An Examination of the Relationship between Generation, Gender, Subject Area, and Technology Efficacy among Secondary Teachers in the United States

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Article Info	Abstract
	The current study uses a correlation design and multiple linear regression to determine whether generation, gender, and subject area predict teachers' technology efficacy as measured by the Technology Proficiency Self-Assessment for 21st Century Leaning (TPSA C-21). An online survey was provided to all participants. The survey consisted of demographic questions and a technology self-efficacy instrument. Results demonstrate that gender and generation are statistically significant predictors of technology efficacy, namely on the Total, WWW, Integrated Applications, and Emerging Technologies Skills subscales of the TPSA C-21. The subject area variable, however, did not demonstrate a statistically significant ability to predict teacher technology efficacy scores on any subscale of the TPSA C-21. The findings of the current study add to the existing body of literature by enhancing understanding of the teachers' perceptions of technology efficacy in one geographic location in the US. These findings are timely, especially given the largely technology dependent nature of education—whether in physical classrooms or in virtual settings and the increasing necessity of using technological tools in education settings. Implications are discussed, including suggestions for future research.

Introduction

In the past two decades, the world has seen the proliferation of and increasing reliance on technology in everyday personal consumption, which has, in turn, led to an increase in utilization of technology in K-12 classrooms (Grant et al., 2015). As a result of this increase, concern has been raised regarding teachers' technology efficacy as they work to create and implement curriculum with technological tools. Teachers cannot be effective in the classroom without being knowledgeable about and having some level of comfort with technology and how technological tools can be leveraged to meet educational goals (DeCoito & Richardson, 2018). However, given a myriad of factors, not all teachers share the same perspective or competence when it comes to technology implementation in the classroom. While many states and districts emphasize the integration of technology and 21st century skills as part of their curriculum and with the intention of creating a learning environment that aligns with the needs an increasingly digital world, not all teachers believe this to be a

necessity or a priority. Therefore, the purpose of this study is to examine the relationship, if any, between teachers' generation, gender, subject area, and technology self-efficacy to better understand how these factors may affect teachers' technology self-efficacy.

Technology Efficacy and Gender

Previous studies have demonstrated a significant correlation between gender and self-efficacy. Research has shown that individuals' perceptions of abilities were often formed out of gender specific societal norms and roles (Pechtelidis et al., 2015). For instance, Dang, Zhang, Ravindran, and Osmonbekov (2016) found that males' technology self-efficacy was typically higher than that of females. Scherer and Siddiq (2015) found that a difference existed between the technology self-efficacy of male and female secondary teachers when examining basic operational skills, advanced operational skills, and collaborative skills, with male teachers demonstrating higher self-efficacy. Pechtelidis, Kosma, and Chronaki (2015) found that college engineering students who were male were viewed as "connoisseurs" of technology and females as "simple users" of technology, further demonstrating that perceptions of self-efficacy have historically differed among genders.

In another study, a researcher examined the technology self-efficacy of pre-service teachers in Turkey and found that, while total scale scores for technology self-efficacy did not differ across genders, an examination of subscale scores did in fact demonstrate differences across genders (Atabek, 2020). For instance, female pre-service teachers tended to report higher levels of self-efficacy around the ability to improve their skill in utilizing technology in education, promoting and providing a model for digital citizenship, and engaging in their own growth the leadership, whereas males tended to report higher levels of self-efficacy towards reflecting on technology use in education and actually using technology in instruction and classroom management. Thus, Atabek (2020) contended that "a nuanced understanding of self-efficacy" (p. 185) is still needed in order to determine how to mitigate differences among gender.

Technology Efficacy and Generation

One factor that may impact perceptions of technology self-efficacy is a person's age or, as often categorized, generation in which they were born. Although people within each generation are able to access communication technology and share equitable potential in utilizing technology for various purposes, the rate at which technological advances have occurred as well as the numerous options for technology tools have served to broaden the gap between technology skill, use, and efficacy among generations (Venter, 2017). Of importance, the technology gap among generations may also be evident in the classroom given the various ages, experiences, and opportunities for learning about technology that occur among teachers in K-12 schools. Since teachers determine the extent to which technology is integrated into the classroom curriculum (Minshew & Anderson, 2015), the impact of teachers' generational categorization should be examined to determine what, if any role it may play in determining teachers' technology self-efficacy (Lowell & Morris, 2019).

