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Understanding The Technology Support Needs Of High School Teachers Implementing A Learning Management System

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UNDERSTANDING THE TECHNOLOGY SUPPORT NEEDS OF HIGH SCHOOL TEACHERS IMPLEMENTING A LEARNING MANAGEMENT SYSTEM

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ABSTRACT

In this study, the researcher explored high school teachers' perceptions of various types of professional development, training, and support provided to and received by them during the implementation of a learning management system. Additionally, the researcher sought to explore the impact support may have on teachers' beliefs about technology and its role/impact on their instructional practice. Data were collected on teachers' perceptions of technology, as well as the most effective types of support (and frequency) they recalled were most useful for their respective skill level with technology. To identify participants' skill level with technology, the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* (TPACK survey) developed by Schmidt et al. (2009) was used. The survey was based on the technological pedagogical and content knowledge (TPACK) framework. This study also utilized the models of continuing professional development (CPD), defined by Kennedy (2005) as a framework to help classify and organize the numerous and varied types of technology professional development (PD), training, and support received during the implementation of the learning management system (LMS). Findings from this study highlighted the varying support needs of teachers based on technology skill and draw a connection between teacher technology skill level and teacher beliefs about technology's role in instructional practice and student learning.

Keywords: instructional technology, educational technology, technology integration, TPACK, teacher technology skill, technology professional development

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CHAPTER 1

INTRODUCTION

While technology regularly impacts almost every aspect of daily life, disputes over the benefits of technology and its place in education, pedagogy, and instructional practice rage on (Burnett, 2014; Casey et al., 2017; Marques, 2016). The debate over appropriate use of technology in the classroom is compounded by the notion schools are slow to change and embrace innovation (Vollmer, 2010). The current system of K-12 public education in America was established during the industrial revolution, when "the concept of schools-as-factories had become a powerful organizing metaphor. Public schools adopted the architecture, language, and methods of the factory" (Vollmer, 2010, p. 46). Writing about the lack of educational transformation in his book, *The New Meaning of Educational Change*, Michael Fullan (2015) provided a historical perspective on educational reforms that have "move[d] incredibly slowly" (p. 6) and how change on a larger scale "eludes" schools" (p. 11). As Massachusetts' former Education Commissioner David P. Driscoll is fond of noting, "If Horace Mann were alive today, the only institution he would recognize would be our schools" (Armour-Garb, 2017, p.10). Given everything that has changed in our society, the mere idea that an individual deceased for more than 150 years could potentially instruct today's student, with methods and pedagogy familiar to students, is both notable and alarming.

However, there is evidence to support the inclusion of technology-enhanced instruction in education and the development of student technology skills (Armour-Garb, 2017; Duval, Kivunja, 2015; Sharples & Sutherland, 2017). The Massachusetts Department of Elementary and Secondary Education (DESE) adopted a comprehensive curriculum framework around student acquisition of technology skills and notes that "meaningful participation in modern society requires fluency in the uses of, impact of, and ability to manipulate technology for living, learning, and working" (Massachusetts DESE, 2016, p.3). Over 20 other states have also adopted their own specific digital literacy standards or frameworks (State Standards for Information, Media, and Digital Literacy, 2017). On a global level, the International Society for Technology in Education (ISTE, 2016, 2017, 2018) has developed technology standards for students, educators, and administrators. Thus, shifting instructional models to include technology and preparing students for a technology-rich future is a common priority of states and other organizations.

Kivunja (2015) articulated the need for students to acquire 21st century skills, as developed by the Partnership for 21st Century Learning (P21), to be successful in college, career, and in life in general. The P21 framework includes, among others, the acquisition of skills in the use of information, media, and technology (Partnership for 21st Century Learning, n.d.).

> Students need broader skills than the 3Rs (reading, writing and arithmetic) to operate in the 21st century. These broader skills known as the 4Cs include: creativity, communication, collaboration and critical thinking. The use of information and communication technologies is crucial in developing the 4Cs in conjunction with understanding how learning takes place. (Keane et al., 2016)

Thus, The Public Policy Institute of New York State, Inc. (2017) reported on the shortage of students graduating with the necessary science, technology, engineering, and math (STEM) skills needed to fill rapidly growing positions in the industry. These reports underscored the need to provide students with technology to ensure they are prepared for an evolving workforce.

Educational technology advocates often argue that technology, properly embedded into instruction, is both motivating and engaging for students. Noted by Parsons & Taylor (2011), with respect to student engagement, today's student has "different needs, goals, and learning preferences than students in the past" (p. xx). Barbour (2014) found a positive correlation between the level of technology integrated into a class and "its effects on student engagement" (p. 76). Similarly, Swayne (2017) examined ELA and math classrooms in grades six through eight and found "higher levels of technology integration can yield higher levels of student engagement" (p. 88). Thus, the contemporary student is different from those in previous generations, and therefore, instruction and methods of engagement (including technology) must also change.

Levels of technology spending by schools and districts indicated some recognition of its importance by school leaders (Ednet Insight, 2015). Findings in the *State of the K-12 Market 2015* report (Ednet Insight, 2015) highlighted the sustained increase in technology spending on tablets, laptops, desktops, and Chromebooks, as well as digital curriculum resources. Increases in the availability of technology in classrooms throughout both schools and districts, as well as the shift to continually embed technology in lesson design and instruction, intensify the need to adequately support teachers' adoption and use of technology (Ednet Insight, 2015). Moreover, "fundamentally, improving technology integration . . . relies on the development of robust, coherent PD programs that are designed with a clear understanding of how teachers use technology" (Higgins & Spitulnik, 2008, p. 519). With an influx of technology in schools and classrooms, "schools and districts have had to come up with systems to support it, and have had to create support roles and find people to fill them" (National Center for Education Statistics, n.d., p.54). Thus, schools and districts planning to implement technology must consider and plan for the total cost of technology integration, which includes, not only the cost of the devices or application, but also the salaries and other associated costs of those who support the use of technology in the classroom.

This researcher considered the perceptions of teachers in a Massachusetts public school district on various types of support provided to and received by them over several years. First, teachers who were on staff during the implementation of an LMS were asked to complete the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* (TPACK) (Schmidt et al., 2009). Then, a subset of teachers were interviewed about their experiences with technology adoption during and subsequent to that initiative. The research study was conducted at a public high school located in Massachusetts, given the pseudonym ABC High School for the purpose of this study.

ABC High School serves students in grades nine through twelve in a comprehensive high school setting as part of the ABC Public Schools. Roughly 850 students attend ABC High School and are supported by nearly 100 faculty and staff. The student population is primarily White, at 80.9%, with 10.1% of the population classified as economically disadvantaged (Massachusetts School and District Profiles, 2019). According to the Massachusetts DESE, ABC High School is meeting accountability expectations in mathematics and English language arts and is making "substantial progress" toward accountability targets (Massachusetts School and District Profiles, 2019).

For the start of the 2012-2013 school year, the district opened a new high school building to house all of its high school level faculty, staff, and students. As part of establishing the new school, the district launched a one-to-one initiative in which every high school student and teacher was given an iPad. To enhance the one-to-one initiative, in 2016, ABC High School evaluated several learning management systems and adopted a single platform, Schoology. The implementation of the Schoology LMS took approximately 18 months and was piloted and implemented in all grades and courses at ABC High School. Since the initial implementation, time, experience, professional sharing, and dozens of PD opportunities, as well as ongoing support, have enhanced the use of the Schoology LMS at ABC High School. Additionally, components of the system like the parent portal, gradebook, and grade syncing with the district's student information system (SIS) have heightened the program's use. Finally, the use of the LMS has been expanded to include the delivery of district PD and use in classrooms with students in grades six through eight. However, only teachers who were part of the initial implementation of the Schoology LMS at ABC High School participated in this research project.

Statement of the Problem

Ideally, when schools and districts purchase new technology, high quality PD and systems of support are in place to help teachers adopt and implement the technology and modify their instructional practices and pedagogy accordingly to increase meaningful technology integration (Edelberg, 2020; Higgins & Spitulnik, 2008). However, with identified barriers to technology integration including, various school departments competing for resources, the initial expense of the technology on its own, and the lack of understanding or acceptance of the need for various types of technology support, support itself may be overlooked and may limit the technology's impact (Hsu, 2016; Moses, 2008). As such, there is a need to collect more data to add to the body of knowledge on teacher perceptions of technology, skill level with technology, and the most effective types of support needed for them to develop their respective skills. It is hoped the findings from this study can be used to increase teacher levels of efficacy for adopting new technologies into their instructional practice and pedagogy, thereby increasing student engagement and achievement, which ultimately indicates a successful implementation.

Purpose of the Study

The purpose of the study was to document teachers' perceptions about the elements of technology support that best assisted them in meeting identified learning objectives with respect to technology adoption and integration, specifically, an LMS. Additionally, the researcher sought to explore the impact support may have on teachers' beliefs about technology and its role/impact on their instructional practices. Data were collected on teachers' perceptions of technology, as well as the most effective types of support they recalled were most useful for their respective skills level. Findings have added to the body of knowledge around technology support in schools and help to quantify, to some degree, how various types of technology support influence the intersection of teachers' content knowledge, pedagogical knowledge, and technology skill.

Research Question(s)

The research questions for this study were:

- How do high school teachers describe the technology support they received on the LMS?
- What are teachers' beliefs about technology and its place in their instruction?
- How does content knowledge, pedagogical knowledge, and technology skill impact high school teachers' technology use?

Conceptual Framework

K-12 educators have an obligation to prepare students to be both college and career ready, ensuring they have the necessary 21st century and technology skills required for continued success (Armour-Garb, 2017; Duval et al., 2017; Kivunja, 2015). Students need to leave their secondary education digitally literate and able to collaborate, communicate, think critically, and create/produce original work (Keane et al., 2016). There is ample evidence that schools and districts have made investments in providing technology resources for instructional staff and students (EdNET Insight, 2015). However, complete, and consistent technology integration has eluded most education systems, which are inherently slow to change (Fullan, 2015; Kurt & Ciftci, 2012; Teo, 2011).

While the evidence for integrating technology is clear, “technology adoption is a complex, inherently social, developmental process” (Straub, 2009). Similarly, pedagogical practice is closely tied to teacher beliefs and can impact successful technology integration (Bai & Ertmer, 2008; Foley, 2017; Prestridge, 2012). The need to appropriately engage students in their current elementary and secondary school classrooms is as important as the need to prepare students for their digital futures. Hence, instructional practices/pedagogy must shift from teacher-centered to student-centered and embed technology, providing learners with opportunities to take charge of their learning rather than acquire knowledge passively and preparing them for a technology-rich world.

Findings from this research study added to the available literature relative to ways of increasing successful and meaningful technology adoption by teachers to both engage students and promote higher levels of student achievement and understanding. Additionally, to strengthen the acquisition of 21st century skills through appropriate support for teachers. The results of this study may assist district and school administrators striving to increase technology integration through a better understanding of how PD, training, support, teacher skill with technology, and beliefs about technology, influence practice.

This researcher utilized the TPACK framework as a conceptual framework to provide structure to the study, categorizing teacher ability into three distinct technology skill levels with other overlapping knowledge areas. The TPACK was developed by Mishra and Koehler in 2006 “to explain the set of knowledge that teachers need to teach their students a subject, teach effectively, and use technology" (McGraw-Hill, 2020, para. 2). In this study, the TPACK framework was utilized to help classify or rank teacher skills with technology. Using a survey based on the TPACK, participants were classified into three technology-based categories of novice user, intermediate user, and advanced user of technology. The researcher sought to explore the types of PD, training, and support found most helpful by each participant through the lens of their individual skill level with technology.

This research study also utilized the Models of Continuing Professional Development (CPD) to help classify and organize the numerous and varied types of technology support received during the implementation of the LMS. The CPD outlines nine primary types of PD models including: training, award-bearing, deficit, cascade, standards-based, coaching/mentoring, community of practice, action research, and transformative (Kennedy, 2005). These nine primary models were then further chunked into three groups. These three groups provided structure and prescribed a general purpose to each PD activity and include transmission, transactional, and transformative (Kennedy, 2005).

Assumptions, Limitations, and Scope

There were three primary assumptions in this research project. First, it was assumed that all participating teachers were using the LMS to an acceptable degree, it was effective in their lesson planning and instruction, and was used daily to deliver content to students. Second, was the assumption that during the implementation of the LMS, all teachers had equal and adequate access to technology support in various forms. Finally, it was assumed that teachers who participated in this research project were open and honest in answering questions related to their technology use when responding to the TPACK survey and during structured interviews.

There were several limitations to this research study. First, the sample size of the study was limited, and participants included only those teachers at one Massachusetts high school. Participants were further limited to only those who were employed by the high school at the time of the implementation of the LMS. Interviews were conducted with only a subset of nine participants based on responses to the TPACK survey. The research study focused on the participants' thoughts, feelings, and attitudes as they related to the PD, training, and support provided to them during the implementation of the LMS and did not include data around other types of support received (i.e., hardware, network, WIFI, other applications, etc.).

While there are many factors that contribute to the success and ease of use of a software application like an LMS, such as the hardware being used or the stability of the internet connection, examination of these factors were not a focus of this research study. Timeframe was also a limitation, as the implementation of the LMS began roughly 5 years prior to the study and therefore, recall of support provided in the early days of the implementation by participants may skew participants' memories of the initial process. Participants were asked about their implementation and support received over time, including during the COVID quarantine (2020-21) leading to remote learning. Finally, transferability of the study was to some degree a limitation. Teacher and school/student demographics, as well as socio-economic status, which may attribute to participants' former technology training and access to varied technology, may potentially impact participant views and may be dissimilar to those in other geographical locations.

The researcher focused on how various types of technology support may influence the intersection of participants' content knowledge, pedagogical knowledge, and technology skill during the implementation of an LMS. The scope of the research study included only teachers at the high school level, grades nine through 12, in one Massachusetts school and is limited to the implementation of one specific LMS, Schoology. For the purpose of this study, support for teachers included technical training on the LMS, integration support, technical support, and just-in-time classroom support. Various forms of support may have been provided by district technology staff, administrators, the district's technology integration specialist, fellow teachers, or the product vendor.

Rationale and Significance

With the growing prevalence of technology in society for both personal and professional purposes, it is imperative that schools provide both students and teachers with access to appropriate educational and productivity technologies. Hence, high quality technology support is required for teachers to effectively integrate and embed technology into their lesson planning and content delivery. School boards, communities, school and district leadership, and teachers need to ensure students are engaged and performing at the highest levels possible. Appropriate, effective, and meaningful technology integration can assist teachers in reaching these lofty goals. Compounding the challenges of implementation is the limited funding available to schools for technology and technology support, making it critical to ensure schools are using support dollars in the most effective way possible.

Definition of Terms

Learning Management System (LMS) – a software application or web-based technology used to plan, implement, and assess a specific learning process. It is used for "eLearning practices" and provides an instructor with a way to create and deliver content, monitor student participation, and assess student performance. An LMS may also provide students with the ability to use interactive features such as threaded discussions, video conferencing, and discussion forums (Rouse, 2019, para. 1).

Pedagogy – refers to the instructional practices used by the teacher to deliver content to students and may also include the decisions made by the teacher on how students use technology to interact with content (Farah, 2020).

Technology – refers to various educational technology, both hardware and software, used in K-12 schools and can include productivity software, educational software, projectors, computer, laptops, mobile devices, etc. (National Center for Education Statistics, 2002, p. 3-4).

