had completed designing the interdisciplinary unit. Balbach (1999) explains, "Interviews are the path to understanding both what happened from the perspective of those involved and how they reacted to it" (p. 7). The interviews were conducted individually in the

building's Lakeview Room, adjacent to the cafeteria. This room, which is outside of the office, was a less intimidating, more informal location to meet. All of the interviews took place during the teachers' plan time. In line with recommendations from Jacob and Ferguson (2012), the time and location of the interviews ensured a quality recording made in a location that was non-threatening with limited distractions. The principal researcher conducted the interviews. Included in the introductory script was a request that the interviewees think of the interviewer as a researcher and not the building's assistant principal. This was stated as an attempt to control potential bias. In spite of this request, it is conceivable that the data was impacted by the professional and personal relationships developed over the five years the researcher has served as the assistant principal at North East Middle School.

The initial interview instrument consisted of three sections. The first section included demographic questions intended to gather information specific to each participant and his or her teaching experience. The second and third sections were replicated from two different sources. The second section asked the subject to provide a description of a lesson or unit. Prior to conducting the interview, the teacher was asked to gather relevant artifacts, which included lesson plans, assessments, worksheets, or student work, from a unit that was recently taught and included technology (digital or non-digital). The interviewee was asked to respond to five prompts and one question about the selected unit. The five prompts and one question were taken from a TPACK Interview Protocol provided for use through a Creative Commons License. Harris, Grandgenett, and Hoffer (2012) designed it.

That same instrument also included three TPACK-specific questions intended to assess how the teacher's lesson design decisions, particularly about technology, fit with the selected content goals and instructional strategies. The technical nature of the questions made them a poor

fit for this research study. Instead, the questions and follow-up questions used in Harris and Hofer's 2011 study, "Technological Pedagogical Content Knowledge (TPACK) in Action: A Descriptive Study of Secondary Teachers' Curriculum-Based, Technology-Related Instructional Planning," to assess teachers' TPACK were used. The four questions in the 2011 study use less technical language and are better suited to elicit thoughtful feedback from teachers, particularly in the initial interview before the short course and collaborative curriculum design. The questions addressed four topics: pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK). The primary questions and prompts from both sections, as well as the follow-up questions, for the initial interview are included in Appendix A.

The final interview was very similar to the initial interview with the exception of the final interview's first section. Questions in that section draw on Guskey's (2000) article on evaluating professional development. In it, he outlines five critical levels of a summative evaluation on professional development. The questions in the final interview are based on Level 1: Participants' reaction and Level 4: Participants' use of new knowledge and skills. The second and third sections of the final interview were the same as the initial interview. Instead of responding to the questions based on a lesson or unit that was previously taught in the teacher's classroom, participants were asked to respond based on the unit created during collaborative curriculum design. The final interview protocol is included in Appendix B.

3.3.3.2 Short Course

After completing the interviews, instructions were given to each teacher on how to register and begin the online course, "Learning First; Tools Last: Curriculum Based Planning with Technology." Appendix C includes the instructions each teacher used. The two-week design for

completing the course was modeled after Mourlam and Bleecker's (2017) study in which teachers completed tasks as they progressed through the modules. During the first week, teachers were asked to complete modules one (Introduction), two (The Learning Activity Types (LAT) Approach), and three (Exploring Taxonomies). Concurrently, the teachers collaborated within a shared Google Slide presentation to analyze a lesson recently taught in their classrooms. The blank slides from the Google Slide presentation that teachers used to respond are included in Appendix D. The task of analyzing a previously taught lesson aligned with the conclusion of the video in Module 3. In it, Harris and Hofer asked teachers to note the lesson's learning goals, technologies used, and learning activities in sequence in accordance with the provided content-specific taxonomies.

During the second week the teachers completed modules four (Planning with Learning Activity Types) and five (Selecting Technologies). They were also asked to continue their work in the Google Sheet either to refresh an old lesson plan or build a new plan. They listed content and process learning goals, listed the original learning activities, considered alternative learning activities with corresponding technologies, made pedagogical decisions, and decided if the change was "worth it" by answering three questions. This process aligned directly with the videos of Module 5. Progressing through the five-step process for planning was preparation for the design of an interdisciplinary unit. Upon completion, teachers were asked to print a screenshot of their student dashboard that indicated that the individual had successfully completed the course. This documentation was collected and retained.

3.3.3.3 Observations

Once all of the teachers completed the Learning Activity Types short course, they were given instructions (Appendix E) and a lesson plan template (Appendix F) in order to develop an

interdisciplinary unit using Harris and Hofer's Learning Activity Types. The work for the unit was to be done during their common planning time over the course of one month. This design allowed the team to develop their own schedule and take into account their other professional responsibilities and unrelated issues that arose. It was not the expectation of the researcher that this work be done day-after-day. Rather, the team was to communicate with the principal researcher on a weekly basis to determine which days would be spent planning. On days when the team was working to design the interdisciplinary unit, the principal researcher observed the process. It was possible that not all seven teachers would attend every day that the planning occurred. If fewer than five teachers were present, the planning session was to be rescheduled. Attendance was documented on the observation protocol (Appendix G).

The principal researcher intended to use the observer-as-participant model outlined by Hesse-Biber and Leavy as cited in *Research and Evaluation in Education and Psychology* (Mertens, 2015). With this model, the principal researcher interacted infrequently with the teachers as they designed the unit, only to discuss specific issues related to procedures. The principal researcher recorded field notes on the observation protocol related to the same four topics included in the interview protocol (pedagogical content knowledge, technological pedagogical knowledge, technological content knowledge, and technological pedagogical content knowledge). Additionally, adherence to the Learning Activity Types approach, reflective comments and questions, and other observations outside of these parameters were recorded.

3.3.3.4 Focus Group

According to Mertens (2005), the purpose of a focus group is to determine how individuals regard a problem (p. 382). A focus group interview was conducted after the teachers had completed the design process of the week-long interdisciplinary unit. The questions were intended

to explore how contextual factors influenced the group's process and instructional decisions. They were based on Kelly's (2008) chapter in *Handbook of Technological Pedagogical Content Knowledge (TPCK) for Educators*, titled, "Bridging Digital and Cultural Divides: TPCK for Equity of Access to Technology." In it he states, "Much of the "wickedness" of the problem of teaching with technology can be attributed to context" (Kelly, 2008, p. 55). The teachers' responses to the seven questions, three of which included a follow-up, provided insight into how they believe the context influenced this professional development opportunity. It also highlighted factors that could be addressed prior to future opportunities. The focus group interview was recorded and transcribed verbatim. The focus group interview prompts can be seen in Appendix H.

3.3.4 Methods for Analysis

The data gathered from the interviews, focus group, observations, and artifacts were analyzed in order to answer the research questions. The analysis was the culmination of many steps, which are described below, to ensure the accurate and transparent process of gathering and coding the data.

3.3.4.1 Data Preparation

Each interview was recorded using the Voice Recorder & Audio Editor app which is freely available on the Apple App Store. The audio files were uploaded from the app to SecureZIP, a data encryption program to ensure their security. After safely transferring the audio files to SecureZip, they were deleted from the app and phone. Because this research provided an in-depth assessment of teachers' professional knowledge, it required the data to be transcribed verbatim

(McClellan, MacQueen, & Neidig, 2003). The principal researcher generated the transcriptions manually. Those transcripts were also be saved to SecureZIP. Each transcript was reviewed by the principal researcher several times for accuracy. The audio file and transcript were each catalogued in a Google Sheet to maintain accurate records of the data that exists and where it is stored.

The field notes gathered during the collaborative design process were documented and summarized at the conclusion of each session. The iterations of the field notes were added to a separate tab in the Google Sheet, while each file was scanned and saved to SecureZIP.

The transcripts and observation notes were uploaded into Box, a cloud-based file management server. Those transcripts and observation notes were coded within multiple Excel spreadsheets by research question. Descriptors were used to tag the various transcripts, ensuring that each subject's responses would remain anonymous. The entire process of handling data was documented and monitored to avoid what McClellan, MacQueen, and Neidig (2003) refer to as research pandemonium, wherein the data tracking becomes disorganized.

3.3.4.2 Coding and Analysis

In order to analyze the data, the principal researcher created codes and categorized information around themes and patterns (Taylor, Powell & Renner, 2003). Initially, open coding, in which the principal researcher makes notes in the margins of the written text, was done on the transcripts and field notes during multiple re-readings. From the open codes, categories were developed in order to facilitate the organization of data into themes or findings. The development of the codebook, which included a code label, definition, when it was and was not used, and an example, was done in an iterative fashion as prescribed in Guest, MacQueen, and Namey's text, *Applied Thematic Analysis* (2011). The codebook was stored in Box. After ensuring that the

coding scheme was viable, the principal researcher closely read and applied it to each written text that was uploaded. As in Harris and Hofer's 2011 study, "Technological Pedagogical Content Knowledge (TPACK) in Action: A Descriptive Study of Secondary Teachers' Curriculum-Based, Technology-Related Instructional Planning," it was essential to look for evidence of pedagogical content knowledge (PCK), technological content knowledge (TCK), technological pedagogical knowledge (TPK), and technological pedagogical content knowledge (TPACK) in the data. These domains were included in the coding scheme.

Next, themes from the data were identified and examined through applied thematic analysis (Guest, Macqueen, & Namey, 2011). This inductive approach utilizes procedures from multiple theories and methodologies in order to present the experiences of the participants in a meaningful way. The transparency of the coding process adds credibility to the dependability of the findings.

3.3.4.3 Research Question 1: What Contextual Factors Influenced the Teachers' Ability to Develop an Interdisciplinary Unit Using Learning Activity Types and Collaborative Curriculum Design?

The principal researcher analyzed the field notes recorded during the collaborative planning process, the final interviews, and the responses to the focus group interview in order to determine what factors influenced the teachers' ability to develop the interdisciplinary unit. Within Mishra and Koehler's (2006) TPACK framework, context is depicted as a circle that surrounds the overlapping knowledge domains of technology, pedagogy, and content. This visual presentation emphasizes that a teacher's TPACK cannot be considered absent the contextual factors that influence his or her teaching. Kelly (2008) explains that "context is a complex, multi-factorial phenomenon" (p. 52) that includes everything from the physical elements of the school and classroom to the teacher's characteristics. He also emphasizes that the combination of

contextual factors specific to a unique classroom must be considered collectively. It was these contextual factors that were analyzed to determine what influence they had on the process of collaborative curriculum design using Harris and Hofer's Learning Activity Types at North East Middle School.

3.3.4.4 Research Question 2: What Impact, If Any, Did Taking the Online Short Course and Collaborating With Grade-Level Colleagues on the Design of an Interdisciplinary Unit Have on Each Teacher's TPACK As It is Applied During Instructional Planning?

Data from the in-depth interviews and field notes were analyzed to determine whether teachers' TPACK changed because of this process and in what ways. Individual teacher responses to the interview conducted prior to the intervention were compared to his or her responses afterwards. This analysis addressed all four domains of the TPACK framework included in the interview protocol (PCK, TPK, TCK, and TPACK) as well as the teacher's description of the lessons and unit. Field notes from the collaborative design work were also considered in addressing this research question.

3.3.4.5 Research Question 3: How Did Completing the Learning Activity Types Short Course and the Collaborative Curriculum Design Process Influence the Teachers' Beliefs Regarding Planning and Technology?

Responses to the first section of the final interview conducted after the teachers had completed the interdisciplinary unit, as well as responses during the focus group, were analyzed to determine whether the participants believed this professional development activity impacted their beliefs regarding planning and technology. The final interview protocol used questions

constructed based on suggestions in Guskey's (2000) article on evaluating professional development. Teachers were asked six questions intended to ascertain their beliefs about their experiences and the efficacy of the professional development activities. Teachers were also asked to reflect on their experience in this professional development process during the focus group. All of this data was analyzed to determine how this process influenced the teachers' beliefs about technology.

4.0 Findings

Educational technology can transform content and pedagogy (Koehler et al., 2014). Unfortunately, many classroom teachers lack the technological pedagogical content knowledge necessary to design lessons that integrate technology and benefit student learning (Ertmer & Ottenbreit-Leftwich, 2010). This study examined a unique approach to professional development intended to enhance teachers' TPACK. The methodology of the study included having the participating teachers complete an online short course titled "Learning First; Tools Last: Curriculum-Based Planning with Technology" and then apply the approach outlined in the course as they collaborated to develop an interdisciplinary thematic unit. The TPACK framework includes a circle surrounding the knowledge domains intended to represent, and emphasize the importance of, teachers' context. This study analyzed the contextual factors that influenced the process for the team of teachers. The participants also provided feedback on their experience and how it impacted them as practitioners. Chapter 4 begins with an analysis of the contextual factors that influenced the teachers as they progressed through the professional development.

