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Teachers' Knowledge and Self-Efficacy Beliefs as Factors Affecting Technology Integration Practices

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Walden University
2020

Abstract

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by

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MEd, University of South Florida, 2013

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Doctoral Study Submitted in Partial Fulfillment

of the Requirements for the Degree of

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Abstract

Research indicates that teachers can be reluctant to integrate technology into their instructional practices. This study examined the problem of insufficient technology integration in high school classrooms, using social learning theory and motivational systems theory as theoretical frameworks. A cross-sectional survey design was used to investigate the relationship between the independent variables, technological pedagogical content knowledge (TPACK), teacher self-efficacy (TSE), and teacher characteristics (experience, education, and subject taught), and the dependent variable, technology integration level (TI). A combined online TPACK questionnaire, Teacher Sense of Efficacy Scale, and Concerns-Based Adoption Model survey were completed by 72 teachers from 6 high schools in an urban Georgia school district to assess their levels of TPACK, TSE, and TI. Linear regression analysis and one-way analysis of variance identified significant relationships between TI level and TPACK subscales: teacher knowledge ($B = .311$, $r = .601$, $p = .011$), content knowledge ($B = .293$, $r = .279$, $p = .033$), and technological pedagogical content knowledge ($B = .612$, $r = .666$, $p = .000$); TSES subscale: instructional strategies ($B = .319$, $r = .337$, $p = .021$), and TSE-Total ($B = .281$, $r = .281$, $p = .017$). Significant mean differences in TI scores were found between vocational/technical education teachers and other teachers of non-core subjects, $F(5, 66) = 2.692$, $p = .028$. Even in technologically well-equipped schools, teachers' choices to utilize or not to utilize technology creates inequity in technological knowledge that adversely affect student learning outcomes. Professional development based on this study's findings; therefore, will engender positive social change by promoting educational equity through improved TI practices among urban high school teachers.

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Dedication

I would like to dedicate this doctoral study to my late grandfather, Fredrick Douglas Rowe, who was the first person to ever tell me that I could accomplish great things with my life. I admire you for overcoming the obstacles faced by a Black man born in the south in 1899, and for helping me understand the importance of focusing on God rather than man. Thanks, grandpa, for telling me, “Junior…I think you’re gonna be alright.” I also dedicate this doctoral study to my mother Jewel Rowe Gilkes for showing me what perseverance looks like, my wife Nicole Gilkes for choosing me as her partner on the journey of life, and my two daughters Noel Gilkes and Jada Gilkes who are the source of my joy.

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I am tremendously grateful for the tireless support of my committee chairperson Dr. Kimberley F. Alkins and committee member Dr. Christopher J. Godat. Your commitment to student success is evident, and I greatly appreciate being both challenged and supported throughout this process. I would also like to thank Dr. Zin M. Htway for providing needed guidance in the area of data analysis.

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Section 1: Introduction to the Study

Introduction

The world is experiencing rapid growth in the advancement and usage of new technologies and this technological boom is driving rapid social changes (Mir & Parrey, 2019). These changes are having a significant effect on K to 12 schools in the United States, expanding opportunities for innovation while at the same time creating a variety of new challenges (Chicioreanu & Ianos, 2019). Teenagers use a wide range of technology daily outside of school but are limited in their use of technology for instructional purposes while in school (Harrell & Bynum, 2018). In 2009, the Pew Research Center conducted an extensive study of U.S. teen internet usage and found that 93% of U.S. teens ages 12 to 17 years, representing approximately 21 million teens, use the internet. Of those 21 million, approximately 11 million teens were online daily (Pew Internet & American Life Project, 2009). In a similar study 9 years later, Pew Research Center researchers found that 95% of U.S. teens have smartphone access, and 45% of these youth report that they constantly use the Internet (Anderson & Jiang, 2018). Technology integration in the classroom is not only important because it enhances learning, but because students who can use technology effectively have better chances to obtain employment and advance in their careers (Lombardi et al., 2017).

Despite the pervasiveness of technology in the lives of teens, researchers have found that K to 12 teachers are often ill-prepared and make little use of technology integrated instructional practices (Espinoza & Neal, 2018). Preservice teachers are not adequately equipped to utilize technology in innovative ways, and for teachers already in the classroom, professional development has been inadequate in keeping up with the rapid changes occurring with educational technology (Bushweller, 2017). In a 2016 survey of U.S. teachers, more than 50% of teachers reported feeling comfortable using new technologies but most of these teachers used technology for testing and drills rather than in interactive or collaborative ways (Edwards & Editorial Projects in Education, 2016). For the past 2 decades, various federal, state, and local education initiatives have called for changes in curriculum, learning materials, assessments, and professional development to infuse technology into teaching and learning (Nepo, 2017; U.S. Department of Education, 2017). Despite these efforts and an initial optimism about the future of technology integration in K to 12 schools, researchers indicate that a problem exists in that technology integration still is not commonplace in U.S. classrooms (Harrell & Bynum, 2018; Pittman & Gaines, 2015).

The purpose of this study was to examine the relationship between the variables technological pedagogical content knowledge (TPACK), teacher self-efficacy (TSE), and level of technology integration (TI) to gain a clearer understanding of why some teachers integrate technology into their instructional practices to a greater degree than other teachers. Section 1 includes an overview of the study and outlines its characteristics as follows: an introduction and background of the study, a description of the problem of insufficient technology integration in the classroom, the purpose of the study, research questions, and the conceptual framework. Additionally, I discuss the assumptions and limitations in this section.

Problem Statement

This study addressed the problem of insufficient technology integration in high school classrooms in a large urban Georgia school district. This problem is significant because technology integration has been demonstrated to improve student engagement and student achievement (Ghavifekr & Rosdy, 2015). Technology integration has been mandated at the federal and state levels, as well as by various influential educational organizations, yet the problem has persisted for more than 2 decades and is prevalent throughout K to 12 education. The problem affects the students in this district because the district has adopted an expensive one-to-one technology program and effective technology integration can improve student achievement and help students become college and career ready in a highly technological society (Urbina & Polly, 2017). Understanding how the variables TPACK and TSE influence teachers' technology integration practices can help create ways to increase teachers' TI levels in high school classrooms, leading to greater academic achievement.

In 2019, Georgia ranked 31st of 50 states in K to 12 education overall when measuring enrollment in pre-K, scores on standardized assessments, and public high school graduation rates (Zeigler, 2019). Classroom technology integration is a way in which academic achievement can be improved by enhancing problem-solving, student and teacher discourse, and higher-order thinking (Delgado, Wardlow, McKnight, & O'Malley, 2015; Kimmons, 2016). By exploring the relationship between the variables TPACK, TSE, and TI this study will add to the collection of knowledge needed to provide insight into addressing the issue of insufficient technology integration in high school classrooms.

Nature of the Study

In this study, I investigated the problem of insufficient technology integration in high school classrooms in a large urban Georgia school district using a cross-sectional survey design. I measured the relationship between high school teachers' TPACK levels, TSE beliefs, years of teaching experience, education level, subject area taught (independent variables), and teachers' TI levels (dependent variable). The TPACK framework was introduced by Mishra and Koehler (2006) and is made up of seven types of knowledge producing overlapping domains starting with the three domains of pedagogical knowledge (PK), technological knowledge (TK), and content knowledge (CK). These three domains intersect in three areas between pedagogy and content knowledge (PCK), technology and pedagogical knowledge (TPK), and technology and content knowledge (TCK). The area where all three domains intersect lies in the center and represents TPACK. The TPACK questionnaire, modified by Jang and Tsai (2012) used for this study, was based on the TPACK questionnaire originally developed by Mishra and Koehler. The TPACK questionnaire is a self-reporting questionnaire used to survey teachers in three knowledge areas: technology, pedagogy, and content knowledge, with a Likert scale from 1 to 5, with 1 meaning totally disagree and 5 meaning totally agree.

TSE was measured by the Teacher Sense of Efficacy Scale (TSES). *Self-efficacy* is defined as a person's perception of his or her own ability to organize and successfully execute behaviors leading to desired goals and outcomes (Bandura, 1989). The TSES short form is a 12-item, Likert-scale, self-rating instrument with three subscales that are used to measure teachers' efficacy in classroom management (CM), student engagement (SE), and instructional strategies (IS). When completing the TSES, the reader responds to questions regarding their self-efficacy beliefs on a scale from 1 (nothing) or low self-efficacy to 9 (a great deal) or high self-efficacy, to determine what creates the most challenges for teachers in their typical teaching activities (Tschannen-Moran & Woolfolk-Hoy, 2001).

TI level was measured by the Concerns-Based Adoption Model - Levels of Use (CBAM-LoU) instrument. *Technology integration* refers to using computers and other technological devices effectively for instructional purposes to promote student learning by allowing students to solve problems through the application of technology skills to learning (Kimmons, 2016). The CBAM-LoU instrument is a short self-report measure used to assess the level of technology utilization (Hall, Loucks, Rutherford, & Newlove, 1975). This instrument is used to describe several user innovation behaviors across eight levels according to the levels of use chart (Hall et al., 1975). The user selects one level to best represent his/her level of technology integration. It typically takes less than 5 minutes to complete the instrument. The levels are: 0-non-use, 1-orientation, 2-preparation, 3-mechanical use, 4a-routine, 4b-refinement, 5-integration, and 6-renewal (Hall et al., 1975), and these levels of use can apply to individuals, groups, or entire institutions. This instrument is a time-efficient tool used for assessing the degree of a teacher's progression toward a high level of technology integration (Institute for the Integration of Technology into Teaching and Learning, 2019).

I administered the TPACK questionnaire, the TSES, and the CBAM-LoU survey to high school teachers to assess their levels of TPACK, TSE beliefs, and their TI levels. The administration of electronic surveys was cross-sectional with data collected in April of 2020. I collected survey data from a convenience sample of 72 teachers at six high schools in the local school district, solicited from a population of 579 high school teachers. The teachers at each of six high school sites were provided with a weblink to the survey via email, and participants were able to complete the survey at a time that was convenient for them. Because participation was voluntary, I sent a reminder email to potential participants at each school 12 days after the initial email request was sent, asking them a second time if they would like to participate in the study. The reminder email was sent to increase the likelihood of reaching the minimum sample size of 55 participants.

Results of this study can help in developing an understanding of how TPACK and TSE influence high school teachers' adoption of technology integrated instruction, which could provide insight into solutions to the local problem of insufficient levels of technology integration in high school classrooms in the local school district. These results can also be beneficial in creating positive social change by providing a clearer understanding of variables influencing teachers' TI levels, which in turn, could be a catalyst for creating classroom learning experiences that mirror the digital world in which students live.

Research Questions and Hypotheses

The problem of insufficient technology integration in high school classrooms raises many questions related to the use of technology in schools, the role of the classroom teacher, and factors affecting teachers that successfully integrate technology and those teachers that are unsuccessful. Given that this study focused on examining the relationship between the variables TPACK level, TSE beliefs, and TI level, I asked the following research questions to gain a better understanding of these relationships.

1. What is the relationship between teachers' TPACK levels and teachers' level of technology integration?

   $H_0$1: There is no relationship between teachers' TPACK levels and teachers' level of technology integration.

   H_a1: There is a significant relationship between teachers' TPACK levels and teachers' level of technology integration.

2. What is the relationship between teachers' self-efficacy beliefs and teachers' level of technology integration?

   $H_0$2: There is no relationship between teachers' self-efficacy beliefs and teachers' level of technology integration.

   H_a2: There is a significant relationship between teachers' self-efficacy beliefs and teachers' levels of technology integration.

3. What is the relationship between teachers' years of experience and teachers' level of technology integration?

$H_0$3: There is no relationship between teachers' years of experience and teachers' level of technology integration.

H_a3: There is a significant relationship between teachers' years of experience and teachers' level of technology integration.

4. What is the relationship between teachers' education level and teachers' levels of technology integration?

   $H_0$4: There is no relationship between teachers' education level and teachers' level of technology integration.

   H_a4: There is a significant relationship between teachers' education level and teachers' level of technology integration.

5. What is the relationship between the subject area taught by teachers' and teachers' levels of technology integration?

   $H_0$5: There is no relationship between the subject area taught by teachers' and teachers' level of technology integration.

   H_a5: There is a significant relationship between the subject area taught by teachers' and teachers' level of technology integration.

I investigated the relationships between independent variables (TPACK, TSE, years of teaching experience, education level, and subject area taught) and the dependent variable (TI), using multiple linear regression analysis, simple linear regression analysis, and one-way analysis of variance (ANOVA). I present a more detailed discussion of the research design and methodology in Section 3.

Purpose of the Study

The purpose of this study was to explore the relationship between the independent variables (TPACK, TSE, years of teaching experience, education level, and subject area taught) and the dependent variable (TI), to gain a clearer understanding of why some teachers integrate technology into their instructional practices to a greater degree than other teachers. This research study was approached from the paradigm of positivism, given that the problem being studied by “breaking complex phenomena down into manageable pieces for study” (Fraenkel, Wallen, & Hyun, 2012, p. 428). Several possible factors contribute to insufficient classroom technology integration in K to 12 schools including poor school infrastructure, insufficient technology, insufficient technological tools, ineffective professional development, low TSE, negative teacher attitudes, and low TPACK (Harrell & Bynum, 2018). Of the factors mentioned, TPACK and TSE are prevalent in the current literature, and researchers have found these two factors to influence teachers’ technology integration practices (Chicioreanu & Ianos, 2019; Dursun, 2019; Harrell & Bynum, 2018; Savage & Brown, 2014).

Theoretical Framework

Social cognitive theory, together with motivational systems theory, provided a sound theoretical foundation for this study, by offering an excellent framework for understanding teachers’ instructional delivery choices that contribute to the problem of insufficient classroom technology integration. In social cognitive theory some degree of an individual’s knowledge acquisition is dependent upon the social context and is a function of social interactions and experiences (Bandura, 1989). Motivational systems theory was developed out of social cognitive theory and proposes that self-efficacy, emotions, and personal goals interact to determine motivation (Ford, 1992). These two theories support the importance of exploring TPACK and TSE, when trying to understand teachers' technology integration practices in the classroom.

Social cognitive theory involves exploring perceptions of self, attitudes, and environmental factors, and is modeled by what Bandura (1989) called "emergent interactive agency" (p. 1175). Social cognitive theory makes a number of assumptions about learning, human agency, and what motivates individuals to engage in behaviors. Regarding the motivation behind human behaviors, Bandura (1989) pointed out, "Persons are neither autonomous agents nor simply mechanical conveyers of animating environmental influences. Rather, they make causal contribution to their own motivation and action within a system of triadic reciprocal causation" (p. 1175). Bandura's system of triadic reciprocal causation involves interaction between cognitive, affective, other personal attributes, and one's environment (Bandura, 1989). Within the framework of social cognitive theory, internal factors believed to influence human behavior must be studied in relationship to related external factors to gain a clearer understanding of the behavior being observed.

Self-efficacy is a central concept within social cognitive theory and is essential to learning in Bandura's model (Bandura, 1977). According to Bandura and Schunk (1981) self-efficacy has to do with making judgments about one's ability to navigate situations containing vague, unpredictable, or highly stressful elements. An individual's own judgment of one's capacity to influence outcomes guides their decision-making and behaviors and leads to courses of action. Bandura's (1977) construct of self-efficacy is frequently used in research related to human motivation and goal attainment. It is important to point out that self-efficacy is a belief about what a person can do rather than self-concept or self-image which has to do with judgments about one's personal attributes (Bong & Skaalvik, 2003; Tschannen-Moran, Woolfolk-Hoy, & Hoy, 1998). Also, of importance is that there is no global measure of self-efficacy. Self-efficacy is a multidimensional and context-specific construct that may additionally be specific to the task at hand, skill specific, or domain unique (Bandura, 1977; Bandura, 1989; Bong & Skaalvik, 2003).

Bandura (1977) described four "sources of self-efficacy beliefs: enactive mastery experiences, vicarious experiences, verbal persuasion, and physiological reactions" (p. 195). Mastery experiences refers to performing a task successfully. Successful completion of a task or challenge enhances our sense of self-efficacy, whereas self-efficacy can be weakened when failing to satisfactorily complete a task or challenge. Vicarious experiences are those in which we observe peers' performance on given tasks. Verbal persuasion refers to verbal encouragement from others, and physiological responses refer to stress responses such as sweating and increase in heart rate. Mastery experiences have been found to be the strongest determinant of self-efficacy (Bong & Skaalvik, 2003; Pajares, 1992). Vicarious experiences have been shown to be most influential when individuals are unsure of their own capabilities or when they lack prior experience, similarly, verbal persuasion may also raise self-efficacy especially when the information comes from someone viewed as competent and reliable (Schunk, 1987).

In the field of education, TSE is one of the most widely researched aspects of teaching and has been studied in relationship to content specific pedagogy, use of instructional tools, teacher retention and a variety of other factors (Miller, Ramirez, & Murdock, 2017; Poulou, Reddy, & Dudek, 2019). TSE is a belief that one can change student learning outcomes (Poulou et al., 2019). In an early model, TSE is described as being made up of three dimensions: (a) self-efficacy for classroom management, referring to teachers' perceived ability to create and maintain an orderly classroom; (b) self-efficacy for instructional strategies, referring to the perceived ability to use a variety of instructional and assessment strategies; and (c) self-efficacy for student engagement, which is the perceived ability to build relationships with students that will motivate them and encourage their engagement in learning (Tschannen-Moran & Woolfolk-Hoy, 2001). These three domains are regarded as independent reflecting distinct aspects of TSE.