Technology Support - refers to the various types of PD, training, and technical support provided to teachers with respect to implementing technology in school (National Center for Education Statistics, 2002, p. 65).

TPACK – Technological pedagogical and content knowledge, a theoretical framework, developed by Mishra and Koehler in 2006 "to explain the set of knowledge that teachers need to teach their students a subject, teach effectively, and use technology" (McGraw-Hill, 2020, para. 2).

Summary

Technology is a daily part of life in the 21st century and thus has found its way into the 21st century classroom (Burnett, 2014; Casey et al., 2017; Marques, 2016). Technology increases productivity and engages students (Barbour, 2014; Parsons & Taylor, 2011). Along with the need to provide teachers with access to technology is the need to provide them with technology support in additional to targeted PD. In an effort to identify elements of technology support that best meet the needs of teachers with a range of skill in technology, this study examined the implementation of the Schoology LMS at ABC High School in central Massachusetts. Using the

TPACK as a framework, this study adds to the body of research around supporting teachers with technology, identifying what works best, and how a teacher's technological skill impacts pedagogy.

In the next chapter, the literature review examines important themes related to educational technology. The chapter includes a brief history of technology in education, teacher beliefs about technology, instructional pedagogy, as well as professional development, training and support for teachers. Two theories that help define the conceptual framework for the study will also be addressed in the next chapter.

CHAPTER 2

LITERATURE REVIEW

The benefits of educational technology and its strategic integration into elementary and secondary level (K-12) classroom instruction has been studied and debated for decades. Some research focuses on general overall technology integration, as well as the targeted use of specific tools such as SMARTBoards, interactive projectors, document cameras, desktop computers, tablets, laptops, online resources, and Web 2.0 tools. Although it is thought barriers to technology integration including insufficient access, limited teacher education, training and PD, and inadequate systems of support, have been all but eliminated, widespread and consistent technology use in K-12 education remains an issue (Kurt & Ciftci, 2012; Teo, 2011).

This research study focused on how various types of technology support may impact the intersection of participants' content knowledge, pedagogical knowledge, and technology skill during the implementation of an LMS. The upcoming sections, address literature regarding technology in education including a brief history, 21st century technology, and teacher beliefs. Literature regarding shifting pedagogy, including the teacher as facilitator and technology's role in shifting pedagogy is included next. Finally, teacher PD, training, and support literature, as well as the two theoretical frameworks that were used as the conceptual framework for this research study are highlighted.

Technology in Education

Technology in education has evolved and has undeniably developed a foothold in education as many "state leaders demonstrate to districts and schools a commitment to digital learning" (State K12 Instructional Materials Leadership Trends Snapshot, 2019, p. 1). This commitment included more than 30 states having a digital learning plan and trends in the purchasing of technology indicate an increase in the acquisition and use of technology in schools (State K12 Instructional Materials Leadership Trends Snapshot, 2019).

History of Technology in Education

Depending on one's personal definition of technology, the discussion of the history of technology in education may start at varying times. Two early technologies in education included the slate board introduced in the 12th century and the printing press invented in the15th century (Bates, 2015). Others may argue a later start of technology in education with the radio in 1924, television in 1960s, or even the Internet and the first LMS in the mid-1990s (Bates, 2015). Presentation technology, perhaps a subset of educational technology, has evolved from early chalk boards and overhead projectors introduced in the 1930s, whiteboards in the 1960s and interactive projectors in the early 2000s (EdTech, 2020; Streisand & Abendschein, 2019). While personal computers and hand-held technology have morphed from the first calculator introduced in 1972, the Apple I in 1975, and the first portable IBM in 1985, technology has and continues to evolve quickly, today even more rapidly than in prior centuries (EdTech, 2020).

Current technologies often seem to blend the use of many earlier technologies with the power and delivery afforded to us by the Internet (mid 1990s) and the introduction of Wi-Fi where "users begin connecting to the Internet without wires" (Zimmermann, 2017, para. 38). In schools, the connectivity of classrooms to the internet "is becoming as essential to the American classroom" (EdNET Insight, 2015, p. 9). In 2002, the LMS Moodle was introduced, with later content delivery systems coming online, such as Apple's iTunes U in 2007. (Bates, 2015; EdTech, 2020). Platforms like these required the improvements to personal computers, used both at home and in schools, and their operating systems through the 2000s, and the development of devices such as the iPad and other tablets introduced around 2010, and the Google Chromebook in 2011 (Edtech, 2020; Zimmermann, 2017).

Teacher Beliefs About Technology in Education

One of the best predictors of how teachers will practice in the classrooms is their beliefs; including their beliefs about technology integration (Hsu, 2016). Chand et al. (2020) articulated several specific factors impacting teacher beliefs about technology. Hence, teaching experience with technology, level of education, teaching experience, gender, teacher confidence and comfort in using technology, and teacher use of technology outside the classroom all impact the use of technology in the classroom. These factors contributed to the make-up of teachers' beliefs about technology and indicate a need for "greater awareness of the bi-directional relationships between technology integration and teacher beliefs, and of the processes by which pedagogical beliefs hinder technology integration or perceived belief-related barriers" (Chand et al., 2020, p. 2755). Concurring, Zeynep et al. (2020) asserted "a positive association has been found between teachers' technology efficacy and their technology integration" and also commented on the "potentially malleable" nature of their beliefs (p. 161). In addition to the development of 21st century skills, Ertmer et al (2012) articulated several positive implications for using technology in the classroom, including the delivery of content and reinforcing skills, enhancing the curriculum, and the transformation of teaching and learning to include technology-rich, project-based learning. Thus, these distinct identified factors affecting teacher beliefs about technology and technology integration, coupled with the flexible and changeable nature of teacher beliefs, indicates the need for varied high quality and supportive PD (Chand et al., 2020, Hsu, 2016).

Shift in Pedagogy

While working to integrate technology into pedagogy, teachers are simultaneously confronting a renewed movement toward constructivist or student-centered approaches to instruction. An instructional shift is occurred, “educational system nowadays are progressing with regards to approach of teaching and learning at every level towards a more active and constructive education” (Agrahari, 2016, p. 133). At the core of this instructional approach, is the positioning of the student at the center of their learning, allowing them to construct their own understanding of content “through discussion, problem-solving, comparing strategies for solving problems, and an in-depth analysis” (Talbert et al., 2019, p. 328). Other strong characteristics of student-centered learning included independence, self-direction, and a clear partnership between the instructor and learner throughout the learning process, as well as during the assessment and evaluation process (Kollmer, 2013).

Student use of technology can support and enhance constructivist methods of instruction, however, instructional pedagogy falling within the continuum from teacher-centered to student-centered is “underpinned” by teacher beliefs, which can be a barrier to technology integration and technology use within the classroom (Bai & Ertmer, 2008; Foley, 2017; Prestridge, 2012). Hall and Higgins (2005) argued K-12 teachers who practice more teacher-centered instruction often use technology in limited ways. Teacher-centered instructors often use technology for daily routines and administrative tasks, yet in these classrooms, technology has little impact on both instruction and student learning (Kollmer, 2013).

The potential impact of technology in the student-centered classroom as a mechanism to facilitate personalized learning, student agency, collaboration, 21st century skills, as well as being a catalyst to increase student proficiency with various technology tools, is sizable. In their study on the paperless classroom, Shonfeld and Meishar-Tal (2017) stated, "the pedagogical rationale that emerged from the teachers reflected the perception that students' needs must be put at the center" (p. 189). They continued, "technology enabled them [teachers] to design lessons that focused on active and meaningful learning and contributed to the enjoyment of learning" (Shonfeld and Meishar-Tal, 2017, p. 189). The National Education Technology Plan further supported the shift in pedagogy to include technology, indicating, "technology can empower educators to become co-learners with their students by building new experiences for deeper exploration of content" (Shonfeld and Meishar-Tal, 2017, p. 28). Technology skillfully embedded into the student-centered classroom engages students through different learning experiences and supports student ownership of the learning process (Kollmer, 2013).

Teacher as Facilitator

Moving toward successful constructivist approaches to technology integration, during which students engage, manipulate, collaborate, and create, requires a shift from teacher as expert (teacher-centered) to teacher as facilitator (student-centered). There is a disparity between pre-service teachers' progressive and innovative attitudes toward education and their eventual practice, which tends to conform to school expectations and their own past experiences in school with teacher as facilitator (Beeman-Cadwallader et al., 2014). Bobis et al. (2020) discussed the shifting identities of teachers after targeted interventions from "sage on the stage" to "meddler in the middle"a s one "who actively scaffolds student learning" thereby "position[ing] their students as autonomous learners who were afforded greater responsibility for their own learning" (p. 628). This enhanced approach, with teacher as facilitator, allows students to construct their own learning, more readily make connections and increases active engagement in the learning process. The findings of Bobis et al. (2020) aligned with those of Zeynep et al. (2020) in that teacher beliefs, attitudes and/or identities can shift and adapt in time and with PD or intervention.

Technology's Role in a Shifting Pedagogy

Kollmer (2013) proffered, "technology is removing the walls of the classroom, extending the boundaries of the academic year and the rhythms of the school day" (p. 7). Easy access to the Internet, cloud-based applications for skills development and remediation, and the proliferation and availability of blended learning, all support Kollmer's assertion. However, as the author indicated, "for some teachers this is a welcome innovation; for others, this is an invasion of what was once the sanctum of the educational institution" (p. 7). Hall and Higgins (2005) noted, "the teacher may need to change from one of controlling every aspect of a lesson to a more protective and facilitative one" (p.112), shifting from the traditional teacher-centered to a more modern student-centered classroom, allowing students to engage with technology and "providing [students with] a safe environment within which students can explore the concrete world through ICTs" (information and communication technology) (p. 112). Hence, when students engage with technology and learning in this way both technology skills and learning are often improved.

While the teacher-centered instructor may certainly use technology in the classroom for planning and instruction, these uses tend to be more focused on the teacher's presentation and administrative duties and/or to simply reinforce student skill (Bai & Ertmer, 2008; Kollmer, 2013). Kollmer (2013) expanded on technology's impact on learning in the teacher-centered classroom stating, "the relationship of the use of technology to teacher-centered instruction is relatively neutral" (p. 56). Baran (2015) concurred and asserted, "low-level technology use is linked to teacher-centered practices, such as drill and practice, while high-level integration is associated with student-centered technology integration activities, such as problem-solving activities" (p. 46) Thus, the evidence indicates, technology's impact on learning and student skill development is limited in the teacher-centered classroom.

Conversely, Reigeluth et al. (2015) argued "powerful technological tools are crucial" for student-centered pedagogy to "work well" (p. 460). In this model, strategic technology use can engage and motivate students, personalize learning, save instructors time, provide just-in-time support, and leads to learner independence (Reigeluth et al, 2015; Fullan & Langworthy, 2014). As Fullan, and Langworthy (2014) articulated, technology paired with newer pedagogies has the potential to "unleash deep learning" (p. 33). Adding to the argument for a change in instructional pedagogy Hsu (2016) offered, "teachers who held constructivist pedagogical beliefs about technology use had high self-efficacy beliefs about technology use, placed positive value on the use of technology, and had two or more practices of high-level learning in their lessons" (p. 30). Hus (2016) highlighted the impact positive teacher beliefs about technology has in instructional pedagogy that includes technology and subsequently student learning.

Teacher Professional Development, Training, and Support

While professional development is an important factor in preparing teachers to effectively use technology, "professional development (PD) [alone] remains largely ineffective as a tool for promoting instructional change or new identity formation" (Thompson, 2017, p. x). Despite access to a variety of resources, including PD, "teachers in the 21st century continue to teach with little change to pedagogy, practice, or professional identity" (p. x). However, making the change to effective technology enhanced pedagogy is a complex initiative requiring significant investment.

There are a variety of forms of PD that can be successful when seeking to increase teacher skill and ability. Effective high-quality PD includes those that contain active learning for teachers, modeling, coaching, and expert support focused on specific needs, as well as PD that provides an opportunity for reflection and is sustained or ongoing (Darling-Hammond et al., 2017). High quality PD changes instructional practice and increases student outcomes and is an essential component of any educational system (Darling-Hammond et al., 2017).

Teacher Professional Development and Support for Technology Integration

Exacerbating the issue of effective technology PD for teachers, is the idea that some teachers "disagree about the value and worth of teaching with technology" and many feel there is little value in teaching with technology and "believe that technology is [not] necessary to teach effectively" (Thompson, 2017, p. 3). Not all teachers are committed to and engaged in PD and many approaches, such as those that are top-down, or one-size fits all are ineffective at sustaining professional learning (Thompson, 2017). While some technology PD activities are ineffective, others, including supportive mentoring, coaching, and those that address teacher beliefs about technology have the potential to successfully alter teaching practice and pedagogy (Higgins & Spitulnik, 2008; Hora & Holden, 2013; Hsu, 2016).

Mentoring

One way to enhance teacher technology use is through mentoring programs and reflective support (Higgins & Spitulnik, 2008). Higgins and Spitulnik (2008) noted, "the importance of multiple supports provided to the teacher over time as she moved from a logistical to inquiry orientation that allowed her to integrate the technology more invisibly" (p. 514). The authors also found:

> exemplary computer-using teachers were more likely to work in a school with other computer-using teachers and exemplary users. These exemplary teachers were also more likely to work in schools with significant technical support and were more likely to have

> initially used computers at the instigation of a technology coordinator or administrator. (p. 514)

Further, Higgins and Spitulnik highlighted the "mentored and informal support" provided to teachers and the importance of allowing teachers to learn from and be supported by other teachers through "established norm[s] of collegiality and support" (p. 516). Baran (2015) also noted the impact of pairing technology training with mentoring to help connect technology integration and pedagogical practice.

Pedagogy-based Coaching

Allowing teachers and coaches to support teacher use of technology aligns closely with the findings from Hora and Holden (2013), who argued "technology-based pedagogical reforms should not attempt to levy global or institution-wide solutions on all faculty at a given institution" (p. 89). Instead, the authors asserted they should ''work within disciplinary clusters and focus on pedagogical techniques that are most effective for the outcomes most closely related to the specific goals" as mentoring teachers and technology coaches would (Hora & Holden, 2013, p. 89). Teachers are responsible for integrating technology, but not all teachers are committed to technology-infused practice that includes specific educational approaches such as blended learning, and specific technologies such as LMS platforms and online communication (Thompson, 2017).

Focus on Teacher Beliefs

Hsu (2016) highlighted a study by Hechter and Vermette (2013), entitled *Technology Integration in K-12 Science Classrooms: An Analysis of Barriers and Implications,* which found that different models of PD and support are needed for teachers who had teacher-centered beliefs about technology integration. The authors asserted helping teachers become successful with integrating technology into pedagogical practice, at a minimum, includes PD and support that addresses attitudes about the efficacy of technology and its impact on students learning outcomes (Hechter & Vermette, 2013).

Conceptual Framework

As the director of technology for a public K-12 school district, this researcher had a vested interest in the transformation of instructional practice to included educational technology as well as increase student engagement and achievement through enhanced pedagogical practices. As such, the study of the of the training, support, and PD that is most effective in assisting teachers with the adoption and implementation of technology was of interest and important to this researcher. In an effort to learn more about the types of PD that best impact teachers' adoption and integration of technology in the classroom based on their technology skill level, as well as their beliefs about the place and role of technology in education, I applied two distinct theoretical frameworks. The first was the technological pedagogical and content knowledge (TPACK) framework and the second was the models of continuing professional development (CPD).