The seven sixth-grade teachers participating in this study collaborated over a period of two weeks to develop an interdisciplinary thematic unit about baseball, titled "Play Ball." The lessons they designed integrated curricular topics into this theme. In math, students analyze and create representations of data gathered about baseball bats. In English language arts, students synthesize information collected during science with articles about baseball bats, generating an informative essay. In science, the students research independent and dependent variables to determine which baseball bat type (medal, wood, or composite) is the most effective. In social studies, the students read non-fiction and informative texts about baseball. The teachers alluded to baseball in many of

their responses during the final interview and focus group discussion. Those responses were coded and will be referenced to support the findings.

4.1 Research Question 1: Contextual Factors

Herring, Koehler, and Mishra (2016) define a teacher's educational context as those factors, both internal and external, that influence his or her practice. They include several examples, such as the school, infrastructure, culture, students, and parents. It is important to consider the contextual factors that influenced the teachers involved in this study as they completed the online short course individually and then collaboratively planned the interdisciplinary unit. To ignore these factors may provide an incomplete picture for practitioners who intend to replicate, or build upon, this study.

Data collected during the interviews and focus group discussion, as well as observation notes, were analyzed to generate a list of commonly referenced contextual factors. Beginning with the first respondent, contextual factors identified in the data were recorded on a spreadsheet. This coding process was repeated by the researcher for all seven teacher-participants. The resulting contextual factors were cross-referenced to avoid redundancy and to generate a comprehensive list. The contextual factors that follow answer Research Question 1: What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?

4.1.1 Availability of Resources

4.1.1.1 Chromebooks

The teachers referenced a variety of technological resources that they incorporated in the lesson plans throughout the interdisciplinary thematic unit. Of the seven participants, all seven (100 percent) mentioned the one-to-one Chromebook initiative, in which students have constant access to their Chromebook throughout the entire school day. Tonya, a sixth-grade English language arts teacher, commented in her final interview, "So the one factor that would have been an issue would be the Chromebooks, but we at the North East Middle School have one-to-one Chromebooks in our classrooms. That makes it really nice." Meredith, who also teaches sixth-grade English language arts, contrasted last year to this year when she stated, "Last year we had access to Chromebooks only when we signed them out and no one else was using them."

4.1.1.2 SMART Boards

In addition to the Chromebooks, six teachers (86 percent) referenced the availability of SMART Boards, digital whiteboards that integrate with a computer and software, in their classroom. Tessa, one of two sixth-grade math teachers, stated, "Obviously having a SMART Board in the classroom is very beneficial to me being able to present the content in a visual manner and allow for those electronic manipulatives for the students to interact with." In the focus group interview protocol, one question focused on resources that, if available, would have made this process more effective or resulted in a better product. The teachers struggled to name any technological resource that was not available that they would have liked to include.

4.1.2 Confidence

The availability of technology and each teacher's individual confidence and comfort level with using technology in the classroom during instruction were not always aligned. Four of the seven teachers (57 percent) expressed their lack of confidence during the final interview or focus group. Ted, who repeatedly lauded his content partner Tessa in the final interview on her ability to locate online resources and select appropriate technologies for various lessons, shared, "I just hope that I have the confidence by then to teach it the way it should be taught using all this fancy technology." Tonya explained that she used this process as a chance to explore new technologies, but only to a certain extent. She said, "I'm only stepping out of my comfort zone a little bit to try a few things, to try and introduce that to myself and to the students." Meredith alluded to a misconception about young teachers' use of technology in instruction when she stated, "And even though I'm a relatively younger teacher, you would think I would have a lot of technology in my lesson plans, but I feel not as comfortable with technology." There was discord between the technology available in the school and teacher confidence to use available technology in the classroom.

4.1.3 State Standards

The Pennsylvania Core Standards and the Pennsylvania System of School Assessments (PSSA) influenced the participating teachers' content decisions during lesson design. After selecting baseball as the theme of the collaboratively designed unit, several of the teachers immediately turned to what eligible content could "fit" within their lessons. This was clear in the unit overview. Each subject area teacher included a brief description of what would occur in that

content area during the unit, as well as the aligned standards. Of the seven participants, five (71 percent) mentioned during the final interviews the need to address State Standards as justification for the content included in the interdisciplinary thematic unit. Tessa stated, “So, first of all, we always look at the Common Core Standards for Pennsylvania.” Matt shared a similar sentiment when he explained, “The objectives that I addressed in the unit were all based on our standards, focusing strictly within science and trying to build on the eighth-grade based on the standards.” This emphasis on alignment and preparation for the PSSA was also expressed as a consideration during the focus group. Tonya emphasized, "I think you think about in your classroom, ‘When am I fitting this in? When am I doing this unit?’ That’s always in the back of your head. Meredith and I were thinking, ‘We have PSSAs to get ready for.’” The Pennsylvania Core Standards and PSSA had a significant influence on the way teachers planned and considered the time they had with students.

4.1.4 Structural Factors

The availability of a common grade-level plan time during the day was an important contextual reality that helped facilitate the process of collaborative curriculum design. The teachers, with limited adjustments to their normal daily schedule, were able to meet between 9:50 and 10:45 to plan collaboratively. Additionally, all teach in the same wing and had a room for daily meetings. That room was always available during team plan time, and interruptions were infrequent. Kate acknowledged the importance of their proximity in the focus group discussion when she stated, “…and because we’re located in the same wing, the same hallway, we’re all close to each other.” However, the utilization of their dedicated common plan time for the development of this unit was also a challenge noted by the teachers. During her final interview, Ann stated,

"There was a lot of time put into this process, and as a team we used a lot of our plan time. And we were not able to do our normal things that we talked about, different things that we do during our plan time." Matt explained, "A lot of things were kind of neglected on those days." The common team plan time made the process of collaborative curriculum design feasible. However, it infringed on time the teachers devoted to administrative responsibilities and discussion of student-related issues.

During a collaborative design process, an individual is often in charge of organizing the task and managing any issues that arise (Psencik, 2009). The North East School District does not employ instructional coaches, and no individual outside of the grade-level group of teachers assisted in the planning. The lack of support personnel is acute within schools serving marginalized students (Kelly, 2008). To this point, 49 percent of the students who attend the school in this study are considered economically disadvantaged ("North East MS", 2019). The purpose of utilizing the Learning Activity Types planning guide aligned to the online short course was to provide a structure intended to reduce issues that might otherwise have been addressed by an instructional coach. Comments shared by the participants indicated that substituting the Learning Activity Types framework for someone tasked with leading the group was only marginally successful. During the focus group discussion, Tessa explained,

> "I think sometimes I felt like I needed a little more guidance. You know? Did I set this up correctly? You know. Is this what needs to be in this column? Is this what needs to be in this column? I think initially a lot of energy was spent on that, figuring out whether or not this was correctly set up. And kind of talking to everybody else, 'Is this how you did it? Is this how you did it?'"

Similarly, the taxonomies were intended to expose teachers to technologies aligned with learning activities with which they may have been unfamiliar. The participants had mixed feelings about the efficacy of the taxonomies. Ann appreciated the taxonomies and expressed her intent to use them when she plans future lessons. She stated, "…the different Learning Activity Types and the taxonomies will definitely help me as a teacher when going through the planning process." Tessa shared a similar sentiment when she stated, "I was looking at the list of taxonomies to see what types of technology would match the activity types." However, several teachers expressed disappointment in the taxonomies' usefulness. Tonya stated, "It had the link, but it really just gave you a little description. I would have liked a little video or a little sample so that I could have known if I should use that or not." Statements made by the participants indicated times during the planning process when an individual tasked with management and organization might have been a benefit to the overall process.

4.1.5 Instructional Factors

The sixth-grade team is comprised of one learning support teacher, one science teacher, one social studies teacher, two math teachers, and two English language arts teachers. Outcomes in this process varied depending on whether a teacher was the only one in a particular content area or if the teacher had a partner. Kate, who teaches social studies, mentioned that although she does sometimes collaborate with the English language arts teachers because of her focus on non-fiction reading, at other times she felt isolated. In the focus group, she shared, "In the process of designing the interdisciplinary unit, I kind of felt like an island at times because I'm social studies." This was noted in the observation of the collaborative planning process. By day three of planning, the teachers had completed the unit overview. Once that was finished, the teachers' interdisciplinary

collaboration segued into departmental planning. The teachers worked in their departments to transfer and expand upon what was written in the overview within the lesson plan template. For Matt and Kate, who alone teach science and social studies, respectively, that meant a lot of individual work. The benefit of the collaborative process was limited for those teachers who are the only ones in a particular subject area.

4.1.6 Collegiality

One intangible aspect of this team mentioned by its members is their personal affinity and respect for one another. Five teachers (71 percent) expressed positive sentiments about the team and collaborating on the unit design process. During the focus group, Meredith mentioned that they all get along really well. Ann expounded that point by stating, "I think that we trust each other. We've all worked together for three years now." Tonya continued, "And we know that we'll give you [Ted] the support that you need, or Tessa will give you the support that you need." At a different point in the focus group discussion, Kate referenced that instructional support when she stated, "I know someone is next door to me. I can ask them a question if something isn't going quite right." The respect, trust, and support among the professionals was a benefit discussed during the interviews and focus group.

4.2 Research Question 2: TPACK Impact

This study is an extension of a study completed by Harris and Hofer (2011) in which a group of social studies teachers participated in a five-month professional development experience

on Learning Activity Types. Like that study, this study considered a variety of data in order to determine the impact the professional development had on the participants' TPACK. Analysis in this section considers the teacher's initial interview as an inflection point that culminated in the final interview after the teachers had completed the Learning Activity Types online short course and the collaborative curriculum design process.

Each teacher's in-depth interviews and lesson plans, as well as his or her observed behavior during collaborative planning, were analyzed to identify impacts on knowledge. The data was coded by teacher with common codes utilized across participants, beginning with the four domains: Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Content Knowledge (TCK), and Technological Pedagogical Content Knowledge (TPACK). Those four domains were subdivided by specific considerations and choices made by the teachers. For instance, a teacher's decision to use a Google Form to assess students' learning because it provides immediate feedback was coded as TPK-Assessment. These codes were listed underneath the four domains and then further divided into a column for responses given before the professional development experience and after the professional development experience. Text from the interviews, observations, and focus group discussion was inserted underneath the appropriate codes to allow for analysis. This coding was completed to answer Research Question 2: What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?

The chart below lists each of the four domains analyzed in this study along with a definition from the literature.

Table 2. Domains of the TPACK Framework and Definitions

Pedagogical Content Knowledge (PCK)	Pedagogical content knowledge is when a teacher can take knowledge of the content and represent it in ways that are powerful and reflective of the students and their abilities (Shulman, 1987).
Technological Pedagogical Knowledge (TPK)	"Knowledge of the existence, components, and capabilities of various technologies that are used in teaching and learning settings, and conversely, knowing how teaching might change as the result of using particular technologies" (Mishra & Koehler, 2006, p. 1028).
Technological Content Knowledge (TCK)	Technological content knowledge is the awareness of technological tools that can improve a teacher's ability to represent content in a way students can learn (Mishra & Koehler, 2006).
Technological Pedagogical Content Knowledge (TPACK)	"Knowledge about the complex relations among technology, pedagogy, and content that enables teachers to develop appropriate and context-specific teaching strategies" (Koehler et al., 2014, p. 102).

The section that follows includes an analysis of each individual teacher, followed by an across-participant analysis of the whole group. The individual analyses are divided into each domain listed above from the TPACK framework. The overlapping nature of the framework is such that evidence can sometimes be categorized in multiple domains. For instance, what is demonstrative of change in TPK may also represent growth in TPACK. In some instances, evidence may be referenced in multiple domains to indicate a change.

4.2.1 Participants

4.2.1.1 Tonya – English language arts teacher with 23 years of experience

PCK

Tonya's pedagogical content knowledge remained consistent between her initial interview and final interview. Her decisions about what to teach and how to teach it are primarily driven by alignment to the Pennsylvania Core Standards and knowledge of her students. She mentioned during her initial interview that she chooses resources based on their alignment to the PA Core. During the collaborative design process, Tonya quickly sought to identify eligible content from the standards that could be addressed in the unit. In both interviews, she alluded to knowledge of her students and the ways they learn best as justification for learning activities. In the final interview, Tonya stated, "And [poetry] is difficult for kids to do. So that will be done together." Her focus on State Standards and planning based on her knowledge of her students was consistent between the unit she selected for the initial interview and the collaboratively designed unit.