Woolfolk-Hoy and Burke-Spero (2005) suggested that there are two dimensions of TSE that have reliably been identified as independent measures: personal teaching efficacy and general teaching efficacy, sometimes referred to as "outcome efficacy." Woolfolk-Hoy and Burke-Spero defined *personal teaching efficacy* as self-efficacy to perform certain behaviors to bring about given outcomes, such as positively affecting student performance. *Outcome* or *general teaching efficacy* was defined as a teacher's belief that school systems can meet the needs of all students, regardless of external factors such as socioeconomic status and home environment. Researchers have found that a teacher might have a high sense of personal efficacy (possessing high self-efficacy for producing positive teaching outcomes) but may also have lower general (outcome) efficacy if it is believed that student learning is a result of home life and other factors outside of teachers' control (Swackhamer, Koellner, Basile, & Kimbrough, 2009).

Motivational systems theory, which was developed out of social cognitive theory, is an additional theoretical framework that supports the investigation of the factors of interest in this study. Ford (1992) described motivation as made up of various personal agency beliefs which are perceptions about desired outcomes that an individual would like to achieve, and he places personal agency beliefs into two categories: capability beliefs and context beliefs. Pajares (1992) described the notion of beliefs as a complicated construct in his widely cited article on the topic, stating that a belief as a construct has a variety of definitions and is quite difficult to precisely define. Pajares (1992) pointed out that a study into beliefs must include examining multiple and sometimes conflicting points of view, which is what motivational systems theory sets out to do. Capability beliefs and context beliefs are related to self-efficacy in that both types of beliefs parallel a domain of self-efficacy. Capability beliefs are one's beliefs about one's internal abilities to influence outcomes, and context beliefs are one's beliefs about external factors or people who may affect their progress toward a goal.

Personal agency beliefs (capability and context) play an important role in situations that involve challenging but reachable goals (Ford, 1992). Personal agency beliefs can either assist or hinder individuals in their pursuit of goals in that capability and context beliefs blend to form ways of believing that determine the degree of motivation a person has toward attaining a desired goal. Supporting the idea that motivation is central to the process of learning, Schunk (1996) described how learning goals (i.e., attaining specific knowledge, skills, or behaviors) influence motivation. When individuals attain knowledge and skills, this promotes self-efficacy, which increases motivation to engage in tasks that individuals are to complete (Dweck, 1991).

Content knowledge is a key component of motivation and the development of TSE (Dweck, 1991; Schunk, 1996). Shulman (1986) introduced the construct pedagogical content knowledge. Shulman described that content knowledge and pedagogical knowledge had traditionally been intertwined into one construct by educational researcher in the past. However, Shulman pointed out that content knowledge and pedagogical knowledge are unique sets of knowledge that a teacher possess and draws upon in the practice of teaching, whereas pedagogical content knowledge has to do with a knowledge based that is created in the space where content and pedagogy overlap. For example, pedagogical content knowledge consists of knowing what makes the learning of content specific knowledge easy or difficult for students to learn.

Shulman (1986) proposed that content knowledge falls into three categories: subject matter, pedagogical, and curricular. Shulman described subject matter content knowledge as, “the amount and organization of knowledge per se in the mind of the teacher” (p. 9). Pedagogical content knowledge referred to “knowledge which goes beyond knowledge of subject matter per se to the dimension of subject matter knowledge for teaching” (Shulman, 1986, p. 9). The third category of content knowledge was described as knowledge of “the full range of programs designed for the teaching of particular subjects and topics at a given level” (Shulman, 1986, p. 10). Shulman’s research in the area of pedagogical content knowledge was the foundation for the development of the TPACK framework by Mishra and Koehler (2006).

Shulman (1998) pointed out the centrality of learning from experience in the development of content knowledge. Shulman stated, “While an academic knowledge base may be necessary for professional work, it is far from sufficient” (p. 519). Shulman went on to discuss the importance of developing ways to learn from experience for professionals in any field. Shulman suggested that the task of finding ways for professionals to learn from their on-the-job experiences, is best undertaken in professional learning communities rather than in isolation.

Self-efficacy beliefs as defined in social cognitive theory, and content knowledge, which plays an important role in motivation and the development of TSE, are well-defined constructs that likely have an influence on teachers’ levels of technology integration. Motivational systems theory from which the factors capability beliefs and context beliefs were defined can help to offer a sharper understanding of how TPACK and self-efficacy beliefs might influence technology integration. The discussion of context beliefs and capability beliefs offered by motivational systems theory also provide great insight into how to choose assessment instruments that best capture the constructs TSE and TPACK.

Operational Definitions

Content knowledge: The acquisition and comprehension of realities, facts, or standards related to academic content areas that are instructed at various levels of the education system or a professional field of study such as school counseling, special education, educational assessment, reading, or educational leadership (Council for the Accreditation of Educator Preparation, 2019).

Pedagogical content knowledge: A center piece of content knowledge for instruction that incorporates: core exercises of educating, such as, making sense of what students know; picking and guiding portrayals of thoughts; evaluating, choosing and adjusting textbooks; settling on alternative strategies and examining the topic area knowledge and understanding involved in these activities (Council for the Accreditation of Educator Preparation, 2019).

Pedagogical knowledge: Educator knowledge about an assortment of instructional practices, procedures, and techniques to advance students' learning (Council for the Accreditation of Educator Preparation, 2019).

Teacher's self-efficacy: A teacher's belief that he or she can produce changes in student learning outcomes (Poulou et al., 2019).

Technological content knowledge: The use of technology to keep up with advancements in an academic discipline (Kabakci-Yurdakul, 2018).

Technology integration: The effective use of technology in the general content areas to enhance student learning by enabling students to use computer and technology skills for the purpose of learning and problem-solving (Kimmons, 2016).

Technological knowledge: An educator's capacity to utilize an assortment of hardware, software, equipment, and frameworks, for example, personal computers, mobile devices, interactive whiteboards, educational software, and social media sites (Kabakci-Yurdakul, 2018).

Technological pedagogical content knowledge: Knowledge of how to develop appropriate and context-specific teaching strategies to teach within an academic discipline by integrating technology in the teaching and learning process through understanding the relationship between technology, pedagogy, and content (Guerra, Moreira, & Vieira, 2017).

Technological pedagogical knowledge: Using technology in instructional methods, such as using a software application for the administration and delivery of educational courses, or differentiating instruction using technology (Kabakci-Yurdakul, 2018).

Assumptions, Limitations, Scope, and Delimitations

This study was correlational in nature and involved collecting data from high school teachers in a large urban school district in Georgia. I investigated the construct TSE using the TSES instrument, and the dimensions of TPACK using the TPACK questionnaire. I measured the constructs TSE and TPACK in relationship to teachers' levels of technology integration, using the CBAM-LoU survey. Both the TSES instrument and the TPACK questionnaire are Likert scale surveys, and the CBAM-LoU is a short self-report measure used to assess the level of technology utilization along a continuum of eight levels. Given that domain of this study was high school teachers in an urban Georgia school district, I made several assumptions when conducting the research, and although the basis for this study is supported by the theoretical foundations and a review of similar research studies, there are weaknesses of this study.

Assumptions

The problem of insufficient technology integration in high school classrooms in the urban Georgia school district in this study is believed to exist based upon anecdotal evidence from teachers in the district and the existing need for a one-to-one technology initiative in the district. The review of the literature underscored the notion that there is an overall underutilization of technology for instructional purposes in school settings around the world. There was also an assumption that all teachers participating in the study have adequate access to instructional technology in their classrooms, and that teachers in all high school content areas have a need to instruct students using technology. Last, I assumed that participants gave honest answers on the instruments used for the study as should be expected when conducting survey research (Simon & Goes, 2013).

Limitations

Teacher self-assessments of technology competency may not be an effective measure of meaningful technology integration, for example, because this study relied on self-reports of teachers, the responses may not accurately reflect the true nature of their TPACK, self-efficacy beliefs or technology integration practices (Kimmons, Miller, Amador, Desjardins, & Hall, 2015). Also, because participation was voluntary, and a weblink for the survey was provided to teachers via email, those completing surveys may tend to have more favorable attitudes toward technology than those choosing not to complete the surveys. This situation would cause the sample of those surveyed to be biased, because teachers with positive attitudes toward technology may be likely to have higher TPACK and self-efficacy beliefs scores than the average teacher. Given that this study used a convenience sample of participants who voluntarily completed an online questionnaire, there is a risk that nonrandom responses were received, which creates a difficulty in generalizing the results from the sample to any population. Similarly, because data were only collected from high school teachers in one school district, and given the differences in populations in school districts across the state of Georgia, results cannot be generalized to teachers of all grade levels, nor to other school districts in Georgia or beyond.

Scope and Delimitations

The domain of this study consisted of high school classrooms in an urban Georgia school district, and addressed the problem of insufficient technology integration by examining the relationship between high school teachers' TPACK levels, TSE beliefs, years of teaching experience, education level, subject area taught (independent variables) and teachers' TI levels (dependent variable). This study was framed from the theoretical perspective of social learning theory and motivational systems theory. This course of study was chosen because of the practicality of building on similar research studies, that examined the similar factors and yielded meaningful results.

The specific delimitations that I imposed on this study were a sample consisting of high school teachers from six high schools in the local school district. The variables researched were limited to TPACK, TSE, and TI, along with teacher characteristics years of teaching experience, education level, and subject area taught. I collected data from participants through an online survey only. I imposed these delimitations for the purpose of making data collection logistically feasible and making the data analysis more manageable.

Significance of the Study

This study is significant in that the results may assist in providing an understanding of how TPACK and TSE beliefs affect high school teachers' TI levels, providing insight into addressing the local problem of insufficient technology integration in high school classrooms. The results of this study can be used to create positive social change by increasing the level of technology integration in an urban school district and providing opportunities for students to improve academic performance and gain greater technological literacy. Teachers could also be positively affected by this study because the results could support and encourage the need to create professional development opportunities that will lead to a better trained and more effective teaching staff.

From a leadership perspective, integrating technology in the classroom supports the goal of teacher leadership by transforming the role of the teacher to that of facilitator, shifting the focus of classroom instruction from teaching-centered to learning-centered (Sandholtz, Ringstaff, & O'Dwyer, 1997). The infusion of technology into the curriculum by using technology integration practices is a cutting-edge phenomenon with potential that has yet to be adequately explored by educators on a large scale (Pittman & Gaines, 2015). For these reasons, and several others, technology integration in the classroom is a topic requiring further study.

Summary

There is a need for K to 12 schools in the United States to keep pace with the rapid societal changes driven by technology, and the way in which we teach students must reflect this. The problem of insufficient technology integration practices among teachers can be addressed by coming to understand the reasons why teachers are reluctant to embrace educational technology. By looking at the factors TPACK and TSE beliefs, researchers indicate that we can gain a clearer understanding of the barriers to technology integration that teachers face. The construct TPACK can answer specific questions about the characteristics of teachers' knowledge that affect technology integration, and TSE beliefs as measured by the TSES can identify classroom, school, and student characteristics that challenge teachers in their attempt to integrate technology daily.

In Section 2 a review of the current literature supported the idea that TPACK and TSE are powerful lenses through which to investigate the problem of insufficient technology integration practices among teachers. Section 3 includes a discussion of the research methodology used for this study. The research methodology section provides information about the research design, method of testing, setting and sampling, instrumentation and materials, and data collection and analysis. Section 4 includes the results of the study and Section 5 includes a discussion, conclusions, and recommendations for future research.

Section 2: Literature Review

Introduction

The purpose of this section is to provide a comprehensive review of the literature surrounding barriers to technology integration in schools, teachers' self-efficacy beliefs, and teachers' TPACK. These three topics form the foundation of the conceptual framework for establishing the significance of this study by addressing the problem of insufficient technology integration practices in high schools. In the review of the literature, I examine previous research studies related to the local problem including those with similar and differing methodologies and findings. Many studies that are a part of this literature review draw from non-U.S. samples. The inclusion of these non-U.S. studies adds to the literature review in that these studies demonstrate the relevance of the factors being explored to the practice of teaching regardless of educational setting. The examination of these three topics (barriers to technology integration in schools, teachers' self-efficacy beliefs, and teachers' TPACK) will focus on the differences in the types of barriers to technology integration faced by teachers, how teachers' self-efficacy beliefs affect their instructional choices, and how teachers' TPACK levels affect their instructional choices.

The first area of the literature review is titled "Barriers to Technology Integration." Examining barriers to technology integration is a logical point from which to begin because without identifying and defining the different barriers to integrating technology into the curriculum in K to 12 schools, the variety of issues related to teachers' technology integration practices cannot be fully explained or understood. The second area titled “Teachers’ Self-Efficacy” presents literature that shows how teachers’ self-efficacy affects instructional choice in general. In the third area, “Technological Pedagogical Content Knowledge,” I examine the construct TPACK and how it might influence teachers’ technology integration practices. Within each of these areas, I will discuss the appropriateness of the use of surveys to assess the constructs described. I conclude Section 2 with a summary of the literature on TSE beliefs and TPACK, and the effect of these factors on teachers’ TI practices.

Literature Search Strategy

The search strategies that I used to review the literature included Internet and database searches using Walden University library databases. These databases included EBSCO ebooks, Education Source, ERIC, Google Books, Pro Quest Central, PsysARTICLES, PsycINFO, SAGE Journals, SAGE Research Methods Online, and SocINDEX with Full Text. I conducted database searches using the following subject terms: *assessment of teachers’ beliefs*, *barriers to technology integration, capability beliefs*, *content knowledge*, *context beliefs*, *instructional efficacy*, *instructional technology, motivational systems theory, pedagogical knowledge, self-efficacy, social cognitive theory, social learning theory, technology integration, technology mandates, teacher instructional beliefs, teacher self-efficacy, teacher technology use,* and *TPACK*. I cross-referenced each subject term with the subject terms *education* and *technology* when I needed to narrow the focus of the search. The results of the search identified three categories that were frequently cited in relationship to the local problem and the purpose of this study: barriers to technology integration, teachers’ self-efficacy, and TPACK. I consulted a total of 50 articles from EBSCO ebooks, Education Source, ERIC, Google Books, Pro Quest Central, PsysARTICLES, PsycINFO, SAGE Journals, SAGE Research Methods Online, and SocINDEX with Full Text database searches published between 2015 and 2020 for this literature review.

Mandates for Technology Integration

Education policy plays a key role in determining the way in which schools conduct teaching (Khodabandelou et al., 2016). The No Child Left Behind Act of 2001 made provisions for technology integration to be implemented in K to 12 schools to increase student achievement and close the achievement gap (No Child Left Behind, 2002). Since 2002, technology integration has been identified by government departments of education and professional organizations as essential for preparing students for 21st-century skills and careers (Harrell & Bynum, 2018; Peker & Erol, 2018). The National Council of Teachers of Mathematics (2015) identified technology as one of its six principles for school mathematics, and regarding the effective use of technology outlined that it is essential that access to technologies that support and advance the other principals, such as logical reasoning, mathematical understanding, communication, and problem solving are available to both teachers and students. The National Education Technology Plan outlines a variety of ways in which preservice teacher education programs need to be redesigned to meet the technology needs of students (U.S. Department of Education, 2017). The International Society for Technology in Education (ISTE) standards for educators point out that it is important for teachers to be proactive and innovative when educating students by implementing effective and promising practices that integrate technology in the curriculum to advance student learning (ITSE, 2019).

The Georgia Technology Plan for the advancement of technology in Georgia schools mirrors the National Education Technology Plan, the ISTE Standards, and the National Council of Teachers of Mathematics technology standards (Georgia Department of Education, 2018). The mission of the Georgia Technology Plan is to change classroom instruction through the effective use of technology and this plan is representative of what has happened across the nation at the state level (Georgia Department of Education, 2018). The most recent version of the Georgia Technology Plan (2018-2021) involves advancing technology integration to personalize the education system by providing teachers with access to their students' academic data, training on how to use the data effectively, access to high quality digital resources, and professional learning opportunities (Georgia Department of Education, 2018). When it comes to technology integration, whether teachers are unprepared or prepared, reluctant or willing, mandates handed down on the national, state and local levels have made it imperative that teachers embrace technology integrated instruction.

Effectiveness of Technology Integration

There have been more than 20 years of research demonstrating the effectiveness of technology integration in schools (Sauers & McLeod, 2018). The broad definition of *educational technology* refers to "computer-assisted instruction (CAI), simulations, games, or laboratory instruments, or technology software/hardware" (Delgado et al., 2015, p. 400). Technology integration in the sphere of education refers to "the meaningful implementation of technology in educational settings to achieve learning goals" (Kimmons, 2016, "Technology Integration," para. 1). There are a myriad of types of technology used in classrooms including but not limited to calculators, laptop computers, interactive white boards, educational software, smartphones, smart response systems, social media, virtual reality devices, and audio-visual technology. Computer technologies are the most popular, widespread, and effective technologies used today, and represent a significant potential in terms of providing solutions for problems related to education (Anil, Batdi, & Küçüközer, 2018; Kan & Yel, 2019). Educators have seen technologies evolve with time, come, and go; however, the effectiveness of CAI has been demonstrated in a wide variety of research studies (Chekour, 2017; Delgado, et al., 2015; Shannon, Styers, Wilkerson, & Peery, 2015; Snyder & Huber, 2019). As access to less expensive technology has improved, more teachers are delivering instruction in various content areas using CAI (Snyder & Huber, 2019).