Technological Pedagogical and Content Knowledge Framework

The TPACK framework identifies the important intersection of the technical skill, pedagogical skill, and knowledge of content that teachers must have for effective instructional practices that include technology. The TPACK framework was used as a means to help classify or rank teacher skill with technology. Participants were classified into three technology-based categories of novice user, intermediate user, and advanced user of technology, using a survey based on the TPACK. The interview questions for this study, coupled with the information gained from the TPACK survey results, helped to answer the research questions and add to the body of research on technology support and training for teachers, as well as teacher beliefs about technology as it relates to their skill level with technology.

Developed by Mishra and Koehler in 2006, The TPACK framework explained "the set of knowledge that teachers need to teach their students a subject, teach effectively, and use technology" (McGraw-Hill, 2020, para. 2). The TPACK is a widely used theoretical concept, both within the educational technology and research communities, to aid in defining and explaining the need to embed technology into teaching and learning (Doering et al., 2009). Hofer and Grandgenett (2012) maintained there are a few places and times preservice teachers acquire the knowledge needed to impact their skills as they relate to the TPACK, including content specific courses (addressing specific subject matter), teaching methods courses (addressing best practices in instructional design and pedagogy), and technology courses and/or practicum experiences which may train teacher on specific technologies. They continued, "TPACK may also be a moving target, as aspects of technology, pedagogy, and content continue to change and evolve within the teaching profession" (Hofer & Grandgenett, 2012 p. 101). To that end, for teachers employed in K-12 settings, schools and districts must provide the PD, mentoring, and support needed to advance teacher skill.

Models of Continuing Professional Development

Additionally, the research study utilized the Continuing Professional Development (CPD), a framework to help classify and organize the numerous and varied types of technology support received during the implementation of the LMS. The CPD first defines nine primary types of PD including, the training model, the award-bearing model, the deficit model, the cascade model, the standards-based model, the coaching/mentoring model, the community of practice model, the action research model, and the transformative model (Kennedy, 2005). These nine primary categories are then further chunked into three groups. These three groups provide structure and prescribe a general purpose to each PD activity and include, transmission, transactional and transformative (Kennedy, 2005).

Summary

The K-12 educational system has an obligation to prepare students to be both college and career ready, ensuring they have the necessary 21st century and technology skills required for continued success (Armour-Garb, 2017; Duval et al., 2017; Kivunja, 2015). Students need to leave their secondary education digitally literate and able to collaborate, communicate, think critically, and create/produce original work.

The need to appropriately engage students in their current elementary and secondary school classrooms is as important as the need to prepare our students for their digital futures (Hall & Higgins, 2005). Thus, student use of technology in the classroom, as well as teachers' instructional practices/pedagogy (and technology use) must shift from teacher-centered to student-centered. This shift may provide learners more opportunities to take charge of their learning, aided by technology, rather than acquire knowledge passively. While the research and evidence for the need to integrate technology into K-12 education is clear, "technology adoption is a complex, inherently social, developmental process" (Straub, 2009, p.626). Additionally, pedagogical practice, as well as technology's place in the classroom, is closely tied to teacher beliefs and can impact successful technology integration (Bai & Ertmer, 2008; Foley, 2017; Prestridge, 2012).

There is ample evidence that schools and districts have made strides and investments in providing the necessary technology resources for instructional staff and students (Ednet Insight, 2015). However, complete, and consistent technology integration has eluded our education system which itself is inherently slow to change (Fullan, 2015; Kurt & Ciftci, 2012; Teo, 2011). Furthermore, instructional practices/pedagogy must shift from teacher-centered to student-centered and include appropriate technologies, providing learners with opportunities to take charge of their learning rather than acquire knowledge passively (Baran, 2015; Kollmer, 2013). Shifts in critical thinking and comprehension contrast the rote memorization and other irrelevant practices during which the teacher was the center of the classroom and learning (Baran, 2015; Kollmer, 2013).

While the research and evidence for both the integration of technology and a shift to student-centered teaching is clear, "teachers of this century, and more poignantly of this decade, must now conceptualize digital literacy terminology as an augmentation to literacy skills learned face-to-face" (Thompson, 2017, p. 1). More simply put, the acquisition of technology skills and digital literacy should be part of the general school curriculum for students. Using technology in the classroom must no longer be a choice, but a requirement and schools and districts must support teachers in successful integration through training that modifies both skill level and beliefs about technology (Hsu, 2016).

Research indicated there are both ineffective and effective methods for providing educators with PD and technology support that changes their beliefs about technology, as well as their practice (Darling-Hammond et al., 2017; Higgins & Spitulnik, 2008; Hora & Holden, 2013, Thompson, 2017). One-size-fits-all and top-down approaches have been found to be ineffective (Thompson, 2017), however mentoring, coaching and tailored training and support with time for reflection is ideal (Darling-Hammond et al., 2017; Higgins & Spitulnik, 2008; Hora & Holden, 2013).

In the next chapter, the researcher will detail the methodology used in the study. Sections include discussion on the purpose of the study and research questions. Additionally, information on site and population, sample methods, instrumentation and data collection, data analysis, limitations, credibility, member checking, transferability, ethical issues and conflict of interest are provided.

CHAPTER 3

METHODOLOGY

Technology has permeated myriad facets of life, including the educational sector. However, schools are slow to change and the adoption of technology in schools for the purposes or teaching and learning, is impacted by a number of factors including access, PD, support, leadership, and teacher beliefs (Kurt & Ciftci, 2012; Teo, 2011, Vollmer, 2010). In this research study, the researcher examined the implementation of an LMS at one Massachusetts high school to gain deeper insight on the perceptions of teachers on the PD, training and support they received through the implementation of the technology. The technology pedagogy, and content knowledge (TPACK) framework was used as a means to assess and identify teacher skill level with technology integration. Data were collected through the use of participant surveys based on the TPACK survey and through interviews with selected survey respondents. A stratified sampling approach based on responses to the survey was used to identify teachers to participate in subsequent interviews.

Purpose of the Study

The purpose of the study was to identify the elements of technology support that best assisted high school teachers in meeting identified learning objectives with respect to technology adoption and integration, specifically, the Schoology LMS. Additionally, the researcher sought to explore the impact support may have had on teachers' beliefs about technology and its role/impact on their instructional practice. Data were collected on teachers' perceptions of technology for instruction, as well as the most effective types of PD, training, and support for their respective technology skill level. Findings add to the body of knowledge around technology support in schools and help to quantify, to some degree, how various types of technology support influence the intersection of teachers' content knowledge, pedagogical knowledge, and technology skill and their beliefs about technology in education.

Research Questions & Design

The research questions for this research study included:

- How do high school teachers describe the technology support they received on the LMS?
- What are teachers' beliefs about technology and its place in their instruction?
- How does content knowledge, pedagogical knowledge, and technology skill impact high school teachers' technology use?

Two qualitative methods of data collection were utilized. One method included the distribution of the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* (TPACK survey) (Schmidt et al., 2009). Additionally, individual one-on-one interviews with teachers were conducted. The TPACK survey was used to gain a better understanding of participants' comfort level integrating technology into the classroom using the TPACK framework. Schmidt et al., 2009, authors of the TPACK survey reported a minimum reliability of .82 in all knowledge areas with the exception of the subcategory for science in the content knowledge area which is .78. The TPACK survey was completed digitally by participants using a common survey tool.

Based on survey results, participants in this research study were classified into three technology-based categories of novice user, intermediate user, and advanced user of technology. Participants from each of the three technology-based categories were selected to participate in the interviews with questions focusing on teachers' perceptions of technology support during the implementation of the Schoology LMS and their beliefs about technology before and after the implementation of the LMS. The study considered the PD, support and/or training found most helpful by each participant through the lens of their individual skill level with technology.

Site Information & Population

This study was conducted at ABC High School located in Massachusetts. Serving students in grades nine through 12, ABC High School is a comprehensive high school setting and part of the ABC Public Schools. Roughly 850 students attend ABC High School and are supported by nearly 100 faculty and staff. The student population is primarily White at 80.9% with 10.1% of the population classified as economically disadvantaged (Massachusetts School and District Profiles, 2019). ABC High School is meeting accountability expectations in mathematics and English language arts and is making "substantial progress" toward accountability targets, according to the Massachusetts DESE, (Massachusetts School and District Profiles, 2019).

At the start of the 2012-2013 school year, the district opened a new high school building to house all of its faculty, staff, and students in grades nine through 12. As part of the new school, the district launched a one-to-one initiative where each high school student and each teacher were given an iPad. In 2016, to enhance the one-to-one initiative, ABC High School evaluated popular LMS including Blackboard, Canvas, and Schoology. The district sought to adopt a single platform to use with all students. Schoology was selected over other systems as the LMS for ABC High School because of its integration with the G-Suite of applications and PowerSchool, the District's student information system, as well as its fully developed application for the iPad. At the time, one or more of these features were not available on other applications. Over the course of about 18 months, the Schoology LMS was piloted and implemented in all grades and courses. Teachers who were part of the initial implementation of the Schoology LMS were asked to participate in this research project.

Sampling Method

This study utilized the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* (TPACK survey) (Schmidt et al., 2009). The purpose of the TPACK survey was to measure and provide content around teachers' comfort, familiarity, and skill with the integration of instructional technology, instructional pedagogy, and content knowledge. All ABC High School teachers present at the time of the LMS implementation were asked to complete the modified TPACK survey. These modifications are only relative to the demographic data, which were collected at the end of the TPACK survey as designed. The TPACK survey was distributed to participants digitally using a common computer-based survey tool.

Stratified random sampling was then used to place teachers into three technology-based categories based on responses and scores from the TPACK survey. These subgroups included: novice user, intermediate user, and advanced user of technology. From these subgroups, interviews were conducted focusing on the support and PD teachers received during the initial implementation of the Schoology LMS and beyond. Nine interviews were conducted with a sampling of teachers selected proportionally from the three subgroups. This sample size ensured the researcher was able to explore the underlying information of the survey information with each selected participant (Creswell, 2015). Stratified random sampling ensures interviews are conducted with participants from each of the three subgroups and with varying technical skill level.

Instrumentation and Data Collection

There were two primary methods of data collection used for this research study, the first was the TPACK survey (Schmidt et al. 2009) (see Appendix A). The TPACK survey was sent via email to all teachers who were part of the initial pilot of the LMS at ABC High School, comprising approximately 40 teachers. The TPACK Survey was sent in December of 2021 and was completed electronically using a common survey tool. Teachers were asked to complete the TPACK survey within two weeks of receipt. The TPACK survey was scored by this researcher, as the authors of the survey asserted researchers must score their own data (Schmidt et al., 2009). While response rates to surveys vary based on a number of factors, “many survey studies in leading educational journals report a response rate of 50% or better” (Creswell, 2015, p. 393). It was hoped at least half of the those who received the TPACK survey would complete it. In total, 18 completed surveys were received. After scoring, nine participants who completed the survey were selected to participate in interviews based on their responses to the TPACK survey. Reponses to the TPACK survey helped to categorize participants into three groups based on skill level with technology: novice user, intermediate user, and advanced user of technology.

The second source of data collection was semi-structured teacher interviews (see Appendix B). The semi-structured interviews ensured all teachers interviewed had the opportunity to answer the primary interview questions, but also allowed the researcher to dig deeper and engage in follow-up questions as needed. Three teachers from each of the three subgroups were selected to be interviewed in late December 2021. The six primary interview questions focused on learning about teachers’ thoughts and feelings regarding technology support during the implementation of the Schoology LMS and their beliefs about technology before and after the implementation of the LMS. Informed consent of participants was gained through the participants' responses to an initial email from the researcher. In the email, the researcher explained the study, provided a link to the TPACK Survey, and sought consent and participation in the subsequent interview process.

Data Analysis

Results from the teachers' TPACK surveys were scored per the requirements of the tool and were used to place participating teachers into three subgroups based on technology skill level. The TPACK Survey is scored with a "value of 1 assigned to strongly disagree, all the way to 5 for strongly agree within defined constructs or sections. For each construct the participant's responses are averaged" (Schmidt et al., 2009). The three subgroups (based on scoring) included: those individuals scoring in the bottom third being considered *novice* users, the middle third of scorers being considered *intermediate* users and those with scores in the top third considered *advanced* users of technology.

From the three distinct skill-based subgroups, a sample of teachers (roughly three) from each subgroup were selected for the interview process. An interview protocol was used with the researcher taking notes on the protocol. Semi-structured one-on-one interviews took place using the prescribed interview questions (see Appendix B). The interviews were conducted via Google Meet (video conferencing) and were recorded using the Google Meet recording tools and transcribed digitally. Recordings and transcripts were saved to this researcher's secure online file storage, once reviewed and no longer needed, they were permanently deleted from file storage.

Participating teachers interviewed had the opportunity to review the transcript of their interview and offer suggestions for corrections, which is referred to as member checking (Saldaña, 2021). After collecting the data and preparing transcripts, the data were reviewed several times and analyzed by "locat[ing] large text segments and assign[ing] a code label to them" (Creswell, 2015, p. 236). The text was then hand-coded for descriptions and themes to be used in reporting. First, transcripts were prepared with the transcript taking the up the left 2/3 of the page, leaving room for coding on the right. Then, hard copies of transcripts setup in this way were printed. Pre-coding, "by circling, highlighting, bolding, underlining, or coloring rich or significant participant quotes or passages" then took place (Saldana, 2021, p. 30) For organizational purposes, codes were entered into a Google Spreadsheet.

The services of an additional coder were secured to ensure interrater reliability and minimize bias (Creswell, 2015; Saldaña, 2021). This individual had no influence on participants before, during, or after the research study. The additional coder was chosen for a few reasons including their educational credentials, familiarity with research, position in the district for which ABC High School is part, and because they were not present (employed by the district) during the implementation of the Schoology LMS. For purposes of confidentiality, the additional coder was provided with a digital copy of the transcripts which only referred to the participant number. The additional coder also manually coded the interview transcripts; their codes were entered onto their digital copy of each transcript using the comments feature in the Google Doc word processing tool. This was done to establish agreement on the major themes found in the transcripts. Both sets of codes were then compared and merged into the Google Sheet by the researcher to ensure all major concepts and themes were captured and aligned.

Two distinct coding methods were utilized to extract data (descriptions and themes) from the interview transcripts. Since the study sought to examine teacher beliefs about technology in their instruction, value coding (Saldana, 2021) was used. Value coding is "the application of codes to qualitative data that reflect a participant's values, attitudes, and beliefs, representing his or her perspectives or worldview" (Saldana, 2021, p. 167). Transcripts were also coded using causation coding (Saldana, 2021). Causation coding is “appropriate if you are trying to evaluate the efficacy of a particular program” (Saldana, 2021, p. 244). Given this researcher sought to explore the various support(s) most effective for participant teachers, this coding approach was appropriate.

Kennedy’s (2005) models of Continuing Professional Development (CPD) framework was used while categorizing the codes generated during the analysis of the data. It was anticipated that patterns would appear related to the nine primary types of CPD Kennedy identified. While reviewing what teachers described the technology support, training, and professional development activities most effective for them in implementing the Schoology LMS, the data from their interviews were categorized based on Kennedy’s models.

