TEACHER TECHNOLOGY EFFICACY: THE RELATIONSHIP AMONG GENERATION, GENDER, AND SUBJECT AREA OF SECONDARY TEACHERS

by

Kimberly D. Woods

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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ABSTRACT

This predictive, correlational study is designed to examine the relationship between the technology efficacy of gender, generation (baby boomers, millennials, and generation X), and subject area using teachers who use 21st century technology tools and devices in a high school setting. In this non-experimental study, participants submitted their online responses to the 34-item survey, Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21), as well as their demographic information via Google Forms. The researcher used multiple regression to analyze participants' anonymous responses. In using a multiple linear regression analysis, the researcher examined results of the TPSA C-21 and concluded that the gender and generation predictor variables showed a statistically significant ability to predict teacher technology, namely on the Total Scale, WWW, Integrated Applications, and Emerging Technologies Skills scales of the TPSA C-21. The subject area variable did not display an ability to predict teacher technology efficacy scores on any scale of the TPSA C-21.

Keywords: 21st century technology, teacher efficacy, mobile devices**,** technology efficacy

Dedication

God is the source of my strength, wisdom, and joy. When I began this doctoral journey, I did not realize the enormous responsibilities that were attached. Because of God's word and Son, Jesus Christ, this experience was possible. In Isaiah 41:10, He states "For I am with you; do not be dismayed, for I am your God. I will strengthen you and help you; I will uphold you with my righteous right hand." His presence and love guided me the entire way.

I would also like to dedicate this dissertation to my family. My grandparents, Samuel and Mattie Gantt and Willie and Pauline Woods, were my role models. They instilled in me the importance of hard work, patience, and diligence in my academic endeavors as well as in the workforce. Another strong staple I had along this journey was my mother, Yolandra Gantt. She taught me to be resilient and to always strive to be better. When situations appeared overwhelming, she offered encouraging words coupled with powerful prayers. My sister as well as numerous uncles, aunts, and cousins also provided their sage advice, and I am eternally grateful. Last, but not least, I want to extend a special dedication to my niece, Kierra Means. She gives me hope that anything is possible.

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List of Abbreviations

Digital Classrooms Plan (DCP)

Florida Teacher Certification Examinations (FTCE)

International Society for Technology in Education (ISTE)

Institutional Review Board (IRB)

Statistical Package for the Social Science (SPSS)

Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21)

Variance Inflation Factor (VIF)

CHAPTER ONE: INTRODUCTION

Overview

In this chapter, the researcher includes information on the examination of the relationship between teacher technology efficacy and generation, gender, and subject area. Some teachers who were not born in the age of modern technology may not be adequately familiar with using devices such as tablets, Chromebooks™, smart phones, iPads®, and e-readers. Other factors that may contribute to this lack of improper implementation are subject area and gender. Low efficacy due to generation, gender, and subject area may also cause teachers to be reluctant to use different types of 21st century technology (Chromebooks™, smart phones, social media apps, and online platforms,) required to meet the needs of not only the current generation of students, but also the districts' goals. In Chapter One, the researcher examines the gaps in literature that lead to the statement of the problem, purpose, significance of the study, research question, and key definitions required to conduct research on technology use and teacher efficacy. The purpose of this study is to examine the relationship between teachers' gender, generation (baby boomer, generation X, and millennials), and subject area, and their technology efficacy.

Background

In addition to subject area comprehension, technology is a major component of establishing a 21st century classroom. According to the Horizon Report (2017), educators are responsible for incorporating 21st century practices into their instruction. Higher level educational practitioners, such as principals and district administrators, deem technology as an important component in instruction, while only 43% of teachers view it as important (Project Tomorrow, 2017). When including technology, teachers are required to function as facilitators and guides instead of disseminators of knowledge. Teachers are expected to use technology devices and tools, such as SmartBoards, Chromebooks™, e-readers, and iPads®, and smart phones, seamlessly in their content areas. In the state of Florida, educators must have the capacity to use available technology as well as develop instructional lesson planning using digital resources (Florida Department of Education, n.d.).

The inclusion of emerging technology tools in the classroom and the skills required to properly implement them may vary. The factors that cause this variation in implementation are linked to efficacy. In examining the link between beliefs and behavior toward technology, Yusop (2015) determined that the dataset that reflects the factors that influence teachers' beliefs toward technology integration was limited in number. Yusop's study revealed that attitude was the factor that influenced teacher technology use. Adequate 21st century technology integration depends on the background, goal, and purpose of the teacher. Teo, Zhou, and Noyes (2016) believed that the intention to use technology is influenced by personal characteristics. The effectiveness of 21st century technology tools can be related to generation, gender, and subject area. Garba, Byabazaire, and Busthami's (2015) study results revealed that eight teachers in rural schools in Malaysia did not possess adequate skills to integrate 21st century technology tools and skills into instruction and content delivery.

Although the study (Byabazaire, and Busthami, 2015) was conducted outside the United States of America, the relevancy exists because of the similar geographical classification of rural area located in the United States. In this study, the predictive relationships between teachers' generation (baby boomer, generation X, and millennial), gender, subject area, and efficacy are the focus even in the rural portions of the study sites. Teachers have a set of standards that will assist in determining their adherence to the implementation of 21st century technology. To address teachers' possible reluctance to use technology and to assist teachers in understanding the requirements for adequate implementation of 21st century technology in the classroom, the International Society for Technology in Education (ISTE) has developed a list of standards for teachers. The ISTE standards, if followed, labels teachers as learners, leaders, citizens, collaborators, designers, facilitators, and analysts of 21st century technology (International Society for Technology in Education, 2017).

Since teachers in this study already adhere to the ISTE standards in their instruction, the researcher can use the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21) to measure their efficacy levels. The researcher focused on the segment of the standards featured in learning catalyst. By adhering to the requirements, teachers collaborate and share resources, design learner driven activities, facilitate learning with technology, and analyze data to drive their instruction (International Society for Technology in Education, 2017). The beliefs teachers have about technology use were analyzed by the researcher after the administration of the TPSA C-21 to high school teachers in the state of Florida. To be effective in the implementation of a 21st century classroom, teachers must adhere to preset general standards to develop digital age learning experiences and assessments, facilitate and inspire student learning and creativity, and model digital age work and learning (International Society for Technology in Education, 2008, 2017).

In order to study the beliefs that teachers have about technology use in the classroom, this researcher determined the predictive relationship of teachers' technology efficacy, gender, generation, and subject area by examining the TPSA C-21 results of teachers in the state of Florida. In 2015, Rick Scott, the Governor of Florida, released the Florida First budget, which allotted $80 million to assist districts in implementing their Digital Classrooms Plans (DCP) (Florida Department of Education, 2017). With these funds, educational leaders ushered in a one-to-one technology initiative in which each student has access to a technology device to be used in and out of the classroom. This initiative was established to reflect the number of technology devices available per student. In this case, each student has access to either a Chromebook™, laptop, or iPad®. For this study, teachers in the state of Florida are required by law as a part of the DCP as required by Florida Statute 1011.62(12)(a)(b)2 and 1001.20(4)(a)1.b (see Florida Department of Education, 2014) to adhere to school regulations and integrate emerging technology skills and devices in instruction with the intent to create a learning environment that will adequately prepare the current generation of students for the future.

The tools required for effective instruction have evolved over time. At one time, the commonly used educational tools were paper, book, pencil, and chalkboard. These tools are required for lecture-styled classes. Even recently, senior-level teachers preferred to implement teacher-centered instruction, such as lectures, question and answer, and prompt discussion while the lower-level seniority teachers preferred the use of smartboards more than the high-level seniority teachers (Bektas, 2013). The evolution of technology has provided entertainment in the form of games, social media interaction, and video production. Since 1980, the rise and usefulness of technology in everyday personal consumption has transitioned into K-12 classrooms (Grant et al., 2015).

Researchers have analyzed the integration of technology into classrooms. The integration of technology in the classroom was examined in the realm of teachers' beliefs in implementing technology in rich-technology based K-12 classrooms in Silicon Valley (Hernandez-Ramos, 2005) and Arizona (Hall & Trespalacios, 2019). Some teachers did not grasp the imminent need (Faizi, 2018) of altering their traditional classrooms. Other studies conducted focused on a variety of factors that influenced this implementation, including teacher gender (Kaya & Yazici, 2018), teachers' experience, gender, and subject area (Lai & Smith, 2018), professional development on technology (Hall & Trespalacios, 2019; Wright, 2010), and years of teaching experience in university setting (Lai & Smith, 2018; Smarkola, 2008). Bektas (2013) examined the gender of elementary teachers in Sakarya, Turkey and determined that it was not a significant variable for the use of computer, Internet, and SMART board®.

Furthermore, previous studies have demonstrated a significant correlation between gender and computer self-efficacy. Dan, Zhang, Ravindran, and Osmonbekov's (2016) study results revealed the mean difference in computer self-efficacy was 5.542 for males and 5.129 for females, which indicated that male's computer self-efficacy was higher than that of females. In addition, Scherer and Siddiq (2015) examined computer self-efficacy of male and female secondary teachers in relation to basic operational skills, advanced operational skills, and collaborative skills to determine that there was a significant difference in favor of males. Pechtelidis, Kosma, and Chronaki's (2015) study using college engineering students revealed the perception of males as "connoisseurs" and females as "simple users" of technology. The perception of their ability was formed out of gender specific societal norms and roles (Pechtelidis et al., 2015).

In this study, the measurement tool (Christensen & Knezek, 2017) the researcher will use to determine technology efficacy places 21st century skills on the forefront. Although previous studies (Inan & Lowther, 2010; Pechtelidis et al., 2015; Scherer & Siddiq, 2015) have explored the relationship between gender, age, and technology self-efficacy, a gap remains in analyzing the relationship of gender, subject area, and generation when using the TPSA C-21 (Christensen & Knezek, 2017). By using the TPSA C-21, the researcher can evaluate the perception of teachers' technology efficacy.

Seemingly, the evolution of technology in education requires a shift in the social climate to include online tools such as wikis, blogs, Facebook®, and Twitter™ within schools. While teachers already modify their instruction on a regular basis (Alexander, Knezek, Christensen, Tyler-Wood, & Bull, 2014; Kim, Choi, & Lee, 2019), a few teachers in Yu's (2013) study indicated the abilities and comfort levels of teachers to integrate technology in the classroom instruction is still a challenge to teachers who have taught for a long period of time. Moreover, teachers with more teaching experience believed that the latest technologies were not needed in order to teach (Kim, Choi, & Lee, 2019). Educators require training, so they can develop knowledge about how to integrate the technology with pedagogical approaches in their classrooms (Garba et al., 2015).

Teacher technology efficacy derives from self-efficacy in Bandura's (1997) social cognitive theory. Efficacy "influences how people feel, think, motivate themselves, and act" (Bandura, 1997, p. 2). For this study, teachers' technology efficacy is their beliefs in how they behave or think regarding technology integration in the classroom. Influences of capability are noted as mastery experience, vicarious experience, social models, and physiological and emotional status (Bandura, 2012). The level of mastery helps shape teachers' perception of their technology. Their perceptions of their mastery levels can impact the frequency and depth of technology use in the classroom. Kwon, et al. (2019) revealed that teachers who are less confident in technology use can be reluctant to integrate it into their classroom instruction.

To teach effectively and maximize students' potential, teachers accept the idea that the learning process for the current generation of tech-savvy students may require developing online social and collaborative activities. Although conducted in a college setting, Stoerger and Krieger's (2016) study revealed that student collaboration can occur by creating virtual teams for a wiki project. In addition, blogging allows minority college students to experience a sense of belonging (Kuo, Belland, & Kuo, 2017). In contrast, the results of Wendt and Rockinson-Szapkiw's (2015) study revealed that students' online collaborative experiences in an eighth-grade physical science classroom did not yield a higher learning community nor higher composite community than the students who engaged in face-to-face activities. However, skills engagement can be promoted through the use of 21st century technologies, such as blogs and wikis via smart phones and tablets (Witecki and Nonnecke, 2015). The skills students are actively engaged in can be developed while completing a collaborative assignment. With the evolution of technology standards developed by ISTE, effective teachers are expected to integrate these emerging technological devices and take on the role of facilitator who can manage students' involvement in digital platforms and virtual environments (International Society for Technology Education, 2017) for academic purposes. Additionally, teachers with high efficacy levels can create mastery experiences for their students (Bandura, 1993).

Technology integration in classroom instruction requires the acceptance and acknowledgment of its benefits from educational leaders and teachers. The constructivist approach to integrating technology in the classroom suggests that teachers must possess a "sensitivity to all aspects of a situation in which learners structure their experience" (Zhang, 2019, p. 378). In order to aid in the success of student learners, educational administrators would benefit from offering teachers adequate and effective industry-sponsored workshops after thoroughly assessing teachers' needs for information about instructional technology use and implementation (Saucier, McKim, Muller, & Kingman, 2014). In Gorder's (2008), he revealed that K-12 teachers in South Dakota did not use video conferencing, web-based collaboration programs, blogs, podcasts, and weblogs in teaching and learning as much as they used presentation software and word application. In a similar vein, teachers acknowledged that Web 2.0 technologies would be beneficial to teaching and learning, but they were not favor using them in the classroom (Faizi, 2018). In this current research study, the results of teachers' perceptions of their current and advanced technology use can also benefit society and its advancement into establishing, maintaining, and evolving to the demands of a 21st-century school environment. Teachers must evolve to accommodate the needs of the current generation of learners who are accustomed to using technology in their everyday lives. The responsibility of including the sociocultural aspect of technology devices in order to improve students' learning experiences falls on all educators.

Two theoretical constructs shape this research: constructivist theory and social cognitive theory. Dewey (1922) explained that "knowing is then a distinctive activity, with its own ends and its peculiarly adapted processes" (p. 186). Constructivists believe that meaning is developed through interactions with others and focuses specifically on environments in which people live and work (Creswell, 2003). Glasersfeld (1995) stated that radical constructivists want to change the old concept of knowledge in order to prevent the continuation of the same hopeless struggle. Piaget (1952) addressed a change in cognitive structures people undergo due to their environment, "accommodation of the schemata to experience develops to the very extent of the progress of assimilation" (p. 415). Adherence to the constructivist theory requires teachers to shift their roles and modify existing materials and activities (Bolliger, 2006) in order to construct a new way of delivering information to the learner. The second theory is social cognitive theory. "People's beliefs in their efficacy influence the types of anticipatory scenarios they construct and rehearse" (Bandura, 1993, p. 118). By using the social cognitive theory as a foundation, the researcher examines teachers' beliefs about technology. In this case, the predictive ability is determined among teachers' technology efficacy, generation, gender, and subject area.

If teachers use technology effectively, the development and implementation of emerging technology-based activities will coincide with the constructivist approach, which is based on the belief that individuals create meaning out of their experiences (Creswell, 2003). By using constructivism and the social cognitive theories as the overarching paradigms of the research project, the researcher's questions are designed to be intentionally broad in their scope to allow participants to develop and espouse their own interpretation of events (Creswell, 2003). The TPSA C-21 provides that broad scope for participants and the researcher. Educators must be willing and comfortable using the modern tools to provide an effective learning opportunity. As a result of this position, this study allows the researcher to determine whether a statistically significant relationship exists between teachers' technology efficacy and generation, gender, and subject area.

Problem Statement

Currently, the empirical research available on the topic of teacher technology efficacy, as it relates to gender, subject area, and generation is contradictory and limited in number in the high schools in America. Ertmer and Ottenbreit-Leftwich (2010) reported that the link between self-efficacy and subsequent integration of technology has been identified as an important area of research. The evidence determining whether a strong predictive relationship exists between technology efficacy and gender, subject area, and generation varies. Baek, Zhang, and Yun (2017) revealed that gender and age influences elf-efficacy, while Perry and Steck (2015) revealed that self-efficacy is influenced by subject matter. Middle school math teachers and college students in an elementary mathematics education program were the focus of Karatas, Tunc, Yilmaz, and Karaci's (2017) study on teachers' perceptions toward instructional technologies, in which female participants scored higher than their male counterparts While the efficacy of teachers as determined by gender, age, and subject matter has been studied (Salleh & Laxman, 2015), these factors have not been used in conjunction with 21st century technology devices as measured by the TPSA C-21 (Christensen & Knezek, 2017), which will be the evaluation tool in this research study.

In this study, the researcher focuses on teachers currently working in the high school environment, who have already begun implementation of various 21st century technology devices in their science, math, history, and literature classrooms. The broad expansion of technology, as well as its evolution, trends, and the impact in the field of education requires teachers to update their technology use. Teachers, regardless of their generation, gender and subject area, are expected to address students' technology needs without having a strong belief in its usefulness, ease of use, or availability. The problem is that limited research is available that provides evidence of the predictive ability of teachers' technology efficacy regarding generation, subject area, and gender as measured by the TPSA C-21.

Purpose Statement

The purpose of this study is to explore the predictive ability of technology efficacy among secondary teachers who use 21st century technology in classrooms in the state of Florida as measured by the TPSA C-21. A limited amount of empirical research is available that examines the predictive relationship of 21st century technology efficacy and the generation, subject area, and gender of teachers employed in American secondary schools. The predictor variables, variables that cannot be manipulated (Gall, Gall, & Borg, 2007) are generation, gender, and subject area. Generation is defined as a group that shares the same birth years and claim to have the same beliefs, values, and outlook on life because they experienced similar world event during their coming of age years (Stanton, 2017). For this study, gender is defined as a person's biological sex. Subject area is defined as the "general overarching category a particular academic discipline falls within" (le Roux & Parry, 2017, p. 87). The criterion variable, the outcome variable (Warner, 2013), is technology efficacy. It is defined as the belief in one's own ability to perform a technologically sophisticated new task (Laver, George, Ratcliff & Crotty, 2012).

Furthermore, research studies have not been consistent in determining whether a relationship exists among the proctor variables (generation, gender, and subject area) in this study. The population used in this study is 78 ninth through twelfth grade teachers employed in four districts within the state of Florida. This study addresses the gaps in literature to provide research-based evidence for teachers and to analyze the factors that may determine teachers' technology efficacy.

Significance of the Study

The significance of this study is to provide empirical research regarding technology efficacy and the use of 21st century technology devices in American high school settings. The familiarity, or lack thereof, teachers have with technology can affect how they think and act toward the implementation of technology (Bleicher, 2014; Chiu & Churchill, 2016). Vongkulluksn, Xie, & Bowman (2018) revealed that having positive value beliefs towards technology is imperative in "overcoming teachers' perception of external barriers to technology integration" (p. 79). Integrating 21st-century technology devices in content-specific high school instruction is relatively new for some teachers in the field of education. This study examines how teachers view their abilities to adequately use 21st century technology in their daily instructional practices.

The results are beneficial for educational administrators and stakeholders in the state of Florida because their goal is to assist and provide instructional personnel and staff with opportunities and training to integrate technology into classroom teaching (Florida Department of Education, n.d.). Participating teachers have an opportunity to view the results of their teacher technology efficacy scores and target technology scales (WWW, Integrated Applications, Email, Teaching with Technology, Teaching with Emerging Technologies, and Emerging Technologies Skills) that are beneficial to them.

Other school practitioners across the United States of America who are considering altering instructional strategies and granting teachers' permission to effectively incorporate emerging 21st century technology skills and devices in instruction within their school system may also benefit from the study. Educational leaders and administrators can address the teachers who lack the skills to use new educational technologies and the value-beliefs required in overcoming existing barriers (Vongkullksn et al., 2018).

By including teachers who are currently implementing 21st century technology such as laptops, tablets, and smartphones in their pedagogy, this study allows other teachers and administrators to determine whether to foster a school climate that allows teachers to take similar risks (Thomas, O'Bannon, & Britt, 2014). The risks, which are tied to cost and instructional effectiveness, consist of transitioning from traditional classrooms to advanced technology-based classrooms (Florida Department of Education, 2014). Participants in this study are required to use 21st century devices in their classrooms, but the perception of their efficacy in implementing and using 21st century technology as well as the predictive relationship between generation, subject area, gender, and technology efficacy are unknown.