Ghavifekr and Rosdy (2015) examined the effectiveness of technology-based instruction and found it to be more effective than traditional instruction due to its ability to produce a learning environment that is more active, effective, and interesting for both teachers and students. Young (2016) conducted a meta-analysis of 13 studies that examined the effect sizes of calculator use on mathematics achievement and found that effect sizes for calculator use tend to range in the moderate level of effectiveness ($.20 < d < .50$), indicating that calculator use has a moderate effect on mathematics achievement. In a study of the use of technology in computer networking subjects, Huang (2019) demonstrated how virtualization technology can help address struggles that teachers face in teaching and assessing students' performance. Kim, Belland, and Walker (2018), in a meta-analysis of the effectiveness of computer-based scaffolding in engineering, technology, science, and mathematics education, suggested that computer-based scaffolding is an important component in improving the higher-order thinking skills of students in problem-based learning.

Havard, Nguyen, and Otto (2018) examined the relationship between the use of computers in fourth grade mathematics and scores on the U.S. Department of Education National Assessment of Educational Progress (NAEP). Their findings showed that when students practiced or reviewed mathematical topics using computers, they achieved higher scores on the NAEP when computers were used once or twice a month as opposed to rarely or not at all. These findings indicated that even moderate classroom computer use can contribute to gains in student achievement.

CAI has also been shown to be effective with students with special learning needs. Results of a meta-analysis that included 22 studies from 2009 to 2017 indicated that CAI can be an effective tool in teaching students with intellectual disabilities (Snyder & Huber, 2019). A study of the effectiveness of a tablet computer application with visually impaired students showed that students answered more mathematics problems accurately and teachers reported that students demonstrated greater motivation when using the iPad application than with their traditional literacy medium (Beal & Rosenblum, 2018). Ok and Ratliffe (2018) conducted a meta-analysis examining the use of handheld electronic devices for teaching English language learner students that involved a comprehensive review of 11 studies published between 2005 and 2016. Their findings indicated that English language learner students improved learning, self-efficacy, and engagement when instructed using mobile devices.

Diverse populations of students have been the subject of research involving CAI, including students from preschool age to adults. In a study of the relationship between preschoolers' literacy and numeracy skills and CAI, results indicated that the use of educational software involving playful learning enhanced numeracy and literacy skills (Rogowsky, Terwilliger, Young, & Kribbs, 2018). An investigation of the effectiveness of digital-based concept mapping showed that instruction using digital-based concept mapping strategy produced higher student performance than instruction using the conventional method (Ahmed & Abdelraheem, 2016).

As a result of the effectiveness of CAI, many schools and school districts have adopted one-to-one technology programs that provide each student in a school or district with his or her own laptop, tablet computer, or other mobile-computing device. In a meta-analysis of 1,055 primary studies from 1987 to 2008 involving various types of computer use, researchers concluded that technology use had a somewhat positive effect on student achievement (Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011). In another meta-analysis exploring the relationship between one-to-one laptop computing programs and elementary and secondary student achievement, researchers looked at articles published between 2001 and 2015 and found that one-to-one laptop programs had a positive effect on students' overall mathematics and science achievement (Zheng, Warschauer, Lin, & Chang, 2016).

One of the latest and most controversial pieces of technology being used in classrooms today are smartphones (Rozgonjuk, Kattago, & Taht, 2018). Smartphone use in the classroom is viewed as controversial because using social media like texting, tweeting, and using snap chat during class are a significant disruption, resulting in a difficult education environment (Kadry & Ghazal, 2019). Regarding the debate over whether smartphones are a benefit to the classroom environment, or a distraction, Green (2019) found that this depends on the teacher. When students are motivated by a teacher who is effective in integrating technology, these students can effectively use their smartphones to learn more course topics, enhance class participation, to access course materials, and to take notes (Green, 2019). Smartphones have proved to be an effective substitute for clickers and other smart response systems and these interactive procedures increase student engagement and participation (Remón, Sebastián, Romero, & Arauzo, 2017). Smartphone applications have been shown to use simulation and experimentation to help students to solve engineering problems (Jain, Chakraborty, & Chakraverty, 2018). As with other types of technology, smartphones can be effectively used in classrooms if the teacher possesses expertise in technology integration (Rozgonjuk et al., 2018). Although teachers use technology daily for tasks such as attendance and grades, despite the demonstrated effectiveness of technology, teachers are not integrating technology into classroom instruction in ways that challenge students and enhance student learning (Pittman & Gaines, 2015).

Technology Integration and Preservice Teacher Education

In response to mandates at the national, state, and local levels and concerns about the lack of technology integration on the part of educational researchers, preservice teacher education programs have added courses aimed at preparing perspective teachers to teach in the information age with multiple technological literacies (Riegel & Tong, 2017; U.S. Department of Education, 2016). In recent years teacher education programs have been mandated by the U.S. Department of Education to improve job preparation for teacher candidates to teach with technology by redesigning technology course delivery in preservice teacher education programs (U.S. Department of Education, 2017). The 2017 National Education Technology Plan described the need to redesign preservice teacher education programs by moving from a single required technology course to integration of technology education throughout the curriculum and sets expectations for equitable online access and availability of technology at school and home regardless of students' socioeconomic background (U.S. Department of Education, 2017). With technology playing such a major role in educating students, researchers have concluded that inadequate technology preparation for educators could result in students lacking the ability to utilize technology for problem-solving and collaboration (Riegel & Tong, 2017).

To ensure that K to 12 students are adequately prepared to live in a technology dependent society, researchers have suggested that it is important for preservice teacher preparation programs to better prepare preservice teachers to use technology in the classroom (Coyne, Lane, Nickson, Hollas, & Potter, 2017). Despite the fact that preservice teachers are receiving training with educational technology, undergraduate, and graduate teacher education programs have not been found to prepare teachers to a “major extent” to use technology in their instruction as much as professional development activities, training, or independent learning (Riegel & Tong, 2017). An example of this disconnect between training and practice was found in a study in which preservice teachers reported that mobile technologies help students learn more easily but were not confident in teaching using mobile technologies (Tonbuloglu & Kiyici, 2018).

Types of technology integration in teacher education programs vary from having one traditional survey course to implementing technology training throughout a teacher education program (Kessler & Hubbard, 2017). Despite the presence of a range of approaches for technology integration, researchers have found that preservice teacher education programs inadequately prepare teachers to effectively integrate technology, which may contribute to the frustration that teachers feel surrounding the effective use of technology (Kuru Gönen, 2019).

Barriers to Technology Integration

Based on the review of related research and literature, technology is underutilized due to various barriers to technology integration (Hsu, 2016). Barriers to technology integration are typically categorized in the literature as either internal or external. External barriers are characterized as those that are beyond the influence of the teacher and reflect school-wide support for integrating technology (Vongkulluksn, Xie, & Bowman, 2018). Internal barriers are those that are intrinsic to teachers, such as knowledge and abilities related to operating specific tools and programs, assessing, and choosing technological resources, and teaching and facilitating learning activities using technology (Xie, Kim, Cheng, & Luthy, 2017). Although classroom teachers may be able to access many technological tools, there are many external factors (poor school infrastructure, ineffective or outdated technology, lack of technological devices, and ineffective professional development) and internal factors (low TSE, lack of knowledge, and negative teacher perceptions) that influence the appropriate use of instructional technology in classrooms (Harrell & Bynum, 2018).

Among these barriers to technology integration poor school infrastructure, ineffective or outdated technology, and lack of technological devices are the ones that have been the most politically charged because they are related to the digital divide and equity issues surrounding socio-economic status and ethnicity (Thieman & Cevallos, 2017). In recent years, the issue of material access has diminished, however, as Harrell and Bynum (2018) pointed out, infrastructure is often disregarded when settling on the choice to buy technological devices and how they will be used in the classroom. Even when schools and school districts are well equipped with technological resources, material access alone does not solve the problem of equity or lack of technology integration (Pittman & Gaines, 2015).

Teacher Self-Efficacy

TSE is frequently cited in the literature as a factor that is strongly correlated with instructional choice, and refers to a teacher's belief that he or she can produce change in student learning outcomes (Poulou et al., 2019). TSE has been identified to be one of the primary factors influencing professional behaviors such as diligence in the profession, work fulfillment, in addition to student engagement, and achievement (George, Richardson, & Watt, 2018). TSE has been conceptualized and assessed contrastingly by various researchers, and although TSE has been associated with teachers' ability to use an instructional tool or method, it has most commonly been referred to as teachers' beliefs about their capacity to produce positive student outcomes (Poulou et al., 2019; Zee, & Koomen, 2016). TSE beliefs have been identified as having an influence not only teachers' motivation and execution of instructional delivery, but in addition the accomplishments of their students (Curtis, 2017; Morris, Usher, & Chen, 2017; Shahzad & Naureen, 2017).

Researchers have categorized TSE within three teaching domains which include classroom management, instructional strategies, and student engagement (Perera, Calkins, & Part, 2019; Poulou et al., 2019). Self-efficacy for classroom management refers to teachers' perceived ability to create and maintain an orderly classroom environment, self-efficacy for instructional strategies refers to the perceived ability to strategically use various strategies in instructing and evaluation, and self-efficacy for student engagement has to do with the perceived ability to interact with students in a way that promotes their persistence toward gaining understanding in the classroom (Perera et al., 2019). When investigating the relationship between observed classroom strategies and self-efficacy in each of the three domains, Poulou et al. (2019) found a significant relationship between self-efficacy for instructional strategies and observed classroom strategies, but no significance was found when examining the other two domains. It is important to note that evidence that the three domains of self-efficacy may develop in phases has been found, with teachers initially creating efficacy in classroom management and in student engagement, and as efficacy progresses, in instructional techniques (Watson & Marschall, 2019).

TSE has also been shown to be a primary indicator of intentions and choice, and influences teachers' motivation to use new instructional strategies (Peker & Erol, 2018). TSE has been shown to be an important factor for encouraging student learning in classroom instruction and learning situations (Choi, Kim, & Lee, 2019), and has been shown to be a somewhat stable and long-term indicator of instructional quality (Künsting, Neuber, & Lipowsky, 2016). TSE has been identified as a factor that has a significant effect on teachers' use of differentiated instructional practices (Suprayogi, Valcke, & Godwin, 2017), and has also been used as a predictor of the utilization of specific instructional methods and practices. For example, Kaygisiz, Anagun, and Karahan (2018) found the TSE of English teachers to be a noteworthy indicator of the language educating techniques.

Higher self-efficacy is correlated with positive teacher behaviors and outcomes, for example, researchers have found that high self-efficacy in teachers compels them to contribute to improving their teaching practices compared to those with low self-efficacy (Birisci & Kul, 2019). Similarly, teachers with low self-efficacy may avoid using instructional strategies that they find to be a challenge to their ability levels (Peker & Erol, 2018). Based on these findings it would be expected that teachers with low self-efficacy may resist differentiating instruction, using strategies that address multiple intelligences, or integrating technology into instructional practices. Conversely, researchers have shown that teachers with higher self-efficacy have a higher probability of using more involved instructional techniques, a larger variety of instructional strategies, and persist with struggling students (Berkant & Baysal, 2018; Birisci & Kul, 2019).

Research by Gkolia, Dimitrios, and Koustelios (2016) showed that individual characteristics, for example, educators' gender, years of experience, education level, and age affected their self-efficacy factors in all three TSE domains. In this study, a higher degree of TSE was found among males, older teachers, and more experienced teachers. In a longitudinal study of early career teachers, it was found that teachers experienced a positive change in self-efficacy during their first 5 years of teaching in all three self-efficacy domains, suggesting that TSE is more malleable during these years (George et al., 2018).

The benefits of possessing high levels of TSE have been shown throughout the literature, leading many researchers to explore ways to increase levels of self-efficacy in preservice teachers (Giles & Kent, 2016; Kiili, Kauppinen, Coiro, & Utriainen, 2016; Kimmons et al., 2015). Researchers have proposed that TSE is increased primarily due to mastery experiences and successful performance, and have identified mastery experiences as the strongest source of TSE (Choi et al., 2019; Dassa & Nichols, 2019; Kimmons et al., 2015). Also, regarding mastery experiences, Kimmons et al. (2015) suggested that effective teacher education preparation coursework requires the development of TSE through performance and reflection. In a study related to mobile technology use, researchers showed that allowing teachers time to develop mastery, and having access to expertise, were key components in building self-efficacy for educators as they progressed (Tilton & Hartnett, 2016). In a study of English language teachers, Cankaya (2018) found that although self-efficacy beliefs of participants were similar based on their teaching level and academic degree level, professional development of participants might contribute to building high self-efficacy levels.

Althauser (2018) discovered that there was a marked improvement in preservice elementary educators' self-efficacy for teaching mathematics following the completion of an elementary methods course, in that preservice teachers reported that they were better able to understand how to utilize activities that were interactive and more engaging. Preservice teachers also reported that as a result of taking the methods course, their confidence for mathematics instruction increased (Althauser, 2018). In a similar study of preservice teachers' self-efficacy, McKim and Velez (2017) found significant positive results when looking at preservice coursework as a predictor of math teaching self-efficacy. Likewise, they found that professional development was a significant, positive predictor of science teaching self-efficacy. Yoo (2016) also showed that professional development education has a positive effect on teacher efficacy.

Teacher Self-Efficacy and Technology Integration

TSE is a variable that can influence many teacher behaviors and practices in the classroom. In one of the earliest studies of teachers' beliefs and the use of technology, Albion (1999) wrote, "Teachers' beliefs are a significant factor in their success at integrating technology and self-efficacy beliefs are an important, and measurable, component of the beliefs that influence technology integration" (p. 1). TSE beliefs have been frequently cited by researchers as an internal barrier to technology integration, because it has been shown to critically affect teachers' technology integration practices (Birisci & Kul, 2019; Hsu, 2016). TSE beliefs, as they relate to technology integration, are cited in the literature as having an influence on instructional choice (Lemon & Garvis, 2016). TSE beliefs are more than likely developed when teachers were K to 12 students, during preservice teacher training, or as practicing teachers (Dursun, 2019). Morrison (2019) conducted a study of TSE and one-to-one technology use among American high school teachers, and found that teachers are more likely to utilize technology in the classroom if they have a higher level of TSE.

Studies have shown that developing positive attitudes toward technology in preservice teachers, by requiring educational technology courses, can be valuable because technology course completion is positively correlated with actual technology use in the classroom (Dursun, 2019; Lemon & Garvis, 2016). In a study of preservice teachers' technology integration practices, TSE was shown to positively influence teachers' intention to use technology (Joo, Park, & Lim, 2018). TSE beliefs have also been found to play an important role in transforming teachers' use of technology from merely that of an instructional tool, into a systematic approach to teaching and learning representing constructivist practices (Birisci & Kul, 2019; Han, Shin, & Ko, 2017; Vu, 2015).

TSE has been shown to play an important role in the formation of teachers' technology integration practices. TSE has been shown to be a variable associated with instructional choice, with low levels of TSE acting as a barrier to technology integration in instruction. In preservice teacher education programs, technology courses have been found to increase TSE, and technology-based professional development has been shown to increase TSE among in-service teachers. Based on the literature, gaining a better understanding of the relationship between TSE and TI could provide valuable insight into improving teachers' technology integration practices in the classroom.

Technological Pedagogical Content Knowledge (TPACK)

When examining factors that affect teachers' instructional practices, researchers have found that both affective and cognitive constructs should be considered when trying to gain an understanding of teachers' motivation to utilize technology for instructional purposes (Joo et al., 2018). While TSE is a construct that addresses the affective nature of teachers' decisions to engage in technology integration practices, TPACK addresses the cognitive nature of teachers' decisions to engage in technology integration practices. Since its introduction by Mishra and Koehler (2006), TPACK has been shown to be positively correlated with TSE, teachers' attitudes toward technology integration, and preservice teachers' pedagogical development, among other factors, such as technological literacy skills, and online reading comprehension techniques (Altun, 2019; Lefebvre, Samson, Gareau, & Brouillette, 2016; López-Vargas, Duarte-Suárez, & Ibáñez-Ibáñez, 2017).

Mishra and Koehler (2006) described what they called the TPACK framework (see Figure 1), consisting of seven categories beginning with the three knowledge domains of TK, PK, and CK. These three domains produce three intersections: PCK, TPK, and TCK. The area where all three domains intersect lies in the center and represents TPACK. The TPACK framework was developed out of a need to better understand the intersections of TK, PK, and CK.

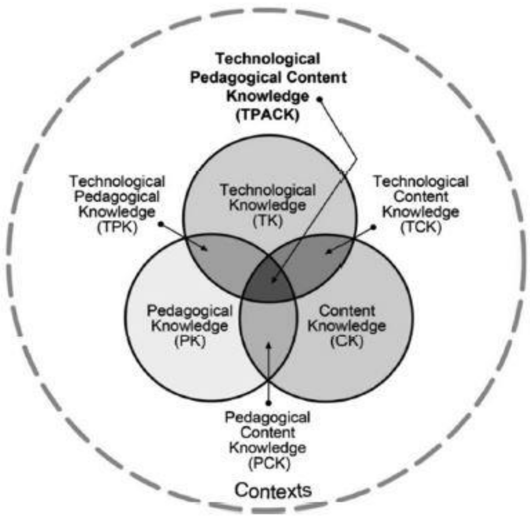

Figure 1.TPACK framework.