Limitations

In addition to limitations inherent in qualitative research, including the skill and biases of the researcher (Anderson, 2010), there were several other limitations to this research study. First, the sample size of the study was restricted and participants included only those teachers at one Massachusetts’ high school. Participants were further limited to only those who were employed by the high school at the time of the implementation of the LMS, Schoology. Interviews were conducted with a further subset of participants based on responses to the TPACK survey; nine in total. Next, the research study was focused on participants’ perceptions and attitudes regarding the support provided to them during the implementation of the LMS and did not include data around other types of support received (i.e., hardware, network, WIFI, other applications, etc.). Timeframe was also a limitation, as the implementation of the LMS began several years ago, and therefore, recall of support provided in the early days of the implementation by participants may have been an issue. Finally, the generalizability or transferability of the study was a limitation regarding teacher and school demographics, as well as socio-economic status which may attribute to participants' former technology training and access to technology may have potentially impacted participants' views and may be dissimilar to those in other geographical locations.

Credibility

In an effort to ensure data collected and analyzed relating to participants' perceptions and attitudes toward the technology support they received during the implementation of an LMS were credible or trustworthy, the researcher collected data from across the spectrum of technology users (beginner, intermediate, and advanced). Prior to assessing their placement on this continuum, participants were asked to complete the TPACK survey to identify their skill level in technology, pedagogy, and content. Based on their responses to the TPACK survey, participants were placed in three skill level sub-groups. These subgroups included: novice user, intermediate user, and advanced user. Data collected through subgroup interviews (three participants from each sub-group) were analyzed to gain deeper insight into technology support for teachers and their beliefs about technology's place in education. The process of collecting interview data from participants with a range of skill levels with technology helped to ensure credibility.

Member Checking Procedures

As part of ensuring the validity of data collected, this study utilized member checking (Creswell, 2015). During member checking, the researcher "asks one or more participants in the study to check the accuracy of the account. This check involves taking the findings back to participants and asking them (in writing or in an interview) about the accuracy of the report"

(Creswell, 2015, p. 259). One participant interviewed from each sub-group was be asked to review preliminary themes from coding to ensure accuracy and validity

Transferability

When a research study can be applied to or conducted in another setting, and similar results can be reached, it is transferable. “Transferability refers to the degree to which the results of qualitative research can be generalized or transferred to other contexts or settings” (Trochim, 2020, para. 4). Detailing all aspects of the site, setting, participants, and methods used to collect and analyze data is considered thick description. Thick description was provided within the report to assist readers in transferring results and findings to other settings. Information provided was as detailed and specific as possible allowing the reader to interpret for themselves the transferability of the study to their own site, setting, participants, or research.

Reliability

Reliability “is concerned with whether we would obtain the same results if we could observe the same thing twice” (Trochim, 2020, para. 5). To ensure the data extracted from interviews and findings were valid and reliable, two reliability tools were utilized. First, a process of coding and recoding using both the values and causation coding methods was used to extract data from participant interviews and observations. After the completion of interviews, the transcripts were coded, a period of time passed, and transcripts were recoded. “Coding is a cyclical act. Rarely is the first pass or first cycle of coding data perfectly attempted” (Saldana, 2021, p. 12). The process of recoding helped ensure the original codes found in the first round of coding were the themes that presented themselves again in subsequent or second round coding. Additionally, the assistance of an external coder was retained to code the interviews to ensure the fidelity of the findings.

Conformability

Ensuring objectivity, impartiality, and the lack of bias during data collection and analysis is an important part of the research process and conformability. "Conformability refers to the degree to which the results could be confirmed or corroborated by others" (Trochim, 2020, para. 7). Confirmability considers how likely another researcher would be, given the same tools and methods, to garner the same findings. However, it is important to note this researcher was part of the initial implementation and had a prior relationship with participants, which could have some impact on conformability.

Ethical Issues in the Study

When working with human subjects, researchers must be aware of the potential for a number of ethical issues that must be identified and addressed throughout the process of completing the study (Sanjar et al., 2014). First, a letter of consent from the Superintendent of the ABC Public Schools, as well as the Principal of the ABC High School, was acquired to conduct the study at the high school. Next, approval to conduct the study was sought and received by the University of New England's Institutional Review Board (see Appendix D). Consent from each study participant was also acquired through email, by participants' response to the initial invitation to participate. This consent helped to ensure they were aware of the goals of the study, the process that was used, and the data that were collected through the survey and the subsequent sub-group interviews. Additionally, the informed consent included their willingness to participate in completing the survey and individual interviews. Finally, care was taken to avoid researcher bias and maintain appropriate researcher-participant relationships.

Conflict of Interest

The primary conflicts of interest in the research study were the researcher's position in the district/school, relationship with study participants, role in the implementation of the LMS, and oversight of technology support provided to study participants before, during, and after LMS implementation. At the time of the study, the researcher served as the Director of Technology for this District. This position is a district leadership position, and therefore, the researcher oversaw all aspects of technology selection, purchase, adoption, and support in all schools within the district. The high school is the largest school in the district and has the most technology in the school system. Therefore, it stands to reason, that this researcher spent significant amounts of time there and had developed some type of relationship with most, if not all, of the faculty and staff who participated in the study. Finally, as the Director of Technology, the researcher was involved with the team who researched the benefits of using an LMS, the selection of the specific system acquired, the development of guidelines for its use, as well as oversight and coordination of all the support provided on the system for faculty, staff, and students.

While serving as the Director of Technology for the District, this researcher had no administrative or supervisory authority over teachers. The researcher's role was to oversee all aspects of the technology department and technology staff. However, the researcher did not hire, evaluate, or discipline instructional staff, as they did not report to him. The researcher did however, diligently worked to build positive, supportive relationships with faculty and believe they were honest and forthcoming with their answers to interview questions. However, the researcher recognized as a district-level administrator there may have been some positional authority natural to my role and therefore it must be recognized. Further, the researcher understood it is important to remain cognizant of the potential impact of my role and that inherent authority. Additionally, it should be noted, that the researcher was one of the leaders of the initiative to adopt an LMS at ABC High School and had a role in determining the support, training and PD provided to teachers. As data were collected and analyzed, the researcher remained conscious of his position and involvement in the initial implementation and spoke thoughtfully to participants working to minimize any potential influence.

Summary

This study examined the impact of the implementation of an LMS at the ABC High School in central Massachusetts. To assess and group teachers by skill, the TPACK framework was used along with classrooms observations. A survey tool developed by Schmidt and Koehler (2009) and an observation checklist developed by Hofer et al. (2011) aided in data collection on technical proficiency. Stratified sampling was then used to further select teachers proportionally from each sub-group to participate in additional data collection through one-on-one interviews. Interviews were then coded and recoded to ensure reliability. Those interviewed were asked to review transcripts for accuracy. Detailed descriptions were utilized to help readers with the transferability of the data and findings from the study into other settings. Findings from this research study may add to the body of research in identify elements of technology support that best meet the needs of teachers with a range of skill in technology, moving technology integration forward thereby increasing student achievement.

In the next chapter, the researcher will discuss the procedures for collecting and analyzing the data, as well as the results of the survey and one-on-one interviews with selected participants. Additionally, the process of interview transcript coding is described. The next chapter closes with a discussion of the 20 themes found among the three groups of interviewed teachers, which includes novice, intermediate and advanced users of technology.

CHAPTER 4

RESULTS

With the adoption of international educational technology standards for administrators, teachers, and students, and the inclusion of technology standards and expectations into the curriculum frameworks for many states, it is incumbent upon K-12 districts and schools to adopt and implement educational technology (ISTE, 2016, 2017, 2018; State Standards for Information, Media, and Digital Literacy, 2017). These technology standards and expectations detail what students must know and be able to do with technology at each grade level and post-graduation. Educational technology engages students, supports differentiated instruction, promotes student achievement, and prepares students for higher education and a 21st century workforce that is increasingly dependent on its members being technologically skilled and savvy (Armour-Garb, 2017; Barbour, 2014; Duval et al., 2017; Kivunja, 2015; Swayne, 2017). However, the successful implementation of educational technology at the district and school levels is dependent on several factors but includes teacher beliefs about technology and the PD, support, and training offered to them (Chand et al., 2020; Higgins & Spitulnik, 2008; Hsu, 2016).

The research findings from this data collection may serve as a lens to better understand the perceptions of teachers regarding technology and the various types of support that have been instrumental during the implementation of the Schoology LMS abased on their individual skill levels. First, teachers who were on staff during the implementation of the LMS were asked to complete the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* (TPACK) survey (Schmidt et al., 2009). Then, a subset of teachers from ABC High School in central Massachusetts were interviewed about their experiences with technology adoption during and subsequent to that initiative. In the analysis section, this researcher details the data collection tools used, how participants for interviews were selected, and the coding process of interview transcripts.

Analysis Method

In this study, the researcher used two qualitative methods of collecting data, surveys, and interviews. First, the TPACK survey (Schmidt et al., 2009) was distributed to potential participants. These surveys were distributed to help the researcher identify participants who would be selected for one-on-one interviews. To select participants for interviews, the researcher used scores from the Technology Knowledge (TK) domain on the TPACK Survey. The three participants with the lowest scores (classified as novice uses of technology), the three participants with the high scores (classified as advanced users of technology), and three selected randomly from the remaining pool (classified as intermediate users of technology) were invited for interviews. Interviews were conducted virtually using video conferencing through Google Meet and were automatically transcribed. After the recorded videos were transcribed and de-identified, participants were provided a copy of their transcript to ensure accuracy and then the transcripts were coded by hand. Broad concepts were identified through value and causation coding (Saldana, 2021). A second round of coding which led to the identification of common themes among participants.

TPACK Survey Distribution

Data collection and analysis for this study began with inputting and formatting the TPACK survey into the REDCap (Research Electronic Data Capture) survey system managed by the University of New England. While entering the survey into the REDCap system, a question asking participants to rank their own technology proficiency as novice, intermediate, or advanced was added to the end of the survey, along with demographic questions that included age, gender, years in district, and subject area taught. Additionally, in an effort to capture data for teachers who do not teach one of the four content areas referenced within the original TPACK survey, an additional option was added to domains within the survey where the four content areas of math, English, science, and social studies appeared. This allowed other teachers and specialists the ability to contribute their experiences. For example, within the Pedagogical Content Knowledge (PCK) domain, a question was added that read, “I can select effective teaching approaches to guide student thinking and learning within the content area I teach.”

A list of potential participants for the study was developed, including their emails, based on high school teachers who were employed at the time of the implementation of the Schoology LMS. A link to the survey, along with an informational letter was emailed to approximately 40 potential participants with an explanation of the study and a narrative request for their participation (see Appendix C). Two subsequent follow-up emails were sent to the same group of potential participants who had yet to respond or engage in the survey. Over a three-week period, from initial recruitment to the closing of the survey, a total of 18 surveys were completed by teachers who were employed at ABC High School at the time the LMS was implemented.

TPACK Survey Analysis

Upon closing the survey to participant responses, the 18 completed surveys were printed and the identification number (ID) assigned to each survey by REDCap was highlighted on each printed copy. The record ID was used as the participant number when scoring the survey responses, recording the survey results in a spreadsheet, and for interview transcripts. To ensure confidentiality as data and findings are further discussed, all participants are referred to by their assigned participant ID number.

Surveys were then hand scored based on the directions provided by Schmidt et al. (2009). The survey contained eleven domains with a varying number of questions in each. For each question, participants answered by selecting one of the five answers in Column A as shown in Table 1. The number in Column B is the score given for each specific response. The scores for each question within a domain were added together to achieve a total final score for each domain.

Table 1

Survey Scoring for the TPACK Survey

Column A	Column B
Strongly Disagree	1
Disagree	2
Neither Agree nor Disagree	3
Agree	4
Strongly Agree	5

A Google spreadsheet was created to collect and organize participant survey data and TPACK scores. All participant scores were entered in separate columns on the spreadsheet for each domain of the survey. Also included in the spreadsheet, was each participant's self-identification or perception of their own technology skill level, noted as either novice, intermediate or advanced, as well as a column that indicated their skill level with technology (novice, intermediate, or advanced) based on their responses to the Technology Knowledge domain on the TPACK Survey.

The TK domain on the TPACK Survey had a total of six questions. As noted above, for each question and answer, participants received a score from 1-5. Therefore, for the TK domain, participants could receive a score with a 25-point range anywhere from 6 to 30. In order to place each participant in one of the three skill level groups, participants were chunked. The three participants with the lowest scores in the TK domain were labeled as novice users of technology. These users had a score within the bottom 10 points of the TK domain. The three participants with the highest scores in the TK domain were labeled as advanced users of technology. These users had a score within the top seven points of the TK domain. Finally, the remaining participants with scores in the middle range of the TK domain were labeled as intermediate users of technology.

Interview Selection

The three participants with the lowest scores in the TK domain and labeled as novice users of technology were selected for interviews. Likewise, the three participants with the highest scores in the TK domain and labeled as advanced users of technology were also selected for interviews. Finally, three participants from the remaining group of intermediate users were selected randomly and based on availability.

Table 2 displays the data collected using the TPACK survey and entered in the spreadsheet for each participant selected for the interview phase.

Table 2

Participants Results from TPACK Survey Selected for Interview

Participant ID #	Self ID	TK (6-30) 6-15 = Nov 16-23 = Int 24-30 = Adv	TCK (1-5)	TPK (9-45)	TPACK (1-5)
2	Int.	15 (Nov)	4	26	4
3	Int.	25 (Adv)	4	33	3
4	Int.	19 (Int)	4	34	4
8	Adv.	24 (Adv)	4	30	4
9	Int.	12 (Nov)	5	35	4
10	Adv.	23 (Int)	5	43	5
13	Int.	23 (Int)	4	35	4
14	Nov.	14 (Nov)	4	24	4
16	Int.	26 (Adv)	5	34	5

The first column lists each participant's ID number. The second column lists how participants self-identified their technology skill level selecting either novice, intermediate, or advanced user of technology. The third column lists participants' scores in the TK domain and the corresponding skill level assigned by this researcher. The remaining three columns of Table 2 list participants' scores in the Technological Content Knowledge (TCK), Technological Pedagogical Knowledge (TPK) and TPACK domains of the survey. It is important to note, the scores calculated for the TCK, TPK, and TPACK domains of the survey were calculated only for the content (e.g., math, English, science, and social studies) area taught by the specific participant. For example, scores for an English teacher were calculated based on questions specific to English, excluding questions about math, science, and/or social studies.

Participant Interviews

Participant interviews were arranged via email and scheduled using a private Google Calendar and assigned a Google Meet link at that time. Teachers at ABC High School were familiar with the Google Suite of productivity tools and regularly utilized both Google Calendar invites and the Google Meets video conferencing application. All correspondence with the participants was private and individual, and any reference to the participant via documents was done using their ID number assigned by the survey tool. During participant interviews, and with their consent, this researcher utilized the recording feature within Google Meets and the iPhone application, Otter. The Otter app used voice recognition to automatically transcribe meeting notes in real time. A free version of the Otter application allowed for 600 minutes of free transcription services or a paid subscription for unlimited time through a monthly or annual subscription (Otter.ai, 2021).