TPK

Much of the technology that Tonya plans to use in the "Play Ball" interdisciplinary thematic unit is similar to what she utilized in her initial unit. It is also largely selected to support her pedagogical practices. In the final interview she stated, "As far as technology, I picked most things that I felt that I would be comfortable with." Both units utilize Google Classroom to share digital resources such as videos that the students can watch independently while they take notes. She did acknowledge in the final interview that she stepped outside of her comfort zone by including in her plans some technology that she had not used previously. For instance, she intends

to utilize Flipgrid, an online tool that allows students to record themselves and create a short video responding to a prompt, as a culminating activity. Tonya's integration of technology relies on what has worked in the past, but also includes examples that demonstrate growth in technological pedagogical knowledge.

TCK

This process positively impacted Tonya's technological content knowledge, or knowledge of the existence of technological tools that can enhance a teacher's representation of the content. As part of the "Play Ball" interdisciplinary thematic unit, she intends to use Google Docs, a word processing application included in G Suite that is easily shared to facilitate collaboration, as a way for students to begin the writing process in science and then continue in the English language arts classroom. In doing this, both teachers will have access to the Google Doc, as well as any other students with whom the author decides to share. She is using Google Docs, a technological tool, to enhance the way that she teaches the content (writing an informative essay). Decisions to use similar technological tools did not occur in the initial unit. This demonstrates a positive impact on her technological content knowledge.

TPACK

Tonya had a conversation with a colleague on the second day of planning about how to teach comparing and contrasting. As part of that discussion, they referenced the Learning Activity Type taxonomies for ideas and ultimately selected an interactive Venn Diagram from Readwritethink.org. As part of this process Tonya utilized the digital taxonomies that she learned about during the online short course to select a teaching strategy using a tool that she had never

tried. This process represents a positive impact on her technological pedagogical content knowledge.

4.2.1.2 Tessa – Math teacher with 12 years of experience

PCK

Like several of Tessa's colleagues, the PA Core standards, her experience, and the time she intends to devote to a particular topic often drive her instructional decisions. When asked during the initial interview how she decided how to teach the content of the unit, Tessa stated, "I actually have a plan and I have 'x' amount of days that I want that plan to be executed in." During the final interview, Tessa explained that the State Standards influenced her decision to teach measures of center and box-and-whisker plots. She specified, "So we decided to teach this content based on the Standards that we have to meet in sixth-grade." The influence of time, experience, and alignment to State Standards restricted any significant impact on Tessa's pedagogical content knowledge during this professional development experience.

TPK

Tessa's technological pedagogical knowledge is enriched by the time she spends searching for resources. Her preparation was clear in the initial interview and the final interview. When asked in the initial interview how she decided on materials, tools, and resources, she replied, "I do a lot of research online just to see if there's anything else that could enhance my teaching." This process led her to websites and interactive flipcharts that she added to her instructional presentations in the initial unit. Tessa's articulation of her technological pedagogical knowledge did become more detailed and deliberate as a result of the professional development experience.

In the “Play Ball” interdisciplinary thematic unit, Tessa included a digital assessment using Google Forms, which she explained allows for more immediate feedback. She also detailed her use of manipulatives embedded within interactive flipcharts and PowerPoint presentations. Tessa’s technological pedagogical knowledge evolved during this process, but her commitment to finding resources remained consistent.

TCK

Tessa utilized technology to support the delivery of content before this study began. However, completing the online short course and participating in collaborative curriculum design increased Tessa’s awareness of other technology that exists to represent content. This outcome reflects a positive change in her technological content knowledge. Examples of choices that demonstrated her technological content knowledge in the initial unit included subject-specific videos, skill practice on content specific websites, and the use of the digital textbook for instruction and practice. During the “Play Ball” interdisciplinary thematic unit, Tessa plans to have the students utilize an online box-plot generator. This tool was something she discovered by selecting an activity type (produce a representation) and researching the possible technologies found in the math Learning Activity Types taxonomy. This professional development experience increased Tessa’s awareness of the tools that she can use to support the delivery and representation of content, a positive impact on her technological content knowledge.

TPACK

There is a notable shift in Tessa’s process descriptions regarding how she selected a particular learning activity or technology between the initial interview and the final interview. In the initial interview, when asked how she decided how to teach the content, she immediately

referenced her experience. She then listed various learning activities that could be applied to any content. She mentioned using flipcharts (a visual presentation composed of pre-made slides), bellringers, and practice on whiteboards. In the final interview, she thoroughly detailed her design process, which is closely aligned to the content of the online short course, "Learning First; Tools Last: Curriculum-Based Planning with Technology." She explained:

> I specifically took a long look at the list of learning activity types in the taxonomy packet from the module to then see if we would be able to incorporate some of the technologies that went hand-in-hand with our Learning Activity Types, while also keeping in mind whether or not we had enough time during the day to make it happen or not.

Tessa's thorough description of her planning process, in which she aligned technology to decisions about content and pedagogy, was impacted by taking the online short course and participating in collaborative curriculum design. This reflects a change in her technological pedagogical content knowledge.

4.2.1.3 Kate – Social Studies teacher with 31 years of experience

PCK

For a social studies teacher, there is not a statewide assessment in the spring aligned to a specific set of history standards. This offers Kate some latitude to select learning goals and content based on her curriculum, but also in support of her English language arts colleagues. These considerations, coupled with her knowledge of her students' needs, comprise the foundation of Kate's pedagogical content knowledge. In her initial interview, Kate explained that her unit is aligned to the class text and deals with Eastern Woodland Indians. This topic becomes a vehicle

for her to focus on skills such as comparing and contrasting, as well as reading non-fiction texts. In the collaboratively planned thematic unit, Kate relied on her resource knowledge to locate appropriate materials, as well as her pedagogical knowledge to design learning opportunities that have worked in the past. Kate's pedagogical content knowledge remained static between her initial interview and final interview.

TPK

Kate's technological pedagogical knowledge is evident in the many technological tools that she used based on her awareness of their capabilities. She used Google Classroom extensively and noted a benefit of the platform during the final interview when she explained, "It's just easy to place that template in Google Classroom. They know right where to access it." During the initial interview, Kate discussed having the students take notes from a Prezi (a web-based presentation software that zooms between points of emphasis). In the initial and final interviews, she mentioned having the students use their Chromebooks to complete an assessment created in Google Forms. Decisions in both units exemplified her technological pedagogical knowledge in action. For Kate, that knowledge domain did not significantly change because of the professional development experience, largely because her technological pedagogical knowledge was already well developed.

TCK

Kate also utilized a variety of technological tools to support her instruction of content. For the Eastern Woodland Indian unit, she created and presented Prezis that included embedded videos related to the topic. She had the students work collaboratively on a digital Venn Diagram projected to the SMART Board to compare and contrast the Eastern Woodland Indians with other Indian

tribes that they studied previously. During the interdisciplinary unit, Kate intends to share a digital timeline template with students through Google Classroom. Each class will populate the timeline with information gleaned from the Library of Congress website. Kate also plans to have the students use their Chromebooks to explore the website of BWP Bats, a baseball bat manufacturer located in Brookeville, Pennsylvania. Kate's technological content knowledge is strong and was so before this professional development experience began.

TPACK

Although a teacher's TPACK is never complete (particularly with respect to technology), Kate's ability to integrate content, pedagogy, and technology was evident before the professional development process began. During the final interview, she explained her commitment to integrating technology as a way to engage students. She stated, "I've always thought that technology is important because that's what the kids are used to and that's what the kids want to use." Whether Kate has students learning to compare and contrast using a digital Venn Diagram projected to the SMART Board, or accessing and analyzing primary sources on their Chromebooks to better understand how baseball began, she consistently integrated technology that supported her decisions related to content and pedagogy. Kate has strong TPACK and used it to develop her lessons and units.

4.2.1.4 Matt – Science teacher with 17 years of teaching experience

PCK

Matt's pedagogical content knowledge did not significantly change because of his participation in this professional development experience. The content that Matt teaches in his

initial unit, as well as the content selected in the "Play Ball" interdisciplinary thematic unit, is driven by the eighth-grade Pennsylvania State Standards. When asked in the final interview to describe the student learning goals addressed in the unit, Matt replied, "The objectives that I addressed in the unit were all based on our Standards, focusing strictly within science and trying to build on the eighth-grade based on the Standards." He is also committed to making science an interactive learning experience. During the initial interview, Matt stated, "I wanted the kids to have hands-on experiences seeing how things are changing physically." Matt made a similar comment in the final interview when he explained, "The main emphasis within science is exploration and getting the kids the hands-on approach to learning." State Standards and his focus on making science interactive drove Matt's content and pedagogical decisions.

TPK

Matt's participation in creating the interdisciplinary thematic unit positively affected his technological pedagogical knowledge. An unexpected facet of this unit design process was the teachers' extensive use of Google Docs for the purposes of planning. The unit overviews, as well as the daily lesson plans, were created by making copies of a shared Google Doc. Several of the teachers struggled to use Google Docs, including Matt. As the only science teacher, he spent a significant amount of time planning on his own. He repeatedly needed assistance from his colleagues to modify the formatting of his lesson plans when something would go amiss. He often struggled to find a Google Doc saved to his Google Drive. However, by the conclusion of the process, he was adjusting the curriculum continua on his own, retrieving the lessons from his Google Drive, and accessing the Google Docs of other curriculum areas when necessary. Ultimately, he ended up including Google Docs in his plans as a way to have students start writing in his class and pick up with research in their English language arts class. As a result of the

collaborative curriculum design process, he now has more experience using Google Docs and was able to access that new technological pedagogical knowledge to enhance his lesson plans.

TCK

Resources purchased by the district support Matt's technological content knowledge. Specifically, Matt relied on his online textbook, DefinedSTEM, and Study Island to represent content using technology in ways that students will learn. He utilized similar technological tools and made similar decisions to present the content in his initial unit and the "Play Ball" interdisciplinary thematic unit. Matt's technological content knowledge was not impacted by his participation in this professional develop opportunity.

TPACK

Matt led the team in selecting the theme of the "Play Ball" interdisciplinary thematic unit based on his experience with the baseball simulation included in Defined STEM, project-based software the district purchased last school year. During his initial interview and his final interview, Matt talked about the simulations included in the software that he utilized in his classroom. In the initial interview, he explained:

> There is a virtual lab that we just covered with physical and chemical changes that had the students interacting on their Chromebooks and picking a specific video. They watched the video, they saw how things were changing, and then they had to identify the different signs that a physical change or a chemical change could be taking place.

In the final interview, he described the baseball simulation that became the foundation of the interdisciplinary thematic unit. He explained, "That would get us into the Defined STEM simulation where the students would be conducting an experiment simulating what the different

types of bats would be doing, holding specific variables constant." His awareness of this program, willingness to modify its content to fit the context of his curriculum, and ability to implement it into his instruction demonstrated his TPACK in action. However, his TPACK did not significantly change between the initial unit and the collaboratively designed unit.

4.2.1.5 Ted – Math teacher with 33 years of experience

PCK

Ted is a self-described "old timer" whose responses in the initial interview demonstrated an approach to lesson design reliant on repetition and routines. Based on his past experiences, including successful results on the PSSA, Ted is inclined to follow the sequence outlined in his digital textbook and lean on the resources, digital and non-digital, provided therein. In the initial interview, he stated, "I have pretty much followed that textbook because it seems to bring success. Our scores are good." Ted emphasized his collaboration with Tessa during the initial interview and final interview. In the final interview he reflected, "Well it was nice to sit down with Tessa, who is my partner, and we talked about what she had done in the past and what I had done in the past." This professional development experience did force Ted to consider alternate approaches to teaching the content; however, those decisions were still driven by collaboration with Tessa and the PSSA. Therefore, Ted's pedagogical content knowledge did not significantly change during this process.

TPK

This process positively impacted Ted's technological pedagogical knowledge. Ted relied exclusively on technological resources provided as a component of the digital textbook to support

his pedagogical decisions in the initial unit. The resources included digital videos and pre-made presentations projected to the classroom SMART Board. It was evident in the final interview that Ted relied on Tessa's technological knowledge to bolster his own when he stated, "Everything that we need is available to us. Although I didn't know that. Thank you to Tessa. Everything that we need is available to use online." This collaboration led to the inclusion of several technological tools that enhanced Ted's pedagogical decisions. For instance, he discussed the use of Google Forms to assess the students during his final interview. Ted's technological pedagogical knowledge benefited from his participation in this professional development experience.

TCK

Ted's technological content knowledge was also enhanced by taking the online short course and participating in collaborative curriculum design. In the initial interview, the singular example demonstrative of Ted's technological content knowledge was his use of a content-related website for student practice. This stands in contrast to the technology rich lesson plans discussed during the final interview. While discussing the collaboratively designed thematic unit, Ted repeatedly mentioned an online box-plot generator that he and Tessa discovered. He explained its benefit when he shared, "We found out we were able to use this box-plot grapher, where the kids, all they have to do really is understand data, find the information, and they simple enter it and it creates the box-plot for them." He also referenced several content specific websites. Ted's technological content knowledge increased during this professional development experience.