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Mishra and Koehler (2006) proposed that researchers were treating PK and CK as unrelated domains prior to the introduction of their framework. Mishra and Koehler realized that for teachers to be successful, they would have to address both domains (content and pedagogy) simultaneously. Likewise, they proposed that when considering teaching with technology, effective technology integration should be represented by the intersection of TK and technological pedagogy. Mishra and Koehler based their research on the work of Shulman (1989), whose seminal work in understanding PCK began the study of exploring the intersection of various types of content knowledge. Since the introduction of this framework, a number of research studies have been conducted using TPACK as a factor that influences TSE and teachers' TI practices.

TPACK and Teacher Self-Efficacy

Quantitative, qualitative, and mixed methods studies conducted to investigate the relationship between TPACK and TSE have had varied findings depending upon which of the seven domains of TPACK are being measured. TPACK studies conducted in a variety of countries have yielded similar findings (see Alqurashi, Gokbel, & Carbonara, 2017; Fathi & Yousefifard, 2019). Alqurashi et al. (2017) found no significant differences when comparing teachers in the United States and Saudi Arabia on their TPACK, when related to technology use. Fathi and Yousefifard (2019) surveyed 148 Iranian students in a quantitative study of technology integration into an English as a foreign language classroom. Fathi and Yousefifard found that most students perceived that their teachers excelled in four components of TPACK: TK, PK, CK, and PCK, but were perceived to be less proficient in TCK, TPK, and TPACK. This study by Fathi and Yousefifard demonstrated the independent nature of each of the seven TPACK domains, by showing how teachers were perceived as proficient in the area of TK, but less proficient when it comes to technological content and technological pedagogy.

A quantitative study of 243 primary, middle, and secondary school teachers showed that most teachers confidence level of knowledge, based upon the TPACK framework, was average, with a significant difference shown in TCK when considering teaching experience (Bingimlas, 2018). López-Vargas et al. (2017) conducted a quantitative study consisting of 208 public school teachers, and found that computer self-efficacy had a significant positive association with each one of the seven TPACK domains. Kola and Sunday (2015) reviewed research on the relationship between TPACK and TSE and found that there was a strong correlation between PCK and TSE. Kola and Sunday concluded that if teachers do not believe that they have an adequate level of PCK, their self-efficacy is likely to be lower, and conversely, those who have higher PCK will have higher self-efficacy.

A case study involving five preservice English teachers, reflected that a lack of training in English PCK was strongly associated with low levels of self-efficacy in English teaching (Filatov & Pill, 2015). In a mixed-methods study of math and science preservice teachers, Thomson, DiFrancesca, Carrier, and Lee (2017) concluded that PCK and TSE are related, and are both predictors of teacher effectiveness when teaching students in their content areas. Similarly, Joo et al. (2018) conducted a quantitative study consisting of 296 Korean students, and found that among preservice teachers, high levels of TPACK are associated with increased TSE. In a quantitative study consisting of 180 teachers, Cai, Wen, Cai, and LV (2019) concluded that civil engineering teachers should strengthen their self-efficacy awareness, and TPACK related knowledge, in order to improve instructional practices.

The aforementioned studies that included TPACK and TSE as variables, have shown that TPACK and TSE are positively associated with each other, where higher levels of each TPACK component are related to higher levels of TSE, and visa-versa. Given the positive relationship between TPACK and TSE, it would be beneficial to include both variables as predictors of teachers’ technology integration practices.

TPACK and Technology Integration

Researchers conducting quantitative, qualitative and mixed-methods studies have found significant relationships between teachers' TPACK and teachers' attitudes toward and use of technology. In a mixed methods study of American preservice secondary mathematics teachers' TPACK, Akapame, Burroughs, and Arnold (2019) found that teachers' attitudes about teaching with technology, and experiences with using technology, influence their technology integration practices. Nelson, Voithofer, and Cheng (2019) studied factors influencing teachers' technology integration practices, and found that TPACK and ISTE Standard alignment varied according to subject area. When studying teachers' TPACK competencies, Sezer (2015) found significant differences regarding TPACK domains depending upon subject area taught. In a quantitative study of the relationship between science teachers' attitudes toward technology and TPACK, Yulisman, Widodo, Riandi, and Nurina (2019) surveyed 88 science teachers in Indonesia and found a positive correlation between favorable teacher attitudes toward technology integration and TPACK.

Lefebvre et al. (2016) found that of the seven components of TPACK, TK and TPK were most strongly correlated with influencing teacher's use of interactive white boards. When looking at teachers' characteristics using a qualitative interpretive study design, Lefebvre et al. interviewed 30 elementary and high school teachers in Cambodia and did not find significant differences when considering gender, or years of teaching experience. However, high school teachers' use of interactive white boards was influenced by TCK to a significantly higher degree than that of elementary school teachers. In an ethnographic research study of the integration of iPad technology, Saudelli and Ciampa (2016) found that teachers' attitudes toward the integration of technology was related to their approach to pedagogy. Saudelli and Ciampa also found that compared to teachers' TK and CK, their PK and years of teaching had a stronger influence on their decisions to integrate mobile technology. When researching TPACK and teachers' beliefs about game-based learning, Hsu, Tsai, Chang, and Liang (2017) found that more experienced teachers possess lower levels of TK and TPACK.

TPACK, Teacher Self-Efficacy and Technology Integration

The relationship between the variables TPACK, TSE, and TI have been explored in many quantitative, qualitative, and mixed-methods research studies. In a quantitative analysis that looked at the effect of TPACK and self-efficacy on teachers' implementation of the ISTE Standards for teachers, Simsek and Sarsar (2019) found no significant differences in regard to technology integration of teachers based upon their level of experience or education level. However, there was a significant difference in regard to gender, with male teachers' demonstrating higher self-efficacy in TK than female teachers. In a similar study, when looking at the relationship between TPACK, TSE, and implementation of educational technology standards, Oskay (2017) found a significant positive relationship between TPACK and self-efficacy in technology integration. Oskay concluded that TSE in educational technology standards significantly influenced teachers' TPACK. In a quantitative study of Turkish preservice teachers' self-efficacy, TPACK, and technology integration, the results showed a significant difference in perception of TPACK according to the subject areas (Simsek & Yazar, 2019). This study also showed that teachers of foreign language subject areas had the highest TPACK scores, and mathematics and Turkish language teachers had the lowest TPACK scores.

Given that the factors TSE and teachers' attitudes toward technology have been shown to positively affect teachers' TPACK, researchers have suggested that courses for preservice teachers, and practicing teachers' professional development trainings, should be created focusing on these relationships. Yulisman et al. (2019) suggested that teachers' attitudes need to be a factor that is considered when attempting to improve teachers' TPACK. Kilic, Aydemir, and Kazanc (2019) found that in a study of preservice science teachers' TPACK and classroom practices, a TPACK-based blended learning environment positively influenced the development of preservice teachers' TPACK. Buss, Foulger, Wetzel, and Lindsey (2018) also showed that teacher candidates' TPACK scores improved from the beginning of their preservice teacher program to their student teaching experience, when learning was TPACK-based.

Birisci and Kul (2019) observed that an increase in TSE beliefs about technology integration was linked to an increase in TPACK. Lu (2018) had similar findings, observing that teachers who engage in the process of creating technology integrated lessons show an increase in TPACK. Lu's research showed that when teachers receive professional development training on using new technologies, the training does not focus on how to effectively implement TI in their teaching from a pedagogical standpoint. Lu goes on to point out that it is the creation of lessons and practice with technology that increases TPACK, not the professional development alone. When professional development is TPACK-based, teachers are more inclined to use technology with a pedagogical approach (Oda, Herman, & Hasan, 2020; Young, Hamilton, & Pratt, 2019).

Researchers have shown that when it comes to using classroom technology, traditionally preservice teachers tend to possess a relatively high level of preparedness, but have limited TPACK, which suggests that there is a need for teacher education courses to focus on increasing effective instruction in TPACK (Coyne et al., 2017). Requiring technology-focused teacher education courses still may not be enough to address the problem of ineffective technology integration in K to 12 classrooms, as Sibert, Laverick, and Machado (2020) found in a study on the effect of a preservice teacher technology course on American teachers' TPACK skills. Although Sibert et al. found that a preservice teacher technology course improved teachers' TPACK levels, they reported that barriers continue to exist that discourage teachers' integration of technology. Sibert et al. suggest that these barriers should be addressed during preservice teacher education.

Summary

In organizing the results of the literature review, it is useful to point out that the rapid growth in the development of new technologies over the past 20 years has had a significant effect on American K to 12 education. During this time, there have been mandates issued at the national and state level, to address the influence of technology on education. Preservice teacher education programs have incorporated teaching with technology courses into their curriculum in response to these mandates. Despite these efforts, barriers to TI exists which impede practicing teachers from utilizing technology in ways that enhance student learning. Two barriers to TI directly related to the local problem and the purpose of this study were prevalent in the literature: TSE beliefs and TPACK. Given that TSE beliefs have been shown to be positively correlated with TPACK levels, and that TPACK levels can be increased through teacher education and professional development, investigating the relationship between TSE, TPACK, and TI can be a key to improving TI and student achievement in the local school setting. I present and discuss my plan for pursuing such an investigation in the next section: Methodology.

Section 3: Research Methodology

Introduction

The purpose of this research study was to explore teachers' TSE beliefs, teachers' TPACK, and teachers' levels of TI in an urban school district in Georgia. In this study, I investigated the relationship between high school teachers' self-efficacy beliefs, TPACK, and technology integration practices. I chose a quantitative approach because this study involved comparing groups of individuals in respect to existing differences, by investigating the relationship between variables that have been clearly defined through existing research. A quantitative approach can produce statistical results that are powerful, in that they can make clear distinctions between groups and identify relationships that may exist between variables (Fraenkel et al., 2012). Section 3 of this study includes a description of the research design and approach, justification for using the design and approach, a description of the setting and sample, instrumentation and materials used for the study, a description of data analysis used, and a description of measure taken to protect the rights of study participants.

Research Design and Approach

In this study, I collected cross-sectional survey data from participants to measure TPACK, TSE, years of teaching experience, level of education, subject area taught, and their level of technology integration. I administered the TSES, the TPACK questionnaire, and the CBAM-LoU survey to a sample of 72 high school teachers in an urban school district in Georgia. A power analysis for linear regression yielded a minimum sample of 55 participants needed to achieve 80% power; therefore, I invited 579 teachers from six different high schools to participate in the study to help ensure that a minimum of 55 participants completed surveys. The variables that each instrument assessed are TSE, TPACK, and the TI level. I collected data from teachers at six high schools in the local school district. After approval from Walden University's and the local school district's Institutional Review Boards (IRB), I contacted the principals at each high school via email and received their permission to invite teachers at their schools to participate and complete the online survey in April of 2020.

I chose a survey design because of the relative simplicity of the design and the quick turnaround in data collection (Creswell, 2003). The survey was web-based, which is advantageous because of its convenience, rapid data collection, confidentiality, and security (Rea & Parker, 2014). In addition, I conducted this study using a correlational approach in that I assessed the relationships between pre-existing characteristics of the sample rather than perform a true experiment, in which participants would be assigned randomly to one or more treatment groups (Yang, 2010). According to Fraenkel et al. (2012), the strengths of a correlational research study using a cross-sectional survey design are that surveys are effective in describing the characteristics of a large population, and they are usually highly reliable because of the standardization of questions. Fraenkel et al. point out that standardized questions make measurement more precise, which ensures that comparable data can be gathered, analyzed, and interpreted. Also, there were no costs involved in administering an electronic survey, and participants were able to access the survey from remote locations in a variety of ways (e.g., personal computer, tablet, or smartphone) using the internet.

Setting and Sample

The unit of analysis for this study was individual secondary school teachers in a large urban school district in Georgia with more than 100,000 students and 6,500 teachers. The teachers in the sample included full-time high school teachers employed by the local school district. I used a convenience sample and tested the null hypotheses that there is no relationship between any of the independent variables (TPACK, TSE, years of teaching experience, education level, and subject area taught), and the dependent variable (level of technology integration). Using an a priori power analysis, I determined the desired sample size *n* by conducting a two-tailed test of a Pearson correlation coefficient with an alpha α = .05, a small effect size *d* = 0.15, and a population value of 529 high school teachers. With those specifications, a minimum of 55 participants were required to have 80% power, with a critical $t(50) = 2.0085$, and $\delta = 2.8722$. I present a post hoc power analysis in Section 4. To assist in assuring a sample size of at least 55 participants, I invited 579 teachers at six high schools in the local school district to participate in this study.

Instrumentation and Materials

The online survey was a combination of three short surveys (TPACK, TSES, and CBAM-LoU) and three teacher characteristics questions which gathered the participants' years of experience, education level, and subject area taught. Participants completed teacher characteristics questions and the TSES (see Appendix A), the TPACK questionnaire (see Appendix B), and the CBAM-LoU survey (see Appendix C) in an electronic format to assess TSE beliefs, TPACK levels, and TI levels. The sample for this study was a convenience sample made up of high school teachers who volunteered to complete the online survey. The authors of the TSES (see Appendix D), TPACK questionnaire (see Appendix E), and the CBAM-LoU survey (see Appendix F) granted permission to use each instrument.

Independent Variables

Teacher pedagogical and content knowledge. The TPACK questionnaire modified by Jang and Tsai (2012) was based on the TPACK questionnaire originally developed by Mishra and Koehler (2006). Jang and Tsai used their modified instrument to assess the TPACK of elementary school mathematics teachers in Taiwan using interactive whiteboards as the primary piece of technology. I modified the wording of these Likert-scale items to apply to any content area represented by the teachers taking the survey using phrases such as “I can clearly explain the content of the subject that I teach” rather than “I can clearly explain mathematical content.” I made this modification to account for wording issues due to translation from Taiwanese Mandarin to English, to reflect the use of all types of educational technology not just interactive whiteboards, and to reflect a survey of teachers in all content areas, not only mathematics.

The TPACK questionnaire is an instrument that surveys teachers in three knowledge areas: technology, pedagogy, and content knowledge. It is a self-reporting instrument with a Likert scale from 1 to 5, with 1 meaning totally disagree and 5 meaning totally agree. The TPACK questionnaire that I used for this study contained the original 35 items created by Jang and Tsai (2012) made up of seven categories each with five items. Jang and Tsai collected reliability data on the four subscales of their questionnaire:

content knowledge (CK) which possesses a Cronbach's α = .862, pedagogical content knowledge (PCK) with a Cronbach's α = .913, technological knowledge (TK) with a Cronbach's α = .892, and TPACK with a Cronbach's α = .972. Their questionnaire overall has a Cronbach's α of .960; therefore, the instrument's reliability is considered to be high. A Cronbach's α greater than 0.80 indicates very good reliability (Hardy & Bryman, 2004).

Self-efficacy. The TSES is a 12-item, Likert-scale, self-rating instrument with three subscales that measure TSE in student engagement, instructional practices, and classroom management. When completing the TSES participants respond to questions regarding their self-efficacy beliefs on a scale from 1 (nothing) or low self-efficacy to 9 (a great deal) or high self-efficacy, to determine what causes the greatest degree of difficulties for teachers in daily teaching activities (Tschannen-Moran & Woolfolk-Hoy, 2001). The TSES is an instrument considered to be reliable and valid with both the short and long form ranking from moderate to highly reliable, and regarding internal consistency reliability an overall Cronbach's α coefficient of .90 was reported, along with subscale alphas of .81 for student engagement, .86 for instructional practices, and .86 for classroom management (Tschannen-Moran & Woolfolk-Hoy, 2001). An internal consistency reliability coefficient of .90 represents a very high level of reliability, meaning that 90% of the total score is measured consistently and represents the participants' true score (Creswell, 2003).

Years of teaching experience, subject area taught, and level of education. When completing the online survey, participants indicated years of teaching experience by selecting one of the following six categories: 0 to 5 years, 6 to 10 years, 11 to 15 years, 16 to 20 years, 21 to 25 years, or 26 or more years. Participants indicated the subject area in which they teach by choosing one of the following nine categories: mathematics, natural science, English/language arts, history/social science, world languages, health/physical education, visual/performing arts, vocational education, or other subject. Participants chose the highest level of education that they have completed from the four choices: bachelor's degree, master's degree, educational specialist degree, or doctoral degree.

Dependent Variable: Teachers' levels of technology integration

The Concerns-Based Adoption Model - Levels of Use (CBAM-LoU) instrument is a short self-report measure used to assess the level of technology utilization (Hall et al., 1975). This instrument is used to describe several behaviors of user innovation through eight levels defined in the Levels of Use Chart (Hall et al., 1975). The user chooses the level that best matches his/her technology integration level. Normal completion time is less than 5 minutes. The levels are as follows: 0-non-use, 1-orientation, 2-preparation, 3-mechanical use, 4a-routine, 4b-refinement, 5-integration, and 6-renewal (Hall et al., 1975). This instrument is a time efficient measure of an educator's level of technology integration along a continuum of technology usage, but because the CBAM-LoU is a single item survey, internal consistency reliability measures cannot be calculated for data gathered through it (Institute for the Integration of Technology into Teaching and Learning, 2019).