At the end of each interview, a copy of the Google Meet video recording was downloaded and saved to a secure folder in cloud storage, and a folder was created for each participant. Also saved in this folder, was a copy of the digital transcription produced by the Otter application. Transcriptions were reviewed and edited by the researcher for clarity, to designate who was speaking at any given point during the interview, and to remove utterances. No substantive edits were made in an effort to ensure the transcript represented the participants' exact voice and comments as recorded. Once the editing of the transcription was completed, each participant was individually emailed a copy of the transcription of their interview. This allowed each participant the opportunity to check the transcription for accuracy. None of the participants provided the researcher with any corrections or changes to the transcript. Once the opportunity for participants to verify transcripts had passed, all recordings of the interviews were permanently deleted from cloud storage.

Transcript Coding

Upon completion of the interviews with the nine participants, the coding process began. Transcripts of one-on-one interviews were reviewed individually and hand-coded by the researcher. As the transcripts were reviewed and coded, high-level concepts through in vivo coding, with a focus toward value and causation coding, which included general statements about an idea or concept and the overarching themes derived from them, were recorded in a Google Sheet (Creswell, 2015; Saldana; 2021). The codes were chronicled in the spreadsheet based on the question and answer they were derived from, with each question and corresponding answer on a different row and each participant's responses in a different column within the spreadsheet. This process was repeated by the researcher to ensure all concepts and themes were captured. Additionally, the services of an additional coder were secured to ensure intercoder reliability and to minimize bias. This individual had no influence on participants before, during, or after the research study. The additional coder was chosen for a few reasons, including their educational credentials, familiarity with research, position in the district for which ABC High School is part, and because they were not present (employed by the district) during the implementation of the Schoology LMS. For purposes of confidentiality, the additional coder was provided with a digital copy of the transcripts which only referenced the participant ID. The additional coder also manually coded the interview transcripts and their codes were entered onto the digital copy of each transcript using the comments feature in the Google Doc word processing tool. This was done to ensure agreement on the major themes found in the transcripts. Both sets of codes were then compared and merged into the Google Sheet to ensure all major concepts and themes were captured and aligned. As the transcripts were coded, emphasis was placed on language that captured teacher beliefs and/or attitudes about technology, both past and present, as well any shift or notable change in their beliefs about technology and/or its use in the classroom, focusing on the PD, training, and or support that stimulated the change. In total, 117 high-level codes were developed from the interview transcripts of the nine participants.

Finally, the participants and the high-level codes or themes associated with their transcripts/responses were disaggregated into the three technology skill level groups (novice, intermediate or advanced) with the data for each group copied to a separate tab within the Google Sheets workbook. From this, another round of coding was completed by the researcher. During this round of coding, the high-level codes developed earlier were further refined, reduced, and condensed into themes common among the participants within each specific technology skill level. As an example, within the sub-group of novice technology users, a code from the transcript of Participant 9 read, “peer to peer instruction in PD [is] helpful.” Similarly, a code from the transcript of Participant 14 read, “peer-to-peer mentoring and teaching and informality [is] most helpful in PD.” Together these were reduced to the common theme for the subgroup of *peer-to-peer learning*.

Presentation of Results

This section presents results from the TPACK survey and interviews of the nine participants selected for the interview portion of the study. Prior to participant interviews, using the results from the TPACK survey, the researcher categorized participants into one of the following groups: novice users of technology, intermediate users of technology, and advanced users of technology. The data collected from the interviews is presented using these categories.

Completed TPACK Survey

Participant scores from the TPACK survey were scored by hand on printed copies of each participant's survey. Table 3 lists data collected from all 18 survey respondents, with the first column containing participants' ID numbers as assigned by the REDCap survey system.

Table 3

Results from all respondents to the TPACK Survey

		Technology Knowledge	Technological Content Knowledge	Technological Pedagogical Knowledge	Technology Pedagogy and Content Knowledge
Participant ID #	Self ID	TK (6-30) 6-15 = Nov. 16-23 = Int. 24-30 = Adv.	TCK (1-5)	TPK (9-45)	TPACK (1-5)
1	Int.	22 (Int.)	4	36	4
2	Int.	15 (Nov.)	4	26	4
3	Int.	25 (Adv.)	4	33	3
4	Int.	19 (Int.)	4	34	4
5	Int.	23 (Int.)	4	33	4
6	Int.	21 (Int.)	5	45	5
7	Int.	17 (Int.)	5	44	5
8	Adv.	24 (Adv.)	4	30	4
9	Int.	12 (Nov.)	5	35	4
10	Adv.	23 (Int.)	5	43	5
11	Int.	20 (Int.)	4	30	5
12	Int.	22 (Int.)	4	36	4
13	Int.	23 (Int.)	4	35	4
14	Nov.	14 (Nov.)	4	24	4
15	Int.	23 (Int.)	4	35	4
16	Int.	26 (Adv.)	5	34	5
17	Int.	17 (Int.)	4	32	4
18	Int.	19 (Int.)	5	43	5

The second column lists how participants self-identified their technology skill level. The third column lists participants' scores in the TK domain and the corresponding skill level assigned by this researcher. The remaining three columns of Table 3 list participants scores in the TCK, TPK, and TPACK domains of the TPACK Survey.

For all participants, with the exception of Participants 2, 3, 9, 10 and 16, responses to the questions of self-identification of technology skill level, matched the scores and ranges assigned to the TK domain on the TPACK survey. While the remaining domains on the TPACK survey that included technology were not used to identify the technology skill level of participants, there were some scores worth noting. For example, the two lowest scores for the TPK domain were 24 and 26 and assigned to Participant 14 and Participant 2, respectively. Both of these participants were selected for interviews and categorized as novice users of technology.

Novice Users of Technology

When coding the transcripts of participants classified as novice users of technology, which included Participants 2, 9 and 14, a total of 39 codes were created from the responses to the 6 interview questions (e.g., participant values person to person work, participant had limited prior knowledge, participant feels large group instruction to be least useful). From the interview transcript for Participant 2, 12 codes were developed, from Participant 9, nine codes were developed, and from Participant 14, 18 codes were developed. From here, distinct and common themes from the larger codes were found. In total, seven themes emerged from the 39 initial codes.

There were several distinct themes present within the transcripts of participants who were classified as novice users of technology. Notably, novice users of technology viewed educational *technology as supplemental* to the learning environment with the technology or *technological* *skill following pedagogy and content.* When speaking about pedagogy, content, and technology, Participant 2 said, “I'm going to stick to what I really believe works... But I've found that if I can then embed the technology part with the content, but not giving up pedagogical practices.” Based on the data collected during the one-on-one interviews, a teacher’s technical ability need only be secondary to their knowledge of the content and their instructional delivery. However, all three participants in the novice category recognized their thoughts, feelings and/or beliefs about technology changed somewhat and there was *evolved thinking about technology* and its place in academic instruction and/or the classroom, yet a *continued hesitation about technology* remained.

With respect to the PD, training, and support provided to teachers during and since the implementation of the Schoology LMS, there were two common themes that emerged from interviews with novice users of technology. First, all participants in this category mentioned a preference for and enjoying *one-to-one instruction*; the direct individual instruction provided to them by an expert technology user or technology integration specialist. Second, novice users of technology found value in learning directly from peers, with *peer-to-peer learning* mentioned in the transcripts of all three participants in this category. Referring to the breakout or roundtable sessions with groups of teachers who were part of the initial Schoology implementation, Participant 9 said, “the professional developments that have been the most helpful have been with other teachers here at this school.” Finally, two participants in this category mentioned the benefits of and enjoying technology instruction that occurred in a *small group setting*.

Intermediate Users of Technology

When coding the transcripts of intermediate users of technology, which included Participants 4, 10 and 13, a total of 47 codes were created from the responses to the 6 interview questions (e.g., participant previously found little value in tech and only regularly utilized it when required, participants values have evolved from being uncertain about technology to valuing full technology integration into instructional practices, participant values teacher lead training). From the interview transcript for Participant 4, 15 codes were developed, from Participant 10, 16 codes were developed, and from Participant 13, 16 codes were developed. Initial codes for the group of intermediate users of technology were entered into a Google Sheets spreadsheet and distinct and common themes from the larger codes were found. In total, seven themes emerged from the 47 initial codes.

Two intermediate users of technology noted *they held initial reservations* about technology and technology's place in their instruction. Participant 4 proffered, "I didn't really do a lot of interactive activities with students, and I didn't really see the value in it, I guess, or I didn't see the possibilities that existed." They also asserted there was *some remaining hesitation about technology*. All three participants in this category discussed *evolving feelings about technology*'s use in the educational setting and shared they felt more *willingness toward technology*, as well as an *evolving recognition of the interdependence to three domains* (technological, content, and pedagogical knowledge). In discussing their changed feelings about technology, Participant 4 said:

> I didn't really see the value in it, I guess, or I guess I didn't see the possibilities that existed, that's probably the better way to say it. When we got Google Classroom, I started seeing more possibility in what students could do with technology and how my life could be easier.

Thus, data from intermediate users indicated growth in their mindset about technology.

With respect to PD, training, and support, like their novice peers, all three intermediate users of technology noted *peer-to-peer learning* and instruction as beneficial to acquiring skill and knowledge of technology. Referencing learning from other teachers, Participant 13 said:

> We've got the expertise of the tech department, but then to have ordinary people, ordinary teachers was really important, I think because then, when we did all use it, we would go to them and ask them . . . we always knew we had that other person nearby to ask.

In contrast to their novice counterparts, but similar to their advanced colleagues, intermediate users of technology appreciated the *as needed support* or just-in-time help provided by a technology specialist.

Finally, intermediate users seemed to feel *large group instruction of technology was fine if skill level of participants match and is hands-on*. Referring to the frustration felt when in a training with participants with various skill levels, Participant 13 said, “sometimes I just get flustered when we're in that Mac lab in the library and you got 12 people all at different levels.” This comment indicated the need to either minimize group training or ensure differentiated instruction for varying technology skill levels is available.

Advanced Users of Technology

When coding the transcripts of advanced users of technology, which included Participants 3, 8 and 16, a total of 31 codes were created from the responses to the 6 interview questions (e.g., participant prefers PD that shows all of the possibility of the technology, participant believes technology helps make lessons more accessible, participant believe the advancement of technology has positively affected teaching practices). From the interview transcript for Participant 3, seven codes were developed, from Participant 8, 13 codes were developed and from Participant 16, 11 codes were developed. Initial codes for the group of advanced users of technology were entered into a Google Sheets spreadsheet and distinct and common themes from the larger codes were recorded. In total, six themes emerged from the 31 initial codes.

In contrast to both the novice and intermediate users of technology, advanced users of technology have *always valued technology* in academic instruction and in the classroom. Participant 16, in discussing their use of technology in the classroom said, “I've always, been a big fan of technology.” Participant 8 elaborated by saying, “I've always used a lot of technology . . . I've been teaching online college classes for a long time before that, so I was kind of comfortable with learning management systems with different tools.” The positive professional experiences with technology of advanced users were evident in their interviews.

Furthermore, all three participants in the advanced category made note of their feelings and beliefs that technology has benefits to students. In discussing the benefits of technology in the classroom, Participant 8 said:

> Technology has opened the door for me to find pictures that are showing a concept or Showing an idea that . . . is much better than anything I can draw and I can get a point across that I might not have been able to otherwise get across.

More specifically, advanced users of technology reported the *belief that technology supports student accessibility and organization*. Contrary to the beliefs of their novice colleagues, two advanced users of technology mentioned the *interdependence of three domains* during instructional delivery in which technological, content, and pedagogical knowledge were valued equally and are symbiotic.

With respect to the PD, support, and training provided to teachers, there was some consensus that advanced users of technology valued and enjoyed *short high-level demonstrations* of technology tools and applications with time allotted for *autonomous exploration*, either during the training or allocated at some other time. Like their intermediate counterparts, all advanced technology users found benefits in the *as needed support* or just-in-time support provided to them. Participant 3 discussed this, sharing, “the most helpful thing is to be able to have a point person.” Important to note, unlike both the novice and intermediate users of technology, advanced users did not mention group technology trainings.

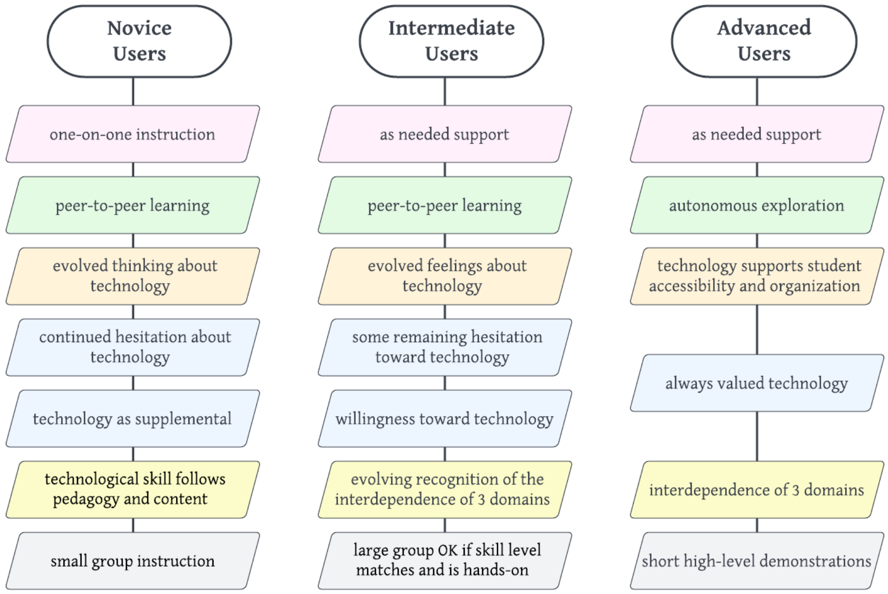
Major Themes from Technology Users

In total, 20 themes were developed from the three groups of technology users interviewed. While there was some overlap in these themes and in participants’ beliefs about technology, its place in instruction and the most helpful PD, support, and training to support it, disparities between the groups existed. For example, while novice and intermediate users of technology seemed to recognize evolved feelings and/or thinking about technology, advanced users clearly indicated always seeing value in technology and its place in instructional practice and the classroom. Likewise, novice and intermediate users found significant value in peer-to-peer learning, with advanced users enjoying some autonomous exploration of technology.

Figure 1 depicts the 20 codes derived from the three individual skill level groups. Figure 1 helps to highlight the similarities and differences among the skill level groups. For example, while novice users of technology prefer *one-on-one instruction*, intermediate and advanced users indicate the requirement for *as needed support* in the event an issue arises while using technology during instruction with students. Similarly, novice and intermediate users highlight a preference for *peer-to-peer learning*, while advanced users enjoy *autonomous exploration* of technology.