TPACK

In contrast to Ted's initial interview, his final interview included a more thorough explanation of how this unit would unfold, including several of the learning activities he and Tessa

selected aligned to technological tools. Ted and Tessa's collaboration on the "Play Ball" interdisciplinary thematic unit led to a much more robust selection of resources aligned to content absent the digital textbook. For instance, in Ted's final interview he mentioned using Google Forms for assessment, content specific websites, and the online box-plot generator. These decisions are justified by their affordances and the way in which they will support his content and teaching approaches. The process of completing the online course and participating in collaborative curriculum design enhanced Ted's technological pedagogical content knowledge.

4.2.1.6 Meredith – English language arts teacher with nine years of experience

PCK

For the initial interview, Meredith elected to discuss a novel study of *Esperanza Rising*. Based on her responses, Meredith's planning process was driven by learning goals supported by the learning activities she selected. She also considered aspects of the story, such as farming, that would be of interest to her students. In the initial interview she stated, "This being a farming community with grapes, we have a lot of discussion about that." While reading the book, she aimed to develop the students' reading comprehension through discussion and synthesis. She emphasized her focus on the historical aspects of the story and the research that she did to highlight elements of the Mexican Revolution. Interestingly, despite her classroom's proximity to the social studies teacher's classroom, as well as their shared planning time, she does not mention any collaboration as part of the unit.

Unlike several of her colleagues, Meredith does not explicitly reference the State Standards or the PSSA as justification for her content decisions in the initial interview or final interview. She does focus on learning goals and engaging her students. Her focus on engagement was evident in

the final interview when she justified the decision to include poetry. She explained, "The other language arts teacher and myself were thinking that poetry might be a way to hit more of the kids and get them interested in the topic of baseball." Meredith's content-driven, student-centered instructional decisions motivated her planning in the initial unit and the collaboratively designed thematic unit. This professional development process did not impact her pedagogical content knowledge.

TPK

Meredith's technological pedagogical knowledge was positively influenced by her involvement in this professional development experience. Meredith frames technology in the *Esperanza Rising* novel study as something she eliminates the need for by printing out resources prior to class. She stated, "The kids don't do much with technology, as they're getting ready for this, because I have it all ready for them." This attitude might stem from limitations of what was available the year before when she last taught the unit. Meredith explained, "Last year we had access to Chromebooks only when we signed them out and no one else was using them. So we couldn't rely on those as we were making any of our lessons or preparing a unit." While Meredith's responses to the initial interview demonstrated her developed efforts to integrate her pedagogical and content knowledge, she does not consider what technology might support her selected learning activities.

Meredith's approach to designing instruction changed as a result of the online short course and collaborative curriculum design. In her final interview, she explained the decision to use Flipgrid. She stated, "After three days of working on [researching and writing an essay], we would do the Flipgrid reaction to how they felt about the whole unit and the study." She also detailed her decision to use Google Docs for student writing to enhance the conferencing process. Meredith's

choices, as well as how she explained the process for including technology, demonstrated her enhanced technological pedagogical knowledge.

TCK

Meredith's limited integration of technology in the initial unit was indicative of her room for growth in technological content knowledge. The only instance in which technology was used to support the representation of content was when she used a Google image search during vocabulary instruction. In contrast, the "Play Ball" interdisciplinary thematic unit contains multiple examples of technology used to enhance the teaching of content. Meredith planned to have the students access Common Lit, a website with digital resources and aligned assessments, on their Chromebooks in order to compare two pieces of fictional writing. She incorporated the digital Venn Diagram on the SMART Board to further enhance that process. The students also used the Chromebooks to conduct research. Meredith's technological content knowledge was enhanced because of her involvement in this professional development experience.

TPACK

If the absence of technology was glaring in the initial unit, its presence and integration into the "Play Ball" interdisciplinary thematic unit was quite extensive. Meredith, working with her content partner Tonya, made technology selections based on learning activities and the paired technologies included in the taxonomies. Meredith plans to have the students write their essay in a Google Doc. She emphasized the benefit of this tool when she explained:

> We would have them typing their actual document in Google Docs so that we could easily access those and they could share them with us and one another. A lot of times they like to have a peer look over their work, too.

Additionally, they intended to integrate digital videos, Flipgrid, and the interactive Venn Diagram. This unit, completed after taking the online short course and participating in collaborative curriculum design, represented significant growth in Meredith's technological pedagogical content knowledge.

4.2.1.7 Ann – Learning Support teacher with 10 years of experience

PCK

As a special education teacher, Ann has a unique perspective when she collaboratively plans lessons and units with her co-teachers. It is clear that she considered what will work with her students, many of whom struggle in a particular subject, and what is included in their individualized education programs. When asked in the initial interview how she decided how to teach the content that the unit will address, she responded:

> We'll try to figure out what the needs are, or the difficulties, what the difficulties might be for these students. We'll then try to chunk each lesson so that it's in small chunks for the kids to learn. We try to teach at a slower pace.

These are not learning activities that are included in the taxonomies, but rather adaptations to the chosen learning activities. Some examples of activities that Ann mentioned in the initial interview included organized chaos (an activity in which students answer one question in order to locate the next question in the classroom), computation with whiteboards, drill and practice, and clozed notes. Ann's focus on her students is consistent with her responses during the final interview. She stated, "I also have to consider adaptations for my students, their specially designed instruction." Ann's pedagogical content knowledge is accessed to support the needs of her students. That did not change between the initial interview and final interview.

TPK

Ann's technological pedagogical knowledge is expanded by her involvement in this professional development experience. She did reference technology in support of pedagogy in the initial interview. Examples included tools such as the SMART Board, hovercam, and flipcharts. She is the only teacher who mentioned an approach to classroom management supported by technology. She and Tessa use ClassDojo, an app that allows teachers to monitor student behavior and communicate with parents as well as to reward students when they are on task. In the final interview, she mentioned her increased awareness of available technological tools. She said, "[The professional development activities] brought forth a lot of different information that we as teachers may not have considered while we were planning and going through the planning process. Especially the technology piece." This observation led to her utilizing additional technological tools such as Google Forms for assessment and Flipcharts with embedded manipulatives.

TCK

Ann's technological content knowledge was also enhanced because of her involvement in the professional development activities. In the initial interview, she only mentioned using the realworld videos that are included with the digital textbook and Study Island for student review and practice. During the final interview, she mentioned having the students participate in an online math game to review mean, median, and mode. She explained, "So the students are able to go right into that on their own Chromebook, one-to-one, and actually participate in that." She discussed having the students use the box-plot grapher. She explained, "Then with technology we were able to find an interactive website where students will actually be able to go on to the website and put in their data into the box-and-whisker plots." Ann's enhanced technological knowledge

was evident in the technological choices she made, as well as the explanation of how they would be utilized.

TPACK

During the development of the "Play Ball" interdisciplinary thematic unit, Ann created and adapted the lessons in consultation with the math and English language arts teachers. When asked how she decided which materials, tools, and resources to use to teach the content of the unit, she explained:

> The short little course that we had taken, it helped a lot because it showed us that we're able to plan, and then choose the different learning activities and go through to choose. And then once we plan that, we were able to look at the different technologies that were available using those different LATs. And it was a really good tool to use because there were a lot of different technologies that we didn't know about.

This is a textbook answer based on the content of the online short course "Learning First; Tools Last: Curriculum-Based Planning with Technology." This approach was evident in the math lessons she chose to discuss. For instance, in order to apply a representation, Ann referenced the taxonomies and selected to use a virtual manipulative. In another instance, she decided to investigate a concept and utilized a content-specific interactive tool. As a result, the instances of technology integration in the "Play Ball" interdisciplinary thematic unit are aligned to the learning goals and are likely to enhance the students' learning. Ann's approach to planning remained student centered; however, the impact on her technological pedagogical content knowledge can be attributed to the short course and the taxonomies that matched learning activities with technology.

4.2.2 Across Participant Results

In addition to analyzing the participants' individual responses during the in-depth interviews and focus group discussion, a holistic look at the impact across participants was also considered. The four domains of the TPACK framework that were addressed within this research included pedagogical content knowledge (PCK), technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK).

4.2.2.1 Pedagogical Content Knowledge

The teachers' knowledge of their students, the Pennsylvania Core Standards, their experience, and the time available for instruction were factors that were consistent influences referenced during the initial interviews and the final interviews following the professional development experience. All four factors can be restrictive and reinforce certain choices regarding what is taught and how it is taught. This professional development experience produced minimal impact on teachers' pedagogical content knowledge, or how a teacher takes content knowledge and represents it in ways that students will understand (Shulman, 1987). There was a small shift away from prior experience as a driving force behind pedagogical decisions. Prior experience was noted by four participants (57 percent) in the initial interview and only two (29 percent) in the final interview. Meredith mentioned this change in her final interview when she stated, "Then instead of just doing what I always do, which I bore myself with sometimes, but to reach outside the box and even to my colleagues." The process of completing the online short course, coupled with the collaborative design process, had relatively little impact on the teachers' pedagogical content

knowledge due to the influence of the PA Core Standards, teachers' knowledge of students, their experience, and time.

4.2.2.2 Technological Pedagogical Knowledge

The knowledge of materials, tools, and resources utilized in the collaboratively designed thematic unit, compared to the individually chosen units described in the initial interviews, was more robust and varied. This was particularly evident in the plans and responses of the math, English language arts, and learning support teachers. Those same teachers were more thorough in describing how they selected the materials, tools, and resources to support their teaching. Their responses indicated an impact on their technological pedagogical knowledge, or knowledge of tools that support learning goals and enhance student experiences. Tessa explained how she approached selecting tools and resources for the interdisciplinary thematic unit: "So, in terms of materials, tools, and resources, we broke down every day into the learning activity types and then we matched them with technologies when it was appropriate." She went on to explain how a technological tool listed in the taxonomies might not meet the learning goals and was not utilized as a result:

> Sometimes some of the learning activity types would recommend different technologies, but we just didn't feel that it would really benefit the students, maybe became of time, maybe because they could do something on paper that they, even if they did it online, they wouldn't understand the concept better or get a more in-depth knowledge of it.

Tessa's explanation regarding the selection of tools, materials, and resources during the collaborative design process was similar to answers given by Ted, Tonya, Meredith, and Ann.

Matt and Kate, who teach science and social studies, respectively, did not experience a similar impact on their technological pedagogical knowledge. For Matt, his initial unit and the "Play Ball" interdisciplinary thematic unit relied on Defined STEM, curricular software embedded with pre-selected tools, materials, and resources. Therefore, there was little change apparent in his responses to the questions. He does utilize many tools that support learning goals and the experiences of the students in the class. He also chose to use a Google Doc for the students' writing process in order to allow for collaboration between subjects, something that he knew to do because of his own growth as a byproduct of the professional development process. For Kate, she planned the social studies component of the interdisciplinary thematic unit almost entirely alone. She relied extensively on what she had used in the past, which does represent a considerable amount of technological tools and online resources. However, there was not a notable change in her technological pedagogical knowledge. The impact on Matt and Kate's technological pedagogical knowledge is in contrast to the other five participants in this study.

4.2.2.3 Technological Content Knowledge

Five of the seven teachers' (71 percent) technological content knowledge, or familiarity with the digital tools available to enhance the content and how it is taught to students, was expanded by this professional development experience. The exceptions were Matt and Kate. In these two cases, the teachers' knowledge did not change because they were already utilizing an extensive repertoire of technological tools to support the content in the initial unit.

The online short course emphasized that although the selection of tools, including technology, should be the final consideration during planning, it must still be a part of the process. As a result, all of the teachers included in their "Play Ball" interdisciplinary thematic lesson plans technological tools in support of the content being taught. It is less clear how frequently that

consideration occurred in the selected units addressed in the initial interviews. Nowhere is the contrast more evident than in the plans of the English language arts teachers. The novel study that Meredith selected for the initial interview is almost completely void of technology. In fact, the only way that technology was used was in support of vocabulary, during which she showed pictures of unknown words to the class using a Google image search. Tonya, her English language arts colleague, also supported vocabulary instruction with digital photos in her selected unit. In addition, she uploaded short videos to Google Classroom for the students to watch that related to the book they are reading. The "Play Ball" interdisciplinary thematic lessons developed by these two teachers included many technological tools specifically intended to enhance the content and how it was taught. For instance, they planned to use an interactive digital Venn Diagram to compare and contrast two pieces of literature. They also planned to have the students access a Google Doc that was started in science class to continue the process of constructing an informative writing piece. They mentioned that the use of Google Docs allows them to access their students' work digitally for review. The technological content knowledge of Tonya, Tessa, Ann, Meredith, and Ted was expanded by this professional development experience.