This study examines the factors that determine teachers' technology efficacies, namely their perceptions of adequately using technology tools and devices in their high school classrooms. Moreover, American high school is the focus because of the limited amount of literature in this area as it pertains to teachers' perception of technology by generation, gender and subject area in America. A plethora of information was available in the university (Anderson, Groulx, & Maninger, 2011; Bao, Xiong, Hu, & Kibelloh, 2013; Faizi, 2018; Karatas, Tunc, et al., 2017; Willis, 2015). K-12 (Yu, 2013; Hall & Trespalacios, 2019; Holden & Rada, 2011; Minshew & Anderson, 2015; Navaridas, Santiago, & Touron, 2013; Vongkulluksn, et al., 2018) and international (Kaya & Yazici, 2018; Serin, 2012; Turel, 2014; Ucus & Acar, 2018) settings. From a constructivist viewpoint, teachers are able to develop and guide students to completing 21st century technology-based activities and assignments using a pedagogy that is different from the archaic teaching practices evident in teacher-centered lectures (Barak, 2017; Krahenbuhl, 2016). This study benefits not only teachers and administrators within the two districts of Florida, but also other educators in other states within the United States of America. Professional development facilitators, teacher organizations, and other practitioners in surrounding districts who have the desire and plan to reexamine the use of technology can also benefit from this study. They are able to reevaluate their technology and curriculum plans to improve the quality and effectiveness of instruction. This study is also beneficial to university administrators who seek to provide adequate technology courses for future teachers enrolled in the education program (Barak, 2017; Lowell & Morris, 2019; Sánchez-Mena, Martí-Parreño, & Aldás-Manzano, 2019).

Research Question

This study examines the following research question:

RQ: Is there a predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning?

Definitions

1. *Baby boomers*- Baby boomers are individuals who were born between 1942 and 1960 (Rickes, 2016). According Venter (2017), baby boomers were born between 1946 and 1964. For this study, the birth years of baby boomers are between 1945 and 1964.
2. *Digital immigrants*- Digital immigrants are people born in the generation before new technology was invented (Wang, Hsu, Campbell, Coster, & Longhurst, 2014).
3. *Digital natives*- Digital natives are native speakers of technology who are fluent in the digital language of computers, video games, and the Internet (Prensky, 2005).
4. *Emerging technology*- Emerging technology is labeled as tools and technologies used in educational environments (Veletsianos, 2010).
5. *Generation*- A generation is a group who are were born during a specific time period. They share similar beliefs and values due to experiencing the same world events during their coming-of-age years (Stanton, 2017). Three categories in this study are baby boomers, millennials, and generation Xers.
6. *Generation X*- A group of individuals who were born between 1961 and 1981 (Rickes, 2016), 1965-1981 (Kamber, 2017), 1965-1976 (Brown, 2012), or 1965-1984 (Masnick, 2017) For the purpose of this study, generation Xers will be dated from 1965-1984.

7. *Mastery experience*- An area of efficacy in which individuals have an opportunity to experience success in a given task. It has been identified as one of the most effective ways for building self-efficacy (Bandura, 1997).
8. *Millennials*- Millennials are individuals born between 1980 and 1990 (Li, Worch, Zhou, & Aguiton, 2015; Owens-Hartman, 2015). Gong, Ramkissoon, Greenwood, and Hoyte (2018) identified millennials as people born during the time frame of 1980 and 2000. Rickes (2016) extended the time frame to 2004. For this study, millennials birth year range is 1985 to 2004.
9. *Mobile devices* -Mobile devices are technology tools in the form of portable digital devices, namely smartphones and tablet computers that allow their users to have internet (cellular or Wi-Fi network) access (Grant et al., 2015). Other devices consist of flip cameras, slates, pads, netbooks, and laptops (Vaughan & Lawrence, 2013).
10. *Physiological and emotional state*- The area of self-efficacy in which people associate their stress reactions and tensions as being susceptible to poor performance (Bandura, 1997).
11. *Self-efficacy*- Self-efficacy is the belief that people have that they can be successful in any given task (Bandura, 1997).
12. *Social persuasion*- Social persuasion is a method in which one is encouraged to succeed through interactions with others (Bandura, 1997).
13. *Teacher efficacy*- Teacher efficacy focuses on the belief teachers have toward how well they can cope with and perform a necessary action they must perform (Gökçek, Günes, & Gençtürk, 2013).

14. *Technology self-efficacy* – This concept is the belief individuals have in their abilities to successfully perform a technologically sophisticated new task (Laver et al., 2012).
15. *Vicarious experience*- An area of self-efficacy that uses social models as an influential way of creating and strengthening efficacy beliefs (Bandura, 1997).
16. *Web 2.0 technologies*- Web 2.0 technologies are social media platforms that are categorized in three forms: social networks (Facebook and Twitter), content sharing and organizing online platforms (YouTube, Dropbox, and SlideShare), and content production and editing websites, such as Wiki, Blogger, Google Docs, and WordPress (Faizi, 2018).

CHAPTER TWO: LITERATURE REVIEW

Overview

In this literature review, the focus, theoretical constructs, and empirical literature that address the use of technology in 21st century classrooms serve as the foundation of the study's predictive correlational design. This review addresses the theoretical perspectives for this study, the application of theories to study, the implications of technology integration, the barriers and benefits of technology integration, the role and impact of self-efficacy, the factors that affect teachers' self-efficacy, and the attitudes towards technology use. In the light of advancements in the 21st century, teachers need to be prepared for efficient use of technology as they educate future generations. Particularly, mobile technology has transformed traditional methods of teaching by creating more independent learning opportunities for students (Chiu & Churchill, 2016).

Despite the benefits of technology, teachers are often unprepared for meeting the demands of technology-rich classrooms (Elstad & Christophersen, 2017). Specifically, factors such as teachers' gender and subject area might influence beliefs, attitudes, and level of mastery of technology use (Chiu & Churchill, 2016) in the classroom. Further research that focuses on this study's predictor variables (generation, subject area, and gender) might shed light on how to better equip teachers to manage the dual challenges of technology-driven classrooms and tech-savvy students. Thus, the primary purpose of this study is to explore whether a predictive relationship exists between teachers' efficacy and the gender, generation (baby boomers, generation X, and millennials), and subject area of teachers who use 21st-century technology in a high-school setting as measured by the TPSA C-21 (Christensen & Knezek, 2017).

Conceptual Frameworks

This study utilizes Bandura's social cognitive (1997, 2012), Dewey's (1922) and Piaget's (1952) constructivism theories in analyzing teachers' self-efficacy beliefs relating to 21st century technology use to maximize student learning. Dewey (1922) believed that the complexity of a new construct dep ends on the individual's prior habits and organization. Using the constructivist theory, the researcher examines the development and creation of teachers' technology-based activities. Bandura (2012) acknowledged the social changes resulting from the advances in technology and underscored how those changes affect education, work habits, and modes of communication. In this section, the researcher presents a detailed analysis of the two theories to examine how the self-efficacy of teachers might help or hinder the incorporation of 21st century technology in the classroom.

Social Cognitive Theory

Bandura's social cognitive theory (1997, 2012) is the foundation for the perception teachers have toward their instruction and tools they are required to utilize. Bandura (1997, 2012) reiterated how people have the capability to produce desired outcomes by exercising self-control and preparing for specific circumstances. He proposed that personal and social values gained from the ability to control situations motivate people to apply self-regulations (Bandura, 1997). According to Bandura (1997), the technological advancements bear testimony to the ability of human beings to modify their environment. The basic premise of Bandura's (2012) social cognitive theory is that human beings' actions are often based on beliefs about their capabilities rather than their actual competencies. Self-efficacy refers to those beliefs and perceptions that guide actions and behaviors to produce valued outcomes (Bandura, 1997) and how well people can organize, create, and manage circumstances in their lives (Bandura, 1997). Indeed, self-efficacy is a primary influence behind human motivation (Bandura, 2012).

In establishing the main sources of self-efficacy, Bandura (1997, 2012) underscored the importance of four categories of experience: mastery, vicarious, social persuasion, and physiological and emotional states. Bandura (1997) argued that when people are successful in their experiences, they gain confidence in themselves that further motivate them to work harder and achieve the desired outcomes. Conversely, failures thwart self-confidence and demoralizes people from taking positive actions (Bandura, 2012). Vicarious experience relates to the sense of efficacy one gains by observing and modeling other people who succeed by overcoming obstacles (Bandura, 1997). Social persuasion suggests that when people are told that they are capable of successfully completing a job, they muster the ability to do so by exerting more effort (Bandura, 2012). Finally, Bandura (2012) believed that people's efficacy beliefs are influenced by their physical and emotional states. For instance, emotional and mental stress as well as physical tiredness can affect their perceptions of their capabilities. Bandura (1997, 2012) underlined how extraneous factors can distort the relation between one's self-belief of capability and action, which in turn, can affect performance levels.

Two key points that come across from Badura's (1997, 2012) social cognitive theory are that human agency allows individuals to play active roles in their lives, exert influence, and modify their actions and that self-efficacy can predict performance to a great extent. In social cognitive theory, people have the tendency to develop rules of behavior based on previous experiences, whether positive or negative, and will alter their cognitions to produce positive results (Liaw & Huang, 2015). With respect to agency, Bandura (2012) postulated that humans actively seek to construe their environments in manners that best suit their purposes. Humans tend to choose actions and behaviors that give them more control over their environments (Bandura, 2012). The belief teachers have about their abilities to adequately provide quality instruction that will result in student success can be impacted by 21st century technology devices. Factors used to determine a high level of technology efficacy in presenting quality instruction include helpful instructional tools overall content knowledge, and effective instructional strategies (Nawi, Hamzah, Ren, & Tamuri, 2015). A proper assessment of one's self-efficacy with respect to one's skills is critical for success (Bandura, 2012).

By adding emerging technology devices in the pursuit of knowledge, teachers provide instruction that somewhat mirrors the social acquisition of knowledge in students' everyday lives. Since the perception is that millennials and generation Xers are more advanced in technology use (Wiedmer, 2015), some teachers who were not born in the age of technology, such as baby boomers, may tend not appreciate it (Venter, 2017), and therefore, omit the major social aspects of advanced technology from their instruction. Even though some teachers are confident in the pedagogical content of their subject areas, they rely on students to assist in learning different aspects of technology tools (Courduff, Szapkiw, & Wendt, 2016). While utilizing student skills can be beneficial, by doing so, teachers may in some ways limit their capabilities to adequately prepare students for the future. Teachers must feel comfortable and be productive in their quest to prepare students whose understanding and usage of the social component of technology far exceeds the knowledge of the teacher. Therefore, a high level of efficacy will most likely be the result of the teacher's experimentation with instruction that improves instructional capabilities, student engagement, and experience (Isbell & Szabo, 2015).

The study of teacher technology efficacy extends constructivist and social cognitive theories because it provides a modern view of how people learn, and the tools they use to learn.

The theories are further advances in that the societal norms in which teachers were born are analyzed to determine whether a relationship of technology efficacy exists. The current study research data will add to the body of knowledge of teacher technology efficacy. By focusing on the relationship among teacher technology efficacy, generation, various subject areas, and gender, the researcher will be able to provide teachers with information that may assist in improving their 21st century instructional technology applications and usage in the future.

Constructivism

Constructivism is a foundation for how people learn by actively interacting with their environment (Krahenbuhl, 2016). Dewey and Small (1897) indicated that “knowledge of social conditions, of the present state of civilization, is necessary” (p. 3). Piaget’s (1952) constructivist theory offers a robust framework for academics to understand how students construct knowledge through active exploration of their environment. The basis of constructivist theory is thinking and understanding (Bolliger, 2006). Krahenbuhl (2016) further explained constructivism as an area of psychology in which psychologists explain the process in which people “come to know what they know” (p. 97). Learning is acquired by “actively attaching meaning to a concept and integrating new or modified constructs into existing knowledge” (Bolliger, 2006, p. 119) and engaging in world events (Mayo, 2010). According to Piaget (1952), individuals interact with their environments and construct their own schemes of knowledge. When individuals are exposed to a novel idea, they grapple with the notion and struggle to understand them. Similarly, they resist the novelty of ideas as they have difficulty in accommodating the ideas in their existing knowledge schemas. Over time, experiences gained from exploring ideas or objects help individuals accommodate new knowledge. This experience is followed by a state of equilibrium, which allows individuals to assimilate the ideas. A new stimulus from the environment restarts the process, and individuals construct and reconstruct their knowledge accordingly (Piaget, 1952). As a result of the application of this theory, teachers will be able to consider the learner and classroom resources due to their personal experience with using email, instant messaging, internet sites, and chatrooms (Baker, Isbell, Wendt, & Wilson, 2013), which can be accessed through 21st century technology, such as tablets and laptops with internet capabilities. Teachers can use constructivism to form new instructional strategies in the classroom and alter their perceptions of technology.

The constructivist framework and all initial components of student-centered, technology-infused, inquiry-based assignments are the primary responsibility of teachers. Constructivism (Piaget, 1952) can help shed light on the role teachers can play in students' development and interaction with technology. The role of the teacher in the students' learning environments is that of a facilitator who poses challenges for the students (Stoeger & Krieger, 2016). In an optimal learning environment, teachers will create opportunities for students to explore and learn. Furthermore, teachers who have a willingness and positive attitude toward the use of technology tools (Holden & Rada, 2011) and adopt the constructivist teaching approach meet the needs of the global world (Ucus & Acar, 2018).

Researchers offer support and criticism of constructivism. Lending support to constructivism, researchers have elaborated on how experiences help individuals to form enhanced schemes allowing them to gain expertise in certain domains (Tourmen, Holgado, Métral, Mayen & Olry, 2017). Piaget's concepts were highlighted to show how workers conceptualize the environment around them (Tourmen et al., 2017). In contrast to Piaget's constructivism, Barrouillet (2015) found the theory to be antiquated in the wake of modern theories and development in biological sciences. He also argued that Piaget's concept of development is more than an acquisition and accumulation of knowledge (Barrouillet, 2015). Despite the criticism, Piaget's theory of constructivism is a viable explanation of the learning process in human beings (Harlow, Cummings, & Aberasturi, 2006; Krahenbuhl, 2016). Constructivism is a foundation for how adults learn by actively interacting with their environment (Krahenbul, 2016).

Application of Theories to Study

The constructivist and social cognitive theories are integrated to form the conceptual framework that guides this research study. First, the basic understanding teachers have toward new technology in an instructional setting guides them in constructing, orchestrating, and delivering instructional activities that are engaging for their students (Kim, Choi, & Lee, 2019). Factors such as teachers' generation, subject area, and gender may play a role in how they perceive new technology (Liaw & Huang, 2015; O'Bannon & Thomas, 2014). The social cognitive theory provides the foundation for the researcher of this study to focus on teachers' technology perceptions within three areas. The researcher can examine the relationship between teachers' technology efficacy, subject area, gender, and generation to determine whether significant relationships exist.

In a technology-infused classroom, teachers' efficacy beliefs are strengthened by repeatedly using different technological tools and applications to produce desired learning outcomes. Constructivism highlights how "learning takes place through a process in which knowledge is built on a foundation of prior knowledge" (Krahenbuhl, 2016, p. 97). In a classroom, teachers face new challenges in dealing with technological devices and are forced to reassess their learning to assimilate the new knowledge. Teachers in recent study Kim et al., 2019) expressed their willingness to alter their traditional instructional methods to incorporate the use of tablets and interactive whiteboards. Similar to the teachers, students were able to overcome challenges presented in the content by being actively engaged with the technological tools in front of them (Courduff et al., 2016). Bandura (1997) argued that people who have desired goals without applying much effort might fail to develop a strong sense of efficacy, and they can easily fall prey to self-doubt if they fail. Thus, teachers who gain mastery and persevere in the face of challenges may have a higher level of efficacy. Considering the constructivist and social learning theoretical framework, the following sections of this chapter will provide a review of the literature and analyze key findings on teacher efficacy in technology use.

Related Literature

Technology use and implementation in the classroom must evolve with technological advancements. The use of technology both in and out of the classroom is inevitable (Erdogan & Dede, 2015). Teachers have adapted and begun infusing current technology devices in classrooms. Some of the greatest challenges in the path of technology integration might stem from teachers' self-efficacy and attitudes toward technology (Elstad & Christophersen, 2017; Oddone, 2016). Given the fact that technological skills are critical for the 21st century workforce, the researcher will examine the factors that have the potential to create barriers for the integration of technology in the classroom. The following sections of the review will allow the researcher to explore the factors that affect teachers' self-efficacy, implications of technology integration, the role and impact of self-efficacy, and the barriers of integration, such as gender, generation, and subject area.

21st Century Technology Skills and Devices

Pertinent to this study, school district leaders, school-level administrators, and teachers have elected to implement 21st century devices, applications, and tools in classroom instruction.

The districts the researcher examined in this study utilized specific technological devices, such as tablets, Smartphones, and laptops. Using technology to produce and publish is an important 21st century skill (Beriswill, Bracey, Sherman-Morris, Huang, & Lee, 2016). Teachers use various 21st century technology devices to assist in their instruction. Apple iPads®, Samsung Galaxy®, and Microsoft Surface Pro® provide easy-to-use apps and access to instructional materials. Another type of device, the laptop, is also portable and has Internet connection capabilities. Google Chromebooks™ and Hewlett Packard™ EliteBooks have been used in the adoption of district-wide one-to-one technology initiatives. Teachers are required to incorporate technology use into their communication and instructional activities with students. The last type of technological device is the smartphone. Apple iPhones® possess the capability to allow teachers to send and receive instruction-related texts and videos and to email messages from any location. Turan and Goktas, (2016) also referenced the use of an online game-based question and answer application, Kahoot, that allows students to use their mobile phones to assess knowledge. In order provide immediate feedback, teachers used WeChat, a smartphone multi-modal app (Zijuan, & Gaofeng, 2016). The functions and modes of mobile phones in the classroom vary greatly, but teachers can integrate these devices to assist their students with comprehending subject matter.

Teachers' Self-Efficacy Beliefs about Technology Use

Using technology to assist students in acquiring knowledge is another layer added on to the responsibilities and duties of content area teachers. Technology self-efficacy is the belief in one's ability to teach in a technology-based classroom (Hineman, Bouory, & Semich, 2015). Teacher self-efficacy is the belief teachers have toward how well they can cope with and perform a necessary action with which they are faced (Gökçek et al., 2013). Each teacher has perceptions that stem from background, educational, or personal experiences. Teachers' belief systems can affect their use of mobile devices (Baek, Zhang, & Seongchul, 2017; Chiu & Churchill, 2016). Thus, investigating the relationships between teachers' technology self-efficacy and their generation, gender, and subject area will shed light on how those factors influence teachers' technology adoption.

The degree to which teachers utilize and integrate technology in their classrooms depends on their attitudes and beliefs about technology and beliefs of self-efficacy (Chiu & Churchill. 2016; Kwon et al., 2019; Mac Cullum, Jeffrey, & Kinshik, 2014). Self-efficacy is the belief in one's ability to achieve the desired outcome (Bandura, 1997; Oddone, 2016). Mobile devices in schools can assist educators in creating innovative educational methods. Teachers' self-efficacies pertaining to their levels of mastery in technology use can predict successful integration of technology (Elstad & Christopherson, 2017). In order to reap the benefits of the technology, teachers' fostering the right attitudes conducive for students' learning and gaining mastery over technology use is critical.

Efficacy is impacted by the teacher's belief in whether the technology is mastered (Hineman et al., 2015). Since millennials have been labeled as people who have a familiarity with the technology, they are believed to use it more than their counterparts. However, (Christensen & Knezek, 2017) argued that using technology for personal use does not equate to effective instructional use. This belief in mastery and effectiveness of technology for efficacy purposes will influence the amount of use in classroom instruction.