Figure 1

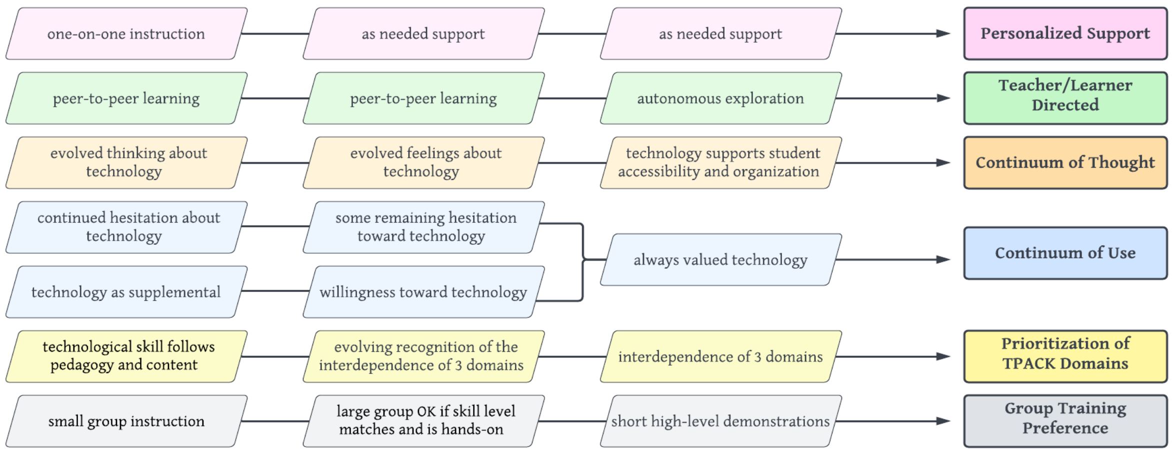
Codes from individual skill level groups



The 20 skill-based themes were further distilled into six major categories including personalized support, teacher/learner directed, continuum of thought, continuum of use, prioritization of TPACK domains and group training preference. Figure 2 illustrates how primary categories were derived from these individual codes spanning across the skill level groups. In addition to identifying the six major categories, Figure 2 creates a visual representation of teachers' progression of skill, thought or preference. For example, with respect to the TPACK, novice users of technology see technological skill as following pedagogy and content, with intermediate users beginning to recognize the interdependence of the three domains (technological, pedagogical, and content knowledge), and advance users recognizing (completely) the importance of all three domains in classroom instruction.

Figure 2

Major categories spanning across the skill level groups



Summary

Data were collected for this study in an effort to illuminate teachers' perceptions and beliefs about technology and the various types of PD, training, and support provided to and received by them during the implementation of the Schoology LMS and since. The TPACK survey (Schmidt, et al. 2009) was administered to qualifying teachers at ABC High School in central Massachusetts, with a subset of respondents interviewed about their experiences with technology adoption during and subsequent to that initiative.

The TPACK Survey developed by Schmidt et al. (2009) was used to help identify teacher skill level with technology, and thus categorize them into three groups; novice, intermediate and advanced users. In total, nine one-to-one interviews were conducted. Interviews were conducted with three participants from each of the three skill level groups. Interview transcripts were coded by hand, resulting in 20 themes. While some of the themes were only common to a specific group, others crossed over into different skill level groups.

The discussion and analysis in the next chapter delves more specifically into the skill-level based themes which can be categized into six major headings including personalized support, teacher/learner directed, continuum of thought, continuum of use, prioritization of TPACK domains and group training preference. These themes and categories coupled with the results of the TPACK survey and applied through the CPD framework are central to the study's implications and the researcher's development of recommendations.

CHAPTER 5

CONCLUSION

Technology skillfully embedded into the student-centered classroom clearly engages students through different learning experiences and supports student ownership of the learning process (Kollmer, 2013). While districts and schools have made great gains in acquiring educational technology, there is some evidence PD and support itself may be overlooked and may limit the technology's impact (Hsu, 2016; Moses, 2008). Exacerbating the issue is the notion that teachers "disagree about the value and worth of teaching with technology" and many feel there is little value in teaching with technology and "believe that technology is [not] necessary to teach effectively" (Thompson, 2017, p. 3). Not all teachers are committed to and engaged in PD and many approaches, such as those that are top-down or one-size fits all are ineffective at sustaining professional learning (Thompson, 2017). To that end, when new technology is purchased, high quality PD and systems of support must be a priority for districts and schools, and must include support that addresses attitudes about the efficacy of technology and its impact on students learning outcomes (Hsu, 2016).

In this study, the researcher used two qualitative methods approach to data collection, comprised of a survey and nine one-on-one interviews. Interviews were conducted with a subset of participants who completed the survey. The purpose of the study was to identify the elements of technology professional development (PD), training, and support that best assist high school teachers in meeting identified learning objectives with respect to technology adoption and integration, specifically, the Schoology LMS. Additionally, the researcher sought to explore the extent to which support impacts teachers' beliefs about technology and its role/impact on their instructional practice. Research questions for this study were:

- How do high school teachers describe the technology support they received on the LMS?
- What are teachers' beliefs about technology and its place in their instruction?
- How does content knowledge, pedagogical knowledge, and technology skill impact high school teachers' technology use?

Findings from this study included the need for various types of one-on-one support, the evolving feelings of teachers about technology, benefits of teacher collaboration, the limited appropriateness of large group PD, and autonomous learning. In the following sections, the implications of these findings are discussed as they relate to teacher skill level with technology and in relation to three specific models of PD.

Interpretation of Findings

Using the TPACK Survey, teacher skill level with technology was assessed and identified. Through the identification of teacher skill level with technology, connections were established between skill level with teacher beliefs about technology and effective PD, training, and support. Participant interviews revealed three primary models of PD they believed were effective in helping teachers implement educational technology, including coaching/mentoring, communities of practice and action research models.

Through the use of the *Survey of Preservice Teachers' Knowledge of Teaching and Technology* (TPACK) (Schmidt et al., 2009), this researcher gathered more clarity around participant skill level with technology. The TPACK survey supported the categorizing of participant teachers' skill level with technology as either novice, intermediate or advanced. Teacher technology skills, coupled with the theoretical framework of the models of continuing professional development (CPD) (Kennedy, 2005), provided clarity and structure around the data collected. Through the one-on-one interview process with three participants from each of the three technology skill levels, this study highlighted the relationship between teacher beliefs about technology, teacher skills with technology, and the most impactful PD to support them in implementing educational technology to support student learning and achievement.

Teacher Beliefs About Technology

This research study generated evidence supported by existing research around teacher beliefs and the meaningful integration of technology into instructional practice. Teacher beliefs about technology were a significant predictor in how they integrate technology in their instruction. While "it is hard to change deep-seated beliefs, such as those . . . teachers may bring with them to their teacher education programs, this is not impossible" (Bai & Ertmer, 2008, p. 107). The data collected from this study highlighted that change is possible and evolves as instructional practice and individual skill with technology develops. One example of this was the evolving feelings noted by intermediate users of technology and their willingness to use technology in the classroom and in their instruction. For clarity, the following section is first divided into teacher technology skill level groups, followed by a discussion of the three models of PD, training, and support as noted in participant interviews.

Novice Users of Technology

Data from participant interviews revealed teachers who were classified as novice users of technology viewed *technology as supplemental* to instructional pedagogy and student learning and not necessarily central to their instruction. Despite recognizing *evolved thinking about technology,* technology still was not a significant instructional practice for them. Data collected from these users indicated *technological skill follows pedagogy and content* and did not hold as much value to them regarding instruction and student learning. In speaking about the role of technology in their classroom, Participant 9 said, "the technology piece is just additional support for what we've already done in the room." Through this statement, Participant 9 signified educational technology was not at the forefront of their instruction and was not central but supporting.

Tying these feelings and beliefs about technology back to the implementation of the Schoology LMS at ABC High School, it is logical these novice users of technology had potentially implemented only the elements of Schoology or the system as a whole, to a degree that potentially only met minimum expectations or requirements set forth by school administration. While not included in this study, it is in alignment with literature reviewed to assume that much of the technology used by novice users of technology was associated with administrative tasks and were more teacher-centered than student-centered (Kollmer, 2013). In this way, for some teachers their beliefs continue to be a barrier to the technology integration in the classroom (Bai & Ertmer, 2008; Foley, 2017; Prestridge, 2012).

Intermediate Users of Technology

The data from intermediate users of technology indicated positive development regarding teacher beliefs about technology and its relationship to content and pedagogy. Participating teachers *held initial reservations* about technology and its place in their instructional practice, and while some *remaining hesitation about technology* existed, they reported *evolving feelings about technology* and a *willingness toward technology* use. For example, Participant 4 stated, "I started seeing more possibility in what students could do with technology and how my life could be easier." Finally, and within the larger category of *prioritization of TPACK domains*, intermediate users reported *evolving recognition of the interdependence to three domains (technological, content, and pedagogical knowledge)*.

Given the ratio of intermediate users to novice and advanced users completing the TPACK survey for this study, regarding the implementation of Schoology at ABC High School and the PD, training, and support provided, intermediate users likely made up the majority of teacher participants. Within the TPACK survey, 12 of the 18 participants who completed the survey were identified as intermediate users, and while only three were interviewed, the data from this sub-group should be encouraging to educational stakeholders. Based on the data collected from this sub-group, such as the *evolving feelings about technology* and a *willingness toward technology* use in the educational setting, it is likely the PD provided served as "a means of closing the gap between the [then] current and potential uses of technology" in the classrooms of these educators (Higgins & Spitulnik, 2008, p. 511). The positive nature of their responses and the developed beliefs about technology integration and its place in their classroom instruction indicated success with respect to PD activities around the Schoology LMS.

Advanced Users of Technology

In some ways, it may appear the PD, training, and support provided to teachers at ABC High School during the implementation of the Schoology LMS had less of an impact on those identified as advanced users of technology as opposed to their novice or intermediate colleagues. Unlike the evolved feelings about technology identified by others, and falling in the category of *continuum of use*, advanced users indicated *always value[ing] technology* and understanding the *interdependence of the three domains* (technological, content, and pedagogical knowledge). This is not to say the PD, training, or support they received was not effective, as they have clearly implemented the system, but PD that addressed their beliefs was less important or necessary to them. However, as noted below, their impact and support of others is crucial. In the following section, the researcher addresses the positive impact of the coaching/mentoring model.

Coaching/Mentoring

Most notable in the data collected from participating teachers and falling under the heading of *personalized support*, is the mention of *one-on-one instruction* by novice users and *as needed support* referenced by intermediate and advanced users of technology. This finding is aligned with research addressing the importance of mentoring programs and reflective support embedded within PD (Higgins & Spitulnik, 2008). With respect to this study, ABC High School, and the implementation of the Schoology LMS, in most cases, this support was provided by the technology integration specialist working in the school with teachers. Of the nine models of PD itemized in the Models of Continuing Professional Development, the data here clearly indicate the importance of the coaching/mentoring model (CMM), in that participants referred to CMM as “the importance of the one-to-one relationship, generally between two teachers, (Kennedy, 2005, p. 10). Thus, novice users of technology may rely on the technology integration specialist for more coaching (training) referring to the technology integration specialist by name during interviews. However, those teachers with better technology skills indicated relying more heavily on the mentoring aspects of the model with the participating teacher requesting the help of the expert to solve a specific issue or problem. In speaking about the *as needed support* received by the technology integration specialist, Participant 10 said, it “has been really helpful when stuff pops up.” Thus, the data indicated that the role of the technology integration specialist was critical.

At ABC High School, the technology integration specialist is a teacher licensed by the Massachusetts DESE as a technology integrationist. While this individual is a teacher with expertise in technology, they do not have a course load of students. Rather, their role is to work with other content area teachers and specialists around the strategic integration of technology into their teaching and instructional practice. Baran (2015) noted the impact of pairing technology training with mentoring to help connect technology integration and pedagogical practice. As the coaching/mentoring model suggests, the role the technology integration specialist plays at ABC High school may vary from teacher to teacher and situation to situation. As Kennedy (2005) asserted, the interpersonal relationships and trust developed through and within this model are key and were apparent in the narratives of participating teachers. In speaking about the support they received during the school shut down in the spring of 2020 due to the Covid19 pandemic, Participant 13 said, "we've just had a lot of people who are committed to helping us and I think that that's been really important." Participant 9 spoke of the encouragement provided during the one-on-one sessions hearing "you're doing the right thing" from the technology integration specialist. Referencing the just-in-time support, they received when needed, Participant 13 said, "I just feel like if I need help, I'm going to ask someone for it and actually get the help." Clearly, the successful integration of technology was dependent upon the support of a trusted technology professional with whom they had developed a relationship. Moreover, it was important and beneficial to teachers of all technical skill levels. In the following section, the researcher addresses the benefits of teachers collaborating in a communities of practice (CoP) model of PD.

Communities of Practice

Common among the data collected for both novice and intermediate users of technology and falling under in the category of *teacher/learner directed*, was the positivity about *peer-to-peer learning*. Prior to ABC High School requiring all teachers to use the Schoology LMS, a smaller subset of teachers piloted the system. The Schoology pilot enabled the school to develop the skills of a small group of in-house experts prior to rolling the system out to the entire teaching faculty. As part of the PD provided to teachers during the larger rollout, roundtable PD sessions were conducted, during which teachers shared their experiences with the Schoology LMS. Referring to one of these roundtable sessions, Participant 14 said, “I like sessions when we as teachers shared what we do.” These roundtable sessions were informal in nature, not facilitated beyond having a specified topic such as Schoology, and simply gave colleagues the opportunity to showcase for their peers, how they used the technology or ask questions about specific features. “A community of practice should create its own understanding of the joint enterprise, therefore allowing the members of that community to exert a certain level of control over the agenda” (Kennedy, 2005, p. 13). The roundtable sessions attended by teachers during the Schoology implementation provided that control.

Higgins and Spitulnik (2008) highlighted the “mentored and informal support” provided to teachers and the importance of allowing teachers to learn from and be supported by other teachers through “established norm[s] of collegiality and support” (p. 516). While not formally following CoP, the roundtable sessions and *peer-to-peer learning* that occurred at ABC High School, aligned with the basic tenets of the CPD model. In the last section, the researcher addresses teachers prepared to participate in the action research model of PD and the extent to which their learning may impact others.

Action Research Model

The action research model (AR), as defined by Kennedy (2005), “limit[s] dependency on externally produced research, instead shifting the balance of power towards teachers themselves through their identification and implementation of relevant research activities” (p. 14). It is this model of the Models of Continuing Professional Development that most closely aligns with the perceptions of advanced users of technology who enjoyed short *high-level demonstrations* with time provided, either during the training session or at another time for *autonomous exploration*. These themes fall in the larger categories of *group training preference* and *teacher/learner directed* respectively. In this model, teachers are provided the time to explore a technology tool and work independently to learn how to use it through hands-on practice or other resources provided by the technology vendor or found online. In support of AR, Participant 13 discussed learning by "play[ing] around" with technology independently. Similarly, Participant 3 mentioned "experiment[ing]" on their own with the technology after a high-level demonstration, which they referred to as a "dog and pony show." Thus, allowing advanced users of technology a quick guided introduction to technology and time to explore was effective for their learning.

Two of the three participants classified as advanced users were members of the small group of teachers who first piloted the Schoology LMS prior to the building-wide implementation at ABC High School. Given that there were no other in-house experts, and the technology integration specialist was also learning Schoology at the same time, these teachers had to receive their initial PD through *high-level demonstrations* provided by the vendor and/or through self-exploration of Schoology, online resources, and trial and error. Pilot teachers played a critical role in the successful PD of their colleagues through roundtable sessions and other support provided by them on the Schoology LMS at ABC High School. These pilot teachers utilized Kennedy's (2005) AR model to learn Schoology on their own and/or with minimal support and then participated in CoPs to support the learning and development of colleagues.