4.2.2.4 TPACK

The teachers in this study are content-centric. They begin the process of designing instruction by selecting the content they intend for the students to learn. For teachers of subjects with an aligned state assessment, those content decisions are significantly influenced by the Pennsylvania Core Standards. Subsequent decisions are driven predominantly by their professed knowledge of their students and how they believe those students will learn best. For five of the seven teachers (71 percent), those decisions in the collaboratively designed unit reflected an increased awareness of, and willingness to incorporate, technology when it was perceived to

enhance learning. The two teachers that did not experience a similar impact described initial units in which technology was already utilized to enhance decisions related to content and pedagogy.

There are examples from the "Play Ball" interdisciplinary thematic unit in each content area in which technology is a tool selected to enhance how the concepts are represented, to apply pedagogical techniques that use technology to teach the content in constructive ways, and to make concepts easier to understand (Mishra & Koehler, 2009). The English language arts teachers plan to use an interactive digital Venn Diagram to support the teaching of comparing and contrasting two texts. The math teachers plan to incorporate an online box plot generator so that students better understand how changes in the collected data impact its graphical distribution. In science, the students will engage in an online simulation in which variables can be held constant; something that would not be possible without technology. Finally, in social studies, the students are able to access primary sources on their Chromebooks as they analyze the history of baseball and enhance their ability to read non-fiction text. Completing the online short course and collaborating to design an interdisciplinary thematic unit was an effective way to enhance the majority of teachers' TPACK.

4.3 Research Question 3: Teachers' Beliefs Regarding Planning and Technology

In addition to the analysis of contextual factors and the impact on teachers' TPACK, this study also sought to determine how participation in this professional development process affected teachers' beliefs regarding planning and technology. All seven participants (100 percent) indicated that they enjoyed the professional development activities and believe that their participation benefited them as practitioners. A number of themes emerged within the responses given during

each participant's final interview. Those themes answer Research Question 3: How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

4.3.1 Collaboration Enhances Planning

Five of the seven participants (71 percent) mentioned that they benefited from the collaboration with colleagues inherent in this process. When asked if the professional development experience was time well spent, Ann responded, "But going through this process and going through it as a team, and being able to discuss different ways that we could start to plan as a team and as individuals, it was well spent." Meredith expressed a similar sentiment when she stated, "I also really liked getting to collaborate with all of my colleagues. And their input kind of helped make my lessons better, I think." She went on to specify that the teachers who have more experience with technology assisted her by sharing what they do so that she could utilize those same tools and techniques in her classroom. Ted pointed out that despite the fact that the teachers meet each day, that time is rarely spent discussing instructional practices. He said, "We don't often have a chance to share cross-curriculum ideas because our day is so busy. But it was really cool to work with these guys every single day." Collaboration with colleagues to design instruction was an element of this process that a majority of the participants pointed to during the final interview as a benefit of the experience.

4.3.2 Forced Reflection Occurred

This professional development experience was an opportunity to examine what teachers have done in the past and to consider new approaches and tools within the collaboratively designed unit. When asked about her experience in this professional development process, Tessa replied, "I think it really makes you think about what you need to do with your teaching and it gives you a little bit of a refresher to jump start what you're going to do in the future." Meredith echoed these sentiments by stating, "Not only did I think more about how I plan, but also, I guess, trying to challenge myself more to look at what other technologies are out there." Kate specifically referenced the online short course as an opportunity for her to reflect on her instruction. She explained, "[The course] got me to think a little deeper and maybe out of the box as I was watching the videos and watching some other teachers model what they used in the classroom. It kind of got me thinking on a different level." Tessa summarized the views of her colleagues when she concluded, "I think it's a good reminder that we all should take some time to reflect on our teaching methods even though we might have been teaching for several years." This professional development experience provided the participants an opportunity to reflect on how they design instruction and to consider different approaches in the future.

4.3.3 An Awareness of Options

All seven teachers (100 percent) felt that this professional development experience increased their awareness of the options that exist, particularly in terms of technology. Based on the individual responses, some of that newfound awareness stemmed from access to the content-specific taxonomies. Ann explained, "[The taxonomies] gave us a ton of different technologies to

look at and to explore which we'll be able to use in the future." Ted was more general when sharing a similar impact on his awareness of tools. He stated, "The thing that I learned more than anything is how many other technological websites and things out there that are available that I never knew how to get to." Tessa echoed Ted's experience by stating, "This development activity showed me that, perhaps there are other activities and technologies that go hand-in-hand that I could now research and see how I could implement into my lessons from here on out." Technological knowledge refers to a teacher's awareness of what tools exist that can be integrated with content and pedagogy to develop effective lessons. This professional development experience enhanced the participants' awareness of options and, by extension, their technological knowledge.

4.3.4 Confidence

Lack of confidence is often an impediment to the integration of technology into lesson planning. Four participants (57 percent) noted a positive impact on their confidence to include technology while planning as a byproduct of the professional development experience. Tonya stated, "I think that this professional development activity is making me not be so fearful and give things a try." An increase in confidence was often relative. Some of the same teachers who mentioned increased confidence still described lacking confidence generally. Matt noted that he feels more confident; however, he also lamented that his confidence is "not where it should be." Meredith explained her own thinking upon completing the online course and the collaborative curriculum design. She said, "But I think that I feel more empowered now to do it. Like, I can do this. Technology is my friend. It's out there." Finally, Kate explained that having researched new

choices she feels “more comfort in [her] zone of technology.” Overcoming insecurities was one result of this process that will likely lead to increased integration of technology into planning.

5.0 Discussion

The purpose of this qualitative study was to explore the impact of a professional development experience that paired a Learning Activity Types online short course with collaborative curriculum design on teachers' TPACK. This chapter begins with a discussion of the major findings and concludes by examining the limitations of the study, opportunities for future research, a conclusion, and a brief reflection.

The analysis included in this chapter is aligned to the three research questions that framed this study:

1. What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?
2. What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?
3. How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

5.1 Interpretation of the Findings

Based on an analysis of the data included in Chapter 4, the following are significant findings related to this study. The interpretation that follows considers how the results can inform instructional practice to aid all teachers and administrators as they seek to utilize the various technological resources being purchased to enhance student learning opportunities.

5.1.1 Contextual Factors

The contextual factors that impacted the teachers' ability to develop an interdisciplinary unit described in this study aligned with many of the contextual factors outlined in the research. The five contextual factors that emerged from the in-depth interviews, focus group discussion, and observations included:

- Availability of resources during the collaborative curriculum design process, as well as technological tools to integrate into classroom instruction
- A teacher's confidence to include technology in his or her instruction
- The influence of Pennsylvania Core Standards on decision making
- Structural factors such as a common plan time and the location of classrooms in the building
- Instructional factors including collegiality and the composition of the interdisciplinary team.

These contextual factors were realized through an analysis of the data, although the degree to which they impacted the results cannot be determined. Understanding that these contextual factors impacted the participants in this study is important knowledge for a practitioner who may decide

to apply this approach in a school setting. The next two subsections divide the contextual factors between those that enhanced the process of collaborative curriculum design and those that detracted from it.

5.1.1.1 Building on Enhancements

Several of the contextual factors detailed in Chapter 4 enhanced the collaborative curriculum design process. During the final interviews, all seven participants (100 percent) articulated the benefit to instructional planning of students' constant access to a Chromebook. The one-to-one initiative, in which each student has access to a Chromebook throughout the day, was possible because the North East School District's administration, teachers, and school directors collaborated to develop a technology plan. That ten-year plan was initiated by the district's building-level administration in coordination with the technology department. The current plan to purchase Chromebooks (which are less expensive than most other laptops) for every student is projected to save the district $27,833 annually (North East School District, 2018). Even a teacher with the most distinguished technological knowledge cannot integrate technology into instruction where there are no resources. Therefore, learning how to plan for ready access to technology is key to sustaining successful projects designed around educational technology (Lim et al., 2013). Access to technological resources is an important contextual factor that affected the ability of the participants to apply their TPACK and design instruction.

The ability of the teachers in this study to undertake collaborative curriculum design was supported by several structural factors. The most essential factor was the daily common team planning time. A common team planning time is a recommendation in *This We Believe: Successful Schools for Young Adolescents* (2003), a seminal publication on the middle school model. The schedule at the site of the study provided each grade-level team with a set time and room in which

to meet. The sixth-grade teachers have time to meet daily for 42 minutes. A common planning time, during which the team of teachers is able to meet and collaborate to design curriculum, is an essential contextual factor required for the professional development approach utilized in this study.

Collegiality was a contextual factor that ended up being a significant benefit to the teachers as they collaboratively designed instruction. The participants expressed their respect, trust, and support of one another during the final interviews and focus group discussion. These feelings translated into actions as the participants shared resources and supported one another as they planned to integrate educational technology into instruction in new ways. The participants indicated during the in-depth interviews and focus group discussion their high regard for one another and the positive impact that collegiality had on the process of designing instruction, as well as the quality of the interdisciplinary unit.

5.1.1.2 Limiting Constraints

Several of the contextual factors included in Chapter 4 detracted from the efficacy of the collaborative curriculum design process. Teachers at the North East Middle School have access to a wide range of technological resources including hardware (e.g., Chromebooks, SMART Boards, digital document cameras) and software (e.g., Study Island, DefinedSTEM, G Suite). That access, even in a district with a majority economically disadvantaged student population, aligns with findings in the report *Reimaging the Role of Technology in Education: 2017 National Educational Technology Plan Update* (2017). That report indicates that the United States has significantly narrowed the first digital divide such that marginalized students have access to devices and internet connectivity at rates close to their non-marginalized peers. The site of this

study is equipped with many technological resources that teachers can choose to include in their instruction.

Despite this investment in digital tools and resources, teachers involved in this study expressed a lack of support to integrate technology as they planned the interdisciplinary thematic unit. During the focus group discussion, Tessa shared her reticence to utilize technology she was unfamiliar with because of the "potential chaos" that could result. Tonya admitted that without additional information about each technological resource, she was not sure whether to include those resources in her lesson plans. During the observations of the planning process, teachers struggled with aligning instruction across subject areas and student outcomes. Without instructional support, students often have less access to achievement-enhancing opportunities with technology, which Kelly (2008) refers to as the second digital divide. The teachers' responses, as well as the observations, indicate that a lack of support was a contextual factor that diminished the effectiveness of this professional development experience.

5.1.2 Impact on Teachers' TPACK

In order to determine what impact the process of completing the Learning Activity Types online short course and collaborative curriculum design had on participants' TPACK, responses from the initial interview were compared to answers during the final interview, comments brought forth by the focus group discussion, and observation notes. This professional development process had the least impact on the participants' pedagogical content knowledge (PCK) due to the influence of other factors, such as State Standards. There was a positive impact on six of the seven participants' (86 percent) technological pedagogical knowledge (TPK), or knowledge of tools that enhance student experiences and support learning goals. This was evident in those teachers'

processes used to select technological tools in support of chosen learning activities. Five of the seven participants (71 percent) experienced growth in their technological content knowledge (TCK). This finding illustrates a change in knowledge and inclusion of digital tools available to enhance how the content is taught. The same percentage of teachers' technological pedagogical content knowledge (TPACK) was positively impacted by this professional development experience. There was a shift in how those five teachers chose to incorporate technology in order to enhance decisions related to content and pedagogy. These changes in knowledge are evident in how the teachers involved in the study planned to utilize tools and resources, including technology, within the collaboratively designed unit compared to the decisions made while developing their initial units.

5.1.2.1 TPACK Growth Occurred. Can It Be Sustained?

This professional development experience was a disruption to the participants' normal routines and behaviors at the site of the study. The teachers have historically devoted the majority of their daily common team planning time to administrative responsibilities and discussion of student issues. During this study, common planning time was utilized to develop lessons, curricular resources, and assessments. Some of the teachers expressed misgivings about the work left unfinished because of their focus on designing the unit, a fact likely exacerbated by the team's decision to complete the plan over a two-week period, frequently on consecutive days. The original methodology provided the teachers flexibility to decide which days to work on collaborative planning. The participants elected to work in an expedited manor for the sake of continuity. Most of the teachers involved in this study shared that the experience forced them to reconsider how they plan and utilize technology in instruction. This professional development experience enhanced the participants' technological pedagogical knowledge, technological

content knowledge, and technological pedagogical content knowledge. There is merit to this approach. However, without addressing how teams utilize their collaborative team planning time, the teachers may not attempt another interdisciplinary thematic unit or utilize the Learning Activity Types approach to lesson design, both of which have benefited the teachers' TPACK.