The attitudes and perceptions of teachers have a huge impact on the effectiveness of their instructional strategies and tools in the classroom. Thus, efficacy can be predictive of teachers' intentions to include or preclude technology tools for students' teaching and learning purposes.

Willis (2015) addressed the direct relationship between higher levels of performance and self-efficacy. Teachers' self-efficacy is also closely related to their perception of mastery in technology use (Hineman et al., 2015; Oddone, 2016). Oddone (2016) identified multiple aspects of self-efficacy: instruction, decision-making, classroom discipline management, parent and community engagement, and overall classroom environment. She highlighted the role played by self-efficacy in improving teachers' technology implementation (Oddone, 2016). Positive perceptions about their mastery of technology skills increased teachers' acceptance of technology and eased implementation of technology (Oddone, 2016).

Meeting teachers' training needs in order to help them establish connections between technology and pedagogy is vital (Barak, 2017; Oddone, 2016). Existing teacher training programs fail to meet teachers' actual training demands (Oddone, 2016). This opinion has been corroborated by other researchers who believe that teacher preparation programs do not meet the technology training needs of the teachers (Burden & Hopkins, 2016). In this respect, modeling peers' teaching methods could help teachers improve teacher training programs and meet the technology needs of the teachers by providing instances of technology use in real situations (Oddone, 2016). On a similar note, Elstad and Christophersen (2017) also emphasized that socializing and collaboration with teachers could help pre-service teachers overcome technological challenges.

Researchers have indicated that teachers who lack self-confidence in using technological devices are reluctant to adopt them for teaching students (Elstad & Christophersen, 2017; Mac Callum et al., 2014; Oddone, 2016). Teachers often experience lower levels of self-efficacy in technology-driven classrooms. Particularly, in 21st century classroom, where students have wide access to mobile devices and are extremely savvy in using them, teachers without proper training feel that they are at a disadvantage (Elstad & Christophersen, 2017). Indeed, teachers might feel threatened when they perceive the students to be more capable than they are in using technology efficiently (Mac Callum et al., 2014). They find themselves incapable of resolving technology-related issues as they arise in the classrooms. Furthermore, they feel the constant pressure of updating their skills and staying abreast of the technological innovations (Burden & Hopkins, 2016; Elstad & Christophersen, 2017). Burden and Hopkins (2016) found that self-efficacy pertaining to technology use also wavered to a great extent in pre-service teachers when they experienced technological impediments.

Teachers lacking in technology self-efficacy might not be motivated to embrace emerging technological devices nor utilize them for students' learning. Yet, teachers must be able to adapt to the social changes augmented by emerging technology and realize the impact such changes can have on their instructional methods. The use of mobile technology is not only pervasive among students, but it is often a preferred mode of learning for them. The current generation of learners is more comfortable using technological tools on a daily basis. As such, student learning can be optimized through the use of popular mobile devices as compared to traditional tools such as pen, paper, and chalkboards. Since teachers' self-efficacy beliefs and attitudes influence their technology use, school administrators often struggle to convince their teachers to use technology in the classroom (Salleh & Laxman, 2015). Given that self-efficacy beliefs or perceptions of one's capabilities were found to be significant predictors of technology use, administrators can provide incentives as well as opportunities for personal growth through tailored intervention programs (Salleh & Laxman, 2015).

Lower levels of self-efficacy beliefs have multiple repercussions on student learning (Hineman et al., 2015; Perry & Steck, 2015; Willis, 2015). Perry and Steck (2015) underscored competence as a critical component of technology adoption. Self-efficacy beliefs of teachers have a reciprocal relationship with student-learning. Researchers have indicated that when teachers gain more confidence and experience in using technology tools, their students also develop positive attitudes towards technology and learning (Baek et al., 2017; Perry & Steck, 2015). Oddone (2016) also highlighted the need for practical experience of using technology to help them overcome their anxieties. Thus, teachers might not be motivated to adopt new technology if they are anxious about it and find it difficult to learn. While self-efficacy can influence efforts and outcomes, researchers have indicated that the value teachers place on a specific task can predict their intentions for using it in the future (Willis, 2015). Thus, perceived task value and interest in the task can impact teachers' self-efficacy (Willis, 2015).

Teachers with a strong sense of self-efficacy will put in additional efforts to overcome challenges to achieve the desired outcomes (Bandura, 2012). However, self-efficacy not only varies from individual to individual, but across domains of knowledge (Bandura, 2012). Irrespective of how self-efficacy is integrated and developed in individuals, Bandura (2012) emphasized that these beliefs are best assessed to be multidimensional rather than uniform. Thus, teachers' self -efficacy can vary across knowledge area and external environmental factors (Bandura, 2012). Researchers have shown that self-efficacy is influenced by teacher demographics, such as age and gender (Baek et al., 2017). When teachers are not adequately prepared for teaching their content area, they cannot achieve their objectives (Nawi, et al., 2015).

Another possible problem that negatively affects teachers' overall efficacy is the lack of knowledge about the various technology skills that are beneficial in their subject area. Educators' perceptions must also be grounded in the belief that they can facilitate as students work collaboratively to accomplish difficult tasks. Professional development improves teacher knowledge and classroom instruction, which in turn increases student achievement (Guo & Yang, 2012; Hassan, 2019). The comfort level and likelihood of teachers using 21st-century technology devices are key to their establishing a routine of future use.

Relationship between Generation and Self-efficacy

A factor in technology that can impact technology efficacy amongst all teachers is the generation in which they were born. Although people within each generation are able to access communication technology, the different forms of technology have broadened the gap amongst each of the generations (Venter, 2017). This gap may also be evident in the classroom with various generations of teachers in American high schools. Researchers (Minshew & Anderson, 2015) believed that teachers play an important part in integrating the technology into the classroom. Therefore, technology use in relation to generation should be addressed to make sure teachers are able to successfully apply the technology to the learning of all students (Lowell & Morris, 2019).

For the purposes of this literature review, teachers will examined in the context of three generations. The beginning phase of a generation is considered to be the time in which the birth rate increases to the time in which it either increases or remains steady (Cogin, 2012). Teachers within the baby boomer, generation X, and millennial generation categories are the predictor variables in this study. Age-related differences in self-efficacy about technology use have been well established in literature (Li, et al., 2015; O'Bannon & Thomas, 2014; Wiedmer, 2015). Teachers from different generations bring unique characteristics to the classrooms that may hinder or facilitate technology incorporation (Wiedmer, 2015). The different generations composed of baby boomers, generation Xers, and millennials foster different values, attitudes, and beliefs (Poláková, & Klímová, 2019; Wiedmer, 2015). Each generation's values are framed with reference to historical and social changes that they perceive and experience during their lifetimes (Wiedmer, 2015).

While technology use is ubiquitous among these generational cohorts, the degree to which they use technology and find it helpful and easy to use varies with the differences in attitudes and skill levels they possess (Wiedmer, 2015). The differences get even more pronounced with the advancements in technology, such as the use of mobile devices (O'Bannon & Thomas, 2014; Wiedmer, 2015). The millennials, people who grew up in an era marked by technical innovations, value specific social constructs (social media, multitasking, and independent learning systems) more than their predecessors (Rickes, 2016; Wiedmer, 2015). Although the baby boomers might use technological devices, they might be unenthusiastic about integrating the devices for teaching as they lack the required skills (O'Bannon & Thomas, 2014) and experience using technology in the classroom (Lowell & Morris, 2019). In comparison, millennials are more tech-savvy and more willing to accept technology use for student-learning purposes (Rickes, 2016). Technology-related decisions are not only guided by the sense of mastery of the technological skills, but also by the importance each generation places on the benefits of technology use (Lowell & Morris, 2019; O'Bannon & Thomas, 2014). Furthermore, Nawi et al. (2015) revealed that age was a factor in their participants' preference of mobile devices because the small scripts were hard to read. Polat, Çelik, and Okçu, 2019 have analyzed how the teachers in the baby boomer generation are thought to be using technology inadequately while millennials use it effectively

Baby boomers. Baby boomer teachers were born after World War II. Cogin (2012) indicated that this generation began in 1947 and ended in 1963, while Rickes (2016), pinpointed the years ranging from 1942 to 1960. Venter (2017) categorized baby boomer as born between the years of 1946 and 1964). For the purposes of this study, baby boomers are defined as people born between 1945 and 1964. Baby boomers are considered to be competitive, independent, and goal oriented (Wiedmer, 2015). In the workforce, namely the education arena, baby boomers question the relevance of social structures (Rickes, 2016). They are known to implement traditional lectures or explicit instruction, such as question-and-answer type activities (Bektas, 2013). In contrast, Poláková, and Klímová (2019) stated baby boomers favor group interactions and discussions, which indicates their work habits are conducive to the adjustments necessary in the implementation of new instructional tools and methods in the classroom. Their competitive nature may be considered a plus when determining their perception of their level of technology efficacy.

Generation X. The next generation of focus is generation X. Teachers in this generation were born during 1961-1981, (Rickes, 2016), 1966-1976 (Cogin, 2012), or 1965-1984 (Masnick, 2017). For the purpose of this study, generation Xers will be dated as born from 1965 to 1984. Their work ethic is less stringent than that of baby boomers. According to Weidmer (2015), they are pragmatic and direct, expect change, and also require some flexibility in rules and workplace regulations. Those born during this time period value the freedom to make their own decisions (Poláková, & Klímová, 2019**).** The notion of using new technology, such as mobile devices, in the classroom could be a change that would not decrease their level of efficacy. Personality-wise, people referred to as generation X are considered to be cynical and disconnected because many were latchkey-kids in their childhood years (Rickes, 2016). As a result, their work ethic and success came from trusting their instincts (Rickes, 2016) instead of relying on teamwork or collaborative groups.

Millennials. Millennials have a distinct birth time frame and characteristics. Millennials were born between 1979-1994 (Cogin, 2012) or from 1980 and 1990, and they are accustomed to varying degrees of technology (Li et al., 2015; Owens-Hartman, 2015). Other time frames for this generation extend to the year 2004 (Rickes, 2016). For the purpose for this study, millennials will be defined as people born between the years of 1985 to 2004. People in this time frame are able to use technology and media in a variety of ways (Kee & Samsudin, 2014, Owens-Hartman, 2015). Their work ethic can affect their perception of technology in that they are familiar with devices that are used in 21st century classroom. Their behavior patterns vary to include confident, team-oriented, entitled, multi-taskers, and conventional (Rickes, 2016). Their behavior is a direct consequence of the parenting methods of their parents, the baby boomers and generation Xers. They prefer to receive information in an informal, active classroom, with the option to complete the more formal direct instruction out of class (Rickes, 2016). This personal preference may impact the millennial teachers' instructional methods and deliveries.

Contrary to these predictive patterns, the various generational cohorts exhibit differences in technology adoption. O'Bannon and Thomas (2014) indicated that teachers 50 years of age and older can learn to adopt technology by getting more exposure to technological devices. Researchers (Kwon et al., 2019; O'Bannon & Thomas, 2014) also addressed years of experience rather than age of the teachers as being significant predictors of the quality of technological adoption and efficacy. Millennials, who are known for their preference for technology tools, often lack the advanced skills required for proper adoption of technology (O'Bannon & Thomas, 2014; Poláková, & Klímová, 2019). Similarly, Christensen and Knezek (2017) pointed to this dichotomy and argued that using technology for personal use does not translate to effective use for instructional purposes. Corroborating the findings of O'Bannon and Thomas (2014), Li et al.

(2015) found that although digital natives are supposedly more technology oriented, it does not necessarily make them competent users of advanced technology in the classroom. Li et al. (2015) further noted that digital natives may need support with technology integration in the teaching workforce.

Some researchers did not find generation to be a significant mediator for self-efficacy about technology use (Lai & Hong, 2015). The results of a study investigating if university students have different thinking and learning techniques regarding digital literacy and connectedness than their predecessors suggested no differences in the generational cohorts (Lai & Hong, 2015). In their analysis of college students in New Zealand, Lai and Hong (2015) found no differences in learning styles or technology use among the different generations of students. Their findings also revealed that generation is a determining factor and can influence self-efficacy. Teachers are not as familiar with using 21st century technology tools as digital natives (Beriswill et al., 2016). Digital natives are native speakers of technology who are fluent in the digital language of computers, video games, and the Internet (Prensky, 2005). Although generation might have negative implications for student leaning, a better understanding of the technological devices and their benefits might motivate teachers to overcome age barriers and adopt technology for enhancing educational outcomes. Furthermore, in spite of the differences, different generational cohorts can also share certain common cultural values (Rickes, 2016).

Relationship Between Gender and Self-Efficacy

One of the widespread differences in technology use that exist amongst teachers is related to gender (Baek et al., 2017; Liaw & Huang, 2015; Scherer & Siddiq, 2015). In the case of this study, gender can be defined as biological sex as determined at birth. In the case of technology, gender differences in technology acceptance have been widely debated (Liaw & Huang, 2015;

Liu & Guo, 2017; Scherer & Siddiq, 2015). The intent to use technology is different among males as compared to females. Males' intents are determined by perceived usefulness, and females' intents are determined by ease of use **(**Liaw & Huang, 2015). In another study, Alhazza and Lucking (2017) revealed that females have a more positive view of utilizing the social components of technology, such as texting and emailing. These research studies revealed mixed results in gender technology efficacy.

While some researchers found teachers' gender to mediate their technology use (Baek et al., 2017; Liaw & Huang, 2015), others found gender to be a non-significant factor in influencing teachers' technology adoption (Li, Li, & Franklin, 2016). Some researchers found that male and female teachers' perceptions about technology adoption vary based on their notions of how technology can be useful for learning purposes (Baek et al., 2017; Liaw & Huang, 2015; Scherer & Siddiq, 2015). Female university teachers in New Zealand had a more positive perception toward mobile technology use than males did (Lai & Smith, 2018). Baek et al. (2017) revealed that elementary and secondary school female teachers fostered more positive attitudes than their male counterpart on certain aspects). These aspects consist of the suitability of mobile technology for the learning objectives, the appropriateness of mobile technology for enhancing learning, and the application of the technology tools for communication (Baek et al., 2017).

Liaw and Huang (2015) examined gender differences in Taiwanese university students' self-efficacy and attitudes towards mobile learning. Specifically, they studied the factors that interplay in shaping participants' attitudes toward technology use. The limited number of resources regarding gender and efficacy in American schools led to the investigation of research done in other countries around the world. Although this study was not based on teachers' demographics, it nonetheless showed important gender -related differences that can affect technology integration. Learners' personal qualities including self-efficacy and anxiety can influence their attitudes towards skill acquisition (Liaw & Huang, 2015). The results of Liaw and Huang's study showed that self-efficacy can predict learners' perceptions of usefulness and ease of use of technology for male and female students. Gender differences may affect attitudes toward mobile learning (Liaw & Huang, 2015). Furthermore, they found that the perceptions of anxiety were a significant predictor for female learners in the area of social network communication (Liaw & Huang, 2015). The researchers emphasized the importance of understanding gender differences in mobile learning in order to tailor training to meet the needs of both genders (Liaw & Huang, 2015). Scherer and Siddiq (2015) indicated that gender difference in self-efficacy persisted amongst Norwegian high school teachers. The results showed that males possessed more self-efficacy than females in terms of basic and advanced operations as well as in collaborative work. However, no gender differences were present in terms of technology use for instruction (Scherer & Siddiq, 2015).

Other researchers have indicated that culture-based gender differences might affect technology adoption for both men and women (Liu & Guo, 2017). By addressing gender biases in America, the researcher will fill the gap in literature toward perception in relation to gender differences. Liu and Guo (2017) highlighted the differences in males and females in terms of personal characteristics as well as roles in society that often contribute to variances in attitudes and behaviors. The researchers analyzed how gender mediated the connection between perceptions of costs and acceptance of mobile devices, perceptions of usefulness and ease of use, trust, and social benefits (Liu & Guo, 2017). The results indicated that adoption of mobile devices was influenced by these factors more strongly for women than men in China (Liu & Guo, 2017). Particularly, they found that women in East Asian countries still faced more challenges in adopting and using mobile devices than their male counterparts (Liu & Guo, 2017). As females play a more family-focused role, perceived costs of technology had a deeper impact on their technology adoption decisions (Liu & Guo, 2017). Interestingly, the study revealed that for male college students, perceptions of usefulness and social advantages were two primary factors that affected their mobile adoption (Liu & Guo, 2017). The results of the study indicated that perceptions of usefulness could predict more mobile adoption for males than for females (Liu & Guo, 2017). The researchers believe the explanation for the differences between males and females' perceptions of usefulness could be that women were not exposed to the technology as much as the men; thus, women lacked experience to consider usefulness as a determining factor (Liu & Guo, 2017).

In contrast, some researchers did not find gender to mediate technology use (Baydas & Goktas, 2016; Li et al., 2016). In their analysis of technology adoption by pre-service teachers, Li et al. (2016) identified the following aspects: self-efficacy and attitudes pertaining to technology use, perceptions about ease of use of technology, and perceptions about barriers relating to technology integration. Their study revealed that, although the constructs were significant predictors of intentions for technology integration, gender did not influence any of those aspects. Baydas and Goktas (2016) found that preservice teachers' gender was not a mediating factor in their technology adoption intentions. Specifically, the researchers analyzed how factors such as perceptions of usefulness, self-efficacy, social effect, anxiety, and intentions affect teachers' use of technology (Baydas & Goktas, 2016). Furthermore, they analyzed if the gender, university, and department of the teachers influenced those factors (Baydas & Goktas, 2016).

Although generation, gender, and subject area have been analyzed separately, these factors are interrelated and influenced self-efficacy about technology use in an interconnected manner. For instance, researchers (Kwon, et al., 2019) have found gender differences that influenced mobile device use, in which male teachers' self-efficacy is higher than that of female teachers. Technical skills were a significant predictor of higher efficacy in males than females (Kwon et al., 2019). Thus, considering the interconnected nature of the factors that influence self-efficacy in the background will help in understanding the true implications of these factors in teachers' technology use.

A review of the literature revealed a lack of consensus pertaining to the gender differences in teachers' self-efficacy. However, in spite of the contradictory findings, researchers agreed that gender could be a significant influence on teachers' self-efficacy relating to technology adoption (Baek et al., 2017; Liu & Guo, 2017). As such, more research exploring the relationship between self-efficacy and gender is needed. Researchers have also pointed to the need for educational trainers and administrators to consider gender specific differences and how those affect technology implementation and use (Liu & Guo, 2017). Researchers indicated that teacher's age and gender could influence technology use (Baek et al., 2017; Liaw & Huang, 2015). More importantly, self-efficacy can facilitate teachers' implementations of technology as they prepare students for a technology-driven market.

Relationship Between Subject Area and Efficacy

Another factor that affects teachers' self-efficacy is their subject area (Chiu & Churchill, 2016). Researchers have underlined that science and mathematics teachers have been predominantly known to exhibit high levels of self-efficacy (Chiu & Churchill, 2016; Szeto & Cheng, 2017). However, further literature supported that the relationship between self-efficacy and subject area was more complex. Although science teachers have been thought to be at the forefront of technology transition in the classroom, they perceive their lack of technology skills and knowledge as barriers in technology integration and classroom practices (Barak, 2017; Wang et al., 2014). Additionally, while some researchers have found that science and mathematics teachers exhibit more self-efficacy than language and humanities teachers (Chiu & Churchill, 2016), others have found that mathematics and science teachers show lower levels of self-efficacy and positive attitudes relating to technology use (Baek et al., 2017). Chiu and Churchill (2016) examined how self-efficacy and attitudes towards technology use varied across different subject areas and whether those beliefs underwent changes after adoption of mobile technology. Additionally, physical education teachers rate themselves to be confident in their ability to integrate technology (Krause, 2017). The researchers identified that different subject-related notions and learning goals accounted for the differences (Chiu & Churchill, 2016). For instance, the humanities and language teachers felt that mobile technology did not contribute significantly to content learning whereas the science and mathematics teachers felt that mobile devices could help them achieve the educational goals (Chiu & Churchill, 2016).