Generation-related differences in technology self-efficacy have been well established within the existing

research literature (Li et al., 2015; O'Bannon & Thomas, 2014; Wiedmer, 2015). Teachers hailing from different generations bring unique characteristics to the classrooms that may hinder or facilitate the choice to utilize technology (Wiedmer, 2015). While individual differences certainly exist, the types of technology and opportunities for engaging with technology are largely a shared experience and differ among generations. As such, each generation's values are framed with reference to historical and social changes that are encountered and experienced during their lifetimes (Wiedmer, 2015). Thus, teachers from different generations may foster different values, attitudes, and beliefs (Poláková & Klímová, 2019; Wiedmer, 2015) which may, in turn, impact the extent to which they feel comfortable with and choose to use technology in teaching practices.

Technology Efficacy and Subject Area

The research literature supports the relationship between self-efficacy and subject area of expertise as being complex**.** Although science teachers have been thought to be at the forefront of technology transition in the classroom, for instance, previous studies have indicated that many science teachers perceive their lack of technology skills and knowledge as barriers to technology integration in classroom practices (Barak, 2017; Wang et al., 2014). Other research has demonstrated that science and mathematics teachers tend to exhibit higher levels of self-efficacy than language and humanities teachers (Chiu & Churchill, 2016) and that physical education teachers tend to rate themselves as confident in their ability to integrate technology (Krause, 2017). Still, others have found that mathematics and science teachers tend to report lower levels of self-efficacy and less positive attitudes relating to technology use (Baek et al., 2017), indicating discrepancy amongst previous research findings.

Chiu and Churchill (2016), for instance, examined how beliefs and attitudes towards technology use varied across different subject areas using a quasi-experimental design. In this study, teachers' beliefs, attitudes, and levels of anxiety around technology implementation were measured pre- and post- use of mobile devices, with teachers being divided into two groups: mathematics and science teachers and language and humanities teachers. The researchers sought to determine whether teachers underwent any changes after adoption of technology. The results indicated that there were, in fact, differences between teachers' self-efficacy and attitudes across subject areas, and that different subject-related notions and learning goals accounted for the differences (Chiu & Churchill, 2016). Specifically, mathematics and science teachers reported a positive change in beliefs after technology implementation, whereas language and humanities teachers did not. Both groups of teachers experienced lower levels of anxiety after technology implementation. However, neither group reported changes in attitudes.

In another more recent study conducted in Turkey, researchers examined more than 3,500 pre-service teachers' technology self-efficacy across subject areas (Simsek & Yazar, 2019). Pre-service teachers in foreign languages and computer education and instructional technologies (CEIT) reported higher levels of technology self-efficacy, followed by physical education, basic education, and science teachers. Mathematics and social sciences teachers reported the lowest levels of technology self-efficacy. However, there remains a dearth of research that examines whether differences exist and, if so, why among teachers in different subject areas. Further, given the

discrepancies within the research literature and the ever-increasing prevalence of technology in day-to-day life, additional research is needed to understand the true nature of the relationship between subject area and technology implementation, especially in the U.S. context.

Theoretical Framework

Two theoretical constructs shape the current study: 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), when considering constructivism in teaching, stated that those who adopt the philosophical underpinnings of constructivism want to change the outdated concepts of knowledge to prevent the continuation of the "same hopeless struggle" (p. 3) and, thus, enact change. Piaget (1952) addressed a change in cognitive structures people undergo due to their environment, noting that "accommodation of the schemata to experience develops to the very extent of the progress of assimilation" (p. 415). Adherence to the constructivist theory, thus, requires teachers to shift their view of their individual roles and modify existing materials and activities (Bolliger, 2006) to construct a new way of delivering information to the learner. Constructivism is closely related to teachers' technology self-efficacy, as individuals construct complex knowledge schemas through the experiences that they gain from active interactions with their environment (Carey, Zaitchik, & Bascandziev, 2015)—in this case, technology integration in the classroom.

Social cognitive theory further frames the current study. Bandura (1993) theorized, "people's beliefs in their efficacy influence the types of anticipatory scenarios they construct and rehearse" (p. 118). Thus, people's beliefs about their own capabilities are often more impactful than their actual competencies. Self-efficacy, thus, refers to one's beliefs and perceptions, which in turn guide actions and behaviors to produce specific outcomes (Bandura, 1997). Four sources of self-efficacy are noted: mastery, vicarious experience, social persuasion, and physiological states. Mastery refers to the confidence that an individual gains as they are successful in a given task. Vicarious experience refers to the confidence an individual gains when seeing another person be successful in a given task. Social persuasion refers to the influence of others on an individual's confidence in completing a given task. And, finally, physiological states refer to the emotional response one experiences when attempting a given task. Each source contributes to one's overall self-efficacy and, thus, their confidence in their ability to be successful on a specific task or in a given situation. Technology self-efficacy, the focus of the current study, can be defined as one's belief in their ability to teach in a classroom with technology (Hineman et al., 2015).