It is incumbent upon school administration to lead an effort in collaboration with the grade-level teachers who share a common planning time to outline expectations and goals to be accomplished during that time. In *This We Believe: Successful Schools for Young Adolescents* (2003), planning ways to integrate the curriculum and reflect on the effectiveness of instructional approaches are two essential components of a daily common planning time. The position paper states, "Addressing the concerns of individual students and day-to-day management details are important topics on a team's agenda but should not consume the bulk of the common planning time" (p. 29). Unfortunately, planning instruction has taken a back seat to student issues and administrative responsibilities at the site of this study. I have observed this behavior in my role as a building administrator. Establishing expectations, refocusing on the original purpose of a common team planning time, and supporting the teachers as they undertake the challenging process of designing instruction are three action steps that should be included in any plan to positively impact teachers' TPACK.

5.1.3 Beliefs About Planning and Technology

Responses during the final interview and focus group discussion reflect the influence that this professional development experience had on the beliefs of the teachers regarding their lesson planning and the use of classroom technology. The teachers involved in this study indicated that collaboration enhanced their planning. When asked if this process was time well spent, Ted

responded, “For an older teacher like me to work with these younger teachers, absolutely. I learned a lot about myself and learned a lot about what they like to do in their classrooms.” The teachers also indicated that this professional development experience forced them to reflect on how they make instructional decisions when designing lessons. Tonya summarized this belief succinctly when she stated, “I’ve been thinking about things more than I have in the past.” The participants expressed an increased awareness of the technological tools and resources that exist. Tessa shared, “I think that [the professional development activities] showed me the different options that there are in relation to activities that could be used in math.” Teachers also indicated that their involvement in this study led to an increase in confidence to include the use of technology in their plans. Even Kate, who did not experience significant change in her TPACK, stated, “Now I have more choices in my mind after doing a little more research and a little more comfort in my own zone of technology.” The stated beliefs of the participants reflect well on the efficacy of the process.

5.1.3.1 Technological Knowledge is Key. Taxonomies Hold Significant Promise.

This study found that technological knowledge is essential to enhanced technological pedagogical knowledge, technological content knowledge, and technological pedagogical content knowledge. A teacher can only incorporate tools into instruction of which he or she is aware. That is not to say that awareness will automatically lead to teachers integrating a technological resource into instruction. Several of the participants mentioned their increased awareness of available technology because of their involvement. For instance, one teacher stated in the final interview, “We’ve taken the time to look at the different technologies and test out the technologies. And I think that I’d be more apt to use [them] in the classroom.” In many instances, the Learning Activity Types taxonomies, in which Activity Types are matched with possible technologies, provided a

starting point for further discussion. Other teachers were underwhelmed by the descriptions provided in the interactive Activity Type taxonomies, which detracted from their usefulness. Tessa stated, "I would like the list of technologies to be a little bit more detailed, or have hyperlinks to certain technologies that are available and how to use them." The taxonomies provided teachers with ideas of tools aligned to activity types; however, the description of the technology and links to the websites were often insufficient.

Some schools and school districts have begun the process of personalizing the taxonomies to include specific technologies aligned to the various activity types. Dr. Judy Harris, who along with Dr. Mark Hofer is at the forefront of the Learning Activity Types model, shared that schools have requested an editable version of the taxonomies that they can adapt to include the tools that are available in the district, as well as curriculum standards (personal communication, February 5, 2019). Dr. Harris has requested that the district send back a digital copy of what they create, which she intends to post on the Learning Activity Types website. Modifying the taxonomies to include available tools and video tutorials at the site of this study would be a significant undertaking, but worth the effort. For instance, Kate, who teaches social studies, could create a video tutorial for using Plickers, an assessment tool that allows teachers to scan student cards using an iPad to gather formative data. A link to her video tutorial could be included in the possible technologies when students are Answering Questions (an activity type included in the social studies taxonomy). Tessa, who teaches math, could create a video tutorial for Nearpod, an interactive presentation software that allows assessment to be integrated between slides, as a technology aligned to the activity type Attend to a Demonstration. Customizing the taxonomies with specific tools and resources could further enhance the teachers' technological knowledge, a prerequisite to using technology as a part of instruction.

5.1.3.2 Technology is a Consistent Consideration.

The deliberate consideration of technology was evident in the teachers' responses during the final interviews, as well as their lesson plans included in the "Play Ball" interdisciplinary thematic unit. This finding is in contrast to the initial interviews, in which responses indicated that teachers often planned lessons and units without contemplating technology that might enhance the content and pedagogy. When asked during the initial interview how she decided which materials, tools, and resources to use to teach the content, Meredith's response did not reference any examples of educational technology. Similarly, Ted's response during the initial interview about how the materials, tools, and resources "fit" the content (a question intended to elucidate a teacher's technological content knowledge) did not include technological tools. Responses during the initial interviews reflected a planning process often void of evidence indicative of the teacher's technological knowledge.

Much of the positive impact on teachers' technological pedagogical knowledge (TPK), technological content knowledge (TCK), and technological pedagogical content knowledge (TPACK) stems from their increased awareness of different technological tools and the time they spent considering those tools during planning. During her final interview, Ann described the planning process used throughout collaborative curriculum design as going a step further by asking teachers to delve into possible technologies aligned to learning activities. Meredith reported that her approach to planning remained largely consistent with the exception of researching technology that she could include in her lesson plans. Responses during the final interviews demonstrated a marked increase in the consistent consideration of technology during the process of designing instruction.

One factor that contributed to this change in the teachers' mindset was their completion of the Learning Activity Types online short course. The approach included in the modules prescribes a sequence of decisions that teachers must make as they develop lessons and units. That sequence includes the following five steps:

1. Teachers choose learning goals while considering contextual factors.
2. Teachers make pedagogical decisions related to the eventual learning experience.
3. Teachers then choose appropriate Learning Activity Types to combine and sequence, forming the students' learning experience.
4. Teachers select assessment strategies that will assist the teacher in monitoring student understanding.
5. Teachers select the tools and resources, including technology, that will best support the prior decisions (Harris & Hofer, 2009).

The selection of tools, including technology, occurs last, and any selection must support prior decisions about content, pedagogy, learning activity types, and assessment. According to this approach to lesson design, technology should never drive decisions about what to teach or how to teach it. Without knowledge of what tools exist (technological knowledge), as well as a process that includes considering those tools to support prior decisions about content and pedagogy, teachers include technology more sporadically with fewer variations.

5.2 Limitations

One limitation of this study was the supervisor to employee relationship between the researcher and participants. Each in-depth interview began with a request that participants try not

to think about the researcher as their assistant principal but as a researcher. However, several participants referenced the researcher in the capacity of assistant principal in responses during the interviews. For instance, while discussing different technologies to use in her planning, Meredith stated, "What else is out there? What has Mr. Karns sent in Google Classroom that I could go back and look at?" The professional relationship between the researcher and the participants is one limitation of this study.

Other limitations stem from the design of the study. It was assumed that the initial instructional unit selected by each participant was reflective of his or her planning process generally, particularly as it related to technology. However, there was no guarantee that this was the case in this particular investigation. Also, the teachers did not actually teach the collaboratively designed "Play Ball" interdisciplinary thematic unit as part of this study. It is possible that a teacher included technology in the unit plan that he or she will ultimately decide not to incorporate into instruction when the unit is taught. The design of the study required an assumption about the initial unit and trust that the "Play Ball" interdisciplinary thematic unit will be delivered to the students as designed.

Another limitation stems from the participants' awareness of key terms at the outset of the study. The TPACK framework had not previously been emphasized in the building or the district through in-service programs or training. This lack of awareness caused several of the questions in the initial interview to be difficult for the participants to understand and answer. The final question in the interview protocol asked teachers to describe how the combination of content, pedagogy, and technology was appropriate for the unit. This is a challenging question to answer without prior knowledge and a definition of each term. Several teachers asked for questions to be repeated or re-read the questions to the themselves before providing responses. A future study could explore

whether participants benefit from in-service training on the TPACK framework, as well as definitions of key terms, prior to conducting the initial interview in order to more accurately reflect the decisions made during the process of designing instruction.

5.3 Possibilities for Future Research

Based on the results of this study, it is clear that pairing a Learning Activity Types online short course with a collaborative curriculum design process is an effective approach to enhancing teachers' TPACK. Future research might focus on variations of this approach that eliminate constraints included in this chapter in order to determine if the impact on TPACK can be further enhanced. A future study could be completed in a school or school district that does employ an instructional coach. That instructional coach could participate during the collaborative curriculum design process, as well as the implementation of the unit, in support of the teachers. Someone else might choose to conduct a similar study in a district that has taken the time to personalize the Learning Activity Types taxonomies with technologies available and activity types aligned to curriculum standards. In both examples, the teachers involved in the study could access supports not available in this study. Comparing the results could provide practitioners with data indicating whether having an instructional coach or modifying the Learning Activity Types taxonomies are worthwhile, particularly considering constraints to resources.

The findings in this research represent the immediate change in teachers' TPACK after completing the online short course and participating in collaborative curriculum design. This study did not consider whether the change is long lasting. Future research could invite teachers to participate in a similar process but assess the impact after an extended time of designing additional

lessons and units. By extending the time to conduct the research, the researcher could acquire more data to determine if the change becomes a part of each teacher's approach to lesson design, or if the process included in this study represents a temporary shift. Expanding the study to include a longer window of time would also give another researcher the opportunity to observe the collaboratively designed thematic unit as it is presented to students. This would address whether the decisions made during the design process were implemented during the delivery of the unit. Evaluating the impact of this approach over a longer period of time, and taking into consideration how the teachers approach planning after the professional development experience concludes, would provide researchers more data on the long-term impact of the professional development experience.

5.4 Conclusion

School administrators would be wise to utilize research-based approaches to professionally develop classroom teachers so that they can effectively integrate technology into instruction. The process of completing a Learning Activity Types online short course and participating in collaborative curriculum design appears to result in a positive impact on teachers' TPACK. These findings, framed within the contextual factors that impacted the professional growth process, validate the aforementioned methodology, thereby providing school administrators with a new process to enhance the TPACK of teachers in their schools.

If teachers are to effectively integrate technology into instruction, they must first have adequate technological knowledge, or knowledge of the technology that exists. The findings of this study indicate that technological knowledge, paired with the Learning Activities Type

framework for lesson design, appears to result in enhanced technological content knowledge, technological pedagogical knowledge, and technological pedagogical content knowledge. Teachers' technological knowledge was enhanced by collaborating with their colleagues, exploring taxonomies included in the Learning Activity Types online short course, and investigating instructional opportunities during the design process. The teachers activated this new knowledge as they considered which tools might support the learning goals that were selected within the interdisciplinary thematic unit. This study utilized a framework for planning that applies technology as a tool in support of content and pedagogy.

There are certain factors that must be in place for this methodology to be successful. The most important contextual factor is the availability of a common planning time during which teachers collaborate on the creation of lessons, materials, and assessments. Without a common planning time, it would be extremely difficult to facilitate the collaborative design of curriculum. Additionally, the availability of technological resources is essential. It is difficult for any teacher to overcome a dearth of tools and resources, regardless of his or her technological knowledge. While the contextual factors that affect teachers vary by location, the availability of a common planning time and access to technological resources are key elements of this approach.

The teachers emphasized that this process was an opportunity for them to reflect on how they design instruction. They also shared that they enjoyed the process of collaborative curriculum development and it increased their confidence to use technology in their instruction. The findings of this research will inform other administrators who wish to support teachers as they attempt to integrate technology into their lessons and units. This is an extremely important responsibility considering the investment districts are making in educational technology around the world and the need to provide students effective learning opportunities.

5.5 Reflection

The findings of this study make clear the importance of providing teachers time to collaborate. It was during the development of the interdisciplinary thematic unit that the participants shared knowledge of resources and approaches to instruction that other teachers coopted into their own lesson planning, thereby enhancing the quality of the student learning opportunities. However, the availability of a common planning time was not new during this research study. Each grade-level team of teachers meets daily for 42 minutes and has done so since the building opened in 1992. Establishing how that time is to be utilized represents an opportunity for administration to ensure that similar collaborative curriculum design efforts occur in the future.

The influence of the PA Core Standards on the teachers' instructional decisions was something that I found surprising during this research study. Five of the seven teachers (71 percent) specifically mentioned the State Standards during the final interviews as justification for the content included in the unit overview. Their efforts to align the content of the interdisciplinary thematic unit did not stop them from questioning whether they would have time to present the unit prior to the PSSA, for which they felt the need to prepare students explicitly. Those same teachers mentioned how much they believed the students would enjoy the opportunity to experience learning around a theme across subject areas. I appreciate the efforts of the teachers to align content and prepare students for the yearly state assessment. It concerns me that their focus on the Standards would infringe on otherwise valuable learning opportunities.

