SELF-EFFICACY OF K-12 MATHEMATICS TEACHERS IN TEACHING MATH

by

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THE EFFECT OF TEACHERS' CHARACTERISTICS AND SCHOOL FACTORS ON THE SELF-EFFICACY OF K-12 MATHEMATICS TEACHERS

by

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DEDICATION

This dissertation is dedicated to all the young people that I have worked with over the years from Maryland, Washington D.C, and Georgia. I truly admire your commitment and quest for learning even when faced with challenging circumstances. You inspired me in so many ways—more than you all could have imagined. I decided to embark on this journey of pursuing a doctorate degree so I can be the best version of myself to serve you all in the greatest capacity that I can.

To my mom and my brother, I appreciate you all for always believing in me and wanting the best for me over the years. Finally, to my soon-to-be wife, Mariama, I appreciate the love, joy, and balance you have brought to my life. I look forward to us starting a family together.

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TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Page

TABLE OF CONTENTS (Continued)

Page

LIST OF FIGURES

Figure Page

LIST OF TABLES

Table Page

LIST OF APPENDICES

Appendix Page

ABSTRACT

OMAR SILLAH

SELF-EFFICACY OF K-12 MATHEMATICS TEACHERS IN TEACHING MATH

Under the direction of SUSIE MORRISSEY, Ph.D.

The need to understand the differences in the self-efficacy of K-12 mathematics teachers based on teachers' characteristics and school factors is imperative because research has shown teachers' self-efficacy to be a mediating factor on students' academic achievement. As such, education policymakers and school administrators need to understand variances in teachers' self-efficacy so that they can better implement programs to enhance and support the self-efficacy of teachers. Based on this fact, this quantitative research tried to provide better understanding of teachers' sense of self-efficacy at a localized level. The research utilized an exploratory cross-sectional design and consisted of 50 K-12 inservice teachers from two rural districts in a southeastern state in the United States. The study examined differences in teachers' sense of self-efficacy (TSES) for teaching mathematics at the K-12 level based on teachers' gender, teaching experience, education level, and school type (elementary school, middle school, and high school). Findings suggest that teachers' overall sense of self-efficacy and subscales efficacies (student engagement, instructional strategies, and classroom management) based on school factors and demographic variables were comparable in the context of rural teachers in the southeast United States. The findings of insignificant differences in teachers' sense of self-efficacy that were discovered in this research might be due to the positive working environment among staff and the dual role of principals that are characteristic of schools in rural settings. The collaborative working nature of staff in schools in rural settings might be enhancing the

collective efficacy of all teachers in such an environment uniformly. Based on the findings of this research, future studies might want to examine the influence of suburban and urban environments on teachers' sense of efficacy for teaching mathematics in K-12 settings, for the experiences of teachers in rural settings might be unique when compared to teachers in other school environments.

CHAPTER 1

INTRODUCTION TO THE STUDY

Albert Bandura, the developer of social cognitive learning theory from which self-efficacy emerged, defined self-efficacy as a "personal beliefs about one's capabilities to learn or perform at designated levels" (as cited in Schunk, 2018, p. 150). Furthermore, Bandura (2012) noted:

> Self-efficacy beliefs affect the quality of human functioning through cognitive, motivational, affective, and decisional processes. Specifically, people's beliefs in their efficacy influence whether they think pessimistically or optimistically, in self-enabling or self- debilitating ways. Self-efficacy beliefs influence how well people motivate themselves and persevere in the face of difficulties through the goals they set for themselves, their outcome expectations, and causal attributions for their successes and failures. (p. 12)

Bandura (1977, 1986) also described self-efficacy as being composed of two facets: efficacy expectation and outcome expectation. Efficacy expectation refers to an individual's belief in their abilities to master a given task, and outcome expectancy refers to the reward an individual thinks they will receive upon performing or mastering a set task. Although expectation plays a key role in an individual's decision to engage or to avoid a task, an individual still needs to be equipped with the necessary foundational skills for a given task to attain success.

In the domain of expectancy efficacy, Bandura (1977, 1986) described various competing factors at play that might affect one's expectancy efficacy in any given situation. For example, an individual with low expectancy efficacy might excel given a task of low difficulty; however,

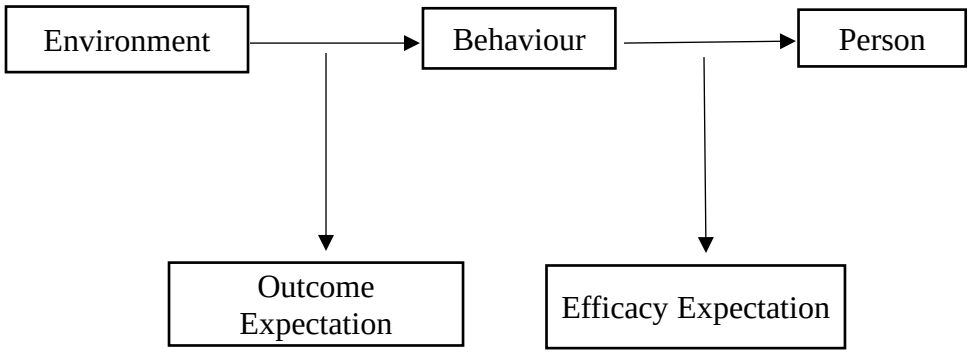
the same individual might quit when given a moderate or difficult task. On the other hand, an individual with high expectancy will not only excel given an easy task, but they will also persevere when faced with challenges during the process of mastering a goal.

In addition to this component of expectancy efficacy, some individuals will only develop specific efficacy skills related to a given task, while others will develop generalized self-efficacy skills that can be translated to other situations. As a result of this multi-dimensional nature of expectancy self-efficacy, Bandura (1977) recommended, "An adequate expectancy analysis, therefore, requires detailed assessment of the magnitude, generality, and strength of efficacy expectations commensurate with the precision with which behavioral processes are measured" (p. 194).

Bandura's (1977) theory of self-efficacy and learning describes this relationship as a triadic process that consists of an individual, the environment, and the individual's behavior. Figure 1 highlights this relationship.

Figure 1

Diagrammatic Representation of the Difference Between Efficacy Expectations and Outcome Expectations



Note. Adapted with permission from "Self-Efficacy: Toward a Unifying Theory of Behavioral Change," by A. Bandura, 1977, p. 193. *Psychological Review*, 84(2), 191-215. https://doi.org/10.1037/0033-295X.84.2.191. Copyright 1977 by American Psychological Association.