Research Question

The research question for this quantitative, predictive correlational study is:

> 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?

Using stratified random sampling, 78 teachers participated in the study stemming from a population of approximately 1000 teachers from 69 high schools in Florida in 2019. Participant demographics are shown in Table 1. Participants were required to use 21st century devices, applications, and tools in their classrooms, as per school district guidelines. Twenty-first century devices included, but were not limited to, laptops, tablets, and smartphones and were used routinely in classroom instruction. Data were collected via online survey and were analyzed using Statistical Package for the Social Science Version 26 (SPSS).

Table 1. Participant 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

Design and Variables

The current study utilized a quantitative, non-experimental correlational design. Standard multiple regression was used to examine the relationship between teachers' generation, gender, subject area, and technology self-efficacy (Gall et al., 2007; Warner, 2013). Three predictor variables were used: generation, gender, and subject area. Generation was defined as a group of people born during a specific time period who 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 academic discipline in which the participating teachers were most recently providing instruction (le Roux & Parry, 2017). Gender was defined as participants' biological sex. The criterion variable, technology efficacy, was defined as the belief in one's own ability to perform a technologically sophisticated new task (Laver et al., 2012).

Instrumentation

An online survey was provided to all participants. The survey consisted of demographic questions and a technology self-efficacy instrument. Participants self-reported demographics including their birth year, gender, current subject area (English, history, science, math, computer science, art, foreign language, band, physical education, other), grades taught (9th, 10th, 11th, 12th), and race/ethnicity (White/Caucasian, Black/African American, Hispanic/Latino, or other).

To measure technology self-efficacy, the survey also included the Technology Proficiency Self-Assessment for 21st Century Learning (TPSA C-21; Christensen & Knezek, 2017). The TPSA C-21 is a 34-item instrument and utilizes a Likert-type scale ranging from a score of 1, indicating strongly disagree, to 5, indicating strongly agree. The TPSA C-21 provides a composite score with a range of 34 to 170 points, with a higher number of points indicating a greater level of self-efficacy in individuals' abilities to integrate technology in the classroom. The TPSA C-21 also includes six subscales: Email, WWW, Integrated Applications, Teaching with Technology, Teaching with Emerging Technologies, and Emerging technologies Skills. The Email subscale measures teachers' beliefs surrounding their ability to send documents as an attachment. The WWW subscale measures teachers' beliefs surrounding their ability to find primary sources using the internet. The Integrated Applications subscale measures teachers' beliefs surrounding their ability to create bar graphs from data generated from spreadsheets. The Teaching with Technology subscale measures teachers' beliefs surrounding their ability to use technology to collaborate with others. The Teaching with Emerging Technologies subscale measures teachers' beliefs surrounding their ability to teach students in a one-on-one environment, with students having their own devices. The Emerging Technologies Skills subscale measures teachers' beliefs surrounding their ability to save and retrieve files from cloud-based environments. The TPSA C-21 has been utilized among teachers, administrators, and paraprofessionals and has demonstrated good reliability in previous research (Cronbach's alpha = 0.96 for the composite score and Cronbach's alpha = 0.75-0.93 for each of the respective subscales; Christensen & Knezek, 2017).

Results

Multiple linear regression analyses were conducted to determine whether a predictive relationship existed between gender, generation, subject area, and TPSA C-21 scores (Gall et al., 2007). Each predictor variable (gender, generation, and subject area) was screened to search for and identify inconsistencies. Of the 80 survey submissions, two were removed due to non-completion. 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). Three assumptions (bivariate outliers, multivariate normal distribution, and non-multicollinearity) were tested for prior to conducting the analysis (Warner, 2013). To ensure tenability of each assumption, the researcher examined scatterplots 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. All assumptions were tenable. Frequencies for each of the related variables were calculated (see Table 2). Descriptive statistics were also calculated (see Table 3).