Interestingly, Chiu and Churchill (2016) also found that while anxiety decreased to some extent as teachers became more familiar with the technological tools, their attitudes did not undergo any changes. The researchers emphasized that this bears evidence that technology integration and ease of use might not contribute to changes in attitudes (Chiu & Churchill, 2016). Thus, core beliefs about the effectiveness of technology to enhance student-learning in specific subject areas affected technology adoption (Chiu & Churchill, 2016). As such, for planning and implementation purposes, taking into consideration how the content in subject areas can make a difference in teachers' attitudes towards technology adoption is important (Chiu & Churchill, 2016).

Baydas and Goktas (2016) found that department or area of study had a significant impact on teachers' technology adoption and efficacy. Their study revealed that preservice teachers in Turkey who were studying mathematics showed lower intentions of technology adoption in comparison to teachers studying English and science (Baydas & Goktas, 2016). Also, Baek et al. (2017) found that science teachers showed the least positive attitude of all teachers toward of mobile technology. This finding contradicted that of Chiu and Churchill (2016), who found that science teachers demonstrated positive attitudes towards technology adoption. Baek et al.'s (2017) study also revealed that language teachers rated technology for communication purposes higher than other teachers. Teachers studying a foreign language also revealed lower intentions of technology adoptions. Contrary to Baek et al.'s (2017) findings, Baydas and Goktas (2016) found that science teachers showed lower levels of anxiety pertaining to technology adoption.

While teachers' self-efficacy varied across subject area of the teachers, researchers found that teachers' instruction-related decisions were influenced by subject-based culture, personal preferences, personal reasoning, and external factors such as school environment (Heitink, Voogt, Verplanken, van Braak, & Fisser, 2016; Howard, Chan, & Caputi, 2015; Szeto & Cheng, 2017). In their Hong Kong-based study on primary and secondary school pre-service teachers, Szeto and Cheng (2017) reiterated teachers' technology and pedagogical knowledge differed across various subject areas. The results indicated that teachers of music and general studies tended to use more technology than teachers of other subjects (Szeto & Cheng, 2017). Several of the teachers expressed their preference for the same technology tools across various subject areas as the tools because they were considered to be engaging student interest. For example, teachers from multiple subject areas used YouTube for teaching purposes (Szeto & Cheng, 2017). Similar to Szeto and Cheng's (2017) study, Heitink et al. (2016), found that Norwegian primary and secondary teachers' reasons behind technology choice and use were guided by interest levels, effectiveness of technology tools to accomplish educational objectives, and learning facilitation. Howard et al. (2015) analyzed the effect of subject area on teachers' technology integrations intentions, particularly their readiness and beliefs. The results indicated that subject area influenced teachers' readiness as well as beliefs (Howard et al., 2015).

Another theme that emerged from Szeto and Cheng's study (2017) was that while teachers across different subject areas used technology to enhance learning, very few teachers utilized technology for assessment or subject-related curriculum learning (Szeto & Cheng, 2017). Also, Chinese and English language teachers used technology not only for teaching the languages, but also to represent the cultural milieu of the countries that spoke Chinese and English (Szeto & Cheng, 2017). Furthermore, the researchers revealed how the resources provided in the curriculum shaped technology use. English, physical education, and music teachers used subject-specific CDs instead of online discussion boards and blogs for demonstrations (Szeto & Cheng, 2017). Additionally, teachers utilized new technological tools to teach the traditional drill practices in mathematics (Szeto & Cheng, 2017). While students showed differences in technology use across different subject areas, Heitink et al. (2016) primarily showed how teachers from multiple disciplines could incorporate technology to teacher pedagogic and subject area contents. For example, while the English language teachers used technology to delineate certain characters, physical education instructors utilized technology to create videos illustrating certain physical activities (Heitnik et al., 2016).

The relationships between teachers' self-efficacy beliefs and their subject areas are complex. Although previous research has found a connection between the two, the topic warrants more in-depth research to understand the true nature of the relationship. The subject of teachers' self-efficacy is congruent with constructivism, in which individuals construct complex knowledge schemas through experiences gained from active interactions with their environment (Carey, Zaitchik & Bascandziev, 2015). The current study will investigate whether subject areas taught by teachers predict their self-efficacy about technology.

Implications of Integrating Technology in Classrooms

The use of technology in today's classrooms is expected for student advancement (Kwon et al., 2019; Nie, Tan, Liau, Lau, & Chua, 2013). In high school classrooms, teachers are required to use technology to impart educational content and assessments and to communicate with students, parents, and colleagues (Ruggiero & Mong, 2015). The students also utilize technology to gain understanding of specific subject areas, complete assignments and collaborative projects, and communicate with teachers. Furthermore, emerging 21st century technologies have allowed students to work collaboratively, a task that is critical for today's workforce (Stoerger & Krieger, 2016). Specifically, Web 2.0 technologies have ushered in a new era of communication and learning that has empowered students to be active agents in their own learning (Kale & Goh, 2014; Yusop, 2015) and allowed teachers to integrate blogs, wikis, multimedia sharing, and social networking (Barak, 2017; Song & Lee, 2014). Web 2.0 technologies are social media platforms categorized in three forms: social networks (Facebook and Twitter), content sharing and organizing online platforms (YouTube, Dropbox, and SlideShare), and content production and editing websites, such as Wiki, Blogger, Google Docs, and WordPress (Faizi, 2018). Researchers have indicated that current student population dislike traditional methods of teaching based on lectures (Stoerger & Krieger, 2016). Students prefer interactive tools that offer them the opportunity to contribute to the learning process (Yusop, 2015). Lecture-based undergraduate classes have been transformed to more collaborative and engaging class by the integration of technology (Stoerger & Krieger, 2016). Stoerger and Krieger (2016) suggested that the use of technology had the potential to engage students in advanced learning and could help foster a sense of cooperation among the students.

In recent years, the use of emerging 21st century technology, such as smart phones, laptops, iPads®, and Elitebooks has enhanced students' learning experiences even further. For instance, mobile technology tools have gained popularity and devices such as smart phones, tablets, and e-readers are constantly being used by students for educational and entertainment purposes (Kee & Samsudin, 2014; Poláková, & Klímová, 2019). Indeed, researchers have argued that the student-centered informal learning context generates interest from students, allowing them to be actively engage in their learning. Devices such as WeChat were designed to facilitate teaching and learning experiences (Zijuan & Gaofeng, 2016). WeChat offers University students in China extensive communication and interactive features for Chinese language translation (Zijuan & Gaofeng, 2016). Similarly, Stockwell and Liu (2015) found mobile device-based tasks to be effective for university students in Taiwan and Japan learning vocabulary. The ubiquitous presence and accessibility of mobile technology makes it easier to be used as a learning device worldwide (Ally, Grimus, & Ebner, 2014; Khlaif, 2018). Additionally, researchers have found that mobile devices such as e-books facilitate learning in fourth grade classrooms (Gwo-Jen, & Chiu-Lin, 2017). Gwo-Jen and Chiu-Lin (2017) found that in a flipped classroom, where teachers offer students out-of-class learning activities, the incorporation of e-books helped students learn concepts by themselves. The integration of technology, particularly 21st century devices, can offer advantages to stakeholders, especially teachers.

Benefits of Technology Integration for Different Stakeholders

An analysis of the benefits of 21st century technology sheds light on the significance of its adoption for educational reasons. Specifically, the benefits of mobile technologies are innumerable, and a dearth of studies pertaining to effects of mobile devices both inside and outside the classroom environment exits (Sorensen, 2016; Sung, Chang, & Liu, 2016). One effect is the enhanced quality of education (Erdogan & Dede, 2015). In addition to creating an opportunity to implement an interactive class, mobile technology has extended the scope for teaching as well as learning beyond the classroom (Baek et al., 2017; Irby & Strong, 2013; O'Bannon & Thomas, 2014). Students and teachers are able to communicate and collaborate not only with peers, but with individuals across the globe (Baek et al., 2017).

Furthermore, mobile technologies offer multiple functionalities within individual devices required for learning such as internet connection, internet browsers, chat and text options, email applications, camera, and recording (O'Bannon & Thomas, 2014). Due to these functions, students can now learn from anywhere and at any time (Irby & Strong, 2013; O' Bannon & Thomas, 2014). They offer flexibility and easy access to educational materials that were previously restricted within classrooms (Baek et al., 2017). Additionally, students can download applications tailored to improving academic skills such as mathematics and language, books, pdf readers, file openers, educational games, and personal activities. In another study Kim, et al., (2019) revealed that incorporating a tablet, was beneficial as it generated interest towards completing tasks, fostered collaborative attitudes, and increased and student engagement.

Another benefit of mobile technology is an economical alternative to more expensive computers (Ebner & Grimus, 2015). Ebner and Grimus (2015) found that in Ghana where scarcity of infrastructure exists like computer labs to support student-learning, mobile technology offers potential for learning. The researchers highlighted the emerging trend of using mobile technology for teaching and learning purposes across Africa as a feasible option to increased digital literacy. The results from a pilot project on high school students revealed that collaborating with students to produce pedagogical content and listening to their feedback helped create streamlined content materials (Ebner & Grimus, 2015).

Integration of technology in school systems offers benefits for teachers, parents, administrators, and society in general in addition to students. Technology integration allows teachers to enhance learning experiences for students (Navaridas et al., 2013; Poláková, & Klímová, 2019). It allows them to make a seamless connection between home and school to continue students' learning outside the classrooms (Ally et al., 2014). Furthermore, mobile technology enables teachers to maintain better home-school communications. More importantly, mobile technology enables teachers to equip students with skills needed for 21st century workforce. Mobile technology, which is markedly different from traditional learning methods, might be advantageous for parents as they can relate to the learning in the classroom. Administrators also may benefit from technology integration as students might be more inclined to meet the learning goals. Overall, technology integration is also beneficial for society as it will prepare the future generation of workers with the skills they need to be successful in their endeavors. In spite of the plethora of advantages, successful technology integration and proper utilization of technology-rich classrooms have been difficult to come by (Burden & Hopkins, 2016). Multiple factors have created hindrances in the path of technology use, which might originate from lack of proper infrastructure like access to internet, availability of required devices, and software applications (Alenzei, 2017; Burden & Hopkins, 2016; Chaaban & Moloney, 2016). Researchers have also pointed to the lack of manpower for providing technical support (Garba et al., 2015). Ebner and Grimus (2015) also stressed the difficulty of adopting instructional materials developed for computers onto mobile devices. In addition, lack of proper teacher training is a formidable concern in the integration of technology.

Notwithstanding these barriers, teachers' personal qualities and demographics often create barriers that have to be addressed prior to technology implementation in classrooms (Burden & Hopkins, 2016). Specifically, teachers' self-efficacy has been identified as a critical predictor of technology implementation and use for learning (Elstad & Christophersen, 2017; Oddone, 2016). In spite of the availability of mobile devices and Web 2.0 technologies, teachers who have not had enough exposure to those devices lack competence in utilizing those technologies for teaching and learning (Barak, 2016).

Attitudes Towards Technology Use

Teachers' adoption of technology use are often dependent on their perceptions of the relative benefits of technology for specific tasks and their perceptions of the barriers in the way of technology adoption (Khlaif, 2018; O'Bannon & Thomas, 2014; Thomas et al., 2014). Even teachers who believe in student-centered education are often disinclined to use technology in classrooms (Burden & Hopkins, 2016). Teachers' perceptions about the use of technology also influence how they integrate technology in their plans. Researchers have recurrently identified factors such as teachers 'attitudes, beliefs, behavior control and apprehensions about technology use to be major determinants of whether teachers use technology in class (Chiu & Churchill, 2016; O'Bannon & Thomas, 2014; Yeap, Ramayah & Soto-acosta, 2016). Teachers who feel confident and favor technology use are more likely to implement it in classroom teaching than teachers who are apprehensive about the prospects of technology use.

One of the concerns that teachers have about technology use is that it might be a source of disruption (Burden & Hopkins, 2016; Ebner & Grimus, 2015; Elstad & Christophersen, 2017; O'Bannon & Thomas, 2014). Burden and Hopkins (2016) found that pre-service teachers in England were apprehensive about students misusing mobile devices. The results of their longitudinal study on teacher preparation revealed that teachers were concerned that mobile devices as a pedagogical tool demonstrated that they only considered the devices as tools needed for collecting and disseminating information and for creating presentations (Burden & Hopkins, 2016). Thus, teachers' attitudes towards mobile technology influenced its adoption for learning. However, the results also suggested marked differences in teachers' attitudes pre and post training (Burden & Hopkins, 2016).

Similarly, Elstad and Christophersen (2017) found that teachers, who perceived technology as a distraction and anticipated its misuse were more averse to technology implementation in classrooms. Additionally, Mustafa and Nurcan (2019) revealed that teachers who have anxiety, fear, or stress will adopt a more traditional approach to instruction. The pervasive concern amongst teachers was the distraction students have with widespread access to technology and internet in and out of school parameters (Elstad & Christophersen, 2017). Teachers exhibited anxiousness about students using mobile devices for texting, cyberbullying or accessing adult content over the internet (O'Bannon & Thomas, 2014; Thomas et al., 2014). Additionally, teachers anticipated that the wide access to internet might affect students negatively, instigating them to use online materials improperly (Ebner & Grimus, 2015). Perry and Steck (2015) found that the inclusion of advanced geometry applications on iPads® did not result in improved student performance. The incorporation of iPads® led to more distractions and deterioration in students' academic performance. Furthermore, factors such as unfamiliarity with the geometry application and iPads®, lack of time for classroom activities, and students' general attitudes towards mathematics could have also influenced their performance (Perry & Steck, 2015). Thus, student's attitudes and performance levels can act as negative influences on teachers' technology adoption if teachers perceive that technology disrupts rather than facilitates learning.

In the past, teachers incorporated technology in their instructional practices quite frequently to mirror the successful use evident in society. Some tools that were introduced lacked effectiveness; thus, dying out (Ruggierro & Mong, 2015). In the educational system, it is important to use technology that serves a greater, more practical purpose in that its advanced capabilities allow students to access (Baek, Zhang, & Seongchul, 2017), create, and validate content from any location (Ally & Prieto-Blázquez, 2014). Currently, mobile devices are the tools that afford teachers the opportunity to establish a different kind of learning relationship (Kim et al., 2019; Merchant, 2012); and thus, give teachers the opportunity to strengthen the learning and creative process for all students.

Role of Teachers in a Technology-driven Classroom

The role of the teacher has evolved with the emerging technologies of the 21st century. Indeed, a paradigm shift in learning and learner's role has occurred, hence the need for change in teachers' roles (Baek et al., 2017). Teachers in technology-driven classrooms often play the roles of facilitators to allow students to learn independently or collaboratively with other students. Traditional methods of teaching utilizing pen, paper, or chalkboard fail to engage students in the learning process. Lecture-based teaching cannot fulfill the learning requirements of the students.

Researchers found that teachers' inhibitions about using mobile technology often originated from their faith in a more teacher-oriented pedagogy as they felt it might give them more control over learning and discipline (Burden & Hopkins, 2016). However, the teachers might gain more control over learning by utilizing technology in their classrooms to increase student engagement (Burden & Hopkins, 2016). Teachers need to adapt to the changing student population. In a technology-integrated class, teachers also have the opportunity to enhance their learning by evaluating the effectiveness of their responses to challenges (Bozkurt & Ruthven, 2017)

The International Society for Technology in Education (2017) specified the role of the teachers as a facilitator in a technology-integrated class. As a facilitator, the teacher creates opportunities for children to explore and learn independently. By adapting to the constructivist approach, teachers exhibit innovation and spontaneity as they shift their focus in response to students' interests and experiences (Ucus & Acar, 2018). Instead of engaging in lecture-based oriented learning, the teacher has to manage student learning strategies in digital platforms and virtual environments (ISTE, 2017) Furthermore, teachers are required to give students the opportunity to demonstrate competency and reflect on their learning using technology (ISTE, 2017).

Researchers (Ally & Prieto-Blázquez, 2014; Kim et al., 2019) highlighted the social changes brought forth by mobile technology where the user or the learner rather than the technology is at the center. The flexibility mobile technology offered to students increased access to education (Ally & Prieto-Blázquez, 2014). Mobile technology has not only increased educators' reach outside the classroom, but it also had increased their students' exposure to a global population of students and experts (Kim et al., 2019). Furthermore, Christensen and Knezek (2017) highlighted that mobile learning supports personalized education, which is aligned with ISTE's (2017) standard five: the teacher uses technology to personalize the learning experiences that foster independent learning. In conclusion, Ally and Prieto- Blázquez (2014) argued in favor of teachers preparing themselves for the technology-driven classes as the traditional modes of education will fail to meet the needs of the current and future generations of students.

Training Needs for Teachers

The best way to strengthen self-efficacy and foster positive attitudes towards technology is to offer teachers ample opportunities to familiarize themselves with the technological changes (Chiu & Churchill, 2016; Oddone, 2016). Researchers have noted that changes in teachers' beliefs are possible through training and that the changes follow a predictable trajectory (Chiu & Churchill, 2016). When teachers perceive that the new technological changes are aiding student-learning processes, they are more likely to alter their views about the efficacy of technology (Chiu & Churchill, 2016). Given the ubiquitous use and application of mobile learning in and out of the classroom environment, the implications of technology integration cannot be doubted (Ally et al., 2014). Consequently, Ally et al. (2014) emphasized that studies on the long-term advantages of adopting mobile technology to increase access to education can benefit practitioners and researchers alike.

Nordlöf et al., (2019) noted teachers' willingness to integrate technology in their classrooms. In the Horizon Report (2017), teachers are expected to be adept in implementing technology-based approaches for their content area and delivery. Teachers expressed desires to integrate technology in their classrooms; however, they identified other factors that challenge their efficacy levels and effective technology integration (Nordlöf et al., 2019). These challenges are (a) experience, education, and interest; (b) subject knowledge; and (c) preparation. In order for teachers to overcome these challenges, they need professional training and a robust support system from the schools (Perry & Steck, 2015). Professional development training can provide teachers with the tools and knowledge they need to overcome barriers (Horizon Report, 2017; O'Bannon & Thomas, 2014).

Teachers have to be knowledgeable about adopting learning materials for mobile technologies and about assisting students to use mobile applications effectively. In order for the integration of technology in classroom teaching to occur, skills development training for teachers is required (Ebner & Grimus, 2015; Kim et al., 2019). Imposing mobile-based learning without properly training teachers would fail to yield desired educational outcomes (Ebner & Grimes, 2015). For instance, older generation teachers that comprise baby boomers and millennials often lack technological skills (Rickes, 2016; Wiedmer, 2015). Hence, researchers have pointed to the need for training programs geared towards changing teachers' attitudes and inhibitions about technology use (Chiu & Churchill, 2016). However, the need exists for proper utilization of mobile technologies in teacher training (Barak, 2017), which is critical for adopting technology to the content matter (Burden & Hopkins, 2016). Researchers have even suggested the importance of teachers being involved in designing courses as that involvement will enable them to share their personal experience and expertise in addressing the needs of the students (McKenny, Kali, Mauriskite, & Voogt, 2015).

Summary

A growing need exists for technology integration in today's classroom. When the type of emerging technology used in society changes, the implementation of this technology in a classroom setting must change also. The lack or inadequate use of 21st century technology within education can only be solved when principals, teachers, and curriculum developers identify and address the root of the problem, teachers' perceptions. Teachers' perceptions of their abilities to adequately implement technology tools have an impact on the level and frequency of technology use in any type of instructional setting. Cogin (2012) and Lowell and Morris (2019) suggested generational differences may be a factor to consider in the implementation of current technology, while O' Bannon and Thomas (2014) attributed it to personal qualities, demographics, and external factors. Nonetheless, a gap in the literature exists pertaining to how factors such as gender, generation, and subject expertise influence teachers' self-efficacy relating to technology use, particularly for the high school teacher population. Most extant literature studies on teachers' self-efficacy have been based on college faculty and students (Liu & Guo, 2017; Seifert, 2015).