Implications

In this section, findings from this study are discussed as they relate to prior research and application in the K-12 educational sphere. The data collected here may be useful to K-12 educators, administrators, and the educational community as a whole as they work to integrate technology more fully into districts, schools, teachers' instructional delivery, and student learning. Educational technology engages students, supports differentiated instruction, promotes student achievement, and prepares students for higher education and a 21st century workforce that is increasingly dependent on its members being technologically skilled and savvy (Armour-Garb, 2017; Barbour, 2014; Duval et al., 2017; Kivunja, 2015; Swayne, 2017). The results of this research study align with and enhance previous literature relative to the impact of teacher beliefs about technology and its use in their instruction, as well as the importance of high-quality technology PD, training, and support.

Connection: Teacher Beliefs, Skill, and Technology Use

Data collected as part of this research study support a connection between teachers' beliefs about technology, their technology skill level, and their use of technology within their instructional practice. This finding builds on the body of knowledge surrounding teacher beliefs about technology and its use in instructional practice. One of the best predictors of how teachers practice in the classroom is their beliefs; this includes their beliefs about technology integration (Hsu, 2016). Given the findings in this study, PD that does not address both teacher skill level with technology and beliefs about technology, will be less effective. Under the larger heading of *continuum of thought*, participant teachers with novice or intermediate technology skills noted *evolving feelings and evolved thinking* around technology in the classroom which aligns with the findings of Zeynep et al. (2020) who referenced the "potentially malleable" nature of teacher beliefs (p. 161).

Technology Integration Specialist

All three subgroups of technology users (novice, intermediate, and advanced) referenced the one-on-one training or just-in-time support they received during and subsequent to the implementation of the Schoology LMS at ABC High School. Through one-on-one interviews, participants identified this type of support as being valuable and important to them. There is clear data, both in this study and in the literature, to support the position of a technology integration specialist within the K-12 educational setting and beyond (Fusco, 2019; Johnston, 2015).

As computers and applications began to take hold in the daily instruction and responsibilities of educational professionals, the term instructional technology specialist began to emerge (Johnston, 2015). Fusco (2019) stated, “the role of the instructional technology specialist is critical in the school community as they are focused on supporting teachers to integrate technology effectively” (p. 135). Supporting the significance of relationships as mentioned in the coaching/mentoring model, Fusco elaborated on the importance of the one-to-one relationship claiming, “effective instructional technology specialists have strong interpersonal skills and know how to connect with individuals to teach them and help them progress to meet their goals” (2019, p. 135). Fusco also noted the uniqueness of these specialists in that they “are educators, but have an expertise in the area of technology, which allows them to focus on sharing their knowledge with their colleagues based on strategic and research-based insight so as they may develop as technology users” (2019, p. 135). The technology integration specialist position is invaluable and arguably critical to the success of technology implementation projects and the ongoing assimilation of instructional technology into instructional pedagogy.

Teacher Time Together

The findings of this study, under the category heading of *teacher/learner directed*, support teachers collaborating and learning from one another in a community of practice. In speaking about the roundtable collaborative sessions with other teachers, Participant 14 said, “one of the better … sessions was when we as teachers shared what we do.” This data aligned with prior research which supports “teachers … learn[ing] from and be[ing] supported by other teachers through established norm[s] of collegiality and support” (Higgins & Spitulnik, 2008, p. 516). Time provided by schools and districts for this type of PD is both beneficial and effective, given the preferential status it has been assigned by teacher. It affords an opportunity for expert teachers and teacher leaders to share their experiences with their peers.

Recommendations for Action

There are four primary recommendations based on the data collected within this study and the existing literature that connected to the results. Teacher leaders, program coordinators, principals, directors, superintendents, and school boards are often invested in maximizing school funding and the positive impact of educational technology. Therefore, these recommendations are pertinent to a wide range of stakeholders. While the recommendations included are made based on this research conducted around the implementation of a LMS at a high school, they are potentially viable throughout the K-12 educational system and could be considered when implementing technology other software and hardware across grade levels.

Assessing Teacher Skill with and Beliefs About Technology

There is ample literature discussing teacher beliefs about technology and how their beliefs impact technology use in the classroom (Chand et al., 2020; Hsu, 2016; Thompson, 2017; Zeynep et al., 2020). Hus (2016) stated:

> Teachers’ beliefs about technology consist of three components: pedagogical beliefs about technology integration, self-efficacy beliefs about technology integration, and beliefs about the perceived value of technology for student learning. These three components were interrelated and were found to be the main predictors of teachers’ classroom technology use. (p. 31)

Results of this study underscored the link between those beliefs, technology use, and teacher skill level with technology with *evolving feelings* and *evolved thinking about technology* being noted by novice and intermediate users of technology. To that end, it may be beneficial, prior to the implementation of a technology initiative or technology related PD or training, for schools and districts to assess and develop a better understanding of each individual teacher's beliefs about technology, as well as their skill level with technology.

Budgeting: Total Cost of Ownership

Effective high-quality professional development (PD) includes that which provides an opportunity for reflection and is sustained or ongoing (Darling-Hammond et al., 2017). High quality PD changes instructional practice and increases student outcomes, is an essential component of any educational system (Darling-Hammond et al., 2017). As such, effective technology PD, training, and support must be factored and budgeted as part of the total cost of ownership when purchasing new technologies. Monies allocated for the initial purchase of technology hardware or software in schools are secondary to the ongoing funds needed for PD if the technology purchased is to be effective and achieve its stated goals (CoSN, 2004). Given the significant impact of technology integration specialists, part of the budgeting for technology may need to include the salaries and associated costs of these positions, as well as time for teachers to work together and build their communities of practice.

Pre-Piloting New Technology

There is literature supporting the pre-piloting of technology as a strategic way to begin the implementation of a new technology within districts and schools (Tucker et al., 2017). The pre-piloting of technology "is a designed opportunity to fail small and fail fast, adapt quickly, and learn from mistakes" (Tucker et al., 2017, p. 20). A pre-pilot was conducted for the implementation of the Schoology LMS at ABC High School, although it was referred to as simply a pilot. Pre-piloting may be best achieved by a subset of users, specifically those with positive beliefs about technology in education and whose skill level with technology is advanced, as found in this study. The mindset and technology skill/use of those involved in the pilot of Schoology at ABC High School, aligned closely with the beliefs of Tucker et al. (2017) who stated, “pre-pilot teachers are usually early adopters who are already using technology with their students” (p. 21). Advanced users of technology fit the criteria to pre-pilot technology.

Participating teachers, whose skill level with technology fell into the novice and intermediate categories, noted *peer-to-peer learning* was valuable to their experiences with learning and implementing the Schoology LMS at ABC High School. This finding aligned closely with Kennedy’s (2005) CoP. At ABC High School, teachers involved in the pilot of the Schoology LMS were key figures in roundtable discussions that supported peer-to-peer learning. Districts and schools seeking to implement a new technology may be well served to pre-pilot technology with early adopters and subsequently utilize the support of those early adopters (advanced technology users) and the lessons learned from the pre-pilot to enable peer-to-peer learning with and amongst the general teacher population. As well, both the CMM and CoP could be facilitated by pre-pilot teachers.

Eliminate (or reduce) the One-Size-Fits-All Professional Development

This study provides further evidence for the elimination (or at least significant reduction) of the one-size-fits-all PD model, particularly as it relates to technology. While not specifically mentioning the one-size-fits-all model, Kennedy (2005) referenced a training model which, by definition, “is generally ‘delivered’ to the teacher by an ‘expert,’ with the agenda determined by the deliverer, and the participant placed in a passive role” and is “subject to criticism about its lack of connection to the current classroom context in which participants work" (p. 237). Conversely, the CMM and CoP, most closely aligned with findings in this study from novice and intermediate technology users. The CMM and CoP also supported conclusions from Hora and Holden (2013) as these models allowed participants to "work within disciplinary clusters and focus on pedagogical techniques that are most effective for the outcomes most closely related to the specific goals" (p. 89). Finally, these models were arguably best equipped to address teacher beliefs and attitudes about technology, its benefits to student learning, and its use in instructional practice (Hsu, 2016).

An exception to the recommendation for the elimination of the one-size-fits-all PD model as it relates to technology, is for those who identify as advanced users of technology. Findings from the current study indicated advanced users of technology *always valued technology* and understood the *interdependence of the three domains (*technological, content, and pedagogical knowledge). Thus, transactional PD, as in Kennedy's (2005) training model, may be more appropriate for advanced users of technology. Advanced users only require technology trainings to address the specific technology skill; thus, the training does not need to address beliefs about technology or its place in educational instruction.

Recommendations for Further Study

The data collected in this study, coupled with existing research and literature, highlighted potential areas for future study. In the sub-sections that follow, the researcher elaborates on the recommended study of connecting teacher beliefs, use and skill, monitoring changing teacher beliefs and improved skills, and the replication of this study with respect to other educational technologies. Study in these areas may continue to add to the available literature and subsequently support K-12 stakeholders in achieving identified goals with educational and instructional technology.

Connecting Beliefs, Use, and Skill

There is substantial literature connecting teacher beliefs about technology and educational technologies to use in classroom instruction and pedagogy (Chand et al., 2020; Hsu, 2016; Thompson, 2017; Zeynep et al., 2020). The findings in this study begin to add the element of teacher skill level with technology, creating a link between their beliefs about technology and their skill level with using technology. Stakeholders within the K-12 educational community may benefit from the findings and recommendations derived from further research on the link between and amongst teacher beliefs about technology, teacher skill level with technology and teacher use of technology in the classroom. While there is ample research around educational technology, and teacher PD, training, and support, additional data and research, adding the element of teacher skill level would serve to better inform technology decision makers, PD, and technology support providers as well as school and district administrators (Baran, 2015; Darling-Hammond et al., 2017; Higgins & Spitulnik, 2008; Hora & Holden, 2013; Hsu, 2016).

Monitoring Changing Beliefs and Improving Skill

There is substantial data connecting teacher beliefs about technology in education and the impact or connection those beliefs have to their instructional use of technology in the classroom. (Chand et al., 2020; Hsu, 2016; Thompson, 2017; Zeynep et al., 2020). The data from this research study indicated both novice and intermediate users of technology referenced evolved, or evolving, feelings or thinking about technology. Given the basis of this research study, this evolution of thinking was specifically related to participant use of the Schoology LMS, which was initially implemented at ABC High School in 2016. It may be valuable to better understand the progression of these feelings over time. Future research may consider if there is an average minimum number of years a teacher must work with technology in their classroom for feelings about technology to substantially evolve. Other research may investigate the minimum amount of time teachers must spend in high-quality effective PD or training for substantial change to occur.

Similarly, while this research study provided some clarity around teacher skill level with technology, it may be beneficial to track teacher skill level with technology over time. Participating teachers in this research study were employed at ABC High School, at a minimum, since 2016 and had access to a wide variety of educational technology resources, tools, as well as PD, training, and support. Future research may consider what the average minimum number of years a teacher must work with technology in their classroom for skill level with technology to substantially evolve. Researchers may also be interested in investigating the minimum amount of time teachers must spend in high quality effective PD or training for substantial change to occur as it relates to their proficiency or skill level with educational technology. It is notable that after roughly six years (or more), with access to a variety of educational technology resources at ABC High School, there are teachers still achieving scores in the lower range (and given the label of novice user of technology for the purposes of this study) on the TPACK survey.

Other Educational Technologies

This study focused on the professional development (PD), training, and support provided to teachers during and subsequent to the implementation of a LMS at a public high school. While the data collected about teacher skill level through the TPACK survey were general and not specific to hardware of software, the research questions and participant responses had a specific focus on the Schoology, LMS implemented at ABS High School, and participation during the

Schoology implementation was a primary factor in determining teacher participation for this study. Additional research, potentially replicating this study, with a focus on other applications or hardware like interactive projectors, individual student computing devices (tablets or Chromebooks), and/or other devices may support the generalization of this study's findings.

Conclusion

Using data collected through participant responses on the TPACK survey (Schmidt et al., 2009), this researcher categorized participant teachers by skill level with technology. Participant technology skill level provided organization for the researcher to document teachers' perceptions of the types of technology PD, support and training that best assisted them during and subsequent to the implementation of the Schoology LMS at ABC High School. The researcher also explored the impact support may have on teachers' beliefs about technology and its role/impact on their instructional practice. Research questions for this study were:

- How do high school teachers describe the technology support they received on the LMS?
- What are teachers' beliefs about technology and its place in their instruction?
- How does content knowledge, pedagogical knowledge, and technology skill impact high school teachers' technology use?

With three distinct categories (novice, intermediate, and advanced) of teacher technology users identified through the TPACK survey, this study married teacher beliefs about technology and the PD, training, and support they found most useful in implementing the Schoology LMS. To that end, novice and intermediate users of technology noted evolving feeling about technology but had not reached complete recognition of the interdependence of the three TPACK domains, technological, content, and pedagogical knowledge. These users most valued the coaching and mentoring provided through one-on-one or face-to-face training and support offered by a technology integration specialist, and/or the knowledge sharing and support provided by colleagues, both individually, and through roundtable discussions in a CoP. In contrast, advanced users of technology noted always recognizing the interdependence on the TPACK domains and argued they have always valued technology's impact for students and its place in their instructional practice. Advanced users, unlike their counterparts, were comfortable with high-level technology demonstrations and autonomous exploration. Such technology PD may be those typically viewed as the "dreaded" one-size-fits all, and those which provide little ongoing support.

A recommendation as a result of this research study is that districts and schools must appropriately budget for the total cost of ownership of educational technology, which must include high quality effective PD, training, and support. This study highlights specifically, the importance of the role of the technology integration specialist, as well as the time teachers need to participate in CoP to support and learn from each other. Without the proper funding for ongoing PD, training, and support, the base investment in educational technology may be wasted.

With the noted benefits and value placed on peer-to-peer learning within this study, districts and schools may benefit from a pre-pilot of educational technology. Pre-piloting should be done with advanced users of technology who understand and value the time spent learning technology independently and enjoy high-level PD and trainings. These advanced users, after embedding the technology into their instructional practice are then key to peer-to-peer learning and CoP, assisting less skilled teachers meet the goals of the target technology.

This study provided further evidence for the elimination (or at least significant reduction) of the one-size-fits-all PD model particularly as it relates to educational technology. The data collected in this study indicated only a small subset of teachers (advanced technology users) finding this type of PD useful. This model is mostly inappropriate for novice and intermediate users of technology because of its “lack of connection to the current classroom context in which participants work” (p. 237). Large group training should be avoided, when possible, especially for novice users of technology.

There was ample evidence from research that teacher beliefs about technology effect technology use in the classroom. This study provided evidence that better understanding teacher technology skill level and teacher beliefs about technology may be valuable. This information is helpful both during the initial implementation of educational technology and when providing the subsequent PD, training, and support needed for continued success and professional growth.

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APPENDIX A

Survey of Preservice Teachers' Knowledge of Teaching and Technology

Denise A. Schmidt, Evrim Baran, and
Ann D. Thompson Center for Technology
in Learning and Teaching
Iowa State University

Matthew J. Koehler, Punya
Mishra, and Tae Shin
Michigan State University

Usage Terms: Researchers are free to use the TPACK survey, provided they contact Dr. Denise Schmidt (dschmidt@iastate.edu) with a description of their intended usage (research questions, population, etc.), and the site locations for their research. The goal is to maintain a database of how the survey is being used, and keep track of any translations of the survey that exist.