Based on this three-way dynamic interaction, realization of mastery for a given task requires alignment of efficacy expectation and outcome expectations. The feedback an individual receives from the environment reinforces this relationship (Bandura, 1977; Schunk, 2018). For example, an individual might have the appropriate efficacy expectation but will not engage in a certain behavior because they might not value the expected outcome of engaging in such a task or they might have received negative feedback from the environment resulting from engaging in a certain task. Conversely, an individual might value the outcome of a certain task, but they might view themselves as lacking the appropriate skills and abilities to perform the task; therefore, they might not attempt the task.

In the case of the self-efficacy of teachers, the literature highlights various factors that are responsible for a teacher's sense of self-efficacy. In one study of preservice elementary and early childhood teachers at a university in Turkey, Harun (2017) cited emotional intelligence and self-esteem as influential factors in the development of the self-efficacy of teachers. Based on the findings of the study, Harun (2017) suggested that more research is necessary to identify effective strategies to develop the self-efficacy of preservice teachers. In addition to emotional intelligence, other researchers have noted a positive relationship to teachers' self-efficacy in subsequent years after teachers experienced delivering high-quality instruction in the past (Holzberger et al., 2013). Holzberger and colleagues utilized a subset of Germany's PISA data of a particular group of students in ninth grade one year and the following year as tenth graders. Holzberger et al. (2013) noted, "Teachers with higher self-efficacy beliefs reported higher cognitive activation, better classroom management, and more individual learning support for students" (p. 779).

Statement of the Research Problem

A 2007 study commissioned by the National Science Foundation (NSF) revealed "middle school mathematics teachers in the United States are not as well prepared to teach this challenging subject as are many of their counterparts in five other countries" (p. 1). The findings by the NSF are of concern for the United States because studies have also reported a significant percentage of U.S students as underperforming on standardized international mathematics assessments, such as the Programme for International Student Assessment (PISA), which is conducted every three years by the Organisation for Economic Co-operation and Development (OECD). In its 2012 publication, the OECD reported that only a little over a quarter of U.S students demonstrated mastery on the math portion of the PISA assessment, and the level of mastery among U.S students seems to have remained stagnant over the past decade. Furthermore, the OECD (2012) report highlighted that "only 50% [of U.S] students agreed that they are interested in learning mathematics" (p. 1). Clearly, as a country, major concerted national and local intervention is necessary to address K-12 mathematics education.

To address K-12 mathematics education, it is necessary to first understand and address the needs of mathematics teachers, since teacher self-efficacy has a direct impact on students' academic performance (Gulistan et al., 2017; Hajovsky et al., 2020; Noble, 2011; Nurlu, 2015; Tschannen-Moran & McMaster, 2009). In fact, Tschannen-Moran et al. (1998) concluded that enhancing a teacher's self-efficacy "can pay dividends of higher motivation, greater effort, persistence, and resilience across the span of a teaching career" (p. 238). Later research conducted by Tschannen-Moran and McMaster (2009) led them to conclude that policy makers and school administrators should be aware of teachers' self-efficacy because it plays an

influential role on “teachers’ implementation of new teaching strategies presented through professional development” (p. 231). In her research, Nurlu (2015) also found this to be true; she discovered that teachers with high self-efficacy were more likely to show persistence and welcome new strategies and ideas when working with students, whereas teachers with low self-efficacy demonstrated the opposite temperament.

A review of the literature also reveals strong evidence that successful program outcomes require a deeper understanding of teacher self-efficacy at a stratified level when designing and implementing professional development. For instance, a female teacher teaching eighth-grade mathematics might have a different level of self-efficacy than a second-grade male math teacher; as such, these two teachers might require different levels of support. One of these teachers might possess a strong sense of self-efficacy in classroom engagement but a poor self-efficacy in classroom management and classroom instruction, whereas this might be the opposite scenario for the other teacher.

Understanding and addressing the self-efficacy of mathematics teachers requires cognizance of the factors that influence teacher self-efficacy. Studies have indicated that teacher gender, principal experience, and ability level of students all play a direct role in influencing teachers’ self-efficacy (Fackler & Malmberg, 2016; Sun & Xia, 2018). Research has also revealed that teaching experience, principal’s leadership style, and participation in a formal or informal pre-teaching education program impact teachers’ self-efficacy (Bellibas & Liu, 2017). Based on the unique dynamic of teachers’ self-efficacy, Bellibas and Liu (2017) noted in their study of survey data of OECD results of various countries, “Variation in teacher self-efficacy is significantly related to the contextual realities of different countries” (p. 64).

Purpose Statement

According to researchers such as Bellibas and Liu (2017) and others who have investigated the self-efficacy of teachers, the relationship between self-efficacy and teacher's sense of self-efficacy is complex. As a result of this reality, more localized studies are necessary for an in-depth understanding of the self-efficacy of mathematic teachers. Understanding mathematics teachers' self-efficacy will equip school leaders and policymakers with the necessary information when designing and implementing professional development programs for mathematics teachers. The purpose of this quantitative research was to understand the difference between group demographic variables, school type, and self-efficacy of inservice mathematics teachers at the K-12 level in a state in the southeastern United States.

Research Questions

The following questions guided this study:

1. What is the difference in teachers' self-efficacy in teaching mathematics based on gender?
2. What is the difference in teachers' self-efficacy in teaching mathematics based on teaching experience?
3. What is difference in teachers' self-efficacy in teaching mathematics based on education level?
4. What is the difference in teachers' self-efficacy in teaching mathematics based on school type (elementary school, middle school, high school)?

Significance of the Study

The significance of research on teachers' self-efficacy was made evident in the study by Scherer et al. (2016), who analyzed teachers' self-efficacy across 32 countries based on 2013 data of the Teaching and Learning International Survey (TALIS). Scherer et al. (2016) reported:

> From a practitioner's point of view and based on the multidimensional information on self-efficacy in the measurement, the needs for professional and personal development can be identified. This information may be used for specific interventions on strengthening teachers' self-efficacy and thereby enhancing their well-being and job satisfaction in order to prevent burnout and emotional exhaustion. (p. 21)

A search of the literature on math teachers' self-efficacy in the United States reveals a dearth of published studies that have examined the subject in detail. Most of the published studies on math teachers' self-efficacy were conducted overseas in countries such as Turkey and Germany. Of the few published studies in the United States, the majority focuses on preservice teachers. A review of the literature failed to yield a study that focuses on the self-efficacy of inservice mathematic teachers in a state in the southeastern United States. This clearly is an issue because, in order for school leaders to recruit and support math teachers, more insight is necessary not only on teacher overall self-efficacy, but also on teacher self-efficacy in different subdomains, such as efficacy for instruction, efficacy for classroom management, and efficacy for student engagement. The findings from this research have the potential to assist school leaders in understanding the variations in the self-efficacy of mathematic teachers and subsequently enabling them to design effective, tailored professional development plans based on the individual needs of mathematics teachers.