Surveys are regarded as being weak in terms of validity and strong in terms of reliability because surveys attempt to capture people's feelings which are hard to grasp using dichotomous questions or Likert scales (Fraenkel et al., 2012). Even though this study includes Likert scale items, which add greater validity than dichotomous questions, these item responses are only approximate indicators of constructs being assessed by the survey questions (Fraenkel et al., 2012). As Fraenkel et al. (2012) pointed out, the question that needs to be asked and answered regarding validity is "Do the results of the assessment provide useful information about the topic or variable being measured?" (p. 148). The surveys used for this study (TPACK questionnaire, TSES, and CBAM-LoU) have all been used in a variety of studies over the past two decades and have provided meaningful and useful information for researchers.

Nonresponse is a possible source of bias in survey research because there is typically a difference between the desired sample pool of respondents and those that respond to the survey (Fox & Tracy, 1986). When there is such a difference between the desired sample and the participating sample the results may not be valid, for example, "a response rate of only 40 or 50% creates problems of bias since the results may reflect an inordinate percentage of a demographic portion of the sample" (Fox & Tracy, 1986, p.47). To address nonresponse a larger sample may be needed than indicated by the power analysis. Also, for this study, TSE beliefs and TPACK may not be the only factors that influence teachers' technology integration practices, so there is a degree of bias associated with the constructs selected to be studied.

Data Collection and Analysis

Data collected for this study was done via online survey. The local school district requires that once research studies are approved by the school district, researchers must request permission to collect data from the principals at each school site. To recruit participants for this study, I sent a participant invitation email containing the survey link (Appendix G), an informed consent form (Appendix H), and information about the study to teachers at six district high schools. Participants completed the survey online, and they were given a 2-week window to complete the survey. Selecting an electronic survey is a fast and low-cost option that provides the opportunity to collect and extract data as well as conduct further measurements based on participant answers to the original questions (Goree & Marszalek, 1995).

I analyzed data using the Statistical Package for the Social Sciences (SPSS). Through the five research questions for this study I sought to determine the following: (a) the relationship between teachers' TPACK levels and teachers' levels of technology integration, (b) the relationship between teachers' self-efficacy beliefs and teachers' levels of technology integration, (c) the relationship between teachers' years of experience and teachers' levels of technology integration, (d) the relationship between teachers' education level and teachers' levels of technology integration, and (e) the relationship between teachers' subject area taught and teachers' levels of technology integration. The null hypothesis is that there is no relationship between any of the independent variables (TPACK, TSE, years of teaching experience, education level, and subject area taught) and the dependent variable (TI).

TSE beliefs, as measured by the TSES instrument total score, are made up of 12 items on three subscales, with a classroom management subscale (from 4 to 36), a student engagement subscale (from 4 to 36), and an instructional practices subscale (from 4 to 36), which produces a total TSES score ranging from 12 to 108. Higher values represent higher TSE beliefs (Tschannen-Moran & Woolfolk-Hoy, 2001). The construct TPACK, as measured by the TPACK questionnaire, is made up of 35 items representing seven domains scored from 1 to 5. Each of the domains, TK, PK, and CK, PCK, TPK, TCK, and TPACK represents a separate score ranging from 5 to 25. Higher scores represent higher levels of each TPACK framework domain (Jang & Tsai, 2012). The CBAM-LoU is made up of 8 items, with each item representing a more complex level of technology integration as follows: 0-non-use, 1-orientation, 2-preparation, 3-mechanical use, 4a-routine, 4b-refinement, 5-integration, and 6-renewal which represents the highest level of technology integration (Hall et al., 1975).

I used multiple linear regression analysis to measure the relationship between independent variables (TPACK, TSE beliefs, years of teaching experience, and education level) and the dependent variable (TI level), given that the dependent variable is ordinal with eight levels and the independent variables are either scales or ordinal. Given that the independent variable is categorical, representing nine categories of subject areas taught, I used a one-way ANOVA to explore the differences between the independent variable (subject area taught) and the dependent variable (TI level).

Protection of Participants' Rights

The researcher's role in data collection and data analysis procedures are consistent with the Walden University IRB process, and the local school district's institutional review process. There was an informed consent process in place that gives potential participants information about the nature and purpose of the study, their role as participants, any potential risk or benefits to them, confidentiality and data integrity, and any potential conflicts of interest. I solicited participation at each high school site by sending an email explaining the nature of the study, making it clear that participants have a right to choose if they would like to participate or not. Those who chose to participate were directed to the URL with the survey. A consent form appeared when the user clicked on the URL. The users had to indicate their consent before they saw the survey. By submitting the completed survey, participants consented to allow their anonymous data to be used as a part of the study. Participants were guaranteed that the surveys were used in compliance with copyright holder's terms. I did not disclose or discuss confidential information with others, including friends or family, and all ethical standards surrounding the confidentiality of data were observed.

I, as the researcher, had no personal contact with the participants in the study. I am a high school mathematics teacher at one of the schools in the district being studied, and I have only a collegial relationship with fewer than 20 of the potential participants that work at the same location. I have no relationships with participants that affected data collection. Participants were able to complete surveys at a time convenient for them and their survey responses were submitted online at the completion of the survey. Given the number of survey items participants were able to complete the survey in approximately 15 minutes.

Because the internet and electronic mail has become such a large part of the way people communicate, there are ethical considerations that are unique to this mode of communication. Ethical issues that should be considered when using online surveys are sample representatives, improper data analysis, and confidentiality versus anonymity (Fox & Tracy, 1986). Regarding sample representativeness, researchers who decide to do studies have a moral commitment to utilize population samples that are comprehensive and include, for instance, race, gender, educational levels, and salary levels (Fox & Tracy, 1986). If a survey is administered online, participants would need to have access to a personal computer, smartphone, and have internet access. All teachers in the district have a laptop computer issued to them by the district, a desktop computer in their classroom, and access to a media center or computer lab. Also, the survey could be completed using a smartphone.

A consideration in data analysis is that even though electronic surveys tend to have higher response rates, researchers may not be able to identify who these respondents are, and this may put the external validity of the study into question (Goree & Marszalek, 1995). Electronic responses were anonymous, because there was no way to determine which teachers chose to take the survey or at which of the six high schools participants worked. No email addresses were collected, and no personal identifying information was collected. The survey only required that teachers provide their years of teaching experience, level of education, and subject area taught. According to Fraenkel et al.

(2012) researchers are ethically bound to guard the confidentiality of participants in their study and to assure participants that confidentiality will be maintained. Given the method of data collection, confidentiality was assured. I will keep the data collected for this study electronically on a flash drive to which only I have access. I will keep the data for 5 years, then the data will be destroyed.

Summary

The research design for this study was a correlational, cross-sectional survey design. The sample of 72 participants received an electronic survey to complete once during April of 2020. I measured the relationships between TSE beliefs, TPACK, years of teaching experience, level of education, and subject area taught (independent variables) and teachers' TI level (dependent variable). The methodology used for this study was consistent with the purpose of the study, which was to explore the relationship between the independent and dependent variables mentioned above, in order to address the problem of insufficient technology integration in high school classrooms in the local school district. The researchers who developed the TSES, TPACK questionnaire, and the CBAM-LoU instruments established the validity of each instrument. Methods used for this study were both appropriate and feasible, and did not pose any ethical concerns given that the surveys were anonymous.

In Section 4, I presented results of the research study, structured around the research questions and hypotheses addressed in the study. The discussion of the results included presentation, interpretation, and explanation of the data as these relate to the research questions and hypotheses. I synthesized and summarized the outcomes of the study using tables, charts, and narrative descriptions, including a discussion of possible alternative interpretations of the data. In Section 5, I include discussion, conclusions and recommendations for future research.

Section 4: Results

Introduction

The purpose of this correlational research study was to investigate the relationship between independent variables (TPACK, TSE, years of teaching experience, education level, and subject area taught) and the dependent variable (TI) among high school teachers in a large urban Georgia school district. In previous studies, TSE has been shown to be a factor that is strongly correlated with instructional choice and teachers' motivation to use new instructional strategies (Peker & Erol, 2018; Poulou et al., 2019). Likewise, TPACK components have been found to be strongly correlated with influencing various types of technology integration (Lefebvre et al., 2016; Saudelli & Ciampa, 2016). In this study I sought to further explore the variables TPACK and TSE as they relate to teachers' level of technology integration in the classroom. I used multiple linear regression analysis, simple linear regression analysis and one-way ANOVA to determine if the responses submitted on the combined TPACK, TSES, and CBAM-LoU survey had any statistically significant relationships between each of the five predictor variables and the outcome variable TI. Section 4 contains a description of the study setting, the data collection process, the data analysis process, the results of the study, and a summary of the findings. Section 4 concludes with a summary of the section and transitions to Section 5 which contains a discussion of the study, conclusions, and recommendations for future study.

Description of the Sample

This study took place in a large urban school district in Georgia involving six of its high schools. I invited high school teachers from each of the six high schools to participate in the study by email. The six high schools from which the participants came are located in the same geographic region of the local school district. Using a convenience sample, the 72 high school teachers that participated in the study were self-selected from a population of 579 high school teachers working at six high schools in the local school district. The participants were teachers who chose to complete the online survey in response to an email invitation that I sent out during the first week of April of 2020. I invited teachers from all academic disciplines to participate, and surveys were completed over a 3-week period. Participants' teaching experience ranged from less than 5 years to more than 25 years, all subgroups of subjects taught were represented, and their education levels ranged from bachelor's degree to doctorate. Regarding teaching experience (see Table 1), the largest subgroup of participants was novice teachers with 0 to 5 years of experience (25%) but most participants were veteran teachers with more than 10 years of experience (61.2%).

Table 1
Years of Teaching Experience Frequencies

Category	Frequency	Percentage	Valid percentage	Cumulative percentage
0 - 5 years	18	25.0	25.0	25.0
6 - 10 years	10	13.9	13.9	38.9
11 - 15 years	13	18.1	18.1	56.9
16 - 20 years	13	18.1	18.1	75.0
21 - 25 years	11	15.3	15.3	90.3
26 or more years	7	9.7	9.7	100.0
Total	72	100.0	100.0	

The largest subgroup of participants by education level was teachers with master’s degrees (50%) with 76.4% of participants having an education level beyond a bachelor’s degree (see Table 2). Given the frequencies within participant subgroups, this sample could be described as consisting of predominantly veteran teachers with advanced degrees.

Table 2
Teachers’ Education Level Frequencies

Category	Frequency	Percentage	Valid percentage	Cumulative percentage
Bachelor’s degree	17	23.6	23.6	23.6
Master's degree	36	50.0	50.0	73.6
Educational specialist degree/ABD	9	12.5	12.5	86.1
Doctoral degree	10	13.9	13.9	100.0
Total	72	100.0	100.0	

More than half of the participants represented three disciplines of the nine subject area groups represented in the study (see Table 3). Mathematics, English/language arts, and natural sciences had a combined frequency of 58.3%. Mathematics was the largest subgroup at 20.8%.

Table 3
Subject Area Taught Frequencies

Category	Frequency	Percentage	Valid percentage	Cumulative percentage
Mathematics	15	20.8	20.8	20.8
English/language arts	13	18.1	18.1	38.9
Natural science	14	19.4	19.4	58.3
History/social science	5	6.9	6.9	65.3
World languages	10	13.9	13.9	79.2
Health/physical education	1	1.4	1.4	80.6
Vocational/technical education	9	12.5	12.5	93.1
Visual/performing arts	4	5.6	5.6	98.6
Other subject	1	1.4	1.4	100.0
Total	72	100.0	100.0	

As shown in Table 4, level of technology use of participants as measured by the CBAM-LoU instrument indicated that 0% of participants were at level 0: nonuse or level 1: orientation, and 75% of participants ranked themselves at the three highest levels of technology use: level 4B: refinement, level 5: integration, and level 6: renewal.

Table 4
Technology Integration Level Frequencies

Category	Frequency	Percentage	Valid percentage	Cumulative percentage
Level 0: Nonuse	0	0.0	0.0	0.0
Level 1: Orientation	0	0.0	0.0	0.0
Level 2: Preparation	2	2.8	2.8	2.8
Level 3: Mechanical use	7	9.7	9.7	12.5
Level 4A: Routine use	9	12.5	12.5	25.0
Level 4B: Refinement	22	30.6	30.6	55.6
Level 5: Integration	23	31.9	31.9	87.5
Level 6: Renewal	9	12.5	12.5	100.0
Total	72	100.0		

These TI level percentages show that most participants regard themselves as beyond level 4A: routine use in which individuals feel comfortable using technology in education, and actively seek to improve teaching and learning using technology. Table 5 shows that the average TI level for the sample of participants was level 4B: refinement, which is the sixth level of use ($M = 6.17$) characterized by individuals varying the use of educational technology to enhance the learning outcomes for students within the classroom.

Table 5
Technology Integration Level Descriptive Statistics

Category	Min	Max	Mean	SD
Technology integration level (TI)	3	8	6.17	1.256

Data Collection

I sought permission from the local school district and the principals at each of six high schools in the district to invite teachers to participate and provide anonymous data using an online survey. High school teachers who participated completed a combined online version of the TPACK questionnaire, the TSES, and the CBAM-LoU survey to assess their levels of TPACK, TSE beliefs, and their TI levels. The authors of each of these instruments granted permission for use. The 52-question survey took less than 15 minutes for each participant to complete, and asked questions related to teachers' knowledge, teacher characteristics (years of teaching experience, subject area taught, and education level), self-efficacy beliefs, and technology integration practices. Data collection began April 1, 2020, when I sent the participant invitation email to a convenience sample of 579 classroom teachers at six high schools. I sent a second email soliciting participation, to the same 579 teachers the week of April 13, 2020. I tallied the final completed surveys on April 17, 2020. There were 72 surveys completed, representing a response rate of 12.4%, and there were no missing data among the 72 complete surveys. Although the response rate was low, participant characteristics were distributed across subject area taught, years of teaching experience, and education level. In addition, an a priori power analysis for linear regression yielded a minimum sample of 55 participants needed to achieve 80% power, and a post hoc power analysis showed that a sample size of 72 achieved 94% power (t (66) = 1.6682, and δ = 3.2863).

Data Analysis

I studied the relationship between five predictor variables (TPACK, TSE, years of teaching experience, education level, and subject area taught) and one outcome variable (TI level). I analyzed the degree to which any noted relationship was significant. The research questions and hypotheses for this study were as follows:

RQ1. What is the relationship between teachers' TPACK levels and teachers' level of technology integration?

$H_0$1: There is no relationship between teachers' TPACK levels and teachers' level of technology integration.

H_a1: There is a significant relationship between teachers' TPACK levels and teachers' level of technology integration.

RQ2. What is the relationship between teachers' self-efficacy beliefs and teachers' level of technology integration?

$H_0$2: There is no relationship between teachers' self-efficacy beliefs and teachers' level of technology integration.

H_a2: There is a significant relationship between teachers' self-efficacy beliefs and teachers' level of technology integration.

RQ3. What is the relationship between teachers' years of experience and teachers' level of technology integration?

$H_0$3: There is no relationship between teachers' years of experience and teachers' level of technology integration.

H_a3: There is a significant relationship between teachers’ years of experience and teachers’ level of technology integration.

RQ4. What is the relationship between teachers’ education level and teachers’ level of technology integration?

H_04: There is no relationship between teachers’ education level and teachers’ level of technology integration.

H_a4: There is a significant relationship between teachers’ education level and teachers’ level of technology integration.

RQ5. What is the relationship between the subject area taught by teachers’ and teachers’ level of technology integration?

H_05: There is no relationship between the subject area taught by teachers’ and teachers’ level of technology integration.

H_a5: There is a significant relationship between the subject area taught by teachers’ and teachers’ level of technology integration.

I analyzed data using SPSS. To test the null hypothesis for Research Question 1, in which I examined the relationship between teachers’ TPACK levels and teachers’ TI level, multiple linear regression analysis was conducted with the seven TPACK subscales as predictor variables and TI as the outcome variable. The construct TPACK, as measured by the TPACK questionnaire, is made up of 35 items representing seven domains scored on a Likert scale from 1 to 5. Each of the domains, TK, PK, and CK, PCK, TPK, TCK, and TPACK represents a separate score, ranging from 5 to 25. Higher scores represent higher levels of each TPACK framework domain. To test the null hypothesis for Research Question 2, in which I examined the relationship between TSE and TI, I conducted multiple linear regression analysis, with the three TSE subscales as predictor variables and TI as the outcome variable. For the overall TSE score, I conducted simple linear regression analysis, with the TSE Total score as the predictor variable and TI as the outcome variable. TSE beliefs, as measured by the TSES instrument total score, are made up of 12 items on the following three subscales (each with scores ranging from 4 to 36): the classroom management subscale, the student engagement subscale, and the instructional practices subscale. The three subscales produce a total TSES score ranging from 12 to 108, with higher scores representing stronger TSE beliefs.