The need to incorporate emerging technology devices and skills in all subject areas shows that sociocultural demands influence academia. Educational leaders and practitioners can provide the necessary resources and professional development training to help teachers learn about the most current advancements in technology (Ruggiero & Mong, 2015). Although the integration of 21st century technology is important, the root of technology integration in the classroom is teachers' perception. The literature review indicated that a predictive relationship might exist between teachers' generation, gender, and subject area and self-efficacy relating to technology use (Baek et al., 2017; Rickes, 2016; Wiedmer, 2015). As such, this study will utilize the Technology Proficiency Self-Assessment Questionnaire for the 21st Century Learning (Christensen & Knezek, 2017) to assess teachers' self-efficacy beliefs about the use of technology. Bandura's (2012) social cognitive theory is included to establish the importance of self-efficacy in improving performance. Additionally, Piaget's (1952) theory of constructivism illustrated how students construct knowledge through multiple experiences. The results of this study will add to the knowledge base on how generation, gender, and subject-area influence self-efficacy among teachers. Furthermore, this study will provide a better understanding of how to provide professional training to educators, so they can overcome barriers.

CHAPTER THREE: METHODS

Overview

This chapter includes the basic methodology of this quantitative, correlational research study. By using standard multiple regression data analysis (Warner, 2013), the researcher examined the relationship between two or more predictor variables and a criterion variable (Gall et al., 2007). The research question addressed the predictive ability of secondary teachers' technology efficacy, subject area, gender, and generation as measured by the TPSA C-21 (Christensen & Knezek, 2017). The participants were drawn from four school districts in Florida. This study was administered to high school teachers from April 2019 to November 2019. Data were collected and analyzed using Statistical Package for the Social Science Version 26 (SPSS). This chapter includes the research design, research question, null hypotheses, participants, setting, research procedure, and data analysis.

Design

This study utilized a quantitative, non-experimental correlational design. The treatment variable was not manipulated (Warner, 2013), and the data were measured (Goertzen, 2017) to determine how the variables influenced a pattern of behavior (Gall et al., 2007). The purpose of this design was to analyze the relationship between a large number of variables (Gall et al., 2017). This design was appropriate for this study because it provided estimates of the statistical significance of the relationship both individually and in combination between variables (Gall, Gall, & Borg, 2007). The predictor variables were generation, subject area, and gender. A predictor variable is a variable that cannot be manipulated and is measured sometime before the criterion behavior occurs (Gall, Gall, & Borg, 2007). For this study, generation was a group of people born during a specific time period. They shared similar beliefs and values due to experiencing the same world events during their coming-of-age years (Stanton, 2017). Subject area was defined as the overarching category of an academic discipline (le Roux & Parry, 2017). Gender was defined as a person's biological sex. The criterion variable, the outcome variable, (Warner, 2013) was technology efficacy, which was defined as the belief in one's own ability to perform a technologically sophisticated new task (Laver et al., 2012). The technology efficacy of male and female teachers in various subjects within three generations (baby boomers, generation X, and millennials) who use 21st century technology in high school classrooms was examined to determine the significance of the relationships.

Research Question

The researcher conducted a study using a non-experimental, predicative correlational design (Warner, 2013). The research question for this quantitative, predictive correlational study was:

RQ: Is there a predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning?

Null Hypotheses

The null hypotheses for this study were:

$H_0$1: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$2: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Email scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$3: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the World Wide Web scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$4: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Integrated Application scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$5: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Teaching with Technology scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$6: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Teaching with Emerging Technologies scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$7: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Emerging Technologies Skills scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

Participants and Setting

The participants for the study were selected from a purposeful convenience sample to ensure that the satisfactory representation of subgroups in the population was represented in the sample (Gall et al., 2007). This sample stemmed from approximately 1000 high school teachers located in the state of Florida from April 2019 to November 2019. The participating schools were located in four districts in the state of Florida. Participating secondary teachers who use 21st century devices, applications, and tools in their classrooms were employed in city, urban, rural, and suburban areas.

The target population consisted of teachers of grades 9-12 who were employed in the public sectors of four districts in Florida. The researcher used a purposeful convenience sample. The sample population in District 1 contained 7 high schools with approximately 3,000 highly qualified teachers and a 1.5-to-1.0 computer to student ratio. In District 2, fifty-one schools were selected from over 60 high schools. Over 40,000 teachers were employed. In District 3, ten high schools were used in an area with roughly 15,000 teachers and approximately 300 school sites. District 4 sample population consisted of approximately 40 teachers from 1 of 8 high schools. The researcher selected the sample from four districts because a sufficient number of teachers who use computer and device hardware and software in their instruction as mandated by Florida Statute 1011.62(12)(a)(b)2 and 1001.20(4)(a)1.b (see Florida Department of Education, 2014) within each area existed (Gall et al., 2007). Therefore, participants in this current study have already begun to incorporate 21st century devices, such as laptops, tablets, and smartphones in their classroom instruction. After receiving approval from IRB, the researcher emailed permission letters copy of the teacher consent letter, and research survey to the research committee within four districts. Upon the district committees' approval, the researcher then requested their assistance in receiving permission from school principals to conduct research. Three of the four district committees sought principals' pre-approval and supplied principals' email addresses as a part of their application procedure. Only one district required the researcher to access principals' email addresses from the district's website. The researcher emailed permission letters and a recruitment letter, which contained a link to the consent form and survey, to each participating principal. Principals forwarded the email to all teachers. Each participant completed the TPSA C-21 via Google Forms. Participation was voluntary.

For this study, the number of participants included in the sample was 78, which exceeds the required minimum for a medium effect size. The required minimum is 66 for a medium effect size with statistical power of 0.7 at the 0.05 alpha level (Gall et al., 2007). The sample came from 69 high schools in the state of Florida. See Table 1 for sample population demographics.

Table 1

Demographics

Variables	*N*
Race/Ethnicity	
Black/African-American	6
Hispanic/Latino	12
White/Caucasian	56
Other	4
Gender	
Female	54
Male	24
Subject Area	
History	10
Mathematics and science	27
Humanities (Art, English, and Foreign Language)	20
Physical Education and other	21
Generation	
Baby boomers	15
Generation X	12
Millennials	51

Instrumentation

The instrumentation used in this study consisted of one survey that included demographic questions and a technology efficacy instrument. The TPSA C-21 (Christensen & Knezek, 2017) was used to measure the criterion variable, teacher technology efficacy. A researcher-constructed demographic survey was used in this study to evaluate the predictor variables, gender, generation, and subject area.

Since the predictor variables used in this study do not indicate which variable is greater than the other, they are categorical and were measured by nominal scales (Gall et al., 2007). By using the information supplied from participants in the demographics survey, the researcher was able to effectively analyze data. The predictor variables were entered in one step in a standard regression analysis and were given equal treatment (Warner, 2013).

Online Demographic Survey

The researcher included an online demographic survey to measure the predictor variables: generation, gender, and subject area. For this study, participants were asked to self-report by typing in their birth year and placing a check mark next to their gender (male or female), subject area (English, history, science, math, computer science, art, foreign language, band, physical education, other), grades taught (9^{th}, 10^{th}, 11^{th}, 12^{th}), and race/ethnicity (White/Caucasian, Black/African American, Hispanic/Latino, or other). This information was provided via Google Forms prior to the start of the TPSA C-21 (See Appendix A).

Participants' technology efficacies were measured using the TPSA C-21, which utilizes a Likert scale ranging from a score of 1, indicating strongly disagree to 5, indicating strongly agree. These sum or average of scores was normally distributed to produce meaningful results (Warner, 2013).

Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning

The researcher used the TPSA C-21(Christensen & Knezek, 2017) to measure the criterion variable, teachers' confidence in their ability to integrate 21st century technology in the classroom, see Appendix B. The TPSA C-21 was developed from an earlier version of Technology Proficiency Self-Assessment Questionnaire (Ropp, 1999) and consideration of the current technology standards as published by ISTE. An exploratory factor analysis was conducted on a preliminary set of data (Christensen & Knezek, 2017). The original instrument (Ropp, 1999) has been used in other studies (Christensen & Knezek, 2017; Gençtürk, Gökçek, & Güneş, 2010). The entire questionnaire consisted of 34 items. The TPSA C-21 was validated using higher order factor analysis and multidimensional scaling (Christensen & Knezek, 2017). Christensen and Knezek's study (2017) was conducted using 466 participants from primary and secondary education. The researcher of the current study selected the TPSA C-21 (Christensen & Knezek, 2017) because it measures teachers' technology efficacy in their ability to integrate 21st century skills and tools within the classroom environment.

The TPSA C-21 has six scales (Email, WWW, Integrated Applications, Teaching with Technology, Teaching with Emerging Technologies, and Emerging technologies Skills) that measure teachers' confidences in integrating 21st century technology tools in the classroom (Christensen & Knezek, 2017). The TPSA C-21 measures teachers' efficacy in their ability to (a) send documents as an attachment (Email scale), (b) find primary resources using the Internet (WWW scale), (c) use spreadsheets to create bar graphs of the proportions (Integrated Applications scale), (d) use technology to collaborate with others who are distant (Teaching with Technology scale), (e) teach in a one-on-one environment with students who have their own devices (Teaching with Emerging Technologies scale), and (f) save and retrieve files from cloud-based environment (Emerging Technologies Skills scale) (Christensen & Knezek, 2017). To determine the instrument's validity, the developers surveyed 466 teachers, administrators, and paraprofessionals in 2014 (Christensen & Knezek, 2017).

The first scale, Email, contains five items with a Cronbach's alpha score of 0.76. The second scale, WWW, has five items with a Cronbach's alpha score of 0.75. The third scale, Integrated Applications, has five items and a Cronbach's alpha score of 0.84. The fourth scale, Teaching with Technology, has five items and a Cronbach's alpha score of 0.89. The fifth scale, Teaching with Emerging Technology, has eight items and a Cronbach's alpha score of 0.93. The last scale, Emerging Technology Skills, has six items and a Cronbach's alpha score of 0.84. The total item scale score is .96. The TPSA C-21 uses a five-point Likert scale that ranges from Strongly Agree to Strongly Disagree (Strongly Agree= 5, Agree = 4, Neutral = 3, Disagree = 2, and Strongly Disagree = 1. The combined possible score on the TPSA C-21 ranges from 34 to 170 points. A score of 34 points is-the lowest possible score meaning that participants have a low confidence in their abilities to integrate technology in their classrooms. A score of 170 is the highest possible score, and it shows that participants have a positive confidence in their abilities to integrate technology in their classroom.

Participants reviewed instructions (Appendix C) and completed the survey on their own devices. The researcher received participants' scores via Google Forms. Scores were uploaded into SPSS Version 26. The researcher received the developer's approval to use the instrument, TPSA C-21 (Appendix D).

Procedures

The researcher gained approval from the Institutional Review Board (IRB) prior to the data collection process (Appendix E). The research committee within each school district received an electronic permission letter to conduct research describing the purpose and rationale of the study, researcher's background and school affiliation, and the number of needed participants (Appendices F). This request was emailed approximately one month prior to the date of the study. Once the researcher received permission from each district's research committee, a recruitment letter was given to principals asking for their assistance in recruiting teachers for this study (Appendix G).

Each principal also received an electronic consent form detailing the purpose and rationale of the study, researcher's background and school affiliation, the needed participants, and the intended dates of administration to the research committee within each district (Appendix H). Teachers were given electronic instructions to complete the survey on their own devices and outside regular work hours. The length of time to complete the survey was approximately 20 minutes, including the demographic section. Data were electronically submitted to the researcher via Google Forms. All participants remained anonymous. The results were uploaded to SPSS Version 26 and recorded in Microsoft Excel.

The researcher coded data using a nominal scale, and each predictor variable represented categories (Gall et al., 2007). The predictor variables—generation, gender, and subject area—represented group membership, and were coded using a dummy-coded variable (Warner, 2013). Gender was coded as 1 for female and 2 for male participants. Subject area was coded as 1 for Humanities (art, English, and foreign language), 2 for history, 3 for math and science, and 4 for physical education/health and other. Generation was coded 1 for baby boomer, 2 for generation X, and 3 for millennials. The criterion variable was coded using the Likert Scale in the TSPA C-21, ranging from 1 to 5. These results were secured on a password-protected computer during and after the completion of the study.

Data Analysis

The researcher used SPSS Version 26 to analyze data from the TPSA C-21 and the demographic survey from teachers who use 21st century technology devices in a high school setting. Data were used to determine the predictive relationship between the criterion variable, teacher technology efficacy, and the combination of predictor variables—gender, subject area, and generation—for teachers who use 21st century technology tools and devices. The most appropriate choice, multiple regression, allows the researcher to reject or fail to reject the null hypothesis (Gall et al., 2007). Multiple regression allows the researcher to analyze the relationship of one criterion variable on the continuous scale with two or more predictor variables (Gall et al., 2007) that have not been manipulated (Warner, 2013).

Data from the demographic survey and the TPSA C-21 were examined. The researcher conducted preliminary screenings by examining scatterplots, descriptive statistics, and the VIF to determine normal distribution and violations (Warner, 2013). Three assumptions were met prior to conducting multiple regression analysis. These assumptions are the assumption of bivariate outliers, multivariate normal distribution, and non-multicollinearity (Warner, 2013). The focus was to look for extreme bivariate outliers on the scatterplot to determine the strength of the relationship between variables (Gall et al., 2007). In examining the scatterplot, the researcher should determine the visual to be in the shape of a cigar. In testing for multivariate normal distribution, the researcher examined a matrix scatterplot to determine if relations between multiple variables are linear (Green & Salkind, 2017; Warner, 2013). To test for non-multicollinearity, each pair of predictor variables—gender, generation, and subject area—and the criterion variable—teacher technology efficacy—were plotted to show a linear relationship, homogeneous variance, and no extreme outliers (Warner, 2013). A variance inflation factor

(VIF) greater than 10 indicates a problem in collinearity (Stine, 1995), which would indicate the predictor variables were difficult to assess (Warner, 2013). The sample size of 78 is greater than the minimum 66 for a medium effect size with .7 statistical power at the .05 alpha level (Gall et al., 2007).

When reporting results, the researcher used the *F* ratio to predict the main null. The predetermined alpha level for the multiple regressions was set at 0.05 (Warner, 2013). For this study, Pearson's *r* (Warner, 2013) was used to determine the effect size. After conducting statistical tests and analyzing data in SPSS Version 26, the researcher rejected or failed to reject the null hypotheses in this study.

CHAPTER FOUR: FINDINGS

Overview

The purpose of this quantitative study was to explore the predictive ability of technology efficacy among secondary teachers who use 21st-century technology in classrooms in Florida as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21). The predictor variables were generation, gender, and subject area, and the criterion variable was technology efficacy. This chapter includes four sections: the research question and null hypotheses, descriptive statistics for the variables and scale score, the results of multiple regression analysis for each predictor variable, and a summary of the study.

Research Question

The research question for this study was:

RQ: Is there a predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning?

Null Hypotheses

The null hypotheses for this study were:

$H_0$1: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$2: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Email scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$3: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the World Wide Web scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$4: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Integrated Application scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$5: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Teaching with Technology scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$6: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Teaching with Emerging Technologies scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

$H_0$7: There is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Emerging Technologies Skills scale on the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning.

Descriptive Statistics

The researcher removed two of the 80 surveys from the analysis due to non-completion. Therefore, over the course of one year, a total of 78 completed and useable surveys were collected (*N*=78). This number was greater than the minimum number of 66 surveys identified *a priori*.

The sample population's birth years were assigned to generation. The distribution of the sample indicated that baby boomers represented 19.2%, generation X represented 65.4%, and millennials represented 15.4%. There were twice as many females (69.2%) as males (30.8%) in the sample population. Also, most of the sample (71.8%) was White/Caucasian, with the next largest race/ethnicity group being Hispanic/Latino at 15.4%. The most reported subject area represented the combined category of mathematics and sciences at 34.6%, as seen in Table 2. Table 3 displays the descriptive statistics for all the technology scales.

Table 2

Frequencies for Variables of Methodology

Characteristic	*N*	%
Generation		
Baby boomers (1945-1964)	15	19.2
Generation X (1965-1984)	51	65.4
Millennials (1985-2004)	12	15.4
Gender		
Female	54	69.2
Male	24	30.8
Subject Area		
Humanities (Art, English, Foreign Language)	20	25.6
History (incl. Other)	10	12.8
Mathematics & Sciences	27	34.6
Other (e.g., Physical Ed.)	21	26.9

Table 3

Descriptive Statistics for the Six Technology Scales and the Total Technology Proficiency Score

Scale	Min.	Max.	*M*	*SD*
Email	15	25	24.12	1.809
World Wide Web	15	25	23.06	2.315
Integrated Applications	12	25	22.17	3.347
Teaching with Technology	15	25	22.27	2.908
Teaching with Emerging Technologies	20	40	34.32	5.295
Emerging Technologies Skills	16	30	28.55	2.948
Total Technology Proficiency	104	170	154.49	14.876

Note: *N*=78

Results

Data Screening

The researcher sought to determine if there was a statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by the TPSA C-21. Each predictor variable (gender, generation, and subject area) was screened in order to search for and identify inconsistencies. Of the 80 survey submissions, two were removed due to the non-completion of the research study. The resulting sample was 78, which exceeds the required minimum of 66 for a medium effect size with statistical power of 0.7 at the 0.05 alpha level (Gall et al., 2007).

The reliabilities of the TPSA C-21 instrument's six technology scales and Total Technology Proficiency scale were calculated for this study by using the Cronbach alpha coefficient. Table 4 shows the Cronbach alpha reliability coefficients for each of the technology scales. Standard rule of thumb for using scales in inferential statistics require scales to achieve an alpha value of at least 0.7 for acceptability. Alpha values over 0.8 are generally regarded as good, and alpha values greater than 0.9 are considered excellent (Pallant, 2016). The scales of Email, Integrated Applications, and Teaching with Technology generated acceptable reliabilities. The scales of Teaching with Emerging Technologies and Emerging Technologies Skills achieved good reliabilities. However, the World Wide Web (WWW) scale's alpha of 0.631 suggested the results of any correlational or regression analysis would need to be interpreted with caution. Finally, the total technology proficiency score had excellent reliability with a Cronbach's alpha coefficient of 0.932.

Table 4

Reliability Coefficients for Six Technology Scales and the Total Technology Proficiency Score

Scale	Cronbach's α
Total Technology Proficiency	0.932
Email	0.730
World Wide Web	0.631
Integrated Applications	0.784
Teaching with Technology	0.741
Teaching with Emerging Technologies	0.863
Emerging Technologies Skills	0.837

Assumptions

Prior to conducting the multiple regression analysis for this quantitative study, three assumptions were tested (Warner, 2013). The assumptions were bivariate outliers, multivariate normal distribution, and non-multicollinearity. The researcher ensured the tenability of each assumption by examining the scatterplot for extreme bivariate outliers (Warner, 2013), a matrix scatterplot to determine the multivariate normal distribution (Green & Salkind, 2017), and VIF to determine non-multicollinearity among the three predictor variables.

A scatterplot was used in order to determine if the data met the assumptions of multivariate normal distribution and bivariate outliers. The scatterplots indicated no extreme bivariate outliers (Warner, 2013), and is in the shape of a cigar. In this study, all assumptions were met.