In addition, the issue of mathematics teacher shortage makes the need to understand the self-efficacy of mathematic teachers in the United States critical. In their investigation of the shortage of mathematics and science teachers in the United States, Ingersoll and Perda (2010) reported U.S. President George W. Bush called for the recruitment of 30,000 new mathematics and science teachers in 2006 to address the teacher shortage in these two critical subjects. Ingersoll and Perda (2010) also noted that leading education organizations such as the National Academy of Sciences, the National Research Council, National Commission on Mathematics and Science Teaching, and the U.S. Department of Education have identified the science and mathematics teacher shortage for the past several years in the United States. To address the critical teacher shortage in mathematics and science, the general assembly of the southeastern state of this study passed a bill in 2009 to provide financial incentive for the recruitment of certified math and science teachers; the legislation allocated $120 million for the program.

Delimitations

This research focused solely on the self-efficacy of inservice K-12 level mathematic teachers in a southeastern state in the United States.

Definitions of Terms

The following is a list of terms used extensively in the research. Definitions are to assist the reader.

Inservice teacher refers to a teacher who has completed prerequisite teacher certification program and who is currently teaching (Stevens et al., 2013; Zee & Koomen, 2016).

Self-efficacy refers to "personal beliefs about one's capabilities to learn or perform at designated levels" (Schunk, 2018, p. 150).

Teacher efficacy "is the teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (Tschannen-Moran et al., 1998, p. 233).

Summary

This chapter served as an introduction of the study that sought to quantitatively analyze the impact of demographic variables and school level factors on the self-efficacy of elementary, middle, and high school inservice mathematics teachers in a southeastern state in the United States. The chapter began with an overview of the theoretical foundation of this research, Bandura's self-efficacy theory, and discussed how research has revealed the effect of self-on an individual's ability to succeed in a given goal or task. This chapter also highlighted the importance of assessing the self-efficacy of inservice K-12 level mathematic teachers because of U.S student underperformance on standardized international mathematics assessments and the National Science Foundation's (2007) determination that U.S. teachers lack preparation to effectively teach mathematics. Four research questions guided this quantitative research of teacher self-efficacy, which was delimited by the researcher to only include U.S. K-12 inservice math teachers in one southeastern state. The chapter concluded by emphasizing the significance of the study and providing key terms to assist the reader

Chapter 2 presents a review of literature relevant to the investigation. Chapter 3 describes the research design and methodology used to answer the research questions. Chapter 4 provides the results, and Chapter 5 offers a discussion of the results, implications, and recommendations for future research.

CHAPTER 2

LITERATURE REVIEW

This chapter presents a review of literature relevant to the problem described in Chapter 1. Reports of teacher shortage and inadequate preparation of mathematics teachers highlight the need for in-depth understanding of the self-efficacy of mathematics teachers in order for school leaders to effectively address these issues. The chapter begins with a discussion of teacher self-efficacy that provides a definition, characteristics, and results of research of self-efficacy. Next is a discussion of the sources of teacher self-efficacy, followed by the internal and external factors that research has revealed to relate to or influence teacher self-efficacy. Also discussed is teacher burnout and its effect on teacher self-efficacy. The chapter ends with a discussion of the history and types of instruments used to measure self-efficacy.

Mathematics Teachers' Self-Efficacy

Research of the self-efficacy of mathematics teachers revealed self-efficacy plays an important mediating role on teachers' job satisfaction, classroom management efficacy, and various important pedagogical practices of teaching (Briley, 2012; Perera & John, 2020). Perera and John (2020) examined quantitative data of 6000 fourth-grade students and 450 inservice Australian teachers and found teacher satisfaction, perceptions of classroom interactions, and student achievement relied heavily on teacher self-efficacy. Briley (2012) investigated 95 preservice teachers at a southeastern university in the United States. Briley (2012) reported:

> [For] Pre-service teachers, personal mathematics teaching efficacy was found to have a statistically significant positive relationship to the belief about the nature of mathematics, to the belief about doing, validating, and learning mathematics, and to the belief about the

> usefulness of mathematics. The pre-service teachers who reported stronger beliefs in their capabilities to teach mathematics effectively were more likely to possess more sophisticated mathematical beliefs. (p. 8)

Tschannen-Moran et al. (1998) defined teacher's self-efficacy as "the teacher's belief in his or her capability to organize and execute courses of action required to successfully accomplish a specific teaching task in a particular context" (p. 233). In forming self-efficacy, a teacher must consider "self-perception of teaching competence (including an assessment of internal resources and constraints) and beliefs about the task requirements in a particular teaching situation (including an assessment of resources and constraints external to the teacher)" (Tschannen-Moran et al., 1998, p. 233). Tschannen-Moran et al. (1998) also posited that self-efficacy is a cyclical process in which an outcome of a teacher's action can reinforces or inhibit the four sources of self-efficacy: mastery experience, vicarious experience, verbal persuasion, and physiological arousal (Bandura, 1977, 1986, 2012). The following sections offer a discussion of these sources, as well as collective efficacy, later identified by Bandura as another source.

Mastery or Performance Accomplishments

Mastery or performance accomplishment, which is self-efficacy gained through actual participation in a task, is the most substantial means of developing self-efficacy (Bandura, 1977, 1986). According to Bandura (1977), once an individual obtains mastery for a given exercise, "occasional failures that are later overcome by determined effort can strengthen self-motivated persistence if one finds through experience that even the most difficult obstacles can be mastered by sustained effort" (p. 195). Over the years, numerous research studies of self-efficacy have substantiated this view of mastery (Bandura, 1986, 2012; Gkolia et al., 2016; Wilson, 2006).

Vicarious Experience

Vicarious experience refers to skills or knowledge acquired from watching someone else perform a task. Although learning can occur through this source, this form of learning can be ephemeral at times (Bandura, 1977, 1982, 1986). Bandura explained:

> Vicarious experience, relying as it does on inferences from social comparison, is a less dependable source of information about one's capabilities than is direct evidence of personal accomplishments. Consequently, the efficacy expectations induced by modeling alone are likely to be weaker and more vulnerable to change. (Bandura, 1977, p. 197)

For vicarious experiences to result in substantial learning, research has shown that there needs to be some level of close identification between the person performing the task and the observer based on demographic variables or ability level (Tschannen-Moran & Hoy, 2007).

Verbal Persuasion

Verbal persuasion is the feedback one receives from others. In a school context, verbal persuasion refers to "interactions that a teacher receives about his or her performance and prospects for success from important others in the teaching context, such as administrators, colleagues, parents, and members of the community at large" (Tschannen-Moran & Hoy, 2007, p. 945). This source of self-efficacy has been noted to be superficial, especially when an individual faces a challenging situation (Bandura, 1977).