An important lesson that I have learned as a result of this study is the positive impact of a professional development opportunity that is collaborative and occurs within the teachers' context over an extended period of time. Given a framework, time, and resources, teachers have the

capacity to design instruction that integrates educational technology in ways that will enhance student learning opportunities, as well as teachers' TPACK. A collaborative approach to professional development is something to be applied in other contexts, supporting teachers as they seek to integrate technological resources in the classroom.

Appendix A Initial Interview Protocol

Prior to the interview:

- Teachers will be asked to gather artifacts they consider relevant to a recent unit designed and delivered to their students. Examples may include, but are not limited to lesson plans, assessments, documents, and notes.

Intended purpose of the interview:

- To determine how teachers' professional knowledge (content, pedagogical, and technological) is integrated to design lessons and units.

Participants:

- The participants will include seven sixth-grade teachers at North East Middle School in the North East School District.

Inquiry questions:

1. What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?
2. What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?
3. How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

Introductory Script

Good morning, __. Thank you for taking the time to speak with me. I am conducting research on how teachers plan lessons and units. I really want to learn more about your process, so please try not to think of me as your assistant principal, but as a researcher. I will not participate in the discussion with you, but rather ask questions and potentially probe for more information. If you are okay with it, I would also like to record our conversation. I will not use any information that will identify you personally in my research in order to maintain your confidentiality. The interview should take about 25 minutes. The risk of your participation is minimal and does not include any health risk. The benefit of your participation is that your input will help me develop a deeper understanding of how teachers plan and use that knowledge to consider future professional development opportunities for other teachers in the district and beyond. Do you agree to participate in this interview? Do you agree to allow me to record the interview?

Demographics

Before we get into talking about the process you use to design instruction, I would like to get more information about your experience as a teacher.

1. What is your current teaching assignment?
2. How many years have you been a teacher?
3. How many years have you been a teacher in this district?
4. What is your highest degree earned?

Section 1: Description of Lesson/Unit

1. Describe the content and/or process topic(s) for the unit.
2. Describe the student learning goals/objectives addressed in the unit. (These will not necessarily be state or national standards. Participants should describe these in their own words.)
3. Describe your students (e.g. grade level, and specific learning needs/preferences).
4. Walk me through the unit as it unfolded in the classroom.
5. What educational technologies (digital and non-digital) did you use and how did you and/or your students use them?
6. Describe any contextual information (e.g. access to a computer lab, materials and resources available; particular department/school-wide initiatives) that influenced the design or implementation of the lesson/project.

Thank you for describing the unit to me so that I have a better understanding of what you designed. Next, let's talk about the decisions you made in order to design the unit.

Section 2: TPACK-Specific Questions

1. Pedagogical content knowledge: How did you decide how to teach the content that this unit addresses?
    a. How, if at all, did these decisions change the content (e.g., scope, depth, or nature of the content)?

2. Technological pedagogical knowledge: How did you decide which materials, tools, and resources to use to teach the content of the unit?
    a. How, if at all, did these decisions change your teaching (e.g., classroom management, assessment of student learning, or ways in which you interacted with the students)?

3. Technological content knowledge: How did the materials, tools, and resources that you used 'fit' the content of the unit?
    a. How, if at all, did these decisions change the content (e.g., adding or subtracting unit subtopics based on available resources)?

4. Technological pedagogical content knowledge: How and why was this particular combination of content, pedagogy, and technology most appropriate for this unit?

References

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229.

Harris, J., Grandgenett, N., & Hofer, M. (2012). Testing an instrument using structured interviews to assess experienced teachers' TPACK. In C. D. Maddux, D. Gibson, & R. Rose (Eds.), *Research highlights in technology and teacher education 2012* (pp. 15-22). Chesapeake, VA: Society for Information Technology & Teacher Education.

Appendix B Final Interview Protocol

Prior to the interview:

- Teachers will be asked to gather artifacts created during the collaborative curriculum design process. Examples may include, but are not limited to lesson plans, assessments, documents, and notes.

Intended purpose of the interview:

- To determine how teachers' professional knowledge (content, pedagogical, and technological) is integrated to design lessons and units.

Participants:

- The participants will include seven sixth-grade teachers at North East Middle School in the North East School District.

Inquiry questions:

1. What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?
2. What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?
3. How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

Introductory Script

Good morning, __. Thank you for taking the time to speak with me. As you know, I am conducting research on how teachers plan lessons and units. I really want to learn more about your process, so please try not to think of me as your assistant principal, but as a researcher. I will not participate in the discussion with you, but rather ask questions and potentially probe for more information. If you are okay with it, I would also like to record our conversation. I will not use any information that will identify you personally in my research in order to maintain your confidentiality. The interview should take about 25 minutes. The risk of your participation is minimal and does not include any health risks. The benefit of your participation is that your input will help me develop a deeper understanding of how teachers plan and use that knowledge to consider future professional development opportunities for other teachers in the district and beyond. Do you agree to participate in this interview? Do you agree to allow me to record the interview?

Section 1: Teacher Feedback

1. Did you enjoy the professional development activities included in this process?
2. Do you feel that this process was time well spent?

3. Have you been able to effectively apply the new knowledge and skills from this professional development activity into your lesson planning?
    a. If yes, in what ways?
    b. If no, why do you think that is?
4. Has this professional development activity increased your confidence to include technology in your lesson planning?
    a. If yes, in what ways?
5. How are you using what you learned in this professional development activity in your planning process?
6. What other ways has this professional development activity changed your ability to use technology in the classroom?

Thank you for responding and providing feedback on the professional development activities completed as part of this study. Next, I would like to ask you some questions about the unit you created during this professional development activity.

Section 2: Description of Lesson/Unit

1. Describe the content and/or process topic(s) for the unit.
2. Describe the student learning goals/objectives addressed in the unit. (These will not necessarily be state or national standards. Participants should describe these in their own words.)
3. Describe your students (e.g., grade level, and specific learning needs/preferences).
4. Walk me through the unit as it unfolded in the classroom.
5. What educational technologies (digital and non-digital) did you use and how did you and/or your students use them?
6. Describe any contextual information (e.g., access to a computer lab, materials and resources available; particular department/school-wide initiatives) that influenced the design or implementation of the lesson/project.

Thank you for describing the unit to me so that I have a better understanding of what you designed. Next, let's talk about the decisions you made in order to design the unit.

Section 3: TPACK-Specific Questions

1. Pedagogical content knowledge: How did you decide how to teach the content that this unit addresses?
    a.How, if at all, did these decisions change the content (e.g., scope, depth, or nature of the content)?

2. Technological pedagogical knowledge: How did you decide which materials, tools, and resources to use to teach the content of the unit?
    a.How, if at all, did these decisions change your teaching (e.g., classroom management, assessment of student learning, or ways in which you interacted with the students)?

3. Technological content knowledge: How did the materials, tools, and resources that you used 'fit' the content of the unit?
    a.How, if at all, did these decisions change the content (e.g., adding or subtracting unit subtopics based on available resources)?

4. Technological pedagogical content knowledge: How and why was this particular combination of content, pedagogy, and technology most appropriate for this unit?

References

Guskey, T. R. (2000). *Evaluating professional development*. Thousand Oaks, CA: Corwin Press.

Harris, J. B., & Hofer, M. J. (2011). Technological pedagogical content knowledge (TPACK) in action: A descriptive study of secondary teachers' curriculum-based, technology-related instructional planning. *Journal of Research on Technology in Education, 43*(3), 211-229.

Harris, J., Grandgenett, N., & Hofer, M. (2012). Testing an instrument using structured interviews to assess experienced teachers' TPACK. In C. D. Maddux, D. Gibson, & R. Rose (Eds.), *Research highlights in technology and teacher education 2012* (pp. 15-22). Chesapeake, VA: Society for Information Technology & Teacher Education.

Appendix C "Learning First; Tools Last: Curriculum-Based Planning With Technology":

A Learning Activity Types Short Course for Experienced Teachers

Description:

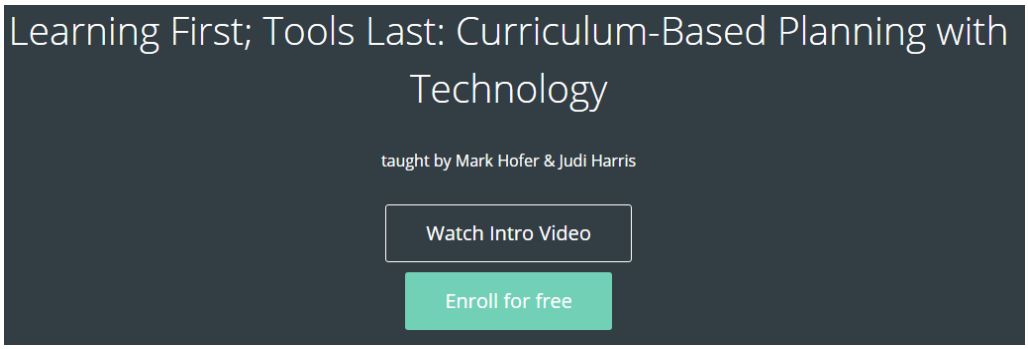
The purpose of this asynchronous, online course is to provide a structure and taxonomies that guide teachers in making decisions about technology after first selecting content goals and instructional strategies. It is taught by Dr. Mark Hofer and Dr. Judi Harris. It consists of the following five modules:

1. Introduction
2. The Learning Activity Types (LAT) Approach
3. Exploring Taxonomies
4. Planning with Learning Activity Types
5. Selecting Technologies

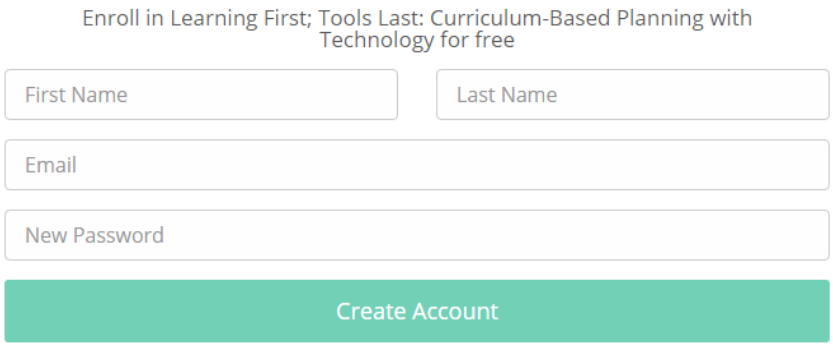
Embedded in each module are resources that can be applied to the process of unit design using Learning Activity Types.

Registration:

1. Please navigate to the following website: http://plp.thinkific.com/courses/learning-first-tools-last
2. You are encouraged to watch the Intro Video. After watching the video, please click on the green box to enroll for free.



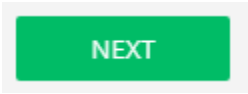
3. You will be prompted to enter your First Name, Last Name, Email, and set a New Password. Then, click "Create Account."



4. After selecting "Create Account," you will automatically enter the course's Dashboard and have the ability to begin Module 1: Introduction.

Course Schedule:

- Week 1-
    - Teachers will be asked to complete Modules 1 (Introduction), 2 (The Learning Activity Types (LAT) Approach), and 3 (Exploring Taxonomies) during the first week.
        - The video in Module 1 (Introduction) is eight-and-a-half minutes. Teachers can also access all Learning First Documents in Module 1.
        - The video in Module 2 (The Learning Activity Types (LAT) Approach) is just over five minutes
        - The video in Module 3 is four-and-a-half minutes.
    - As you complete a component of a module, you must click "next" in the lower right corner for the course to recognize your progress.

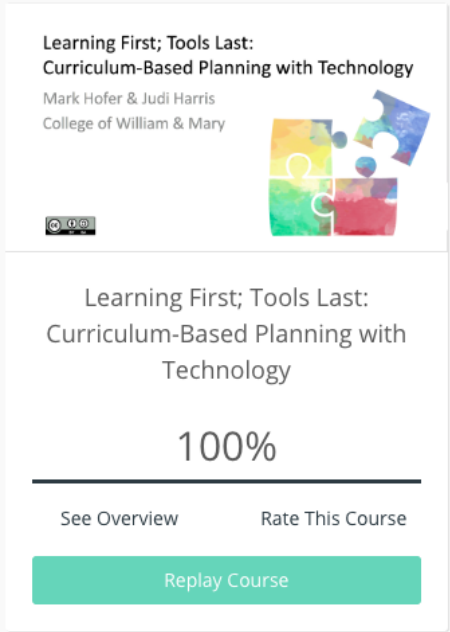


    - **Also during this week, you are asked to complete the task described at the end of the Module 3 video. Consider a lesson you've recently taught in your classroom. Think of the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies. Record this information into the shared Google Slide presentation. There is an example already included. You're encouraged to look at what other teachers share as well.**

- Week 2-
    - To re-access the course, please navigate to the same address listed in the registration section. This time, select "sign in" in the upper right corner (if you are not already) and type in your email address and password.