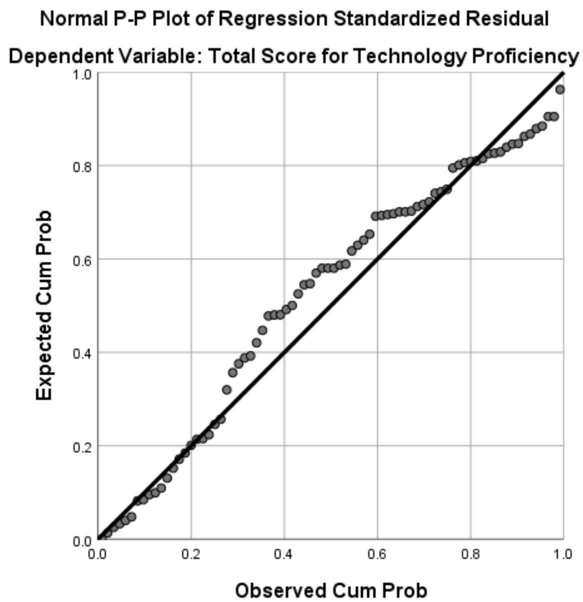

Figure 1. Scatterplot of the Total Technology Proficiency scale

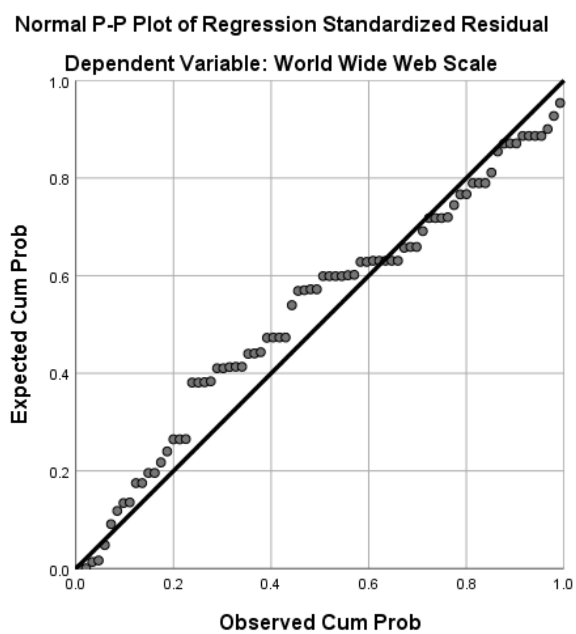

Figure 2. Scatterplot of the World Wide Web scale

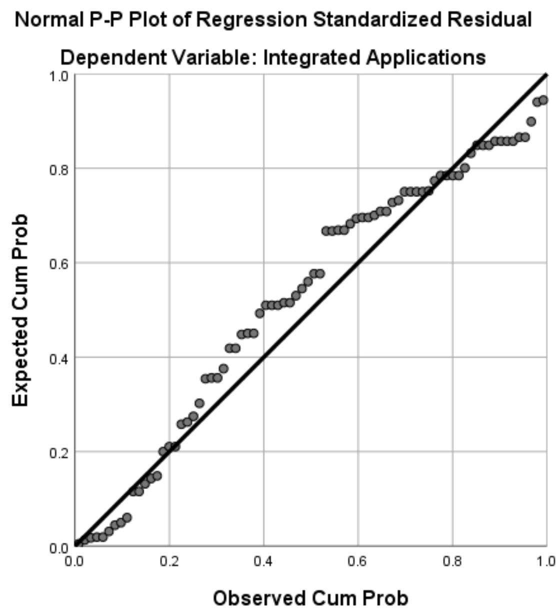

Figure 3. Scatterplot of the Integrated Application scale

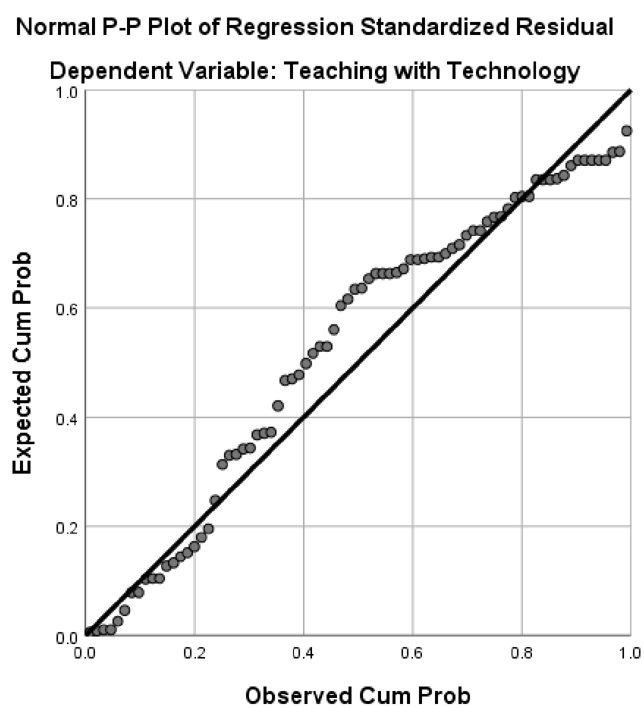

Figure 4. Scatterplot of the Teaching with Technology scale

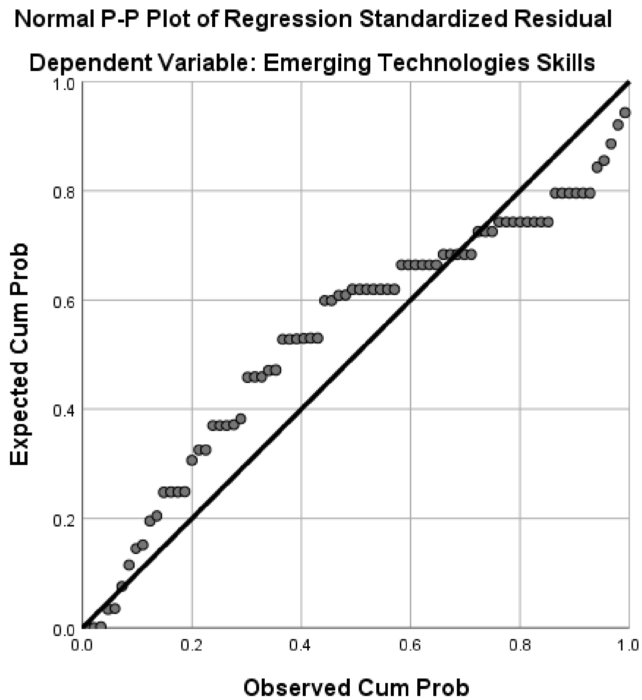

Figure 5. Scatterplot of the Emerging Technologies Skills scale

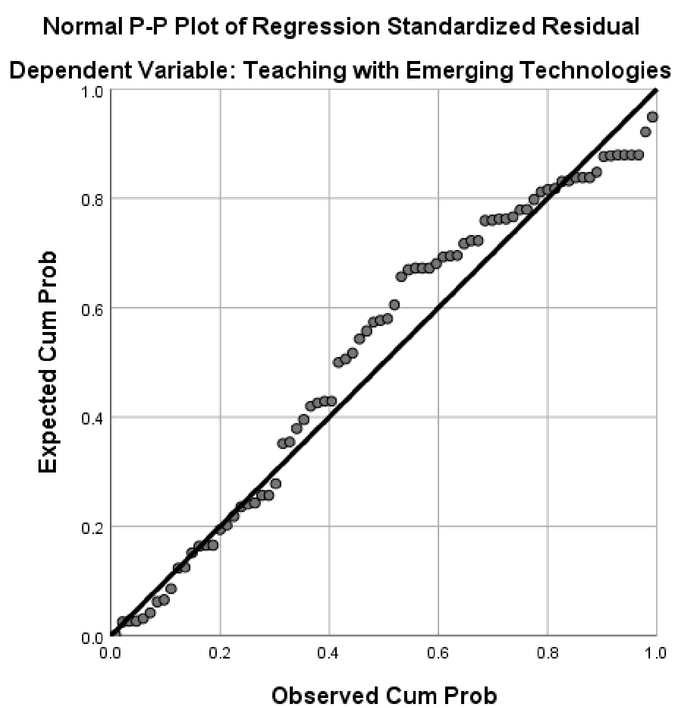

Figure 6. Scatterplot of the Teaching with Emerging Technologies scale

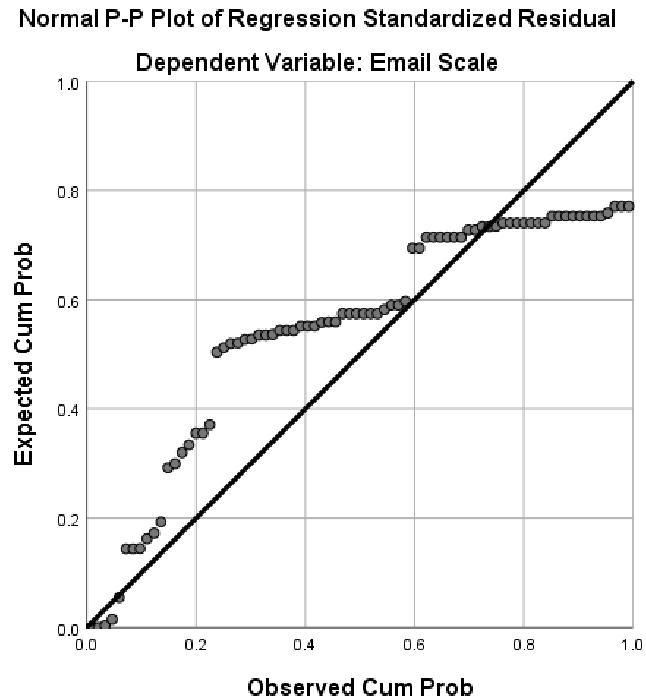

Figure 7. Scatterplot of the Email scale

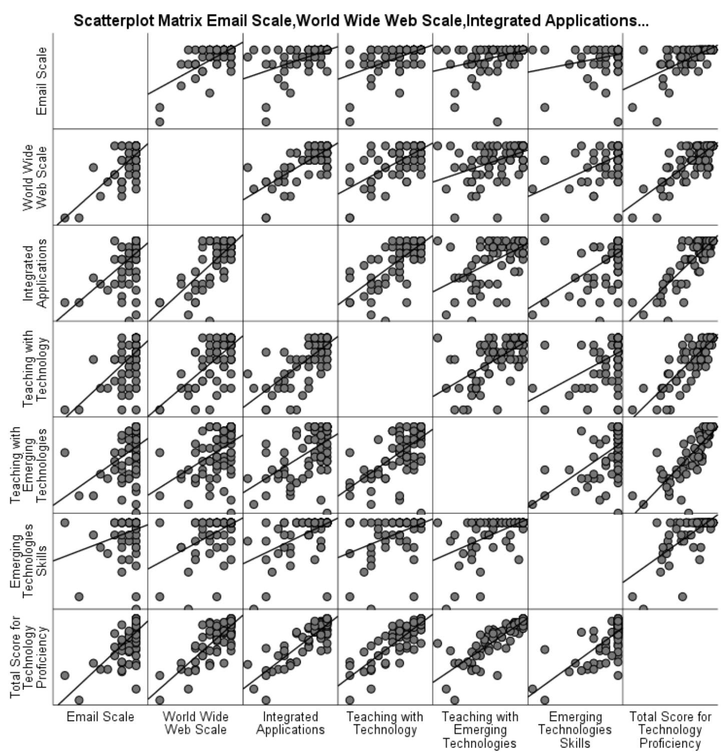

Figure 8. Matrix Scatterplot between criterion variables

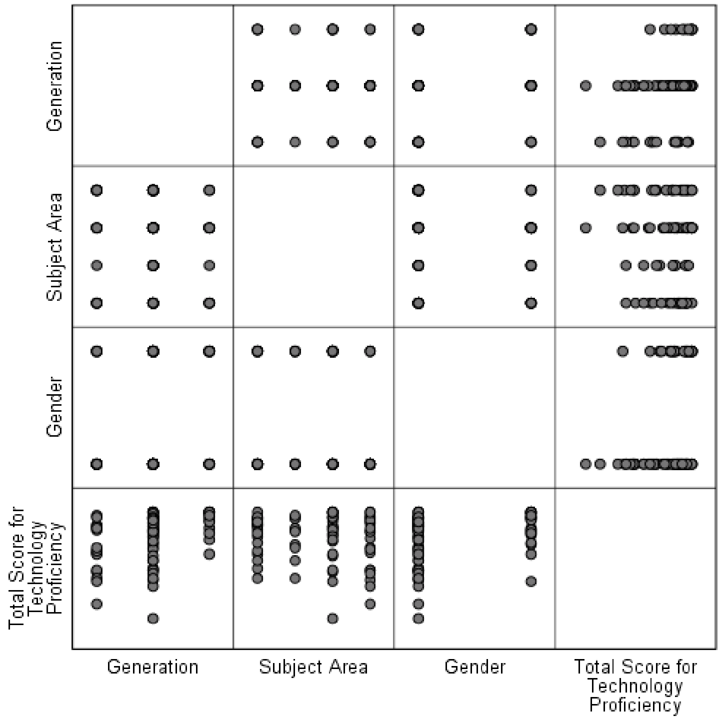

Figure 9. Matrix Scatterplot between total proficiency and predictor variables

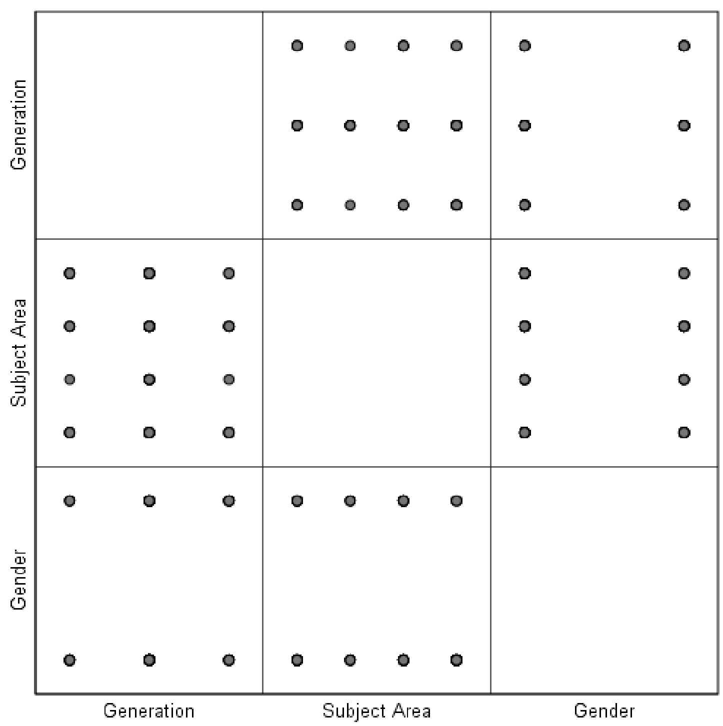

Figure 10: Matrix scatterplot between predictor variables

Table 5

Assumption of Non-multicollinearity for the Total Score Scale

Predictor variables	VIF
Subject area	1.011
Generation	1.020
Gender	1.029

To test for non-multicollinearity, each pair of predictor variables (generation, gender, subject area) was assessed by calculating the VIF. Generation yielded a VIF of 1.020. For subject area, the VIF was 1.011. The VIF was 1.029 for gender. A value greater than 10 indicates a problem in collinearity (Stine, 1995). Multicollinearity does not exist; therefore, all assumptions were tenable.

Results of Null Hypotheses

Multiple linear regression analyses were conducted to determine whether a predictive relationship existed between a criterion variable and multiple predictor variables (Gall et al., 2007). In this study, the researcher examined whether a statistically significant predictive relationship existed between the predictor variables (gender, generation, subject area) and the criterion variable (self-efficacy as measured by the TPSA C-21). The predictor variables were participants' generation (baby boomers, generation X, and millennials), gender, and subject area. For the generation variable, the categories were coded to indicate that more recently born teachers represented a higher value. Baby boomers were coded as 1, generation X were coded as 2, and millennials were coded as 3. Therefore, the direction of the slope was related to the generation. For gender, the categories were numerically coded in alphabetical order, so that females were coded as 1 and males as 2. The criterion variables for the respective regression models were the continuous (interval) scores for the scale of Email, WWW, Integrated Applications, Teaching with Technology, Teaching with Emerging Technologies, Emerging Technology Skills, and Total Technology Proficiency. Subject areas were coded 1 for humanities (art, English, and foreign language), 2 for history, 3 for math and science, 4 for physical education/health and other. The following sections highlights the finding for the seven regression models generated for this study.

Results of Null Hypothesis One

Null Hypothesis one states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning. The regression model for predicting Total scale scores was statistically significant. As seen in Table 6, the regression model was statistically significant, F (3, 74) = 5.387, p = .002. The predictor variables produced significant ability to predict scores on the Total scale, and the researcher rejected null hypothesis one. The model showed an R of .423. The R^2 for the model produced a large effect at 0.179. The variance accounted for in the model was 17.9%.

Table 6
Multiple Regression Model Summary for Total Technology Proficiency Scores

				Change Statistics				
R	R^2	Adjusted R^2	SE	R^2 Change	F Change	df_1	df_2	F change
.423	.179	.146	13.75	0.179	5.387	3	74	0.002*

Note. * indicates statistically significant, p < .05.

Table 7

Multiple Linear Regression ANOVA Table for Predicting Total Technology Proficiency Scores Using the Predictors of Generation, Gender, and Subject Area

Model	*SS*	*Df*	*MS*	*F*	*p*
Regression	3,054.335	3	1,018.112	5.387	.002*
Residual	13,985.152	74	188.989		
Total	17,039.487	77			

Note. * indicates statistically significant, $p < .05$.

Of the three predictor variables of teacher generation, teacher gender, and subject area, only subject area did not demonstrate statistically significant ability to predict teachers' Total Technology Proficiency scores. Generation showed the standardized β of 0.296, $p = 0.007$. The standardized β for gender was 0.243, $p = 0.026$. Table 8 displays the results of the predictor variables on the Total scale.

Table 8

Variables in the Multiple Linear Regression Model Predicting Total Technology Proficiency Scores

Model	Unstandardized Coefficients		Standardized Coefficients	*T*	*P*
	B	Std. Error	Β		
(Constant)	132.513	7.809		16.968	< 0.0001
Generation	7.457	2.678	0.296	2.784	0.007**
Gender	7.772	3.421	0.243	2.272	0.026*
Subject Area	-1.072	1.381	-0.082	-0.776	0.440

Note. * indicates statistically significant predictor variable, $p < .05$.

Results of Null Hypothesis Two

Null hypothesis two states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Email scale of the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning. The regression model for predicting scores on the Email scale was not statistically significant, F (3, 74) = 1.341, p = 0.268, as seen in Table 9. The variance accounted for in the model was 5.2%. Therefore, the model did not significantly predict scores on the Email scale, and the researcher failed to reject null hypothesis two.

Table 9

Multiple Regression Model Summary for Email Scale

				Change Statistics				
R	R^2	Adjusted R^2	SE	R^2 Change	F Change	df_1	df_2	p for F change
0.227	0.052	0.013	1.797	0.052	1.341	3	74	0.268

Table 10

Multiple Linear Regression ANOVA Table for Predicting for Email Scale Score Using the Predictors of Generation, Gender, and Subject Area

Model	*SS*	*Df*	*MS*	*F*	*P*
Regression	12.991	3	4.330	1.341	0.268
Residual	238.971	74	3.229		
Total	251.962	77			

Results of Null Hypothesis Three

Null hypothesis three states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the WWW scale of the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning. The regression model for predicting scores on the WWW scale was statistically significant as seen in Table 11. As seen in Table 11, the regression model was statistically significant, F (3, 74) = 6.759, p = .0000. The predictor variables produced significant ability to predict scores on the WWW scale, and the researcher rejected null hypothesis three. The model showed an *R* of .464. The R^2 for the model produced a large effect at 0.215. The variance accounted for in the model was 21.5%.

Table 11

Multiple Regression Model Summary for WWW Scale

				Change Statistics				
R	R^2	Adjusted R^2	*SE*	R^2 Change	*F* Change	df_1	df_2	*F* change
0.464	0.215	0.183	2.092	0.215	6.759	3	74	0.0000*

Note. * indicates statistically significant, $p < .05$.