I examined the null hypotheses for Research Questions 3 and 4 using simple linear regression analysis. I measured the relationship between teachers' years of experience and TI level by asking participants to indicate the number of years that they have been teaching. Participants chose one of the following six categories: 0 to 5 years, 6 to 10 years, 11 to 15 years, 16 to 20 years, 21 to 25 years, and 26 or more years. I coded categories in numerical order from 1 (0 to 5 years) through 6 (26 or more years). I measured the relationship between teachers' education level and TI level by asking participants to indicate the highest level of education that they have completed: bachelor's degree, master's degree, educational specialist degree, or doctoral degree. I coded the categories in numerical order from 1 (bachelor's degree) through 4 (doctoral degree). I examined the null hypothesis for Research Question 5 using one-way ANOVA, given that the predictor variable, subject area taught, is nominal. I measured the relationship between teachers' subject area taught and TI level, by asking participants to identify which of the following nine subject areas they teach: mathematics, natural science, English/language arts, history/social science, world languages, health/physical education, visual/performing arts, vocational/technical education, or other subject.

I used the CBAM-LoU instrument to measure the outcome variable for this study, TI, which is made up of 8 items (see Figure 2 for a detailed description of the 8 levels), with each item representing a category of a more complex level of technology integration as follows: 0-non-use, 1-orientation, 2-preparation, 3-mechanical use, 4a-routine, 4b-refinement, 5-integration, and 6-renewal. I coded the categories in numerical order from 1 (Level 0: Non-use) through 8 (Level 6: Renewal).

	Concerns- Based Adoption Model Levels of Use of an Innovation (CBAM-LoU) Please mark one category that best indicates your overall level of use of information technology.
○	Level 0: Non-use I have little or no knowledge of information technology in education, no involvement with it, and I am doing nothing toward becoming involved.
○	Level 1: Orientation I am seeking or acquiring information about information technology in education.
○	Level 2: Preparation I am preparing for the first use of information technology in education.
○	Level 3: Mechanical Use I focus most effort on the short-term, day-to-day use of information technology with little time for reflection. My effort is primarily directed toward mastering tasks required to use the information technology.
○	Level 4A: Routine I feel comfortable using information technology in education. However, I am putting forth little effort and thought to improve information technology in education or its consequences.
○	Level 4B: Refinement I vary the use of information technology in education to increase the expected benefits within the classroom. I am working on using information technology to maximize the effects with my students.
○	Level 5: Integration I am combining my own efforts with related activities of other teachers and colleagues to achieve impact in the classroom.
○	Level 6: Renewal I reevaluate the quality of use of information technology in education, seek major modifications of, or alternatives to, present innovation to achieve increased impact, examine new developments in the field, and explore new goals for myself and my school district.

Figure 2. CBAM-LoU instrument level descriptions.

Source: Institute for the Integration of Technology into Teaching and Learning (2019). The Concerns-Based Adoption Model - Levels of Use (CBAM-LoU v1.1). The University of North Texas, Denton, TX.

Results

Null Hypothesis 1

To approach Research Question 1, I conducted a multiple linear regression analysis to test the null hypothesis that stated there is no relationship between teachers' TPACK levels and teachers' TI levels. Descriptive statistics for the seven TPACK subscales showed scores ranging from a minimum of 10.00 to a maximum of 25.00 (see

Table 6). The prediction of TI from the seven TPACK subscales (TK, CK, PK, TPK, PCK, TCK, and TPACK) were evaluated yielding the following results. The multiple linear regression model was significant, showing that the predictor variables (the seven TPACK subscales) were a good predictor of the outcome variable (TI level). An R^2 value of 0.557 indicated that the seven TPACK subscale measures accounted for approximately 56% of the variance in teachers' TI level scores (see Table 7).

Table 6
TPACK Instrument Descriptive Statistics

Category	Min	Max	Mean	SD	N
Technological Knowledge (TK)	10.00	25.00	18.5833	3.95663	72
Content Knowledge (CK)	18.00	25.00	22.4583	1.90579	72
Pedagogical Knowledge (PK)	16.00	25.00	21.7361	2.18183	72
Technological Content Knowledge (TCK)	10.00	25.00	19.9306	3.10985	72
Pedagogical Content Knowledge (PCK)	15.00	25.00	21.0000	2.07602	72
Technological Pedagogical Knowledge (TPK)	10.00	25.00	19.9861	3.55438	72
Technological Pedagogical Content Knowledge (TPACK)	10.00	25.00	19.6944	2.96761	72

Table 7
TPACK Instrument Model Summary

					Change Statistics				
Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	*R* Square Change	*F* Change	df1	df2	Sig *F* Change
1	.746[a]	.557	.509	.880	.557	11.498	7	64	.000

a. Predictors: (Constant), Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Pedagogical Content Knowledge (TPACK)

As shown in Table 8, the linear combination of TPACK measures was significantly related to the TI measure, F (7, 64) = 11.498, p = 0.000. The results of the multiple linear regression analysis revealed a statistically significant association between TK, CK, and TPK (see Table 9). Controlling for CK and TPK, the regression coefficient B = 0.311, 95% C.I. (0.024,0.174), p = 0.011, associated with TK suggests that for every one unit increase in TK, the TI level increased by 0.311 units. The R^2 value of 0.361 associated with this regression model suggests that TK accounts for 36% of the variation in TI, which means that 64% of the variation in TI level cannot be explained by TK alone. The confidence interval associated with the regression analysis does not contain 0, which means the null hypothesis, there is no association between TK and TI, can be rejected. Similar results were found for CK and TPK.

Table 8
TPACK Instrument ANOVA

Model		Sum of Squares	df	Mean Square	*F*	Sig.
	Regression	62.389	7	8.913	11.498	.000b
1	Residual	49.611	64	.775		
	Total	112.000	71			

a. Dependent Variable: Technology Integration Level (TI)
b. Predictors: (Constant), Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Pedagogical Content Knowledge (TPACK)

Table 9
TPACK Instrument Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for *B*		Correlations		
Model		*B*	SE	Beta	T	Sig.	Lower Bound	Upper Bound	Zero Order	Partial	Part
1	(Constant)	-2.214	1.383		-1.601	.114	-4.976	.549			
	TK	.493	.188	.311	2.631	.011	.024	.174	.601	.312	.219
	CK	.966	.443	.293	2.181	.033	.016	.370	.279	.263	.181
	PK	-.397	.383	-.138	-1.038	.303	-.232	.073	.330	-.129	-.086
	TCK	-.338	.335	-.167	-1.010	.317	-.201	.066	.584	-.125	-.084
	PCK	.272	.336	.090	.808	.422	-.080	.189	.389	.100	.067
	TPK	1.081	.281	.612	3.849	.000	.104	.328	.665	.434	.320
	TPACK	-.046	.255	-.022	-.181	.857		-.111	.513	-.023	-.015

Technology Integration Level (TI), Technological Knowledge (TK), Content Knowledge (CK), Pedagogical Knowledge (PK), Technological Content Knowledge (TCK), Pedagogical Content Knowledge (PCK), Technological Pedagogical Knowledge (TPK), Technological Pedagogical Content Knowledge (TPACK)

a. Dependent Variable: Technology Integration Level (TI)

Controlling for TK and TPK, the regression coefficient *B* = 0.293, 95% C.I. (.016, .370), *p* = 0.033, associated with CK suggests that for every 1 unit increase in CK, the TI level increased by 0.293 units. The R^2 value of 0.078 associated with this regression model suggests that the CK accounts for 7.8% of the variation in TI, which means that 92.2% of the variation in income cannot be explained by CK alone. The confidence interval associated with the regression analysis does not contain 0, which means the null hypothesis, there is no association between number of CK and TI, can be rejected. Similar results were found for TPK.

Controlling for TK and CK, the regression coefficient *B* = 0.612, 95% C.I. (0.104, 0.328), *p* = 0.000, associated with TPK suggests that for every 1 unit increase in TPK, the TI level increased by 0.612 units. The R^2 value of 0.443 associated with this regression model suggests that the TPK accounts for 44.3% of the variation in TI, which means that 55.7% of the variation in income cannot be explained by TPK alone. The confidence interval associated with the regression analysis does not contain 0, which means the null hypothesis, there is no association between number of TPK and TI, can be rejected.

Null Hypothesis 2

To approach Research Question 2, I conducted a multiple linear regression analysis to test the null hypothesis that there is no relationship between TSE beliefs and TI levels. Descriptive statistics for the three TSE subscales showed scores ranging from a minimum of 6.00 to a maximum of 36.00 (see Table 10). The prediction of TI from the three TSE subscales; TSE for student engagement (SE), TSE for instructional strategies (IS), TSE for classroom management (CM), and the combined score (TSE-Total) were evaluated. The multiple linear regression model was significant, showing that the predictor variables (the three TSE subscales) were a good predictor of the outcome variable (TI level). As shown in Table 11, the R^2 value of 0.117 associated with this regression model suggests that the three TSE subscale measures accounted for 11.7% of the variation in TI, which means that 88.3% of the variation in TI cannot be explained by TSE.

Table 10

TSES Instrument Descriptive Statistics

Category	N	Min	Max	Mean	SD
Student Engagement (SE)	72	6.00	35.00	25.2361	5.25811
Instructional Strategies (IS)	72	12.00	36.00	29.0417	4.38126
Classroom Management (CM)	72	13.00	36.00	29.8750	4.30505
Teacher Self Efficacy (TSE-Total)	72	36.00	107.00	84.15	11.405

Table 11

TSES Subscales Model Summary

					Change Statistics				
Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	*R* Square Change	*F* Change	df1	df2	Sig *F* Change
1	.342a	.117	.078	1.206	.117	3.004	3	68	.036

a. Predictors : (Constant), Student Engagement (SE), Instructional Strategies (IS), Classroom Management (CM)

The linear combination of TSE subscale measures was significantly related to the TI measure, $F(3, 68) = 3.004$, $p = 0.036$. The results of the multiple linear regression analysis revealed a statistically significant association between IS score and the TI measure (see Table 12). The regression coefficient $B = 0.319$, 95% C.I. (0.014,0.168), $p = 0.021$, associated with IS suggests that for every 1 unit increase in IS, the TI level increased by 0.319 units (see Table 13). The confidence interval associated with the regression analysis does not contain 0, which means the null hypothesis, there is no association between number of IS and TI, can be rejected.

Table 12
TSES Subscales ANOVA

Model		Sum of Squares	Df	Mean Square	*F*	Sig.
	Regression	13.105	3	4.368	3.004	.036
1	Residual	98.895	68	1.454		
	Total	112.000	71			

a. Dependent Variable: Technology Integration Level (TI)
b. Predictors: (Constant), Student Engagement (SE), Instructional Strategies (IS), Classroom Management (CM)

Table 13
TSES Subscales Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for *B*		Correlations		
Model		*B*	Std. Error	Beta	*t*	Sig.	Lower Bound	Upper Bound	Zero Order	Partial	Part
1	(Constant)	3.046	1.153		2.643	.010	.746	5.347			
	Student Engagement (SE)	-.030	.139	-.032	-.219	.828	-.077	.062	.167	-.026	-.025
	Instructional Strategies (IS)	.365	.154	.319	2.369	.021	.014	.168	.337	.276	.270
	Classroom Management (CM)	.088	.165	.076	.535	.594	-.060	.105	.199	.065	.061

a. Dependent Variable: Technology Integration Level (TI)

To investigate the relationship between predictor variable TSE-Total and the outcome variable TI, I conducted a simple linear regression. As shown in Table 14, the model explained approximately 7.9% of the variability with an R^2 value of 0.079. The predictor variable TSE-Total was found to be statistically significant B = 0.281, 95% C.I. (0.006, 0.056), p = 0.017, indicating that for every 1 unit increase in TSE-Total score, the measure TI level increased by 0.281 units. Therefore, the null hypothesis is rejected, and the alternative hypothesis is retained.

Table 14
TSES Total Model Summary

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	Change Statistics *R* Square Change Statistics	*F* Change	df1	df2	Sig *F* Change
1	.281	.079	.066	1.214	.079	6.018	1	70	.017

a. Predictors : (Constant), TSE Total

Table 15
TSES Total ANOVA

Model		Sum of Squares	Df	Mean Square	*F*	Sig.
	Regression	8.867	1	8.867	6.018	.017
1	Residual	103.133	70	1.473		
	Total	112.000	71			

a. Dependent Variable: Technology Integration Level (TI)
b. Predictors: (Constant), TSE Total

Table 16
TSES Total Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for *B*		Correlations		
Model		*B*	Std. Error	Beta	*T*	Sig.	Lower Bound	Upper Bound	Zero Order	Partial	Part
1	(Constant)	3.559	1.072		3.319	.001	1.420	5.698			
	TSE total	.031	.013	.281	2.453	.017	.006	.056	.281	.281	.281

a. Dependent Variable: Technology Integration Level (TI)

Null Hypothesis 3

To approach Research Question 3, I conducted a simple linear regression analysis to test the null hypothesis that stated there is no relationship between teachers' years of experience and TI level. The prediction of the variable TI from the variable years of teaching experience was evaluated yielding the following results. The model explained approximately 3.2% of the variability with an *R*2 value of 0.032 (see Table 17). The relationship between the predictor variable and outcome variable was not found to be statistically significant (see Table 18), B = -0.178, 95% C.I. (-0.308, 0.042), *p* = 0.135, therefore the null hypothesis must be retained. The predictor variable, years of teaching experience was negatively correlated with outcome variable TI (see Table 19).

Table 17
Years of Teaching Experience Model Summary

					Change Statistics				
Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	*R* Square Change	*F* Change	df1	df2	Sig *F* Change
1	.178	.032	.018	1.245	.032	2.288	1	70	.135

a. Predictors: (Constant), Years of Teaching Experience

Table 18
Years of Teaching Experience ANOVA

Model		Sum of Squares	Df	Mean Square	*F*	Sig.
1	Regression	3.545	1	3.545	2.288	.135
	Residual	108.455	70	1.549		
	Total	112.000	71			

a. Dependent Variable: Technology Integration Level (TI)
b. Predictors: (Constant), Years of Teaching Experience

Table 19
Years of Teaching Experience Coefficients[a]

		Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for *B*		Correlations		
Model		*B*	Std. Error	Beta	*T*	Sig.	Lower Bound	Upper Bound	Zero Order	Partial	Part
1	(Constant)	6.584	.312		21.073	.000	5.961	7.207			
	Years of teaching experience	-.133	.088	-.178	-1.513	.135	-.308	.042	-.178	-.178	-.178

a. Dependent Variable: Technology Integration Level (TI)

Null Hypothesis 4

I conducted a simple linear regression analysis to approach Research Question 4, which tested the null hypothesis stating that there is no relationship between teachers’ education level and TI. The prediction of the variable TI from the variable teachers' education level was evaluated yielding the following results. The model explained approximately 3.6% of the variability with an R^2 value of 0.036 (see Table 20). The relationship between the predictor variable and outcome variable was not found to be statistically significant (see Table 21), *B* = -0.189, 95% C.I. (-0.560, 0.060), *p* = 0.112, therefore the null hypothesis must be retained. The predictor variable, years of teacher's education level was negatively correlated with outcome variable TI (see Table 22).

Table 20
Education Level Model Summary

Model	*R*	*R* Square	Adjusted *R* Square	Std. Error of the Estimate	Change Statistics: *R* Square Change Statistics	*F* Change	df1	df2	Sig *F* Change
1	.189	.036	.022	1.242	.036	2.593	1	70	.112

a. Predictors: (Constant), Education Level

Table 21
Education Level ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	4.000	1	4.000	2.593	.112
	Residual	108.000	70	1.543		
	Total	112.000	71			

a. Dependent Variable: Technology Integration Level (TI)
b. Predictors: (Constant), Education Level

Table 22
Education Level Coefficients[a]

Model		Unstandardized Coefficients *B*	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	*T*	Sig.	95.0% Confidence Interval for *B* Lower Bound	95.0% Confidence Interval for *B* Upper Bound	Correlations Zero Order	Correlations Partial	Correlations Part
1	(Constant)	6.708	.367		18.285	.000	5.977	7.440			
	Education level	-.250	.155	-.189	-1.610	.112	-.560	.060	-.189	-.189	-.189

a. Dependent Variable: Technology Integration Level (TI)

Null Hypothesis 5

I conducted a one-way ANOVA to approach Research Question 5, which tested the null hypothesis stating that there is no relationship between the subject area taught by teachers' and their TI level. First, I conducted an analysis to determine whether means on the dependent variable TI level, are significantly different among groups of teachers by subject area taught (*N* = 72). The independent variable, subject area taught, included the following 9 groups: mathematics, English/language arts, natural science, history/social science, world languages, health/physical education, vocational/technical education, visual/performing arts, and other subject). To address the assumption of normality, I added groups with a very small number of cases (history/social science; *N* = 5, health/physical education; *N* = 1; and visual/performing arts; *N* = 4) to the other subject group (see Table 23). According to Green and Salkind (2016) in most cases, a sample size of 15 cases per group is large enough to produce acceptable *p* values.