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

Multiple linear regression analyses were conducted to determine whether a predictive relationship existed between gender, generation, subject area, and TPSA C-21 scores. The results demonstrated that the overall regression model for predicting Total TPSA C-21 scores was statistically significant ($F(3, 74) = 5.387$, $p = .002$). The model demonstrated an $R = 0.423$ and an $R^2 = 0.179$. The model accounted for 17.9% of the variance. When examining the contributions of generation, gender, and subject area individually, the results demonstrated that teacher generation ($\beta = 0.296$, $p = 0.007$) and teacher gender ($\beta = 0.243$, $p = 0.026$) were statistically significant predictors of Total TPSA C-21 scores. Subject area did not reach statistical significance ($\beta = -0.082$, $p = 0.440$) in predicting Total TPSA C-21 scores.

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

The predictive ability of generation, gender, and subject area on each of the subscales of the TPSA C-21 were calculated. The overall regression model for predicting scores on the Email scale was not statistically significant, $F(3, 74) = 1.341$, $p = 0.268$. Therefore, the model did not demonstrate statistically significant

predictive ability on the Email scale. The overall regression model for predicting scores on the WWW scale was statistically significant, $F(3, 74) = 6.759$, $p = .0000$. The variance accounted for in the model was 21.5% ($R = 0.464$, $R^2 = 0.215$). The subject area variable, however, did not demonstrate statistically significant ability to predict teachers' WWW scores ($\beta = -0.078$, $p = 0.452$). Generation showed the standardized β of 0.214, $p = 0.043$. The standardized β for gender was 0.367, $p = 0.001$.

The overall regression model for predicting scores on the Integrated Applications scale was statistically significant, $F(3, 74) = 4.503$, $p = .006$. The variance accounted for in the overall model was 15.4% ($R = 0.393$, $R^2 = 0.154$). The subject area variable did not demonstrate statistically significant ability to predict teachers' Integrated Applications scores ($\beta = -0.040$, $p = 0.710$). Generation showed the standardized β of 0.27, $p = 0.015$. The standardized β for gender was 0.243, $p = 0.028$. The overall regression model for predicting scores on the Teaching with Technology scale was not statistically significant, $F(3, 74) = 2.298$, $p = 0.084$. Therefore, the model did not produce a significant ability to predict scores on the Teaching with Technology scale. The overall regression model for predicting scores on the Teaching with Emerging Technologies scale was not statistically significant, $F(3, 74) = 2.511$, $p = 0.065$. Therefore, the model did not produce a significant ability to predict scores on the Teaching with Emerging Technologies scale. The overall regression model for predicting scores on the Emerging Technologies Skills scale was statistically significant, $F(3, 74) = 7.053$, $p = .0000$. The variance accounted for in the overall model was 22.2% ($R = 0.472$, $R^2 = 0.222$). Generation showed a statistically significant ability to predict teachers' Emerging Technologies Skill score ($\beta = 0.402$, $p = 0.000$). Gender ($\beta = 0.095$, $p = 0.0.364$) and subject area ($\beta = -0.179$, $p = 0.0.087$) did not reach statistical significance.

Discussion

Although steadily increasing, empirical research using the factors of generation, gender, and subject area for predicting technology efficacy has been limited in number, especially when measured by the TPSA C-21. The findings of the current study, therefore, add to the existing body of literature by enhancing understanding of the teachers' perceptions of technology efficacy in one geographic location in the US. These findings are timely, especially given the largely technology dependent nature of education—whether in physical classrooms or in virtual settings (Office of Educational Technology, 2020)—and the increasing necessity of using technological tools in education settings.

The results of this study show that the predictive variables of gender and generation are statistically significant predictors of scores on the Total TPSA C-21, aligning with previous research findings (Baek, et al., 2017; Liaw & Huang, 2015; Scherer & Siddiq, 2015). When considering gender, Buabeng-Andoh (2019) found that male teachers' overall information and communication technology usage scores in education settings for self-efficacy were higher than those of female teachers, indicating that gender may play a role in teachers' self-efficacy. This finding is important, especially considering that an overwhelming majority of teachers in K-12 settings identify as female (National Center for Education Statistics, 2020). However, it is still not clear what underlying factors might contribute to the differences among genders, which should be further explored, mirroring what Atabek (2020) indicated regarding the nuances of gender-based differences in technology self-efficacy.