Physiological States

Emotional arousal is the body's physiological reaction when faced with a given circumstance (Bandura, 1977, 1986). Perceived stressful situations are said to cause an increase in physiological reaction and stress level. Although stressful emotional arousal might lead an

individual to avoid a particular situation instinctively if possible, Bandura (1977, 1986) emphasized that mastery and an individual's cognitive processing of a circumstance can overcome this reaction. Bandura (1986) contended:

> Mastery experiences and comparative appraisals are more reliable diagnostic indicants of capability than affective arousal, which bears no uniform relationship to performance accomplishments. Moreover, whether or not perceived self- efficacy is affected by emotional arousal depends on how such information is cognitively processed. Many factors, including appraisal of the source of arousal, the level of activation, the circumstances under which arousal is elicited, and personal experiences on how arousal affects one's performance, influence the efficacy meaning given to arousal. (p. 365)

It appears that the negative physiological reaction one feels when faced with unwanted situations can be lessened over time with exposure and mastery.

Collective Efficacy

Although Bandura did not initially designate collective efficacy as a source of self-efficacy, over the years, researchers have identified it as a crucial source of self-efficacy. Collective self-efficacy, defined as the belief in a group in achieving a shared mission, is subject to the influence of group members and the environment in a dynamic reciprocal relationship (Tschannen-Moran & Hoy, 2007). To attain collective self-efficacy success, Bandura (1982) contended it "requires cogent means of relating factional interests to shared purposes. The unifying purposes must be explicit and attainable through concerted effort" (p. 145). Veiskarami et al. (2017) discovered collective self-efficacy contributed positively to teachers' personal self-efficacy. Key factors that enhance collective self-efficacy in a school context are as follows:

> An orderly culture focused on a strong press for academics, administrators who were responsive to teachers' concerns and encouraged them to try new ideas, and teachers who encouraged one another in their attempts to address student needs were found to be significant contributing factors. (Tschannen-Moran & Hoy, 2007, p. 947)

Summary of Sources of Self-Efficacy

The sources of self-efficacy highlighted in the *Teachers' Self Efficacy* section are subject to the influence of many factors, as noted in Table 1.

Table 1

Contributing Factors to the Subdomains of Sources of Self-Efficacy

Sources of Self-Efficacy	Contributing Variables
Performance Accomplishments	Performance desensitization Performance exposure Self-Instructed performance Participant modeling
Vicarious Experience	Live modeling Symbolic modeling
Verbal Persuasion	Suggestion Exhortation Self-Instruction Interpretive treatments
Emotional Arousal	Attribution Relaxation Biofeedback Symbolic desensitization Symbolic exposure

Note. Bandura, A. (1977). Adapted with permission form "Self-Efficacy: Toward a Unifying Theory of Behavioral Change," by A. Bandura, 1977, p. 196. *Psychological Review*, 84(2), 196. https://doi.org/10.1037/0033-295X.84.2.191. Copyright 1977 by American Psychological Association.

Using Bandura' theory of self-efficacy as a basis, various researchers have attempted to develop instruments to measure sources of teachers' self-efficacy over the years. However, no instrument emerged as an ideal tool of measurement. In a meta-analysis of 82 empirical studies focused on measuring sources of teaching self-efficacy, Morris et al. (2016) found "research on the sources of teaching self-efficacy has overwhelmingly relied on designs that do not convincingly establish causality" (p. 825). Furthermore, Morris et al. (2016) concluded, "Although exploratory studies of the sources can help to identify possible efficacy-relevant events, only experimental studies can establish whether or not those events are in fact antecedents, or sources, of teaching self-efficacy" (p. 825). The studies reviewed in the meta-analysis by Morris and colleagues (2016) focused on various combinations of sources of self-efficacy in the domains of verbal persuasion, vicarious experience, physiological arousal, and mastery experience. Of the 82 studies reviewed, 73 examined teachers' mastery, 58 examined vicarious experiences, 56 examined persuasions, and 43 examined physiological and affective states. It is not surprising that most of the studies sought to measure the relationship between mastery and self-efficacy, for mastery has been shown to play the most significant role in the development of self-efficacy (Bandura, 1977, 1982, 1986, 2012; Holzberger et al., 2013; Lauermann & König, 2016; Williams & Williams, 2010). As a result of discrepancy in a universally accepted instrument for measuring sources of teaching self-efficacy, this study focused on the overall sense of teachers' self-efficacy by using the Teachers' Sense of Efficacy Scale (TSES) instrument developed by Tschannen-Moran and Hoy (2001), discussed later in this chapter.

Factors that Determine Differences in Teacher Self-Efficacy

Internal and external factors influence the self-efficacy of teachers (Bellibas & Liu, 2017; Djigić et al., 2014; Dofková, 2019; George et al., 2018; Gkolia et al., 2016; Klassen & Chiu, 2010; Norton, 2019; Nurlu, 2015; Peker & Erol, 2018; Ryan et al., 2015; Sehgal et al., 2017; Shaukat et al., 2019; Stevens et al., 2013; Thomson et al., 2020; Versland & Erickson, 2017). The following sections present a review of the studies that have revealed these factors.

Characteristics of Teachers with Low Self-Efficacy vs. Teachers with High Self-Efficacy

In the study by Nurlu (2015), which consisted of 33 elementary school teachers from Turkey, the teachers' approach to teaching reflected the differences in the level of self-efficacy among teachers. Nurlu (2015) explained:

> Teachers who have a higher self-efficacy belief also show a higher level of effort and persistence with students. In addition, they are more open to new ideas and new methods, believe in students' achievements and take responsibility for students' success. Furthermore, they place more importance on building a warm relationship with their students rather than with the parents. They are more tolerant, tending to support low-attaining students. They make more effort to help students improve their self-confidence as learners of mathematics. (pp. 36-37)

Teacher age can also account for the differences in the level of math self-efficacy of teachers (Peker & Erol, 2018). In a study of elementary and high school teachers in Turkey, Peker and Erol (2018) found, "Teachers in the age group of 41-50 had higher self-efficacy beliefs than teachers in age groups 21-30 and 31-40" (p. 8).

In addition, background knowledge is a factor that contributes to the differences in self-efficacy levels of math teachers (Stevens et al., 2013). Stevens et al. (2013) analyzed the development of self-efficacy among teachers partaking in a professional development program and discovered that teachers with varying levels of mathematical background knowledge had different levels of math self-efficacy acquisition. Another interesting finding from the research by Stevens et al. (2013) was that between Year 1 and Year 2 timeframes, all teachers experienced a decline in their self-efficacy, which the researchers attributed to the break in the school year. However, by the end of Year 2, teachers with higher mathematical background knowledge displayed a much higher level in their self-efficacy as compared to their previous highest level of self-efficacy, which was measured at the end of Year 1. This was not the case for teachers with lower math background knowledge, for their level of math self-efficacy did not rebound to the previous level measured at the end of year one (Stevens et al., 2013).