Version 1.1: (updated September 1, 2009). This survey was revised to reflect research results obtained from its administration during the 2008-2009 and 2009-2010 academic years. This document provides the latest version of the survey and reports the reliability scores for each TPACK domain. (This document will be updated as the survey is further developed).

The following papers and presentations highlight the development process of this survey:

Schmidt, D. A., Baran, E., Thompson A. D., Koehler, M. J., Mishra, P. & Shin, T. (2009-10). Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers. *Journal of Research on Technology in Education, 42*(2), 123-149.

Schmidt, D. A., Baran, E., Thompson A. D., Koehler, M. J., Mishra, P. & Shin, T. (2009). The Continuing Development, Validation and Implementation of a TPACK Assessment Instrument for Preservice Teachers. Paper submitted to the 2010 Annual Meeting of the American Educational Research Association. April 30-May 4, Denver, CO.

Schmidt, D., Baran, E., Thompson, A., Koehler, M.J., Shin, T, & Mishra, P. (2009, April). *Technological Pedagogical Content Knowledge (TPACK): The Development and Validation of an Assessment Instrument for Preservice Teachers.* Paper presented at the 2009 Annual Meeting of the American Educational Research Association. April 13-17,San Diego, CA.

Schmidt, D., Baran, E., Thompson, A., Koehler, M.J., Mishra, P., & Shin, T. (2009, March). *Examining preservice teachers' development of technological pedagogical content knowledge in an introductory instructional technology course.* Paper presented at the 2009 International Conference of the Society for the Information and Technology & Teacher Education. March 2-6, Charleston, SC.

Shin, T., Koehler, M.J., Mishra, P. Schmidt, D., Baran, E., & Thompson, A.,(2009, March). Changing technological pedagogical content knowledge (TPACK) through course experiences. Paper presented at the 2009 International Conference of the Society for the Information and Technology & Teacher Education. March 2-6, Charleston, SC.

How do I use the survey? The questions you want are most likely questions 1-46 starting under the header "TK (Technology Knowledge)". In the papers cited above, these categories were removed so that participants were not oriented to the constructs when answering the survey questions. The items were presented in order from 1 through 46, however. The other items are more particular to individual study and teacher education context to better understand results found on questions 1-46. You are free to use them, or modify them. However, they are not the core items used to measure the components of TPACK.

How do score the survey. Each item response is scored with a value of 1 assigned to strongly disagree, all the way to 5 for strongly agree. For each construct the participant's responses are averaged. For example, the 6 questions under TK (Technology Knowledge) are averaged to produce one TK (Technology Knowledge) Score.

Reliability of the Scores (from Schmidt et al, 2009).

TPACK Doman	Internal Consistency (alpha)
Technology Knowledge (TK)	.86
Content Knowledge (CK)	
Social Studies	.82
Mathematics	.83
Science	.78
Literacy	.83
Pedagogy Knowledge (PK)	.87
Pedagogical Content Knowledge (PCK)	.87
Technological Pedagogical Knowledge (TPK)	.93
Technological Content Knowledge (TCK)	.86
Technological Pedagogical Content Knowledge (TPACK)	.89

Thank you for taking time to complete this questionnaire. Please answer each quest

ion to the best of your knowledge. Your thoughtfulness and candid responses will be greatly appreciated. Your individual name or identification number will not at any time be associated with your responses. Your responses will be kept completely confidential and will not influence your course grade.

DEMOGRAPHIC INFORMATION

1. Your ISU e-mail address

2. Gender
   a. Female
   b. Male

3. Age range
   a. 18-22
   b. 23-26
   c. 27-32
   d. 32+

4. Major
   a. Early Childhood Education (ECE)
   b. Elementary Education (ELED)
   c. Other

5. Area of Specialization
   a. Art
   b. Early Childhood Education Unified with Special Education
   c. English and Language Arts
   d. Foreign Language
   e. Health
   f. History
   g. Instructional Strategist: Mild/Moderate (K8) Endorsement
   h. Mathematics
   i. Music
   j. Science-Basic
   k. Social Studies
   l. Speech/Theater
   m. Other

6. Year in College
   a. Freshman
   b. Sophomore
   c. Junior
   d. Senior

7. Are you completing an educational computing minor?
   a. Yes
   b. No

8. Are you currently enrolled or have you completed a practicum experience in a PreK-6 classroom?
   a. Yes
   b. No

9. What semester and year (e.g. Spring 2008) do you plan to take the following? If you are currently enrolled in or have already taken one of these literacy blocks please list semester and year completed

Literacy Block-I (C I 377, 448, 468A, 468C)	
Literacy Block-II (C I 378, 449, 468B, 468D)	
Student teaching	

Technology is a broad concept that can mean a lot of different things. For the purpose of this questionnaire, technology is referring to digital technology/technologies. That is, the digital tools we use such as computers, laptops, iPods, handhelds, interactive whiteboards, software programs, etc. Please answer all of the questions and if you are uncertain of or neutral about your response you may always select "Neither Agree or Disagree"

	Strongly Disagree	Disagree	Neither Agree or Disagree	Agree	Strongly Agree
TK (Technology Knowledge)					
1. I know how to solve my own technical problems.					
2. I can learn technology easily.					
3. I keep up with important new technologies.					
4. I frequently play around the technology.					
5. I know about a lot of different technologies.					
6. I have the technical skills I need to use technology.					
CK (Content Knowledge)					
Mathematics					
7. I have sufficient knowledge about mathematics.					
8. I can use a mathematical way of thinking.					
9. I have various ways and strategies of developing my understanding of mathematics.					
Social Studies					
10. I have sufficient knowledge about social studies.					
11. I can use a historical way of thinking.					
12. I have various ways and strategies of developing my understanding of social studies.					
Science					
13. I have sufficient knowledge about science.					
14. I can use a scientific way of thinking.					
15. I have various ways and strategies of developing my understanding of science.					
Literacy					
16. I have sufficient knowledge about literacy.					
17. I can use a literary way of thinking.					
18. I have various ways and strategies of developing my understanding of literacy.					

PK (Pedagogical Knowledge)					
19. I know how to assess student performance in a classroom.					
20. I can adapt my teaching based-upon what students currently understand or do not understand.					
21. I can adapt my teaching style to different learners.					
22. I can assess student learning in multiple ways.					
23. I can use a wide range of teaching approaches in a classroom setting.					
24. I am familiar with common student understandings and misconceptions.					
25. I know how to organize and maintain classroom management.					

PCK (Pedagogical Content Knowledge)					
26. I can select effective teaching approaches to guide student thinking and learning in mathematics.					
27. I can select effective teaching approaches to guide student thinking and learning in literacy.					
28. I can select effective teaching approaches to guide student thinking and learning in science.					
29. I can select effective teaching approaches to guide student thinking and learning in social studies.					
TCK (Technological Content Knowledge)					
30. I know about technologies that I can use for understanding and doing mathematics.					
31. I know about technologies that I can use for understanding and doing literacy.					
32. I know about technologies that I can use for understanding and doing science.					
33. I know about technologies that I can use for understanding and doing social studies.					

TPK (Technological Pedagogical Knowledge)					
34. I can choose technologies that enhance the teaching approaches for a lesson.					
35. I can choose technologies that enhance students' learning for a lesson.					
36. My teacher education program has caused me to think more deeply about how technology could influence the teaching approaches I use in my classroom.					
37. I am thinking critically about how to use technology in my classroom.					
38. I can adapt the use of the technologies that I am learning about to different teaching activities.					
39. I can select technologies to use in my classroom that enhance what I teach, how I teach and what students learn.					
40. I can use strategies that combine content, technologies and teaching approaches that I learned about in my coursework in my classroom.					
41. I can provide leadership in helping others to coordinate the use of content, technologies and teaching approaches at my school and/or district.					
42. I can choose technologies that enhance the content for a lesson.					

TPACK (Technology Pedagogy and Content Knowledge)					
43. I can teach lessons that appropriately combine mathematics, technologies and teaching approaches.					
44. I can teach lessons that appropriately combine literacy, technologies and teaching approaches.					
45. I can teach lessons that appropriately combine science, technologies and teaching approaches.					
46. I can teach lessons that appropriately combine social studies, technologies and teaching approaches.					

Models of TPACK (Faculty, PreK-6 teachers)					
47. My mathematics education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
48. My literacy education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
49. My science education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
50. My social studies education professors appropriately model combining content, technologies and teaching approaches in their teaching.					
51. My instructional technology professors appropriately model combining content, technologies and teaching approaches in their teaching.					
52. My educational foundation professors appropriately model combining content, technologies and teaching approaches in their teaching.					
53. My professors outside of education appropriately model combining content, technologies and teaching approaches in their teaching.					
54. My PreK-6 cooperating teachers appropriately model combining content, technologies and teaching approaches in their teaching.					

	25% or less	*26% - 50%*	*51% - 75%*	*76%-100%*
Models of TPCK				
55. In general, approximately what percentage of your teacher education professors have provided an effective model of combining content, technologies and teaching approaches in their teaching?				
56. In general, approximately what percentage of your professors outside of teacher education have provided an effective model of combining content, technologies and teaching approaches in their teaching?				
57. In general, approximately what percentage of the PreK-6 cooperating teachers have provided an effective model of combining content, technologies and teaching approaches in their teaching?				

APPENDIX B

Interview Protocol Form

Study: *Understanding the Technology Support Needs of High School Teachers Implementing a Learning Management System (LMS)*

School/Organization:

Date:

Time:

Location:

Interviewer:

Interviewee:

Release form signed? *YES / NO*

Notes to interviewee:

Thank you for your participation. I believe your input will be valuable to this research.

Confidentiality of responses is guaranteed. You will not be identified in the study in anyway.

Approximate length of interview: *30 minutes, five major questions with follow-up questions as appropriate.*

Purpose of research: *The purpose of the study is to document teachers' perceptions about the elements of technology support that best assisted them in meeting identified learning objectives with respect to technology adoption and integration, specifically, an LMS. Additionally, the study seeks to explore the impact support may have on teachers' beliefs about technology and its role/impact on their instructional practice. Data will be collected on teachers' perceptions of technology, as well as the most effective types of supports (and frequency) they recall were most useful for their respective skills level. Findings will add to the body of knowledge around technology support in schools and help to quantify, to some degree, how various types of technology support influence the intersection of teachers' content knowledge, pedagogical knowledge and technology skill.*

Methods of disseminating results: ???

1. Prior to the implementation of Schoology, before high school began using the LMS, describe your thoughts and feelings about technology and its place in your classroom and instruction?

Response from Interviewee:

Reflection by Interviewer

2. Thinking back to the pilot and implementation of Schoology, when the high school first began using the LMS, describe the technology support, training, or professional development sessions that you felt were most helpful to you?

Response from Interviewee:

Reflection by Interviewer

3. Based on the TPACK Survey you completed, describe your technical knowledge, pedagogical knowledge and content knowledge and how these three domains inform your instructional practice and lesson delivery.

Response from Interviewee:

Reflection by Interviewer

4. Describe how your thoughts and feelings about technology and its place in your classroom and instruction have changed over the last several years?

Response from Interviewee:

Reflection by Interviewer

5. What technology support, training or professional development sessions have been helpful to you since the implementation, including during this past year with Covid and remote and hybrid learning?

Response from Interviewee:

Reflection by Interviewer

6. What are the types of technology support, training or professional development that are least helpful or beneficial to you, explain why?

Response from Interviewee:

Reflection by Interviewer

- Closure
  - Thank you to interviewee
  - reassure confidentiality
  - ask permission to follow-up ______

APPENDIX C

Information Sheet

Title of Study or Project: Understanding the Technology Support Needs of High School Teachers implementing a Learning Management System (LMS)
Date of Review: 11/24/2021
Principal Investigator: Neil L. Trahan Phone: 508-887-1303

You may be eligible to take part in a research study. The information that will be discussed gives you important information about the study. It describes the purpose of this research study, and the risks and possible benefits of participating. The word "we" means the study investigator and other research staff.

Why are you being asked to take part in this study?

You are being asked to take part in this research study because you were teaching at the Grafton High School during the initial implementation of the Schoology Learning Management System.

What is the purpose of this research study?

The purpose of the study is to document teachers' perceptions about the elements of technology support that best assisted them in meeting identified learning objectives with respect to technology adoption of the Schoology learning management system. Additionally, the study seeks to explore the impact support may have on teachers' beliefs about technology and its influence on their instructional practice. Data will be collected regarding teachers' perceptions of technology, as well as the types of support (and frequency) they recall were most useful for their respective skill level.

What is involved in the study?

If you agree to take part in this study, you will be asked to complete a survey based on the TPACK and possibly participate in a one-on-one interview. Only 8 or 9 participates who complete the survey will be asked to participate in the interview.

If you agree, the survey will take about 10 minutes. If you are selected and agree to an interview, the interview will take about 30 minutes and can be done remotely using Google Meets.

What are the risks and benefits of this study?

As with any study involving collection of data, there is the possibility your confidentiality information will beshared with others. Every precaution will be taken to secure your personal information to ensure confidentiality. The information gathered could help both this researcher and other educators better understand teacher beliefs about technology, as well as plan and execute more appropriate technology related professional development, support and training.

Do you need to give your consent in order to participate?

By completing the survey, you are indicating that you have had your questions answered, and you agree to take part in this research study.

Participation in this study is voluntary. You do not have to take part. If you decide not to take part or if you change your mind later there will be no penalties or loss of any benefits to which you are otherwise entitled. You can stop the survey or interview at any time.

What about privacy and confidentiality?

We will do our best to keep your personal information private and confidential. However, we cannot guarantee absolute confidentiality. Your personal information may be disclosed if required by law. People from oversight agencies and organizations such as the Department of Health and Human Services, Office for Human Research Protections may also look at your study records.

The results of this study may be shown at meetings or published in journals to inform other professionals. We will keep your identity private in any publication or presentation about the study.

By law, the investigators are required to protect your private information. The investigator and staff involved with the study will keep your private information collected for the study strictly confidential.

What if you have questions about the study?

If you have questions about the study, call the study investigator, Neil Trahan at 508-887-1303. You may also contact Dr. Debra Welkley at dwelkley@une.edu if you have questions or concerns.

APPENDIX D

UNE UNIVERSITY OF NEW ENGLAND

Institutional Review Board
Mary DeSilva, Chair

Biddeford Campus
11 Hills Beach Road
Biddeford, ME 04005
(207)602-2244 T
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Portland Campus
716 Stevens Avenue
Portland, ME 04103

To:	Neil Trahan
Cc:	Debra Welkley
From:	Mary DeSilva, ScD, MS, MSFS
Date:	December 7, 2021
Project # & Title:	**IRB Protocol # 0921-14: Understanding the Technology Support Needs of High School Teachers Implementing a Learning Management System (LMS)**

The Institutional Review Board (IRB) for the Protection of Human Subjects has reviewed the materials submitted in connection with the above captioned project and has determined that the proposed work is exempt from IRB review and oversight as defined by 45 CFR 46.104 (d)(2)(ii).

Additional IRB review and approval is not required for this protocol as submitted. If you wish to change your protocol at any time, including after any subsequent review by any other IRB, you must first submit the changes for review.

Please contact the IRB at (207) 602-2244 or irb@une.edu with any questions.

Sincerely,

Mary DeSilva, ScD, MS, MSFS
Chair

IRB#: # 0921-14
Submission Date: 09/15/2021
Status: Exempt, 45 CFR 46.104 (d)(2)(ii)
Status Date: 12/07/2021