Table 12

Multiple Linear Regression ANOVA Table for Predicting WWW Scale Score Using the Predictors of Generation, Gender, and Subject Area

Model	*SS*	*Df*	*MS*	*F*	*P*
Regression	88.757	3	29.586	6.759	.0000*
Residual	323.923	74	4.377		
Total	412.679	77			

Note. * indicates statistically significant, $p < .05$.

Of the three predictor variables used in this study, the subject area variable did not demonstrate statistically significant ability to predict teachers' WWW scores. Generation showed the standardized β of 0.214, $p = 0.043$. The standardized β for gender was 0.367, $p = 0.001$. Table 13 displays all results of the predictor variables on the WWW scale.

Table 13

Variables in the Multiple Linear Regression Model for Predicting WWW Scores

Model	Unstandardized Coefficients		Standardized Coefficients	*T*	*P*
	B	Std. Error	B		
(Constant)	19.449	1.189		16.364	< 0.0001
Generation	0.837	0.408	0.214	2.055	0.043*
Gender	1.828	0.521	0.367	3.510	0.001*
Subject Area	-0.159	0.210	-0.078	-0.756	0.452

Note. * indicates statistically significant predictor variable, $p < .05$.

Results of Null Hypothesis Four

Null hypothesis four states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Integrated Applications scale of the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning. As seen in Table 14, the regression model for predicting scores on the Integrated Applications scale was statistically significant, F (3, 74) = 4.503, p = .006. The model showed an R of .393. The R^2 for the model produced a large effect at 0.154. The variance accounted for in the model was 15.4%. The predictor variables produced significant ability to predict scores on the Integrated Applications scale, and the researcher rejected null hypothesis four.

Table 14

Multiple Regression Model Summary for Integrated Applications

				Change Statistics				
R	R^2	Adjusted R^2	*SE*	R^2 Change	F Change	df_1	df_2	F change
0.393	0.154	0.120	3.140	0.154	4.503	3	74	0.006*

Note. * indicates statistically significant, $p < .05$.

Table 15

Multiple Linear Regression ANOVA Table for Predicting the Integrated Applications Scale Score Using the Predictors of Generation, Gender, and Subject Area

Model	*SS*	*Df*	*MS*	*F*	*p*
Regression	133.206	3	44.402	4.503	.006*
Residual	729.627	74	9.860		
Total	862.833	77			

Note. * indicates statistically significant, $p < .05$.

Of the three predictor variables of teacher generation, teacher gender, and subject areas, only subject area did not demonstrate statistically significant ability to predict teachers' Integrated Applications scores. Generation showed the standardized β of 0.27, $p = 0.015$. The standardized β for gender was 0.243, $p = 0.028$. Table 16 displays the results of all the predictor variables in the Integrated Applications scale.

Table 16

Variables in the Multiple Linear Regression Model Predicting Integrated Applications Scores

Model	Unstandardized Coefficients		Standardized Coefficients	*T*	*P*
	B	Std. Error	B		
(Constant)	17.188	1.784		9.636	< 0.0001
Generation	1.530	0.612	0.270	2.502	0.015*
Gender	1.748	0.781	0.243	2.237	0.028*
Subject Area	-0.118	0.315	-0.040	-0.373	0.710

Note. * indicates statistically significant predictor variable, $p < .05$.

Results of Null Hypothesis Five

Null hypothesis five states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Teaching with Technology scale of the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning. As seen in Table 17, the regression model for predicting scores on the Teaching with Technology scale was not statistically significant, *F* (3, 74) = 2.298, *p* = 0.084. The model showed an *R* of .292. The R^2 for the model produced a small effect at 0.085. The variance accounted for in the model was 8.5%. Therefore, the model did not produce a significant ability to predict scores on the Teaching with Technology scale, and the researcher failed to reject null hypothesis five.

Table 17

Multiple Regression Model Summary for Teaching with Technology

				Change Statistics				
R	R^2	Adjusted R^2	SE	R^2 Change	F Change	df_1	df_2	F change
0.292	0.085	0.048	2.838	0.085	2.298	3	74	0.084

Table 18

Multiple Linear Regression ANOVA Table for Predicting the Teaching with Technology Scale Score Using the Predictors of Generation, Gender, and Subject Area

Model	*SS*	*Df*	*MS*	*F*	*p*
Regression	55.508	3	18.503	2.298	0.084
Residual	595.838	74	8.052		
Total	651.346	77			

Results of Null Hypothesis Six

Null hypothesis six states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Teaching with Emerging Technology scale of the Technology Proficiency Self-Assessment

Questionnaire for 21st Century Learning. As seen in Table 19, the regression model for predicting scores on the Teaching with Emerging Technologies scale was not statistically significant, F (3, 74) = 2.511, p = 0.065. The model showed an R of 0.304. The R^2 for the model produced a small effect at 0.092. The variance accounted for in the model was 9.2%. Therefore, the model did not produce a significant ability to predict scores on the Teaching with Emerging Technologies scale, which leads to failing to reject null hypothesis six.

Table 19

Multiple Regression Model Summary for Teaching with Emerging Technologies

				Change Statistics				
R	R^2	Adjusted R^2	SE	R^2 Change	F Change	df_1	df_2	F change
0.304	0.092	0.056	5.146	0.092	2.511	3	74	0.065

Table 20

Multiple Linear Regression ANOVA Table for Predicting Teaching with Emerging Technologies Scale Scores Using the Predictors of Generation, Gender, and Subject Area

Model	*SS*	*Df*	*MS*	*F*	*P*
Regression	199.478	3	66.493	2.511	0.065
Residual	1,959.509	74	26.480		
Total	2,158.987	77			

Results of Null Hypothesis Seven

Null hypothesis seven states that there is no statistically significant predictive relationship between teachers' generation, gender, subject area, and technology self-efficacy, as measured by the Emerging Technologies Skills scale of the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning. The regression model for predicting scores on the

Emerging Technologies Skills scale was statistically significant. As seen in Table 24, the regression model was statistically significant, F (3, 74) = 7.053, p = .0000. A predictor variable produced significant ability to predict scores on the Emerging Technologies Skills scale, and the researcher rejected null hypothesis seven. The model showed an R of .472. The R^2 for the model produced a large effect at 0.222. The variance accounted for in the model was 22.2%.

Table 21

Multiple Regression Model Summary for Emerging Technologies Skills

				Change Statistics				
R	R^2	Adjusted R^2	SE	R^2 Change	F Change	df_1	df_2	F change
0.472	0.222	0.191	2.652	0.222	7.053	3	74	0.0000*

Note. * indicates statistically significant, $p < .05$.

Table 22

Multiple Linear Regression ANOVA Table for Predicting Emerging Technologies Skills Scores Using the Predictors of Generation, Gender, and Subject Area

Model	SS	Df	MS	F	P
Regression	148.828	3	49.609	7.053	.0000*
Residual	520.467	74	7.033		
Total	669.295	77			

Note. * indicates statistically significant, $p < .05$.

Of the three predictor variables of generation, gender, and subject area, a statistically significant ability to predict teachers' Emerging Technologies Skill score was shown in the generation variable. The generation variable showed the standardized β of 0.402, p = 0.0002. Table 23 displays the results of the predictor variables on the Emerging Technologies Skills scale.

Table 23

Variables in the Multiple Linear Regression Model Predicting Emerging Technologies Skills Scores

Model	Unstandardized Coefficients		Standardized Coefficients	*T*	*P*
	B	Std. Error	B		
(Constant)	25.043	1.507		16.623	< 0.0001
Generation	2.005	0.517	0.402	3.882	0.0002*
Gender	0.603	0.660	0.095	0.914	0.364
Subject Area	-0.462	0.266	-0.179	-1.735	0.087

Note. * indicates statistically significant predictor variable, $p < .05$.

Summary

This chapter contained the findings for the study whose purpose was to explore the predictive ability of technology efficacy among secondary teachers who use 21st century technology in classrooms in Florida as measured by the seven scales of the TPSA C-21. The actual sample used was 78 teachers working in Florida who completed the survey during 2019. The regression models for predicting scores on the scales measuring Email, Teaching with Technology, and Teaching with Emerging Technologies Skills were not significant. The regression models in which the variables of generation and gender significantly predicted the scores occurred for WWW, Integrated Applications, and Total Technology Proficiency. Interestingly, only generation predicted scores on Emerging Technology Skills. Chapter 5 presents the discussion of the statistical findings related to research, the implications, and the recommendations.

CHAPTER FIVE: CONCLUSIONS

Overview

In Chapter Five, the researcher provides an overview of the study results presented in Chapter Four. The researcher reflects on the related literature surrounding various facets of teacher technology efficacy, the theoretical frameworks, and the null hypotheses. Furthermore, the implications and limitations of the research study as well as recommendations for future research are addressed.

Discussion

The purpose of this quantitative study was to explore the predictive ability of technology efficacy among secondary teachers who use 21st century technology in classrooms as measured by the TPSA C-21. The researcher analyzed data and addressed the following research question: Is there a predictive relationship between teachers' technology self-efficacy and their gender, generation, subject area, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st century learning? The researcher rejected or failed to reject the null hypotheses. The focus of this chapter was on the results, literature, and theory presented in and as a result of this research study.

Null Hypothesis One

Null hypothesis one states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by the TPSA C-21. The regression model for predicting Total Technology Proficiency scale scores was statistically significant, F (3, 74) = 5.387, p = .002. The variance for in the model was 17.9%. Generation showed the standardized β of 0.296, p = 0.007. The standardized β for gender was 0.243, p = 0.026. Subject area was the only predictor variable that did not demonstrate statistically significant ability to predict to predict teachers' Total Technology Proficiency scores. Gender and generation predictor variables demonstrated statistically significant ability to predict scores on the Total Technology Proficiency scale, and the researcher rejected null hypothesis one.

This study adds to the body of literature by further examining the predictive ability among a combination of factors (generation, gender, and subject area) and teacher technology efficacy of teachers in American high schools. In support of previous studies (Baek, et al., 2017; Liaw & Huang, 2015; Scherer & Siddiq, 2015), gender and generation were found to be statistically significant predictors of teacher technology efficacy. Buabeng-Andoh (2019) revealed males' overall information and communication technology in education usage scores for self-efficacy were higher than those of females. Much of the research examining male and female technology efficacy was conducted in (a) countries other than the United States (Baek et al., 2017; Lai & Smith, 2018; Scherer & Siddiq, 2015) and (b) with middle school teachers or college students enrolled in teacher education programs (Baydas & Goktas, 2016; Li et al., 2016; Liaw & Huang, 2015). Although steadily increasing, empirical research using the factors of generation, gender, and subject area predicting technology efficacy has been limited in number, especially when measured by the TPSA C-21. This study focuses on secondary teachers' technology efficacy in American public schools, in which gender and generation continue to be factors that reveal a gap still exists, and, thus, further study is needed.

Subject area did not have a statistically significant ability to predict teachers' Total Technology Proficiency scale scores in this study. In contrast, other previous research revealed science and math teachers exhibit high levels of self-efficacy (Chiu & Churchill, 2016; Szeto & Cheng, 2017). In addition, language and humanities teachers did not display a more positive attitude and belief about technology use than science and math teachers (Chui & Churchill, 2016). The results of this current research are similar to Baek et al. (2017) in that mathematics and science teachers showed lower levels of self-efficacy and positive attitudes relating to technology use. Teachers who have a higher confidence and efficacy in their technology skills use technology more frequently (Li, Garza, Keicher, & Popov, 2019) and have an improvement in their instructional capabilities, student engagement, and experience (Isbell & Szabo, 2015). The results of the factors support the notion that efficacy could change over time depending on awareness, targeted and personalized training, and exposure to 21st century technology devices and applications (Hall & Trespalacios, 2019).

Null Hypothesis Two

Null hypothesis two states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by the Email scale on the Technology Proficiency Self-Assessment Questionnaire for 21st century learning. The regression model was not statistically significant, F (3, 74) = 1.341, p = 0.268, as measured by the Email scale. The variance accounted for in the model was 5.2. Thus, the researcher failed to reject null hypothesis two.

The results of this current study in were in contrast to other studies (Dang, Zhang, Ravindran, & Osmonbekov, 2016; Scherer & Saddiq, 2015; Alhazza & Lucking, 2017). Email capabilities, such as digital competency, administrative technology functions, and basic operational skills were embedded in a variety of categories that measured teacher technology efficacy (Scherer & Saddiq, 2015). These capabilities were aligned with the items in the Email scale (Christensen & Knezek, 2017). Dang et al., (2016) revealed computer self-efficacy for males is higher than females. In addition, Scherer and Saddiq (2015) revealed a significant difference in secondary teachers' computer self-efficacy in relation basic operational skill and advanced operational in favor of males. However, Alhazza and Lucking (2017) revealed that females have a more positive view of utilizing the social components of technology, such as texting and emailing. The current study does not support previous finding regarding subject area. Krause (2017) found that physical education teachers were confident in their ability to integrate technology. Similarly, science and mathematics teachers exhibited more positive attitudes and beliefs about the use of technology than language and humanities teachers (Chiu & Churchill, 2016).

The findings of this current study suggest that the sample population of males and females used in the study was not a statistically significant predictor as it pertains to the basic component of 21st century technology skills and applications in Email scale. Since these data contradicts those of other studies by revealing that gender, generation, and subject area are not factors to consider when determining technology efficacy in the classroom, the findings do not support that gaps in gender, generation, and subject area exist in teacher technology efficacy. This study also contradicts the results that indicated self-efficacy is one of the greatest challenges of technology integration among teachers (Elstad & Christophersen, 2017; Oddone, 2016). The findings support the constructivism theory, in which new stimuli from the environment causes teachers to restart their processed and they are able to construct and reconstruct their knowledge accordingly (Piaget, 1952).

Null Hypothesis Three

Null hypothesis three states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by the WWW scale on the TPSA C-21. The regression model was statistically significant, F (3, 74) = 6.759, p = .0000. The R^2 for the model produced a large effect at 0.215. The variance accounted for in the model was 21.5%. Of the three predictor variables used in this study, the subjects taught variable did not demonstrate statistically significant ability to predict teachers' WWW scores. Generation showed the standardized β of 0.214, $p = 0.043$. The standardized β for gender was 0.367, $p = 0.001$. The predictor variables produced significant ability to predict scores on the WWW scale, and the researcher rejected null hypothesis three.

The results in this study added to the body of knowledge in support of previous research (Lai & Hong, 2015; Scherer & Siddiq, 2015). Wiedmer (2015) indicated that millennials and generation Xers are more advanced in technology use than baby boomers. (Lai and Hong (2015) found generation to be a factor for determining technology self-efficacy. In relation to gender, a study of Norwegian high school teachers showed that males possessed more self-efficacy than females in terms of basic and advanced operations as well as collaborative work (Scherer & Siddiq, 2015).

In conclusions, the findings of this current study add to the body of knowledge by presenting empirical data that determines whether a gap exists between gender, generation, subject area, and teacher technology efficacy. In determining that generation and gender gaps remain prevalent, educational leaders can provide opportunities to assist teachers in building efficacy, and combat the notion of teachers being unprepared for meeting the demands of technology-rich classrooms (Elstad & Christophersen, 2017).

Null Hypothesis Four

Null hypothesis four states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by the Integrated Applications scale on the TPSA C-21. The regression model for predicting scores on the Integrated Applications scale was statistically significant, (F (3, 74) = 4.503, $p = .006$). The R^2

for the model produced a large effect at 0.154. The variance accounted for in the model was 15.4. Subjects taught was the only variable that did not demonstrate statistically significant ability to predict teachers' Integrated Applications scores. Generation showed the standardized β of 0.27, $p = 0.015$. The standardized β for gender was 0.243, $p = 0.028$. The predictor variables produced significant ability to predict scores on the Integrated Applications scale, and the researcher rejected null hypothesis four.

The results of this study pertaining to subject area contrasted with those of previous studies. Science teachers perceive their lack of technology skills and knowledge as barriers in technology integration and classroom practices (Barak, 2017; Wang, et al, 2014). However, the findings of this study pertaining to generation is similar to a previous study (Lowell & Morris, 2019). Generation is also a significant predictor of Integrated Applications on the TPSA C-21, which supports Lowell and Morris's (2019) statement regarding addressing the generation variable in order to make sure teachers are able to successfully apply the technology to the learning of all students.

The findings of this study also add to the current understanding of the social cognitive theory in examining factors that can distort the relation between one's self-belief of capability and action, which in turn, can affect performance levels (Bandura,1997, 2012). Additionally, teachers who adopt the constructivist teaching approach meet the needs of the global world (Ucus & Acar, 2018).

Null Hypothesis Five

Null hypothesis five states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by Teaching with Technologies scale on the TPSA C-21. The regression model for predicting scores on the

Teaching with Technology scale was not statistically significant, F (3, 74) = 2.298, p = 0.084. The model showed an R of .292. The R^2 for the model produced a small effect at 0.085. The variance accounted for in the model was 8.5%. None of the predictor variables produced significant ability to predict scores on the Teaching with Technology scale, and the researcher failed to reject null hypothesis five.

The findings of this study both support and contrast with results found in other studies (Li et al., 2019; Scherer & Siddiq, 2015; Venter, 2017). Li, et al. (2019) study revealed a significant difference regarding technology use and beliefs in teaching with technology as it relates to teachers' subject area, gender, and age. Males' scores were statistically more significant than those of females, teachers younger than 45 years of age were statistically more significant than those of teachers older than 45 years of age, and science teachers' scores were statistically more significant than those of English and math teachers (Li et al., 2019). In addition, Venter (2017) stated that some teachers who were not born in the age of technology, such as baby boomers may not appreciate it, which can result in the omission of the major social aspects of advanced technology from their instruction. The findings of this current study are not aligned with previous research studies.

This current study adds to the body of knowledge in teacher technology efficacy in that it reveals that the gender, generation, and subject area gaps are not apparent. In considering the social cognitive theory, teachers develop rules of behavior based on previous experiences, and will alter their cognition to produce positive results (Liaw, & Huang, 2015). Teachers are willing to alter their traditional instructional methods to incorporate the use of tablets and interactive whiteboards (Kim et al., 2019). The findings contribute to the body of knowledge in that they reveal the efficacy of teachers who are currently using 21st century devices in their classrooms for instructional purposes.

Null Hypothesis Six

Null hypothesis six states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by Teaching with Emerging Technologies scale on the TPSA C-21. The regression model for predicting scores on the Teaching with Emerging Technologies scale was not statistically significant, $F(3, 74) = 2.511$, $p = 0.065$. The variance accounted for in the model was 9.2%. The model showed an R of 0.304. The R^2 for the model produced a small effect at 0.092. None of the predictor variables produced significant ability to predict scores on the Teaching with Emerging Technologies scale, and, thus, the researcher failed to reject null hypothesis six.

The results of this study were varied. The findings of this research reveal that gender, generation, and subject area were not deemed significant predictors of efficacy, and thus, did not align with other research studies (Kwon et al., 2019; Nawi et al., 2015). For example, Nawi et al. (2015) stated that generation was a factor in reference to technology (mobile devices) integration and efficacy; the small scripts were hard for participants in the baby boomer generation to read. A more recent study (Kwon et al., 2019) revealed that males had higher self-efficacy levels than females in a school that had a one-to-one technology initiative with iPads.

In contrast, this current research aligned with other studies (Khlaif, 2018; Scherer & Siddiq, 2015) in that a significant predictive ability does not exist. Khlaif (2018) revealed that subject area was not statistically significant in regard to teaching with emerging technology, such as tablets. Each use of tablets by math, science, and English teachers through their school's one-to-one initiative revealed that other factors such as technical infrastructure, instructional assistance and technical support impacted their use and efficacy (Khlaif, 2018). Scherrer and Siddiq (2015) used gender as a factor, only to determine the technology efficacy in teachers' ability to use wikis and blogs as a collaborative tool in the classroom was not significantly between in males and females. These participants' efficacy levels could be impacted by the DCP (Florida Department of Education, 2017), which requires teachers to integrate technology and provide professional development opportunities pertaining to 21st century technology in the classroom.