When considering subject area, the results of the current study demonstrated no statistically significant predictive ability between subject area and Total TPSA C-21 scores. The current findings contrast with previous research which has shown that science and math teachers tend to exhibit higher levels of technology self-efficacy than language and humanities teachers (Chiu & Churchill, 2016) and, conversely, that foreign language teachers report higher levels of technology self-efficacy than science, mathematics, and social sciences teachers (Simsek & Yazar, 2019). The discrepancy in results amongst previous study and the current study could support the notion that efficacy may change over time depending on awareness, the extent to which training is targeted and personalized, and exposure to 21st century technology devices and applications (Hall & Trespalacios, 2019). It is possible, too, that findings regarding potential differences based on subject area may not be generalizable across geographic locations.

Subscales

When considering the individual subscales of the TPSA C-21, the current study found no statistically significant predictive ability of generation, gender, or subject area on the Email subscale, differing from findings of previous studies (Dang et al., 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). While examining a sample population of undergraduate students at a large public university, Dang et al.'s (2016) work found that computer self-efficacy for males was higher than females. Given the limited exploration of technology self-efficacy among teachers, Dang et al.'s findings are important to take under consideration. In addition, Scherer and Saddiq (2015) revealed a significant difference in secondary teachers' computer self-efficacy in relation to basic operational skill and advanced operational skill, in favor of males. However, Alhazza and Lucking (2017) revealed that female pre-service teachers had a more positive view of utilizing the social components of technology, such as texting and emailing, than male pre-service teachers.

The current study found a statistically significant predictive ability of generation and gender on the WWW subscale. This finding aligns with previous research (Lai & Hong, 2015; Scherer & Siddiq, 2015; Wiedmer, 2015). Wiedmer's (2015) work, for instance, supports that millennials and generation Xers are typically more advanced in technology use than baby boomers. Lai and Hong (2015) found generation to be a factor for determining frequency of and type of technology use when examining a large sample population of undergraduate and graduate students. When considering the predictive ability of gender, previous study examining a sample population of teachers in Norway found that male teachers reported a higher technology self-efficacy than female teachers, specifically with basic and advanced technology operation skills (Scherer & Siddiq, 2015). However, the same study found that there was no difference among genders when examining technology self-efficacy specific to instructional purposes. While further exploration is needed, the findings of the current study indicate that generation and gender, at least among the sample population studied, do in fact influence technology self-efficacy. Thus, it may be beneficial for teachers to be provided opportunities for building self-efficacy that are more gender- and age-equitable in nature to mitigate perceptions that some

genders and ages are more, or perhaps less, prepared for meeting the demands of technology-rich classrooms (Elstad & Christophersen, 2017).

When considering the Integrated Applications subscale, the current study found no statistically predictive relationship. This finding is interesting as previous research indicates that teachers of some subjects tend to believe that a lack of technology skills and technology knowledge were barriers to their technology integration and resulting classroom practices (Barak, 2017; Wang et al, 2014). However, previous study has also determined that generation can be a significant predictor of Integrated Applications, which supports Lowell and Morris's (2019) assertion that generation may play a role in teachers' applications of technology in the classroom. The findings of this study also add to the understanding of the social cognitive theory and in examining factors that can impact the relationship between one's self-belief of capability and one's chosen action. This, in turn, can affect performance levels and, likewise, self-efficacy beliefs (Bandura, 1997, 2012). It may be that teachers in the current study have sufficiently utilized technology to create representations of data and, thus, no differences in their beliefs about their ability exist. This is not surprising given the increased focus on use of data to inform instructional practice.

No statistically significant findings were demonstrated when considering the Teaching with Technologies subscale. Previous study revealed mixed results (Li et al., 2019; Scherer & Siddiq, 2015; Venter, 2017). Li et al. (2019), for instance, found a significant difference in technology use and beliefs in the ability to teaching with technology as it relates to teachers' subject area, gender, and age. In Li et al.'s (2019) study, males' levels of self-efficacy were significantly higher than those of females. Teachers younger than 45 years of age demonstrated significantly higher self-efficacy than teachers older than 45 years of age. Science teachers' levels of self-efficacy were significantly higher than those of English and math teachers. The current study, however, calls into question the generalizability of Li et al.'s (2019) findings and suggests that teachers may develop rules of behavior based on previous experiences, and, therefore, will alter their beliefs and behaviors (Liaw & Huang, 2015). Teachers in the current study appeared to be able and willing to alter traditional instructional methods, aligning with previous research, to incorporate the use of tablets and interactive whiteboards in instructional practice (Kim et al., 2019).