Personality and Teacher Self-Efficacy

The American Psychological Association (2021) defined personality as "individual differences in characteristic patterns of thinking, feeling and behaving" (para. 1). Personality can be grouped into five distinct categories: neuroticism, extraversion, openness, agreeableness, and conscientiousness (Gurven et al., 2013). According to research on personality and teachers' self-efficacy, Djigić et al. (2014) conducted a study in Serbia with 168 primary school teachers, of whom over half taught mathematics of the five dimensions, and found, of the five personality types, conscientiousness was the only statistically significant predictive personality type of teacher's self-efficacy. Roberts et al. (2014) defined the psychological meaning of conscientiousness as "a spectrum of constructs that describe individual differences in the

propensity to be self-controlled, responsible to others, hardworking, orderly, and rule abiding" (p. 315). Other studies (Baier et al., 2018; Klassen & Tze, 2014) have also noted the insignificant relationship between conscientiousness and teachers' self-efficacy.

Principals' Leadership and Teacher Self-Efficacy

Principals' leadership style may have a direct effect on teachers' self-efficacy (Sehgal et al., 2017). According to Sehgal and colleagues (2017), a principal can help strengthen teachers' self-efficacy through the establishment of a collaborative working environment for teachers. Furthermore, Versland and Erickson (2017) discovered principals' actions that positively influence teachers' self-efficacy can lead to positive student achievement. Versland and Erickson (2017) offered recommendations that align with Bandura's principles of self-efficacy on how principals can support the self-efficacy of teachers:

- Consistency in implementation of new initiatives.
- Exposure to other content areas beside the primary subject that a teacher may be teaching.
- Promotion of positive working relationship among teachers along with leader/expert teachers acting as a model for other teachers.
- Principal leading by example.
- Principal creating a culture of hope and a positive atmosphere in which teachers felt empowered about what they were doing.

Relationship Between Teaching Experience and Teacher Self-Efficacy

Research has shown a positive correlation between teachers' classroom experience and self-efficacy (Gkolia et al., 2016; Klassen & Chiu, 2010). Gkolia et al. (2016) concluded that

"teachers with longer teaching experience may be more capable of handling classroom discipline and engaging students to the learning process" (p. 468). Shaukat et al. (2019) also found a positive relationship between teachers' experience and self-efficacy for teachers working with students with special needs. Another important finding from the research of Shaukat et al. was that teachers with more experience did not only have greater self-efficacy, but they also were more likely to have greater sense of job satisfaction. It appears that of the three aspects of self-efficacy (efficacy for instructional strategies, efficacy for classroom management, and efficacy for student engagement), classroom management is a skill that requires time to master. Based on this fact, it should not be surprising that teachers with more experience tend to have better self-efficacy. Shaukat et al. (2019) conducted their study with 94 female teachers and 24 male teachers with various levels of education (bachelor's degrees and advanced degrees) and varying ages in Pakistan. In addition, the participants had a wide range of teaching experience and subjects taught.

Although teachers with extensive years of teaching experience appear to have higher levels of self-efficacy as compared to teachers with less seniority (Bellibas & Liu, 2017; Gkolia et al., 2016; Klassen & Chiu, 2010), research has noted that the self-efficacy of a teacher with extensive experience appears to go through some transition phase during a teacher's career. For example, in their study of 1,430 inservice teachers (69% female and 31% male), Klassen and Chiu (2010) attributed a decline in self-efficacy to changes in motivation during a teachers' tenure. The findings of the study are significant because the participants consisted of teachers of diverse demographic variables in terms of grade levels and geographic location (urban, suburban, rural, and other) in Canada (Klassen & Chiu, 2010). The findings in the longitudinal study

conducted in Australia by George et al. (2018) support the finding of changes in teachers' self-efficacy over the years noted by Klassen and Chiu (2010).

Relationship Between School Type, School Context, and Teacher Self-Efficacy

In reference to the relationship between teachers' self-efficacy and school type, studies have found that teachers in the lower grade levels tend to possess greater self-efficacy as compared to teachers in the higher grade levels (George et al., 2018; Gkolia et al., 2016; Klassen & Chiu, 2010). Interestingly, studies have revealed that self-efficacy differences are not only evident between elementary, middle school, and high school teachers, but "variation of teachers' self-efficacy associated with teaching level can also occur within a school" (Klassen & Chiu, 2010, p. 748). Like teaching experience, classroom management appears to be the key mediating factor in terms of teachers' overall sense of self-efficacy. As for teachers' self-efficacy in instructional strategies, George et al. (2018) reported in their longitudinal study of 74 early career teachers in Victoria, Australia that they found no difference between primary and secondary school teachers. In regard to school context, Page et al. (2014) conducted research with 67 inservice teachers and found that teachers in an urban setting had lower self-efficacy when compared to teachers in suburban and rural settings.

Relationship Between Gender and Teacher Self-Efficacy

A review of the literature examining the relationship between gender and teachers' self-efficacy revealed a variety of conclusions between these two factors from studies conducted in different parts of the world (Gkolia et al., 2016; Manzar-Abbas & Lu, 2015; Shaukat et al., 2019). In a study of 103 preservice primary school teachers in China, Manzar-Abbas and Lu (2015) discovered that female teachers had a higher sense of self-efficacy as compared to male

teachers. Shaukat et al.'s (2019) study of 120 special education teachers (78% female and 21% male) at five public schools in Pakistan confirmed this finding. However, in their study of 640 teachers from 77 schools in Greece (59.5% female and 39.2% male), Gkolia et al. (2016) found that male teachers had a higher sense of self-efficacy in all three domains of teachers' self-efficacy (engagement, instructional strategies, and classroom management). The participants were diverse in terms of teaching experience, age range, and school level (elementary and high school).

Self-Efficacy of Mathematics Teachers Across School Levels: K-12

Research on the self-efficacy of elementary school mathematic teachers has noted lower levels of self-efficacy for teachers during the actual teaching phase when compared to the preservice phase (Dofková, 2019; Thomson et al., 2020). In a longitudinal study that followed 245 preservice teachers through their teaching preparation program and into their first two years of teaching in the United States, Thomson et al. (2020) reported, "Efficacy is typically highest during the preservice years and decreases within two years of graduating" (p. 11). In a study of 77 elementary school preservice teachers from the Czech Republic, Dofková (2019) speculated that elementary school teachers reporting high self-efficacy for teaching mathematics during preservice training stems from the lack of practical experience of teaching on a daily basis.