- Teachers will be asked to complete Module 4 (Planning with Learning Activity Types) and Module 5 (Selecting Technologies).
  - The first video in Module 4 is roughly one-and-a-half minutes. Teachers may then select either Option 1: Refresh an Existing Plan or Option 2: Create a New Plan.
    - **As the teacher watches the chosen video, he or she is asked to follow along on the corresponding task with Learning Activity Types guide. That guide is also included in the Google Sheet.**
  - The video in Module 5 is just over seven minutes.
    - **As the teacher watches the video, he or she is asked to complete the Learning Activity Types guide by assessing and selecting technology.**

Congratulations! You've completed the "Learning First; Tools Last: Curriculum-Based Planning with Technology" short course. Please print the Dashboard homepage indicating that you have completed all five modules and provide that to the principal investigator.



Appendix D North East Middle School Google Slide Presentation

NORTH EAST MIDDLE SCHOOL

Steven Karns

Math Teacher 1: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.		
LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

MATH LATs TAXONOMY

Math Teacher 1 (Slide 1 of 3): **Please complete as you watch Module 5**

List content and process learning goals for the lesson/project here:			
Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

MATH LATs TAXONOMY

Math Teacher 1 (Slide 2 of 3): **Please complete as you watch Module 5**

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← →		More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ← →		Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ← →		Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this Instruction. ← →		I can allot a week or more for this Instruction.	Other considerations:
Students need a significant amount of scaffolding. ← →		Students can work effectively with less scaffolding.	
Students will work in a whole group. ←	Students will work in small groups.	Students will work Individually. →	

Math Teacher 1 (Slide 3 of 3): **Please complete as you watch Module 5**

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

Math Teacher 2: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.		
LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

MATH LATs TAXONOMY

Math Teacher 2 (Slide 1 of 3): Please complete as you watch Module 5

List content and process learning goals for the lesson/project here:			
Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

MATH LATs TAXONOMY

Math Teacher 2 (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← → More student-directed instruction			Technology resources available:
Students have fewer prior experiences with the topic. ← → Students have more prior experiences with the topic.			Human resources available:
Students should develop a basic understanding of the topic or skill. ← → Students should develop a deep understanding of the topic or skill.			School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this instruction. ← → I can allot a week or more for this instruction.			Other considerations:
Students need a significant amount of scaffolding. ← → Students can work effectively with less scaffolding.			
Students will work in a whole group.	Students will work in small groups.	Students will work Individually.	

Math Teacher 2 (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

ELA Teacher 1: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.		
LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

K-6 LITERACY LATs TAXONOMY SECONDARY ELA LATs TAXONOMY

ELA Teacher 1 (Slide 1 of 3): Please complete as you watch Module 5

List content and process learning goals for the lesson/project here:			
Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

K-6 LITERACY LATs TAXONOMY SECONDARY ELA LATs TAXONOMY

ELA Teacher 1 (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← → More student-directed instruction			Technology resources available:
Students have fewer prior experiences with the topic. ← → Students have more prior experiences with the topic.			Human resources available:
Students should develop a basic understanding of the topic or skill. ← → Students should develop a deep understanding of the topic or skill.			School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this instruction. ← → I can allot a week or more for this instruction.			Other considerations:
Students need a significant amount of scaffolding. ← → Students can work effectively with less scaffolding.			
Students will work in a whole group.	Students will work in small groups.	Students will work Individually.	

ELA Teacher 1 (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

ELA Teacher 2: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.

LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

K-6 LITERACY LATs TAXONOMY SECONDARY ELA LATs TAXONOMY

ELA Teacher 2 (Slide 1 of 3): Please complete as you watch Module 5

List content and process learning goals for the lesson/project here:

Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

K-6 LITERACY LATs TAXONOMY SECONDARY ELA LATs TAXONOMY

ELA Teacher 2 (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← →		More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ← →		Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ← →		Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this Instruction. ← →		I can allot a week or more for this Instruction.	Other considerations:
Students need a significant amount of scaffolding. ← →		Students can work effectively with less scaffolding.	
Students will work in a whole group. ← →	Students will work in small groups.	Students will work Individually.	

ELA Teacher 2 (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

SCIENCE Teacher: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.

LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

SCIENCE LATs TAXONOMY

SCIENCE Teacher (Slide 1 of 3): Please complete as you watch Module 5

List content and process learning goals for the lesson/project here:

Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

SCIENCE LATs TAXONOMY

SCIENCE Teacher (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← →		More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ← →		Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ← →		Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this Instruction. ← →		I can allot a week or more for this Instruction.	Other considerations:
Students need a significant amount of scaffolding. ← →		Students can work effectively with less scaffolding.	
Students will work in a whole group. ← →	Students will work in small groups.	Students will work Individually.	

SCIENCE Teacher (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

SOC. STUD. Teacher: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.		
LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

SOC. STUD. LATs TAXONOMY

SOC. STUD. Teacher (Slide 1 of 3): Please complete as you watch Module 5

List content and process learning goals for the lesson/project here:			
Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

SOC. STUD. LATs TAXONOMY

SOC. STUD. Teacher (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← →		More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ← →		Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ← →		Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this Instruction. ← →		I can allot a week or more for this Instruction.	Other considerations:
Students need a significant amount of scaffolding. ← →		Students can work effectively with less scaffolding.	
Students will work in a whole group. ← →	Students will work in small groups.	Students will work Individually.	

SOC. STUD Teacher (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

LS Teacher: (Please complete this slide after Module 3)

Consider a lesson you've recently taught in your classroom. Think of the the learning goals, identify technology, and list Learning Activity Types using the subject-specific taxonomies.		
LEARNING GOALS:	TECHNOLOGY:	LEARNING ACTIVITY TYPES (IN SEQUENCE):

LS Teacher (Slide 1 of 3): Please complete as you watch Module 5

List content and process learning goals for the lesson/project here:			
Existing LATs in Lesson/Project	Possible LAT Substitutions	Refreshed Sequence of LATs	Technologies

LS Teacher (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← →		More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ← →		Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ← →		Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this Instruction. ← →		I can allot a week or more for this Instruction.	Other considerations:
Students need a significant amount of scaffolding. ← →		Students can work effectively with less scaffolding.	
Students will work in a whole group. ← →	Students will work in small groups.	Students will work Individually.	

LS Teacher (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

LS Teacher (Slide 2 of 3): Please complete as you watch Module 5

Pedagogical Continua			Additional Considerations
More teacher-directed instruction ← →		More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ← →		Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ← →		Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relative to plan:
I can allott 30-60 minutes for this Instruction. ← →		I can allot a week or more for this Instruction.	Other considerations:
Students need a significant amount of scaffolding. ← →		Students can work effectively with less scaffolding.	
Students will work in a whole group. ←	Students will work in small groups.	→ Students will work Individually.	

LS Teacher (Slide 3 of 3): Please complete as you watch Module 5

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

Appendix E Learning Activity Types Unit Plan Instructions

Now that you've completed the course "Learning First; Tools Last: Curriculum Based Planning with Technology," it's time to apply this process to practice. Along with the other teachers in sixth-grade, please collaborate to design an interdisciplinary unit about a topic of your choosing. The unit's plan should include an overview of the topic and must be at least one week in duration. Included in the final product should be lesson plans, resources, assessments, and other materials that will be used in its implementation in the classroom. Please only work on the design of this unit during the team-plan time. The lesson design template is linked below to assist you in this process:

Learning Activity Types (LAT) Lesson Planning Guide

Taxonomies:
K-6 Literacy: http://activitytypes.wm.edu/K6Literacy.html
Math: http://activitytypes.wm.edu/Math.html
Music: http://activitytypes.wm.edu/Music.html
Physical Education: http://activitytypes.wm.edu/Physical%20Education.html
Science: http://activitytypes.wm.edu/Science.html
Secondary ELA: http://activitytypes.wm.edu/SecondaryEnglish.html
Social Studies: http://activitytypes.wm.edu/SocialStudies.html
Visual Arts: http://activitytypes.wm.edu/VisualArts.html
World Languages: http://activitytypes.wm.edu/WorldLanguages.html
ESOL Strategies: http://activitytypes.wm.edu/ESOL.html

Appendix F Learning Activity Types Unit Plan Template

Learning Goals for Lesson or Project

List content and process learning goals for the lesson/project here:

Learning Activities of Technologies

Sequence of LATs	Technologies

Contextual Considerations

Pedagogical Continua	Additional Considerations
More teacher-directed instruction ⟷ More student-directed instruction	Technology resources available:
Students have fewer prior experiences with the topic. ⟷ Students have more prior experiences with the topic.	Human resources available:
Students should develop a basic understanding of the topic or skill. ⟷ Students should develop a deep understanding of the topic or skill.	School/district-wide initiatives relevant to plan:

I can allot 30-60 minutes for this Instruction. ⟷ I can allot a week or more for this Instruction. Students need a significant amount of scaffolding. ⟷ Students can work effectively with less scaffolding. Students will work in a whole group. — Students will work in small groups. — Students will work Individually.	Other considerations:

Is It Worth It? Test

- Will this particular use of a tool or resource help students to do something that is difficult or impossible to do without it?
- Will this tool or resource help students to do something in a better way?
- Is the use of this tool or resource feasible, given contextual conditions?

Reference

Harris, J., & Hofer, M. (n.d.). *Create with LATs* [Docx]. http://activitytypes.wm.edu/shortcourse/Create%20with%20LAT_s%20Guide.docx

Appendix G Observation Protocol

Date: _____
Time:
- Start: _____
- End: _____

Participants:

× Science	× ELA 1	× Math 1
× Social Studies	× Learning Support	× Math 2
× ELA 2	×	×

	Description of Participants' Activities
Pedagogical Content Knowledge (PCK)	
Technological Pedagogical Knowledge (TPK)	
Technological Content Knowledge (TCK)	
Technological Pedagogical Content Knowledge (TPACK)	

Application of LATs approach	
Reflective comments & questions:	
Other observations of what seems to be occurring:	

Appendix H Focus Group Questions and Prompts

Intended purpose of the focus group:

- To gather feedback about the cohort's impressions of the process of collaborative curriculum design using Harris and Hofer's Learning Activity Types.

Participants:

- The participants will include seven sixth-grade teachers at North East Middle School in the North East School District.

Inquiry questions:

1. What contextual factors influenced the teachers' ability to develop an interdisciplinary unit using Learning Activity Types and collaborative curriculum design?
2. What impact, if any, did taking the online short course and collaborating with grade-level colleagues on the design of an interdisciplinary unit have on each teacher's TPACK as it is applied during instructional planning?
3. How did completing the Learning Activity Types short course and the collaborative curriculum design process influence the teachers' beliefs regarding planning and technology?

Introductory Script:

Good morning, everyone. Thank you for taking the time to speak with me. As you know, I'm conducting research on how teachers integrate technology into their instruction. As part of that research, I am interested to explore your perception of the process and what contextual factors you believe influenced your work. I will not participate in the discussion with you, but rather ask questions and potentially probe for more information. If you are okay with it, I would also like to record our conversation. I will not use any information that will identify you personally in my research in order to maintain your confidentiality. This focus group should take about 45 minutes. The risk of your participation is minimal and does not include any health risks. The benefit of your participation is that your input will help me develop a deeper understanding of whether this approach is worthy of further consideration and application with other teachers in the district and beyond. Do you all agree to participate in this interview? Do you all agree to allow me to record the interview?

Section 1: Contextual Impact

1. What resources available at this school influenced the process of designing this unit and the instructional decisions that you made?
    a. Are there resources that, if available, you believe would have made this process more effective or resulted in a better product?
2. As you consider this team of teachers, how did your characteristics influence the process of designing the interdisciplinary unit and the instructional decisions that you made?

    a. Were there decisions that you made because of your own personal characteristics, such as your "knowledge, skills, and dispositions"? (Kelly, 2008, p. 52)?
3. Consider the students you teach. Did their demographics ("the ethnic, socio-economic, cultural, physical, cognitive, social, psychological, and experiential characteristics" (Kelly, 2008, p. 52) influence the process and the decisions that you made?
    a. What decisions that you made might have changed had those demographic characteristics been different?
4. What physical elements of the school, such as the design of your classroom or the way the classrooms are situated in the building, influenced this process of collaborative curriculum design and the instructional decisions that you made?
5. What characteristics of the school, "such as its philosophy, and its explicit and tacit expectations of parents, teachers, students, and administrators" (Kelly, 2008, p. 52) were considerations as you designed this unit?
6. What would you consider major challenges that you encountered during this professional development opportunity?
7. Do you have any other thoughts on how this process was influenced by the context of the study and you as participants?

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