When considering the Teaching with Emerging Technologies subscale, the current study demonstrated no statistically significant predictive ability. These findings are in contrast with some previous studies (Kwon et al., 2019; Nawi et al., 2015). Nawi et al. (2015), for instance, found that generation did impact technology integration and technology self-efficacy as the small scrips inherent to some technological tools were cited as being difficult for those of the baby boomer generation to read. Kwon et al. (2019) found that male teachers reported higher technology self-efficacy than females in a school that followed a one-to-one technology initiative.

The findings of the current study, though, align with other previous studies (Khlaif, 2018; Scherer & Siddiq, 2015). Khlaif (2018), for instance, found that subject area did not impact teachers' beliefs around teaching with emerging technology, such as tablets. Other factors, such as technical infrastructure, instructional assistance, and

technical support, however, did impact mathematics, science, and English teachers' use of technology (Khlaif, 2018). Scherrer and Siddiq (2015) examined gender as a factor, only to determine that teachers' technology efficacy in relation in relation to their beliefs about their ability to use wikis and blogs as a collaborative tool in the classroom was not significantly different between males and females. The current findings could be indicative of efforts within the particular school district examined, which requires teachers to integrate technology in the classroom and provides professional development opportunities pertaining to 21st century technology (Florida Department of Education, 2017).

Finally, when considering the Emerging Technology Skills subscale, the current study demonstrated a statistically significant predictive ability related to generation, but not between the subscale and gender or subject area. As with several of the previously discussed subscales, earlier study has shown mixed results (Baydas & Goktas, 2016; Kwon et al, 2019; Li et al., 2016; Liu & Guo, 2017; Wang et al., 2018). Kwon et al. (2019), for instance, determined that technical skills were a significant predictor of technology self-efficacy, with males demonstrating higher levels than females. Gender, however, was not determined to influence perceptions of ability to adopt or integrate technology in other study (Baydas & Goktas, 2016; Li et al., 2016). Krause (2017) demonstrated differences among teachers of different subject areas and their beliefs about their ability to integrate technology. However, the current findings align with Weidmer (2015) who demonstrated that teachers from different generations possess different characteristics and beliefs that impact their technology familiarity and usage. The current findings could demonstrate a societal shift given the increased access to and prevalence of technology in daily life (Christensen & Knezek, 2017), but do indicate that differences may remain amongst teachers of different generations.

Recommendations

As with any study, there are limitations to the current research. The TPSCA-21 serves as one limitation, as it is a self-report instrument. It is possible that results could be different if other measurement instruments were utilized. Additionally, the WWW subscale demonstrated a Cronbach's alpha of 0.63, which may indicate that the scale is not measuring what it is intended to measure or that further refinement of the scale may be warranted (Rovai, Baker, & Ponton, 2013). Future research should examine the WWW subscale or examine revisions to the subscale. Future research could also utilize a mixed-methods approach to obtain a more accurate understanding of teachers' use of technology, perhaps including interviews to ascertain teachers' perceptions of technology efficacy from a qualitative approach.

Participants from only one geographic area were included in the study, which may limit the generalizability of the current findings. In addition, while the sample size met the minimum standard for the analysis (Warner, 2013), a larger sample size may yield different results. Furthermore, more women than men participated in the study, more math and science teachers participated in the study than other fields of expertise, and more participants from generation X participated in the study as compared to other generations. While these findings are representative of the current teacher demographics within the US, including a more diverse sample could yield different results or allow greater generalizability of the findings. However, the current study does further

inform the body of knowledge and calls into question some findings reported in previous study, indicating on ongoing need to examine factors that predict teachers' technology self-efficacy.

Conclusion

For many teachers, the addition of technology to classroom instruction has proven beneficial for student engagement, curricular relevance, and content retention. Professional development opportunities continue to emphasize the need for 21st century learning, including digital literacy and technological skills. However, the ability and willingness for a teacher to learn about technology and enhance their own skill set for the purposes of classroom teaching may depend on a number of factors, including gender, generation, and subject area of expertise. This study utilized a correlation design and multiple linear regression to determine how, if at all, these factors may predict teachers' technology efficacy. In many ways, results of the study contrasted with previous research studies associated with gender- specific perceptions of technology use, as well as generational and subject area predictors. In other ways, the current study supports previous findings. What remains consistent, however, is our knowledge that technology will continue to play a role in educating students in K-12 classrooms. Recognizing and taking steps to better understand teachers' attitudes toward technology implementation is a first step in addressing persistent gaps and, importantly, supporting teachers as they seek to enhance their instructional practices.

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