At the middle school level, a review of the literature of the self-efficacy of middle school teachers revealed "in general, research has found that teachers in elementary schools have higher self-efficacy compared to teachers in middle schools" (Ryan et al., 2015, p. 148). In a study of 101 fifth-, sixth-, and seventh-grade teachers from 18 schools in the Midwestern United States, Ryan et al. (2015) found that teachers' self-efficacy varied within subjects, grade level, gender,

and teaching experience. Furthermore, Ryan et al. (2015) reported, “Middle school teachers (both 6th and 7th grades) reported lower self-efficacy than elementary school teachers in regard to classroom management” (p. 152), but “there was no difference between elementary and middle school teachers’ self-efficacy for instruction and student engagement” (p. 152). It appears that self-efficacy of classroom management might be a challenge for middle school teachers.

In the area of middle school mathematics, Norton (2019) surveyed 99 middle school preservice mathematics teachers in Australia in the areas of self-efficacy and confidence. Norton (2019) found that preservice teachers tend to overestimate their level of preparedness to teach mathematics. These findings aligned with the reports of Dofková (2019) and Thomson et al. (2020) regarding the self-efficacy of elementary school preservice teachers.

At the high school level, Shoulders and Keri (2015) discovered teachers with advanced degrees and over 15 years of teaching experience had high levels of self-efficacy for classroom management and instruction but not for student engagement. The findings of the research by Shoulders and Keri (2015) derived from survey results from 256 high school teachers from 21 rural public schools in the United States.

In conclusion, teachers’ overall self-efficacy and subdomain self-efficacies seem to vary across school types and school contexts. In addition to this, variables such as gender, teaching experience, and level of teachers’ education appear to influence teachers’ self-efficacy across school levels (Ryan et al., 2015). In the area of mathematics, a difference exists between the reported self-efficacy of preservice teachers and their actual self-efficacy for teaching mathematics once they transition from preservice teaching to full-time teaching. Unfortunately, there seems to be a dearth of studies that have examined a combination of the self-efficacy of

inservice teachers and teaching mathematics in detail. The lack of significant research on this topic was made evident in the remark of researchers Burić and Kim (2020):

> It has been observed that many studies on teacher self-efficacy have been conducted in various fields, but the majority have focused primarily on preservice teachers. It is evident that studies on teacher self-efficacy and self-efficacy beliefs of mathematics teachers are at a limited number in the literature. (p. 100)

Summary of Teacher Self-Efficacy Around the World

The findings of variances in teachers' self-efficacy around the world validates the point made by Tschannen-Moran and Hoy (2001) that teacher self-efficacy is context and subject-matter specific. Context and subject-matter specificity refer to a teacher's self-efficacy in regard to both personal efficacy and outcome efficacy, which are the two components of self-efficacy according to Bandura (1977, 1986, 2012). In the case of teaching mathematics, a teacher might have high personal efficacy and outcome efficacy to teach seventh-grade math; however, the same teacher might have low personal efficacy expectation and low outcome efficacy in their ability to teach Algebra at the high school level, even though they may have a background in mathematics. Variation in teacher self-efficacy can also emerge within the three subdomains of self-efficacy (class management, student engagement, instructional strategies) based on the geographic location of the school and/or school type. Overall, although numerous studies have looked at the self-efficacy of teachers based on teachers' characteristics and school factors, it appears that a limited number of research studies have examined these relationships specifically from the perspective of inservice mathematics teachers. Further research could prove especially helpful to avoid teacher burnout.

Teacher Self-Efficacy and Burnout

Burnout refers to the exhaustion of one's emotional resources in performing the daily task of work that requires extensive social interaction with others as integral characteristics of the job (Cansoy et al., 2017; Skaalvik & Skaalvik, 2010). Burnout is said to be experienced in three forms: exhaustion, depersonalization, and decreased sense of personal accomplishment (Cansoy et al., 2017; Skaalvik & Skaalvik, 2010). Exhaustion may manifest in the form of low energy, fatigue, and feeling emotionally worn out. Depersonalization results in psychologically distancing oneself from others and interacting with others in a clinical manner without emotion. Decreased sense of personal accomplishment is characterized by self-doubt, sense of inadequacy in effectively performing the duties of one's job, and lack of emotional satisfaction in one's accomplishment from performing their duties (Cansoy et al., 2017; Skaalvik & Skaalvik, 2010).

Numerous studies of the relationship between burnout and teachers' self-efficacy have found teachers' self-efficacy as a variable that can predict burnout among teachers (Skaalvik & Skaalvik, 2010). This implies that teachers with high levels of self-efficacy are less likely to experience the negative aspects of burnout, while teachers with low levels of self-efficacy are more likely to experience the negative dimensions of burnout. In other words, teachers with a high sense of self-efficacy will most likely experience lower levels of exhaustion and depersonalization, while experiencing higher levels of personal accomplishment when compared to teachers with lower levels of self-efficacy (Aloe et al., 2014; Cansoy et al., 2017; Savas et al., 2014; Zee & Koomen, 2016). Cansoy et al. (2017) analyzed the responses of 416 teachers (60% female and 40% male) in elementary, middle, and high school in Turkey for the 2015-2016 academic year and discovered that efficacy of student engagement was a strong predictor of all

three components of burnout. In that same year, Aloe et al. (2014) conducted an extensive meta-analysis of 16 studies that focused specifically on the relationship between teachers' self-efficacy of classroom management and the three facets of burnout for teachers. Aloe et al. (2014) highlighted the impact of self-efficacy on teachers leaving the profession in their remark that "teachers with lower self-efficacy may turn their feelings inward decreasing their overall sense of accomplishment and increasing their level of disengagement. This maladaptive pattern of responding may eventually lead teachers to leave the profession" (p. 117). Based on the literature, it is evident that teachers' self-efficacy plays a crucial mediating role in burnout levels, which directly impact teachers' decisions to remain in or leave the classroom permanently, thus highlighting the importance of further study of teacher self-efficacy.

History of Instruments for Measuring Teachers' Sense of Self-Efficacy

Prior to Bandura's social cognitive theory in the 1970s, instruments aimed at measuring teacher self-efficacy were said to be designed based on Julian Rotter's social learning theory from the 1950s. Building upon Rotter's theory of social learning, Gibson and Dembo (1984) receive wide acknowledgment as the first to develop an instrument that incorporated both Rotter's principle of social learning theory and Bandura's theory of self-efficacy to measure teacher self-efficacy (McGee & Wang, 2014; Tschannen-Moran et al., 1998). The Gibson and Dembo Teacher Efficacy Scale (TES) instrument consisted of 30 Likert items. Gibson and Dembo (1984) discovered some interesting differences between teachers with high self-efficacy and teachers with low self-efficacy:

- Time spent preparing for a lesson.
- Wait-time provided to students to give an answer to a question.