The findings of this current study add to current understanding and generalization regarding teacher technology efficacy among high school teachers who use 21st century tools, applications, and skills in America. Educational leaders and teachers can receive additional empirical data that will provide better insight to the factors that predict teacher technology efficacy. As a result, they will be better informed when determining and planning technology-based professional development and technology support.

Null Hypothesis Seven

Null hypothesis seven states that there is no statistically significant predictive relationship between gender, generation, subject area, and self-efficacy, as measured by the Emerging Technologies Skills scale on the TPSA C-21. The regression model was statistically significant, F (3, 74) = 7.053, p = .0000. The model showed an R of .472. The R^2 for the model produced a large effect at 0.222. The variance accounted for in the model was 22.2%. Generation (standardized β of 0.402, p = 0.0002) was the only variable to demonstrate a statistically significant ability to predict teachers' Emerging Technologies Skill score. Since the predictor variable, generation, produced significant ability to predict scores on the Emerging Technologies Skills scale, and the researcher rejected null hypothesis seven.

This current research results in this study both supported and contradicted other findings regarding generation, gender, and subject area (Baydas & Goktas, 2016; Kwon, et al, 2019; Li, et al., 2016; Liu & Guo, 2017; Wang, Chen, & Chen, 2018. In terms of gender, Kwon, et al. (2019) determined that technical skills were a significant predictor of higher efficacy in males than females. Perceptions of technology (mobile devices) are different between males and females, which can be attributed to an imbalance of exposure (Liu & Guo, 2017). In contrast, gender was not determined to influence perception of technology adoption or integration (Baydas & Goktas, 2016; Li et al., 2016). The finding in the current study supports constructivism theory in that it addresses that "learning takes place through a process in which knowledge is built on a foundation of prior knowledge" (Krahenbuhl, 2016, p. 97). Each generation has set characteristics that highlight their technology familiarity and usage (Wiedmer, 2015), and the generation gap is still prevalent in the confidence level of participants in this study. In contrast, a gap in subject area was not determined in this study. The results of this study contrast with those of Krause (2017), in which physical education teachers were deemed to be confident in their ability to integrate technology, namely digital video cameras.

The findings of this current study contribute to the body of knowledge of teacher technology efficacy by providing empirical research that addresses that the generation gap is still prevalent in teacher technology efficacy. However, a gap is not apparent in subject area and gender variables. The findings support a shift occurring in generation, gender, and especially subject area, in which teachers are confident in their abilities to use 21st century technology, such as eBooks, podcasts, audiobooks, and retrieving files in a cloud-based environment (Christensen & Knezek, 2017). The findings are also aligned with the Horizon Report (2017) in that teachers are expected to be adept in implementing technology-based approaches for their content area and delivery.

Implications

The researcher used two theories as a foundation for this study. Bandura's social cognitive theory (1997, 2012) and Dewey's (1897; 1922) and Piaget's (1952) constructivism. Teachers' self-efficacy is related to their mastery level. In considering generation, gender, and subject area, the researcher analyzed the data and determined which factors predicted the scales on the TPSA C-21. Teachers perceive technology to be useful in their implementation of constructivist pedagogy, which strengthens their intention to use technology (Teo & Zhou, 2017). New and emerging technologies in the education arena give teachers the opportunity to utilize technology devices, tool, and apps in their classroom instruction. Their efficacy is tied to how well they can construct and reconstruct knowledge (Piaget, 1952).

The teachers in this study already used technology in their classrooms, and the results did not reveal a significant predictive relationship between efficacy and subject area. Using constructivism to alter their perceptions and form new instructional strategies to include the use of technology tools and devices is beneficial to teachers in 21st-century classrooms. This study presented three factors out of several pertaining to teachers and technology. The amount of research that exists on this topic (secondary teachers' technology efficacy as predicted by gender, generation, and subject area) was initially limited, but it is steadily growing.

Results from this study provide practical implications pertaining to teacher technology efficacy among generations, gender, and subject area of American high school teachers. The incorporation of 21st century technology in the classroom is expected to increase in this technology-driven era. Educational leaders and practitioners may use the results of this study to determine the beliefs teachers have regarding emerging technology skills, World Wide Web, Integrated Applications, Technology Proficiency, E-mail, and Teaching with Technology based on their generation, gender, and subject area in educational settings. In doing so, these leaders and practitioners can make more informed and cost effective decisions regarding the selection of professional development diversity trainings in relation to the targeted technology efficacy skills, tools, and applications examined in this current research study. Similarly, teachers in other states within America can also examine the results of their American colleagues since limited research is available that pertain to American secondary teachers. By doing so, teachers can receive 21st-century professional development opportunities that are more meaningful and beneficial. Last, university administrators with the notion of creating equity in education in mind, can review the results in order to provide adequate instructional opportunities for non-traditional students enrolled in education-related classes and programs (Lowell & Morris, 2019).

Limitations

The results and implications are used to offer recommendations for future studies. The first limitation involved issues with reliabilities found in the instrument's six subscales; WWW scale (0.631) was below the acceptable .7 Cronbach's alpha reliability used for this current research study. The reliability level can be considered a weakness of the instrument, which indicates that the scale is not measuring the technology efficacy as it pertains to using the WWW to find primary resources and create/keep track of web pages, as the author intended. Great care should be taken when using the WWW scale, or the researcher could opt to use another instrument. However, the Cronbach's alpha for the Total Technology Proficiency scale was .932, which is excellent and deems the scale as reliable.

The second limitation was sample population. The researcher used one geographic area, which may not generalize teachers in other geographic locations in the United States of America. In addition, the sample size, 78 participants, used for this study met the minimum standard for this analysis (Warner, 2013). By having more participants in this study, the researcher may yield different results. Furthermore, a lack of equity occurred in the population. Women consisted of 69.2%, math and science consisted of 34.6%, and the generation X consisted of 65.4 % of the total participants within their respective categories. Including more participants would lead to a stronger generalization within the population.

Another limitation to consider is the self-reported results of the participants within this non-experimental predictive, correlational study. Participants may have been inaccurate in their response to the demographic survey, as it pertains to their gender and generation. They may have either over or under reported their technology efficacy levels. The researcher could interview and include focus groups by conducting research using the mixed-method approach.

Recommendations for Future Research

During this research study, recommendations involving teacher technology efficacy arose. The first recommendation pertains to expanding the sample population. Researchers could include teachers who use 21st century technology in more than one state to possibly increase the sample population. Participants could have been selected from other states in America because teachers in other locations may not have the same factors that predict their efficacy levels. In addition, seeking approval from valid and reliable teacher groups and organizations instead of district committees may yield larger participant participation, which could yield different results.

The next recommendation relates to the utilization of a different research study. A more accurate account regarding subject area, generation, and gender can be gathered when using in a mixed-method study, which would require using both qualitative and quantitative analyses. The addition of the mixed-method approach would be more beneficial in determining teachers' perceptions in their abilities to use technology in the classroom. The researcher could establish a focus group that includes high school teachers who use 21st century tools, skills, and applications from various areas in the United States to respond to a questionnaire and interview questions.

The third recommendation is regarding the limitation of the instrument, namely the reliability of the WWW scale. Another factor to consider for future research of teacher technology efficacy is technology support (Khlaif, 2018). The last recommendation pertains to personal and professional technology usage as determined by years' experience as a factor in examing the efficacy of secondary teachers.

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Appendix A

Electronic Demographic Survey

Teacher Demographics:

Please write in or place a check mark next to the appropriate response.

1. Birth year: _______

2. Gender: ___Male ___ Female

3. Subject(s) to be taught in the 2018-2019 school year: Check all that apply

___ English

___history

___ math

___computer science

___art

___foreign language

___band

___physical education/health

___ other

4. Grade Level(s) Taught: Check all that apply

___9th

___10th

___11th

___12

5. Race/ethnicity: Check the one that applies

___White/Caucasian

___Black/African American

___Hispanic/Latino

___Asian

___Biracial

___Other

Appendix B

Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning

5=Strongly Agree 4=Agree 3=Neutral 2=Disagree 1=Strongly Disagree

I am confident that I could…

1. …send an email to a friend.
   5 4 3 2 1

2. …subscribe to a discussion list.
   5 4 3 2 1

3. …create a distribution list to send e-mail to several people at once.
   5 4 3 2 1

4. …send a document as an attachment to an e-mail message.
   5 4 3 2 1

5. …keep copies of outgoing messages that I send to others.
   5 4 3 2

6. …use an Internet search engine (e.g., Google) to find Web pages related to my subject matter interests.
   5 4 3 2 1

7. …search for and find the Smithsonian Institute Web site.
   5 4 3 2 1

8. …create my own web page.
   5 4 3 2 1

9. …keep track of Web sites I have visited so that I can return to them later. (An example is using bookmarks.)
   5 4 3 2 1

10. …find primary sources of information on the internet that I can use in my teaching.
    5 4 3 2 1

11. …use a spreadsheet to create a bar graph of the proportions of the different colors of M&Ms in a bag.

5 4 3 2 1

12. …create a newsletter with graphics.
5 4 3 2 1

13. …save documents in formats so that others can read them if they have a different word processing program (e.g., saving Word, pdf, RTF, or text).
5 4 3 2 1

14. …use the computer to create a slideshow presentation.
5 4 3 2 1

15. …create a database of information about important authors in a subject-matter field.
5 4 3 2 1

16. … write an essay describing how I would use technology in my classroom.
5 4 3 2 1

17. … create a lesson or unit that incorporates subject matter software as an integral part.
5 4 3 2 1

18. … use technology to collaborate with teachers or students, who are distant from my classroom.
5 4 3 2 1

19. … describe 5 software programs or apps that I would use in my teaching.
5 4 3 2 1

20. ….write a plan with a budget to buy technology for my classroom.
5 4 3 2 1

21. … integrate mobile technologies into my curriculum.
5 4 3 2 1

22. … use social media tools for instruction in the classroom (e.g., Facebook, Twitter, etc.)
5 4 3 2 1

23. … create a wiki or blog to have my students collaborate.
5 4 3 2 1

24. …use online tools to teach my students from a distance.
5 4 3 2 1

25. … teach in a one-to-one environment in which the students have their own device.

5 4 3 2 1

26. …find a way to use a smartphone in my classroom for student responses.

5 4 3 2 1

27. … use mobile devices to connect to others for my professional development.

5 4 3 2 1

28. … use mobile devices to have my students access learning activities.

5 4 3 2 1

29. … download and listen to podcasts/audio books.

5 4 3 2 1

30. … download and read e-books.

5 4 3 2 1

31. … download and view streaming movies/video clips.

5 4 3 2 1

32. … send and receive text messages.

5 4 3 2 1

33. … transfer photos or other data via a smartphone

5 4 3 2 1

34. … save and retrieve files in a cloud-based environment.

5 4 3 2 1

Appendix C

Instructions for administering the TPSA C-21

Good morning/Good afternoon participating educators,

You have agreed to participate in a research study in which the completion of a demographics survey and an online survey, the Technology Proficiency Self-Assessment Questionnaire for 21st century learning, is required. The length of time to complete the 34-item survey and demographics is approximately 20 minutes.

Please select one choice per item, ranging 1 -5.

A score of 1 = strongly agree, 2= disagree, 3 =neutral, 4=agree, 5=strongly agree.

Once you have completed the survey, select the submit icon in order to ensure results are downloaded and saved in Google Forms Your results will be sent to Kimberly D. Woods.

Appendix D

[redacted]

Reply all
Wed 6/14, 7:40 PM

Hello Kimberly,
You may use the TPSA C21 survey instrument for your dissertation study. We just ask that you give proper credit and citations to it. I would love to hear from you regarding your findings.
Kind regards,
Rhonda Christensen

On Tue, Jun 13, 2017 at 4:05 PM, [redacted] wrote:

Dear Dr. Christensen,

I am a doctoral candidate at Liberty University in Lynchburg, Virginia. My doctoral chair is Dr. Jillian Wendt. I am working on a dissertation that will allow me to conduct a correlational study to examine the predictive relationships between technology efficacy of teachers who use mobile devices and their age, gender, and subject area.

My purpose for contacting you is to seek permission to use the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning as it appears in Journal of Digital Learning in Teacher Education (2017). I would greatly appreciate your consideration of my request, and I look forward to communicating with you in the future.

Sincerely,

Kimberly D. Woods

Doctoral Candidate, Liberty University

Re: [External] Re: Permission to use Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21) for publication purposes

From: Rhonda Christensen [redacted]
Sent: Monday, June 8, 2020 10:58 AM
To: Woods, Kimberly [redacted]>
Cc: Gerald Knezek <[redacted]
Subject: [External] Re: Permission to use Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21) for publication purposes

[redacted]

Hello Kimberly,
Congratulations on being so close to completion on your doctorate. I look forward to reading about it.
Yes, you may include it in your dissertation publication credited as your indicated.
[redacted]
Rhonda Christensen

On Mon, Jun 8, 2020 at 8:47 AM Woods, Kimberly <[redacted]> wrote:

Dear Dr. Christensen,

In June of 2017, I emailed you to ask your permission to use the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning as it appears in Journal of Digital Learning in Teacher Education (2017.) Now, I am seeking your permission to use the actual questionnaire for publication purposes, which is a requirement of graduation. I will include proper credit and citation of the questionnaire as you previously requested.

As stated in a previous email, I am a doctoral candidate at Liberty University in Lynchburg, Virginia. My doctoral chair is Dr. Jillian Wendt. The focus of my dissertation is to examine the predictive relationship between technology efficacy and teachers' generation, gender, and subject area.

I would greatly appreciate your approval of my request, and I look forward to your reply. Thank you for the generosity you have shown thus far.

Sincerely,

Kimberly D. Woods

Appendix E

Conditional IRB approval gained on August 9, 2018. IRB exemption gained on April 19,2019.

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

April 19, 2019

Kimberly D. Woods
IRB Exemption 3384.041919: Teacher Technology Efficacy: The Relationship Among Age, Gender, and Subject Area of Secondary Teachers

Dear Kimberly D. Woods,

The Liberty University Institutional Review Board has reviewed your application in accordance with the Office for Human Research Protections (OHRP) and Food and Drug Administration (FDA) regulations and finds your study to be exempt from further IRB review. This means you may begin your research with the data safeguarding methods mentioned in your approved application, and no further IRB oversight is required.

Your study falls under exemption category 46.101(b)(2), which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:101(b):

> (2) Research that only includes interactions involving educational tests (cognitive, diagnostic, aptitude, achievement), survey procedures, interview procedures, or observation of public behavior (including visual or auditory recording) if at least one of the following criteria is met:
>
> > (i) The information obtained is recorded by the investigator in such a manner that the identity of the human subjects cannot readily be ascertained, directly or through identifiers linked to the subjects;

Please note that this exemption only applies to your current research application, and any changes to your protocol must be reported to the Liberty IRB for verification of continued exemption status. You may report these changes by submitting a change in protocol form or a new application to the IRB and referencing the above IRB Exemption number.

If you have any questions about this exemption or need assistance in determining whether possible changes to your protocol would change your exemption status, please email us at [redacted]

Sincerely,

[redacted]

G. Michele Baker, MA, CIP
Administrative Chair of Institutional Research
Research Ethics Office

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Appendix F

Permission letter

Date

[redacted]

Dear [redacted]

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The title of my research project is Teacher Technology Efficacy: The Relationship Among Age, Gender, and Subject Area of Secondary Teachers and the purpose of my research is to explore the predictive ability of technology efficacy among at least 150 secondary teachers who use 21st century technology in classrooms in central western and southeastern Florida through the use of the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning (TPSA C-21).

I am writing to request your permission to conduct my research in [county] schools. I am also asking for assistance in contacting potential participants by having a representative from the district send recruitment emails on my behalf at a later date.

Participants will be asked to go to the designated webpage and click on the link provided to complete the survey. Participants will be presented with informed consent information prior to participating. Taking part in this study is completely voluntary, and participants are welcome to discontinue participation at any time.

Thank you for considering my request. If you choose to grant permission, respond by email to [redacted]

Sincerely,

Kimberly D. Woods
Liberty University doctoral candidate

Appendix G

Recruitment letter
Date:

[redacted]

Dear [redacted]

Thank you for supporting my research efforts. I am writing to ask if you would be willing to forward the below email to teachers who teacher 9th-12th grade in your district.

Dear [county] Schools Teacher:

As a graduate student in the School of Education at Liberty University, I am conducting research as part of the requirements for a doctoral degree. The purpose of my research is to examine whether a predictive relationship between at least 150 secondary teachers' age, gender, subject area, and technology self-efficacy, as measured by the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning exists. I am writing to ask for your support in allowing me to recruit teacher participants.

If you are 18 years of age or older and teach 9th -12th grade, you will be asked to do the following:

1. Complete the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning and a brief demographic survey.

The 34-item survey, which will be available in the fall of the 2018-2019 school year, should take approximately 20 minutes for you to complete. Your participation will be completely anonymous, and no personal, identifying information will be collected.

To participate, go to the designated webpage, click on the link provided, and complete the survey.

A consent document is provided as the first page you will see after you click on the survey link. The consent document contains additional information about my research. Please click on the survey link at the end of the consent information to indicate that you have read the consent information and would like to take part in the survey.

Sincerely,

Kimberly D. Woods
Liberty University Doctoral candidate

Appendix H

CONSENT FORM

Teacher Technology Efficacy: The Relationship Among Secondary Teachers
Kimberly D. Woods
Liberty University
School of Education

You are invited to be in a research study of teacher technology efficacy. You were selected as a possible participant because of your experience using 21st century devices in your classroom. Please read this form and ask any questions you may have before agreeing to be in the study.

Kimberly D. Woods, a doctoral candidate in the School of Education at Liberty University, is conducting this study.

Background Information: The purpose of this study is to determine whether teacher technology efficacy is predicted from a combination of subject area, gender, and age (baby boomers, generation X, and millennials) among secondary teachers who use 21st century technology devices and tools.

Procedures: If you agree to be in this study, I would ask you to do the following:

1. Complete the Technology Proficiency Self-Assessment Questionnaire for 21st Century Learning and a brief survey. (20 minutes)

Risks: The risks involved in this study are minimal, which indicates that they are equal to the risks participants encounter in daily life.

Benefits: Participants should not expect to receive a direct benefit from taking part in this study.

Benefits to society include an awareness and improvement of professional development and training on the effective and adequate use of 21st century devices and tools in the field of education.

Compensation: Participants will not be compensated for participating in this study.

Confidentiality: The records of this study will be kept private. In any sort of report I might publish, I will not include any information that will make it possible to identify a subject. Research records will be stored securely, and only the researcher will have access to the records.

- The researcher will not request participants' names. Participants' records and responses will remain anonymous.
- The research data will be stored on a password locked computer and may be used for future presentations. After three years, all electronic records will be deleted.

Voluntary Nature of the Study: Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with Liberty University. If you decide to participate, you are free to not answer any question or withdraw at any time prior to submitting the survey without affecting those relationships.

How to Withdraw from the Study: If you choose to withdraw from the study, please exit the survey and close your internet browser. Your responses will not be recorded or included in the study.

Contacts and Questions: The researcher conducting this study is Kimberly D. Woods. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her [redacted] You may also contact the faculty chair, Dr. Jillian Wendt at [redacted]

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Institutional Review Board, [redacted], Lynchburg, VA 24515 or email [redacted]

Please notify the researcher if you would like a copy of this information for your records.

Statement of Consent: I have read and understood the above information. I have asked questions and have received answers. I consent to participate in the study.

(NOTE: DO NOT AGREE TO PARTICIPATE UNLESS IRB APPROVAL INFORMATION WITH CURRENT DATES HAS BEEN ADDED TO THIS DOCUMENT.)