Table 23
Subject Area Taught Descriptive Statistics

Category	N	Min	Max	Mean	SD	SE	95% Confidence Interval for Mean Lower Bound	Upper Bound
Mathematics	15	4	8	6.53	1.060	.274	5.95	7.12
English/language arts	13	4	7	5.92	1.188	.329	5.21	6.64
Natural science	14	4	7	5.79	.975	.261	5.22	6.35
Other subject	11	3	8	5.45	1.572	.474	4.40	6.51
World languages	10	4	8	6.40	1.430	.452	5.38	7.42
Vocational/technical education	9	6	8	7.11	.782	.261	6.51	7.71
Total	72	3	8	6.17	1.256	.148	5.87	6.46

The assumption of homogeneity of variances was tested and found tenable using Levene's Test, *F* (5,66) =1.434, *p* = 0.224, not violating the assumption of homogeneity of variances with $p > 0.05$ (see Table 24). The analysis resulted a statistically significant difference between groups as determined by the one-way ANOVA, F (5,66) = 2.692, p = 0.028 (see Table 25).

Table 24
Test of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Technology integration level (TI)	Based on Mean	1.434	5	66	.224
	Based on Median	1.212	5	66	.313
	Based on Median and with adjusted df	1.212	5	57.266	.315
	Based on trimmed mean	1.413	5	66	.231

Table 25
Technology Integration Level ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	18.970	5	3.794	2.692	.028
Within Groups	93.030	66	1.410		
Total	112.000	71			

Post hoc comparisons to evaluate pairwise differences among group means were conducted with the use of a Tukey HSD because equal variances were justifiable (see Table 26). Tests revealed significant pairwise differences between the mean scores of vocational/technical education teachers and teachers in the other subject group [-1.657, 95% CI (-3.22, -0.09), p = 0.032]. There was no statistical significance associated with any of the four remaining groups (mathematics, English/language arts, natural science, or world languages).

Table 26
Multiple Comparisons

Dependent Variable: Technology Integration Level (TI)	(I) Subject Area Taught	(J) Subject Area Taught	Mean Difference (I-J)	SE	Sig.	95% Confidence Interval for Mean Lower Bound	Upper Bound
Tukey HSD	Mathematics	English/language arts	.610	.450	.752	-.71	1.93
		Natural science	.748	.441	.540	-.55	2.04
		Other subject	1.079	.471	.213	-.30	2.46
		World languages	.133	.485	1.000	-1.29	1.56
		Vocational/technical education	-.578	.501	.857	-2.05	.89
	English/language arts	Mathematics	-.610	.450	.752	-1.93	.71
		Natural science	.137	.457	1.000	-1.20	1.48
		Other subject	.469	.486	.928	-.96	1.90
		World languages	-.477	.499	.930	-1.94	.99
		Vocational/technical education	-1.188	.515	.206	-2.70	.32
	Natural science	Mathematics	-.748	.441	.540	-2.04	.55
		English/language arts	-.137	.457	1.000	-1.48	1.20
		Other subject	.331	.478	.982	-1.07	1.74
		World languages	-.614	.492	.811	-2.06	.83
		Vocational/technical education	-1.325	.507	.108	-2.81	.16
	Other subject	Mathematics	-1.079	.471	.213	-2.46	.30
		English/language arts	-.469	.486	.928	-1.90	.96
		Natural science	-.331	.478	.982	-1.74	1.07
		World languages	-.945	.519	.459	-2.47	.58
		Vocational/technical education	-1.657*	.534	.032	-3.22	-.09
	World languages	Mathematics	-.133	.485	1.000	-1.56	1.29
		English/language arts	.477	.499	.930	-.99	1.94
		Natural science	.614	.492	.811	-.83	2.06
		Other subject	.945	.519	.459	-.58	2.47
		Vocational/technical education	-.711	.545	.782	-2.31	.89
	Vocational/technical education	Mathematics	.578	.501	.857	-.89	2.05
		English/language arts	1.188	.515	.206	-.32	2.70
		Natural science	1.325	.507	.108	-.16	2.81
		Other subject	1.657*	.534	.032	.09	3.22
		World languages	.711	.545	.782	-.89	2.31

Summary

After analyzing data, I found significant relationships between TI level and TPACK subscales: TK, $B = .311$, $r = .601$, $p = .011$, CK, $B = .293$, $r = .279$, $p = .033$, and TPK, $B = .612$, $r = .665$, $p = .000$. TPACK itself was not found to be a significant predictor of TI level. I also found significant relationships between TI level and TSE-Total, $B = .281$, $r = .281$, $p = .017$, and the TSES subscale measure IS, $B = .319$, $r = .337$, $p = .021$. Thus, self-efficacy for classroom management and self-efficacy for student engagement were not significantly related to TI level, but overall TSE was significantly related. Results for subject area taught by the teacher showed that vocational/technical education teachers had a significantly higher level of TI when compared to teachers in the category other subject, $F\ (5, 66) = 2.692$, $p = .028$.

Section 5: Discussion, Conclusions, and Recommendations

Introduction

The purpose of this quantitative correlational research study was to investigate the problem of insufficient TI in high school classrooms in a large urban Georgia school district by examining the relationship between high school teachers' TPACK levels, TSE beliefs, years of teaching experience, education level, and subject area taught as predictor variables, and teachers' TI levels as the outcome variable. Much research supports the fact that TI in the classroom is beneficial to students' overall academic achievement (Delgado et al., 2015; Kimmons, 2016; Urbina & Polly, 2017; Young, 2016). However, research studies have also shown that there are a variety of barriers to TI yet to be addressed in K to 12 schools (Hsu, 2016; Vongkulluksn et al., 2018; Xie et al., 2017). In the local school district, there is a one-to-one technology initiative in which all teachers and students in schools have been issued Chromebooks (laptops), and teachers have been provided with a variety of types of instructional technology to use as they see fit. In designing this study, I was interested in finding out to what extent teachers integrated technology given the high level of access to technology available in the local school district.

I chose the variables TPACK and TSE beliefs because these are measures that have been identified by researchers to be associated with the problem of lack of TI in the classroom. TSE beliefs have been identified as one of numerous internal barriers to technology integration (Birisci & Kul, 2019; Hsu, 2016) and as a variable that influences instructional choice (Dursun, 2019; Lemon & Garvis, 2016; Morrison, 2019).

Components of the TPACK framework have been shown to be related to teachers' attitudes toward technology use (Akapame et al., 2019; Lefebvre et al., 2016; Saudelli & Ciampa, 2016; Yulisman et al., 2019).

I chose a cross-sectional survey design because of the simplicity and power of the design and the quick turnaround in data collection. Because the survey was web-based, I was able to collect data quickly and insure the confidentiality and security of data. The study participants consisted of 72 teachers from six high schools in the local school district. The five research questions addressed the relationship between the outcome variable, TI, and predictor variables: TPACK, TSE, years of teaching experience, education level, and subject area taught. Linear regression analysis, and one-way ANOVA identified significant relationships between TI levels and multiple predictors. TPACK subscale measures TK, CK and TPK had a significant influence on teachers' TI levels using multiple linear regression analysis. TSE subscale measure IS was found to significantly influence teachers' TI levels using multiple linear regression analysis, and total TSE score was shown to be significantly related to TI level using simple linear regression analysis. I found no significance between teachers' TI levels and the teacher characteristics, years of teaching experience and education level, but subject area taught yielded significant results when comparing the means of TI level scores of vocational/technical education teachers to those of teacher in the other subject group. This introduction to Section 5 is followed by an interpretation of the findings, implications for social change, recommendations, and conclusion.

Interpretation of Findings

Theoretical Framework and Findings

Social cognitive theory and motivational systems theory were the theoretical perspectives from which this study was developed. Social cognitive theory supported investigating TSE and its relationship to TI, while motivational systems theory supported investigating the relationship between TPACK and TI. The TSE findings reflected the way in which self-efficacy is defined as a multidimensional and context-specific construct (Bandura, 1977, 1989; Bong & Skaalvik, 2003), in that among the three dimensions of TSE, only instructional strategies had a significant relationship to TI. I did not find a significant relationship between TSE subscales: classroom management or student engagement, and teachers' implementation of TI practices. Bandura and Schunk (1981) described self-efficacy as having to do with making judgments about one's ability to navigate vague or unpredictable situations, and of the three TSE subscales, developing new instructional strategies to teach with technology represents a more ambiguous unpredictable situation than student engagement or classroom management.

Social cognitive theory, as it relates to TSE, describes mastery experiences to be the strongest determinant of self-efficacy (Bong & Skaalvik, 2003; Pajares, 1992). Given the relationship between mastery experiences and self-efficacy, I would have expected to find a significant relationship between teachers' years of experiences and TI, or teachers' educational level and TI, but neither relationship was significant in this study, and both relationships had a negative correlation. The study finding showed that mastery experiences in TI are not necessarily gained through increasing teachers' education level, or through the daily experience of teaching, but must be gained through the specific practice of integrating technology on a daily basis.

Motivational systems theory, which was developed out of social cognitive theory, describes motivation as a construct made up of various perceptions about desired outcomes that an individual would like to achieve (Ford, 1992). TPACK relates to motivational systems theory in that when individuals attain knowledge and skills, this promotes self-efficacy which increases motivation to engage in tasks that individuals desire to complete (Dweck, 1991). In motivational systems theory, knowledge is the catalyst for motivating individuals to engage in behaviors that produce desired outcomes. The findings of this study are consistent with motivational system theory, because the TPACK subscale CK was found to be a significant predictor of TI. Motivational systems theorists have found that CK is a key component of motivation and the development of TSE (Dweck, 1991; Schunk, 1996). Contrary to what one might expect based upon motivational system theory and the role of knowledge, TCK and PCK were not significant predictors of TI in this study. Based on the TPACK framework, TCK is a type of knowledge that is more specifically related to TI than CK; however, the results of this study showed that this was not the case.

The significant relationship between TK and TI, and TPK and TI in this study are consistent with motivational systems theory because the implementation of technology in the classroom requires knowledge of technology itself, and technological pedagogy. The study findings related to subject area taught are also consistent with motivational systems theory in that vocational/technical education teachers had the highest level of TI and they had a significantly higher level of TI than teachers in the other subject category. When looking at all of the subject areas taught (mathematics, English/language arts, natural science, world languages, vocational/technical education, and other subject), while teachers in all subjects use technology to varying degrees, one might expect vocational/technical education teachers to rely most heavily on teaching with technology on a daily basis.

TPACK Findings

Research Question 1 addressed the relationship between teachers' TPACK levels and teachers' TI level. The results of the study showed significant correlations between teachers' TI level and TPACK subscale measures TK, CK, and TPK. The significant relationship between TI level and TK (r = .601) indicates that teachers who have a greater knowledge of various types of technology available for classroom instruction also demonstrate a greater degree of use of technology in the classroom. The significant relationship between TI level and CK (r = .279) indicates that teachers who possess a deeper level of knowledge in their content area also use classroom technology to a greater degree. Lastly, the significant relationship between TI level and TPK (r = .665) indicates that teachers who have a better understanding of what is the best technological approach needed to implement an instructional strategy or pedagogical approach, will also use technology in the classroom at a higher level.

Of importance to the findings of this study are those relationships between teachers' TI level and TPACK subscale measures that were not found to be significant; (a) PK (r = .330) or overall pedagogical knowledge; (b) TCK (r = .584) or teachers' knowledge of which technologies are most useful in teaching a particular topic within a specific content area; (c) PCK (r = .389) or knowledge of specific strategies needed to teach specific content; and (d) TPACK (r = .513) or the knowledge of what specific technology is most effective to teach a particular strategy within a particular content area. All seven TPACK subscale measures were positively correlated to TI level, but only three of the seven measures (TK, CK, and TPK) had a significant effect based on regression analysis.

The results of this study regarding the relationship between TPACK subscale measures and TI level are consistent with the findings of Lefebvre et al. (2016) who showed that TK and TPK were the TPACK subscale measures most strongly correlated with teachers' use of interactive white boards. The findings of studies that show a positive association between TPACK components and TI support the theoretical framework of social learning theory (Bandura, 1989), in that TPACK scores represent participants' perception of his or her mastery, and motivation to engage in behaviors is increased by mastery experiences. Nelson et al. (2019) found that TPACK was a strong predictor of ISTE Standard alignment, which is a measure of TI level. Saudelli and Ciampa (2016) had findings that were contrary to those found in this study in that teachers' attitudes toward the integration of technology were related to their approach to pedagogy, and compared to their TK and CK, teachers' PK had a stronger influence on their decisions to integrate mobile technology.

Teacher Self-Efficacy Findings

Research Question 2 addressed the relationship between TSE beliefs and teachers' TI level. The results of the study showed significant correlations between teachers' TI level and the TI subscale IS. The significant relationship between TI level and IS (r = .337) indicates that teachers who have a higher level of self-efficacy for instructional strategies, also integrate technology in the classroom to a greater degree. Neither TSE for classroom management (r = .199) nor TSE for student engagement (r = .167) were found to be significantly related to TI level.

Poulou et al. (2019) had similar findings when investigating the relationship between observed classroom strategies and self-efficacy in each of the three domains (IS, CM, and SE), where IS was significant, but no significance was found when examining CM and SE. Overall TSE has been found to be related to TI level in studies as well. Morrison (2019) conducted a study of TSE and found that teachers are more likely to utilize technology in the classroom if they have a higher overall level of TSE. Joo et al., (2018) found that TSE was shown to positively influence teachers' intention to use technology.

Teacher Characteristics Findings

Research Questions 3, 4, and 5 addressed the relationship between TI and the three independent variables that addressed teacher characteristics (years of teaching experience, subject area taught, and education level). The results of the study showed no significant correlations between teachers' TI level and the three teacher characteristics, with the exception of a significant pairwise difference between the mean scores of vocational/technical education teachers and teachers in the other subject groups [-1.657, 95% CI (-3.22, -0.09), p = 0.032]. Among the subject area groups, vocational/technical education teachers had the highest mean score in TI (m = 7.11), which represents the CBAM-LoU level 5: Integration (the second highest level of technology integration). Vocational/technical education teachers are likely to rely on technology as an essential part of their instructional practices given the nature of their content area.

In prior research studies significant differences were not often found between TI level and the variables years of teaching experience, subject area taught, or education level. Simsek and Sarsar (2019) found no significant difference between TI level and years of experience or education level when studying the effect of TPACK and self-efficacy on teachers' implementation of the ISTE Standards for teachers. In a study comparing teachers in the United States and Saudi Arabia on their use of technology and TPACK, Alqurashi, Gokbel, and Carbonara (2017) found no significant differences when controlling for years of teaching experience or education level.

Other researchers have found significant effects of teacher characteristics (years of teaching experience, subject area taught, and education level) on TPACK domains and TI level. Sezer (2015) found significant differences among teachers of different subject areas regarding TPACK domains, showing significant differences in TK, TPK, and TPACK depending upon subject area taught. In this study, I did not compare subject area groups on TPACK domain scores however, vocational/technical education teachers had the highest mean score in TI level (m = 7.11). Nelson et al. (2019) found that TPACK and ISTE Standards alignment vary according to teachers' subject area taught and years of experience has a moderate positive correlation to ISTE Standards alignment. Saudelli and Ciampa (2016) found that years of teaching experience had a stronger influence on teachers' decisions to integrate mobile technology than their TK and CK, and lower levels of TPACK were found among older and more experienced teachers. According to Hsu et al. (2017) more experienced teachers frequently possess lower levels of TK and TPACK, however in some cases these differences are not significant.

Limitations of the Study

When interpreting the results of the study it is important to identify limitations that may have influenced the results. First, the results were limited to a single school district in Georgia, and six high schools out of 28 in the district. Second, the study was conducted during a time when teachers were sheltering in place and teaching online due to the COVID-19 pandemic, so during this time all teachers were forced to teach using technology. Third, those teachers who chose to participate in the study are likely to have a more positive attitude toward teaching with technology than those choosing not to participate, given that the study topic was factors affecting technology integration practices. An additional limitation of this study is that the TPACK questionnaire, the TSES, and the CBAM-LoU survey are self-assessment instruments. Because scores on the instruments come from self-ratings, the TPACK subscale scores, TSE subscale scores and TI level scores measure participants' perceptions of their knowledge, self-efficacy and level of technology use, which may not be objective and may not accurately reflect the true level of these variables. Concerns about the difference between an individual's self-reported and enacted TPACK were raised by Akapame et al. (2019) in their case study of preservice secondary math teachers' TPACK.

Implications for Social Change

Mir and Parrey (2019) pointed out that rapid growth in the advancement and usage of new technologies continues to drive rapid changes in society. Because change does not occur uniformly across all sectors of society, rapid changes in society can cause inequity. These changes are having a significant effect on K to 12 schools in the United States (Chicioreanu & Ianos, 2019), creating opportunities for innovation while at the same time producing social challenges. While inequity in access to technology exists among K to 12 schools and their students, this study has implications for addressing the inequity that exists in how teachers use technology in the classroom. Even in technologically well-equipped schools, the way in which teachers choose to utilize or not to utilize technology creates inequity of technological knowledge and expertise among students, as well as an inequity in student learning outcomes. This study showed that teachers' TI level is affected by their knowledge (TK, CK, and TPK) and affected by their beliefs about their ability to effectively influence student outcomes (TSE). The results of this study highlight the need for technological pedagogy courses in preservice teacher education programs, and for ongoing technological pedagogy related professional development for in-service teachers. Teachers acquire TK and TPK more through the trial and error of daily teaching experience than through preservice education or in-service teacher training, so it is incumbent upon K to 12 schools to foster a school culture that provides opportunities for teachers to experiment with technology within their content areas (Nelson et al., 2019). Providing opportunities for teachers to develop their technology integration skills will require schools and school districts to examine their values and beliefs when it comes to determining the place of technology in the life of students and teachers.