- Student grouping (delivery of instruction in small group vs. whole group),
- Feedback given to students (positive vs. negative tone).

Over the years, researchers have developed various other teacher self-efficacy instruments, including one by Albert Bandura in the 1990s. The instrument by Bandura consisted of 30-item questions with seven subscales: "efficacy to influence decision making, efficacy to influence school resources, instructional efficacy, disciplinary efficacy, efficacy to enlist parental involvement, efficacy to enlist community involvement, and efficacy to create a positive school climate" (Tschannen-Moran et al., 1998, p. 219). Bandura's instrument measured "along a 9-point continuum with anchors at 1—Nothing, 3—Very Little, 5—Some Influence, 7—Quite A Bit, and 9—A Great Deal" (Tschannen-Moran & Hoy, 2007, p. 948).

Unfortunately, most teacher self-efficacy instruments lacked reliable measures of both personal competence and analysis of the task as one comprehensive instrument. Tschannen-Moran and Hoy (2001) maintained, "Teacher efficacy must assess both personal competence and an analysis of the task in terms of the resources and constraints in particular teaching contexts" (p. 795). Therefore, Tschannen-Moran and Hoy deemed it essential to develop an all-in-one teacher self-efficacy instrument that captured both personal competence and daily essential tasks of teaching. The Teachers' Sense of Efficacy Scale (TSES), created by Tschannen-Moran and Hoy (2001), utilizes the principles of Bandura's 30-item Likert scale with additional questions and input from seminar participants at the Ohio State University College of Education.

Development of the Teachers' Sense of Efficacy Scale (TSES)

The Teacher Sense of Efficacy Scale (TSES), previously known as the Ohio State Teacher Efficacy Scale (OSTES), resulted from the collaboration between eight doctoral

graduate students with teaching experience of 5-28 years and two researchers at a seminar in the College of Education at The Ohio State University. The group developed the initial OSTES based on Bandura's 30-item Likert scale and additional questions generated by each of the seminar participants. The new OSTES incorporated 23 of Bandura's 30-item Likert scale and rejected 7 items deemed as nonessential to the daily task of teaching. In addition to this, the group added 19 questions dealing with aspects of teaching to the initial instrument, which Bandura's instrument failed to address. After further discussion among the seminar participants, a 52-item, 9-point Likert-scale developed. To assess the validity of the newly developed OSTES instrument, Tschannen-Moran and Hoy conducted three subsequent studies.

Study 1

The first validation study conducted by Tschannen-Moran and Hoy consisted of 224 participants, of which 146 were preservice teachers and 78 were inservice teachers of diverse ethnicity, gender, and age groups. Participants responded to the 52-item instrument. In addition to this, they completed a 4-point scale which asked respondents to assess the importance of the items in the OSTES.

Analysis showed all survey items in the OSTES were significant. Further analysis consisted of principal-axis factoring, which is based on adjusted correlation matrix, along with varimax rotation; principal-axis factoring (Everitt, 2002). This analysis identified 32 of the original 52 items as contributing most significantly to the overall scale and disregarded the other 20 questions. Of the 32 items selected, 31 had an eigenvalue ranging from 0.62 to 0.78. The one item selected that had the lowest eigenvalue of 0.595 dealt with motivation. Tschannen-Moran

and Hoy incorporated this item into the 32-item scale because it was deemed to be a significant variable in teaching.

Study 2

The second validation included 217 participants, 70 preservice teachers and 147 inservice teachers. On average, the inservice teachers had 8.5 years of teaching experience. As in Study 1, Study 2 participants were diverse in terms of age, gender, and teaching experience. The same principal-axis factoring with varimax rotation procedure used in Study 1, along with a scree test, refined the 32-item instrument to 18-items with three distinct subfactors: (a) "efficacy for student engagement," (b) "efficacy for instructional strategies," and (c) "efficacy for classroom management" (Tschannen-Moran & Hoy, 2001, p. 797).

Further validity testing of the 18-item OSTES instrument involved participants responding to questions on four different recognized teacher efficacy instruments. Analysis of participants' responses revealed that the 18-item OSTES aligned with the four established teacher efficacy scales. To ensure that inclusion of preservice teachers did not affect the overall analysis, researchers conducted a correlation analysis, which revealed that the 18-items scale was valid for both preservice and inservice teachers. Although the instrument appeared to be valid, Tschannen-Moran and Hoy (2001) noted that they had some concerns about the three subscales of efficacy of classroom management, efficacy of instructional strategies, and efficacy of student engagement. As a result of these concerns, they conducted further analysis.

Study 3

In Study 3, Tschannen-Moran and Hoy (2001) decided to add new items specifically to address issues with the assessment of efficacy of classroom management. The new questions

added to the 18-item OSTES resulted in an instrument with 36 total items. The researchers then administered the 36-item instrument to 410 teachers to solicit their response. The participants consisted of 103 preservice teachers and 255 inservice teachers at three universities. As in the initial two studies, the participants were diverse in terms of age, gender, race, and teaching experience. Furthermore, they taught at all school levels, including preschool, elementary school, middle school, and high school.

Using principal-axis factoring along with varimax rotation analysis and scree test, a 24-item scale along with a 12-item scale with the three subscales identified in Study 2 emerged as having high reliabilities. The validity of the new scales was tested by comparing participants' responses to three established teachers' efficacy scales. The result revealed that the newly developed OSTES instrument, which is now known as the TSES, aligned with the established teachers' efficacy scales at that time. Although the 12-item and 24 -item OSTES are reliable and valid, Tschannen-Moran and Hoy (2001) cautioned that "for preservice teachers, the total score seems to be the most appropriate gauge of efficacy. Subscale scores may have little meaning for prospective teachers who have yet to assume real teaching responsibilities" (p. 801). In addition, Tschannen-Moran and Hoy (2001) noted that the OSTES is a better measurement of teachers' self-efficacy as compared to other teachers' efficacy instruments at that time:

> The OSTES moves beyond previous measures to capture a wider range of teaching tasks. Both the Rand and Gibson and Dembo instruments focused on coping with student difficulties and disruptions as well overcoming the impediments posed by an unsupportive environment. Lacking were assessments of teaching in support of student thinking, effectiveness with capable students, creativity in teaching, and the flexible

> application of alternative assessment and teaching strategies. The OSTES addresses some of these limitations by including items that assess a broader range of teaching tasks. The three dimensions of efficacy for instructional strategies, student engagement, and classroom management represent the richness of teachers' work lives and the requirements of good teaching. (p. 801)

The OSTES appears to be an ideal instrument in assessing teachers' self-efficacy due to its comprehensive design, which includes accounting of the different job responsibilities teachers are task with on a daily basis.