Recommendations for Action

The findings of this study suggest that by increasing the technological knowledge, content knowledge, and technological pedagogical knowledge of teachers, teachers' level of TI can be increased. Similarly, by increasing TSE for instructional strategies, teachers' level of TI can be increased. While working as a professional educator for the past 25 years, I do not recall having worked in a school district that offered ongoing professional development that focused on technological content and pedagogy. In the case of the local school district in which this study was conducted, the adoption of a one-to-one technology program should also require ongoing professional development for teachers, and technology training for students. The importance of quality professional development in sustaining a one-to-one technology program was researched by Morrison (2019) who found that among American high school teachers, content-driven professional development is needed, in addition to clear expectations for technology use, and access to instructional coaches.

An example of effective content-driven professional development is shown in a study by Oda et al. (2020) who examined the effect of TPACK-based professional development on American in-service teachers. Oda et al. found that teachers who gained a better understanding of how TK interacts with PK and CK for meaningful TI, used technology with a pedagogical approach. Young et al. (2019) conducted a study of TPACK-based professional development with American teachers working in an urban setting, found that the professional development produced gains in mathematics teachers' perceptions of their PK, TK, PCK, and TCK.

Also, of importance, the teacher evaluation process encourages teachers to integrate technology, but TI is not a firm standard on which teachers are assessed throughout the school year. Training and evaluation go hand and hand. School districts can make great strides in increasing teachers’ use of technology for teaching and learning by developing a technology competency program that will provide teachers with ongoing, relevant, and effective professional development. Once a technology competency program has been implemented, it would then be appropriate to set technological competencies as a part of the teacher evaluation process.

Recommendations for Further Study

Throughout the process of conducting this research study, results brought to mind recommendations that could help in understanding ways to increase the level of TI in classrooms. Future researchers could learn from conducting the following studies in response to the study findings and limitations:

1. Examine the amount and type of TI training teachers have received as preservice and in-service teachers.
2. Conduct a qualitative, or mixed-methods study as a means of investigating the ways in which teachers utilize technology in the classroom daily.

3. Conduct a qualitative, or mixed-methods study as a means of investigating the effect of professional development on teachers' use of technology-integrated instruction.
4. Conduct a comparative quantitative, qualitative, or mixed-methods study that will include students and teachers responding to the same types of questions about teachers' use of technology-integrated instruction.
5. Create an objective assessment of TPACK based on subject area taught and conduct a mixed-methods study investigating the relationship between TPACK and observed use of technology in the classroom.

Conclusion

Throughout the history of the United States technology has played a role in the growth and improvement of all types of organizations including businesses, the military, and even churches. Schools have also benefited from the use of technology, but there is still a great deal more that schools can gain through the implementation of technology integration in teaching and learning. This study sheds light on the fact that there are factors that influence teachers' use of technology in the classroom such as TPACK and TSE that need to be investigated further and understood to increase the presence and quality of teaching with technology.

Even though further research is needed in order to better understand ways in which to promote a more robust use of instructional technology, there is enough empirically-based information already available to make marked improvements in the way we educate students in the United States. Through informed, creative and committed educational leadership, K to 12 schools can be transformed into communities in which cutting-edge technology closes achievement gaps and provides all students with 21st century skills for success.

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Appendix A: Teacher Characteristics Questions and Teachers' Sense of Efficacy Scale

Teacher Characteristics Questions

Teacher Characteristics	Indicate your years of teaching experience, level of education and subject area taught below. Make only **ONE** choice from each category.					
1) Years of Teaching Completed	0-5 years	6-10 years	11-15 years	16-20 years	21-25 years	26 or more years
2) Highest Level of Education Completed	Bachelor's Degree	Master's Degree	Educational Specialist Degree/ ABD	Doctoral Degree		
3) Subject Taught (If more than one subject category, choose the one subject that you teach the most.)	Mathematics	English/ Language Arts	Natural Science	History/Social Science		
	World Languages	Health/Physical Education	Vocational/ Technical	Visual/ Performing Arts	Other Subject	

Source: Armando L. Gilkes

Teachers' Sense of Efficacy Scale (TSES)

This questionnaire is designed to help gain a better understanding of the kinds of things that create challenges for teachers. Your answers are confidential.

<u>Directions</u>: Please indicate your opinion about each of the questions below by marking any one of the nine responses in the columns on the right side, ranging from (1) "None at all" to (9) "A Great Deal" as each represents a degree on the continuum. **Please respond to each of the questions by considering the combination of your *current* ability, resources, and opportunity to do each of the following in your present position.**	None at all		Very Little		Some Degree		Quite A Bit		A Great Deal
1) How much can you do to control disruptive behavior in the classroom?	1	2	3	4	5	6	7	8	9
2) How much can you do to motivate students who show low interest in school work?	1	2	3	4	5	6	7	8	9
3) How much can you do to calm a student who is disruptive or noisy?	1	2	3	4	5	6	7	8	9
4) How much can you do to help your students value learning?	1	2	3	4	5	6	7	8	9
5) To what extent can you craft good questions for your students?	1	2	3	4	5	6	7	8	9
6) How much can you do to get children to follow classroom rules?	1	2	3	4	5	6	7	8	9
7) How much can you do to get students to believe they can do well in school work?	1	2	3	4	5	6	7	8	9
8) How well can you establish a classroom management system with each group of students?	1	2	3	4	5	6	7	8	9
9) To what extent can you use a variety of assessment strategies?	1	2	3	4	5	6	7	8	9
10) To what extent can you provide an alternative explanation or example when students are confused?	1	2	3	4	5	6	7	8	9
11) How much can you assist families in helping their children do well in school?	1	2	3	4	5	6	7	8	9
12) How well can you implement alternative teaching strategies in your classroom?	1	2	3	4	5	6	7	8	9

Source: Tschannen-Moran, M., & Woolfolk-Hoy, A. (2001). Teacher efficacy: Capturing an elusive construct. Teaching and Teacher Education, 17, 783-805.

Appendix B: Technological Pedagogical Content Knowledge (TPACK) Questionnaire

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 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 (Technological Knowledge)					
1. I know how to solve many of my own technology problems.					
2. I learn to use new technologies easily.					
3. I keep up with important new educational technologies.					
4. I routinely design lessons in which students learn using technology.					
5. I know about a lot of different technologies.					
CK (Content Knowledge)					
6. I have sufficient content knowledge of the subject that I teach.					
7. I can clearly explain the content of the subject that I teach.					
8. I am aware of common misconceptions that students' have in the subject that I teach.					
9. I am aware of the prerequisite knowledge students' need to be successful in the subject that I teach.					
10. I use different ways of assessing students' levels of the understanding of the subject that I teach.					
PK (Pedagogical Knowledge)					
11. I use appropriate instructional tools (e.g. pictures, models, examples) to explain concepts within the subject that I teach.					
12. I can adjust my teaching approaches for students with different learning styles.					
13. In teaching, I create atmosphere for appropriate interactions between teachers and students.					
14. I adjust my teaching based on students' levels of comprehension.					
15. I use different teaching approaches when teaching different content in my subject area.					
TCK (Technological Content Knowledge)					
16. I use technology to enhance students' understanding and learning of the content.					
17. I use technology to explain concepts in the subject that I teach that are difficult for students to understand.					
18. I use technology to promote teaching activities for a specific course unit.					
19. I can choose appropriate technology that enhances my teaching for a specific course unit.					
20. I help students use technology to collect or organize information.					
PCK (Pedagogical Content Knowledge)					
21. My teaching approaches make students stay interested in the content of this subject matter.					
22. I use different teaching approaches such as group discussion and cooperative learning to teaching the contents.					
23. I know how to choose effective teaching approaches to guide students' learning and thinking.					
24. I use a variety of teaching approaches to transform subject matter into comprehensive knowledge.					
25. I create a classroom circumstance to promote students' interest for learning.					
TPK (Technological Pedagogical Knowledge)					
26. I use technology to create teaching activities for student interactions.					
27. I use technology to explain the content of the subject matter.					
28. I use technology to enhance my teaching effectiveness.					
29. I use technology to get students motivated in learning and help them learn diligently.					
30. I use technology to enrich my teaching materials and content.					
TPCK (Technological Pedagogical Content Knowledge)					
31. I integrate contents, technologies, and teaching approaches to teach subject units.					
32. I use interactive whiteboards (technology) to promote learning and inquiry of lessons.					
33. I use technology to find out students' understanding of abstract concepts of the subject.					
34. I use technology and teaching approaches in different course units to help students comprehend easily.					
35. Using technology can improve my teaching approaches to promote students' learning.					

Source : Jang, S.-J., & Tsai, M.-F. (2012). Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. Computers & Education, 59(2), 327–338.

Appendix C: Concerns-Based Adoption Model (CBAM-LoU) Survey

	Concerns- Based Adoption Model Levels of Use of an Innovation (CBAM-LoU) Please mark one category that best indicates your overall level of use of information technology.
○	Level 0: Non-use I have little or no knowledge of information technology in education, no involvement with it, and I am doing nothing toward becoming involved.
○	Level 1: Orientation I am seeking or acquiring information about information technology in education.
○	Level 2: Preparation I am preparing for the first use of information technology in education.
○	Level 3: Mechanical Use I focus most effort on the short-term, day-to-day use of information technology with little time for reflection. My effort is primarily directed toward mastering tasks required to use the information technology.
○	Level 4A: Routine I feel comfortable using information technology in education. However, I am putting forth little effort and thought to improve information technology in education or its consequences.
○	Level 4B: Refinement I vary the use of information technology in education to increase the expected benefits within the classroom. I am working on using information technology to maximize the effects with my students.
○	Level 5: Integration I am combining my own efforts with related activities of other teachers and colleagues to achieve impact in the classroom.
○	Level 6: Renewal I reevaluate the quality of use of information technology in education, seek major modifications of, or alternatives to, present innovation to achieve increased impact, examine new developments in the field, and explore new goals for myself and my school district.

Source: Institute for the Integration of Technology into Teaching and Learning (2019). The Concerns-Based Adoption Model - Levels of Use (CBAM-LoU v1.1). The University of North Texas, Denton, TX.

Appendix D: TSES Permission Letters

William & Mary
School of Education

MEGAN TSCHANNEN-MORAN, PHD
PROFESSOR OF EDUCATIONAL LEADERSHIP

March 4, 2020

Armando,

You have my permission to use the Teacher Sense of Efficacy Scale (formerly called the Ohio State Teacher Sense of Efficacy Scale), which I developed with Anita Woolfolk Hoy, in your research.

You can find a copy of the measure and scoring directions on my web site at http://wmpeople.wm.edu/site/page/mxtsch .

Please use the following as the proper citation:

> Tschannen-Moran, M & Hoy, A. W. (2001). Teacher efficacy: Capturing an elusive construct. *Teaching and Teacher Education, 17*, 783-805.

I will also attach directions you can follow to access my password protected web site, where you can find the supporting references for this measure as well as other articles I have written on this and related topics.

All the best,

Megan Tschannen-Moran
William & Mary School of Education

P.O. Box 8795 • Williamsburg, VA 23187-8795 • (757) 221-2187 • mxtsch@wm.edu

On Feb 29, 2020, at 5:46 PM, Armando Gilkes <[redacted]> wrote:

Greetings Dr. Woolfolk-Hoy,

I am a doctoral student at Walden University and I would like to request permission to use the TSES Short version for my research. My research study is entitled Teachers' Knowledge and Self-Efficacy Beliefs as Factors Affecting Technology Integration Practices.

I would greatly appreciate your consent to use the TSES.

Thank you!

Armando Gilkes
Doctoral Student
Walden University

From: Anita Woolfolk Hoy [redacted]
Sent: Saturday, February 29, 2020 5:48 PM
To: Armando Gilkes [redacted]
Subject: Re: Teacher Sense of Efficacy Scale (TSES)

You are welcome to use the TSES in your research as you describe below. This website might be helpful to you:

http://u.osu.edu/hoy.17/research/instruments/

Best wishes in your work

Anita

Anita Woolfolk Hoy, PhD
Professor Emerita
The Ohio State University
7655 Pebble Creek Circle, Unit 301
Naples, FL 34108

[redacted]

Appendix E: TPACK Questionnaire Permission Email

(a) A Leon G [redacted]

to jang

Hello,

I am trying to reach Syh-Jong Jang in order to request the use of your TPACK questionnaire that was used in your study "Exploring the TPACK of Taiwanese elementary mathematics and science teachers with respect to use of interactive whiteboards. Computers & Education, 59, 327–338. Jong, S., & Fang, M. (2012)."

I am a doctoral student at Walden University and I am researching the relationship between TPACK and Technology Integration practices of secondary school teachers.

If you would allow me to use your questionnaire for my research, I would be very grateful.

Thank you.

Armando Gilkes
Doctoral Student
Walden University

(b) Jang [redacted]

Sun, Jul 7, 2019, 11:53 PM

to me

OK
I give you the permission to use the TPACK instrument.

Jang

A Leon G [redacted]

Appendix F: Concerns-Based Adoption Model (CBAM-LoU) Survey Permission

Instruments
for
Assessing
Educator Progress
in
Technology Integration

By:
Gerald Knezek
Rhonda Christensen
Keiko Miyashita
Margaret Ropp

ITTL
Institute for the Integration of Technology in Teaching and Learning
University of North Texas
Department of Learning Technologies

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VI. CONCERNS-BASED ADOPTION MODEL LEVELS OF USE

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Appendix G: Participant Invitation Email

April 1, 2020

Dear [redacted] Educator,

I am in the process of completing my doctorate in Teacher Leadership through Walden University, and I am inviting high school teachers to participate in my doctoral research study that investigates the relationship between teachers' content knowledge, self-efficacy beliefs and the degree to which teachers integrate technology. Included in this document is a link to an online survey that asks a variety of questions about teachers' sense of efficacy, daily teaching practices and level of technology use, taking roughly 10 to 15 minutes to complete. The survey is completely anonymous as no identifying information will be collected from you. If you choose to participate, click on this link or enter the URL provided at the bottom of the page into the web browser of your computer, smartphone, or other device to access the questionnaire.

Through your participation I hope to understand what factors influence the degree to which teachers integrate technology. I hope that the results of the survey will be useful for providing a basis for creating technology-related professional development opportunities for teachers. Regardless of whether or not you choose to participate, please let me know if you would like a summary of my findings.

Sincerely,

Armando L Gilkes
Doctoral Student
Walden University
[redacted]

SURVEY URL: **https://**[redacted]

Appendix H: Consent Form

You are invited to take part in a research study about the relationship between teachers' beliefs about technology and the degree to which teachers integrate technology when teaching. The researcher is inviting currently working high school teachers to be in the study. The researcher received permission to invite you to participate in this study by the [redacted] Office of Accountability, Research, Data, and Evaluation as well as your school principal. This form is part of a process called "informed consent" to allow you to understand this study before deciding whether to take part. This study is being conducted by a researcher named Armando L Gilkes, who is a doctoral student at Walden University. You might already know the researcher as a teacher with the [redacted] School District, but this study is separate from that role.

Background Information:
The purpose of this study is to is to explore the relationship between teachers' knowledge, self-efficacy beliefs and the degree to which they integrate technology when teaching.

Procedures:
If you agree to be in this study, you will be asked to:

• Complete an online survey of your teaching knowledge, self-efficacy, and your level of utilization of technology.
• Spend 10 – 15 minutes completing the survey on your own, at a time convenient with your schedule via the internet using a computer, tablet or smart phone. Your involvement in this study will end once you complete the survey.

Here are some sample survey items:
• To what extent can you craft good questions for your students?
• I can clearly explain the content of the subject that I teach.
• I use technology to create teaching activities for student interactions.

Voluntary Nature of the Study:
This study is voluntary. You are free to accept or turn down the invitation. No one at [redacted] School District will treat you differently if you decide not to be in the study. If you decide to be in the study now, you can still change your mind later. You may stop at any time.

Risks and Benefits of Being in the Study:
Being in this type of study involves no known risks to you as a participant in this study, other than some risk of the minor discomforts that can be encountered taking a survey. Being in this study would not pose risk to your safety or well-being. The collection of this data may be beneficial in understanding the technology needs of teachers, and could

be useful in creating professional development opportunities for teachers that would assist them with technology integration.

Payment:
There is no compensation for your participation in this study.

Privacy: Reports coming out of this study will not share the identities of individual participants. Details that might identify participants, such as the location of the study, also will not be shared. Even the researcher will not know who you are. The researcher will not use your personal information for any purpose outside of this research project. Data will be kept secure by using password protected files. Data will be kept for a period of at least 5 years, as required by the university.

Contacts and Questions:
You may ask any questions you have by contacting the researcher at [redacted]. If you want to talk privately about your rights as a participant, you can call the Research Participant Advocate at my university at [redacted]. Walden University's approval number for this study is **04-01-20-0065178** and it expires on **March 31st, 2021.**

Please print or save this consent form for your records.

Statement of Consent:
I have read the above information and I feel I understand the study well enough to make a decision about my involvement. Please indicate your consent by clicking "Begin".

Thank You!