Summary

This chapter was a review of literature pertinent to teacher self-efficacy. The chapter discussed findings from research regarding variables that strengthen teachers' self-efficacy along with variables that weaken teachers' self-efficacy. In addition to this, the chapter provided a historical overview of attempts by researchers to develop an instrument for assessing teachers' self-efficacy, which ultimately led to the TSES by Tschannen-Moran and Hoy (2001), which is currently the most widely used instrument by researchers in measuring teachers' self-efficacy.

CHAPTER 3

METHODOLOGY

The objective of this research was to gain a comprehensive understanding of the self-efficacy of inservice K-12 mathematics teachers in a southeastern state in the United States based on demographic variables and school variables. Chapter 1 and Chapter 2 highlighted the significance of understanding teachers' self-efficacy at a localized geographic school location and grade level context. Also, Chapter 1 and Chapter 2 provided an overview of Bandura's theory of self-efficacy and presented the findings of studies that revealed a positive correlation between teachers with high sense of self-efficacy and student achievement in mathematics. Chapter 3 reiterates the research questions, along with researcher's hypotheses for each of the research questions. Also provided are descriptions of the research design, participant selection and protection, data collection procedures and instrumentation, and data analysis techniques.

Research Questions and Hypotheses

The following research questions guided this research:

1. What is the difference in teachers' self-efficacy in teaching mathematics based on gender?
2. What is the difference in teachers' self-efficacy in teaching mathematics based on teaching experience?
3. What is difference in teachers' self-efficacy in teaching mathematics based on education level?
4. What is the difference in teachers' self-efficacy in teaching mathematics based on school type (elementary school, middle school, high school)?

The researcher did not anticipate a statistically significant difference in teachers' self-efficacy based on gender. The researcher did anticipate that teachers with over 10 years of teaching experience would have statistically significant higher overall sense of self-efficacy as compared to teachers with less than 10 years of teaching experience. Additionally, the researcher predicted that teachers who had attained a post-bachelor's degree would have statistically significant higher self-efficacy as compared to teachers with only a bachelor's degree. The researcher also anticipated statistically significant difference among teachers based on whether they taught at elementary school, middle school, or high school. Finally, the researcher predicted that elementary school teachers would have an overall higher sense of self-efficacy as compared to middle and high school teachers.

Research Design

This research used an exploratory cross-sectional design, which the researcher deemed appropriate because the research focused on a particular group of interest: inservice K-12 mathematics teachers in a southeastern state in the United States. Further, cross-sectional design was suitable since data collection occurred at only one point in time, and the researcher did not seek to determine causality or relationship. The researcher used SurveyMonkey, an online survey tool, to collect data from participants for demographic data and completion of the TSES instrument.

Participants

Participants of the study were current inservice K-12 mathematics teachers in a southeastern state in the United States. To identify school districts for participation, the researcher obtained an Excel data file of all K-12 schools in the state from the U.S. Department

of Education (2021). In this study, elementary school referred to K-5th grades, middle school referred to 6th-8th grades, and high school referred to 9th-12th grades. The Excel data file, which included county public schools, city schools, and public charter schools in the southeastern state, had a total of 203 school districts (U.S. Department of Education, 2021).

Using the Excel data file provided by the U.S. Department of Education (2021), the researcher randomly selected 10 out of 50 school districts based on SPSS randomizer option from a top-down list. Using each school district's website to locate the appropriate email of district personnel, the researcher then emailed a solicitation email to the school district research department and or school superintendents' contact persons around the end of 2020-2021 academic year. Since only two responded, the researcher contacted the eight school districts that did not respond to the initial solicitation email and reached out to an additional 30 school districts at the start of the 2021-2022 school year. The researcher was hoping to get as much teacher participation as possible. Some of the school districts indicated that they were not currently accepting new research, while others did not respond after 2 to 3 emails and phone calls. Based on this solicitation process, two school districts agreed to participate as study sites.

To ensure that only inservice K-12 mathematics teachers were part of the research, the first question on the SurveyMonkey link asked possible participants whether they were currently teaching mathematics in a K-12 school setting in the southeastern state at the time of the research. If a candidate responded, "Yes," they received instructions to complete the survey solely from the perspective of teaching mathematics. If a candidate responded, "No," they were thanked for their time and unable to access the survey. The study excluded "No" responses.

Protection of Subjects and Participants

Participants agreed to the terms of the informed consent prior to completing the survey. The form outlined the goals of the research and addressed the issue of confidentiality. Also, the Mercer Institutional Review Board (IRB) reviewed the design of the study to ensure confidentiality and protection of participants' information. Based on the IRB confidentiality policy, participants did not provide their names or email addresses. The researcher collected only general demographic information for data analyses. Furthermore, the researcher did not assign personal identifiers such as name or school district during data collection. Instead, participants received a generic ID number solely as an identifier for data collection and analysis.

Procedures

As part of the study procedures, the researcher did the following:

1. applied and received Mercer IRB approval (see Appendix A);
2. accessed the U.S. Department of Education data file of 203 public school districts in the southern state;
3. employed the Rv.Uniform randomizer function in SPSS to identify county and/or city school districts for participation solicitation;
4. located and accessed the websites of the 50 identified districts to find the emails of the district personnel responsible for mathematics professional development and research;
5. sent a recruitment email (see Appendix B) to the appropriate contacts of the identified districts;

6. upon receiving approval to solicit participation from the initially identified public school districts, forwarded an email of the SurveyMonkey link of the study to the appropriate contact of each school district to share with teachers;
7. ensured the SurveyMonkey link was available for three months;
8. ensured closure of the SurveyMonkey link after three months; and
9. transferred data from SurveyMonkey into IBM SPSS software for analysis.

Instrumentation

To gain answers to the research questions, the researcher collected responses from participants using online survey instrumentation. First, participants completed demographic questions. Next, participants completed questions from the short form of the TSES (Tschannen-Moran & Hoy, 2001) by selecting responses presented in a Likert rating of 1-9. Participants accessed the demographic questions and the TSES using the same SurveyMonkey link.

Demographic Data

SurveyMonkey is a user-friendly online survey platform. Surveys can be designed in various ways to solicit response from participants. Some possible answer choices include a dropdown list, multiple choices, short open-ended responses, and paragraph responses. For this study, the primary forms of collection of data were the multiple choice option and the dropdown list response types. Appendix C displays a sample of the SurveyMonkey used for this study.

Prior to completing the survey, participants responded to a question asking if they were presently teaching mathematics; if a participant answered “yes,” they did not receive access to complete the rest of the survey. If a participant answered “no,” they were unable to proceed with the survey at that point. Additionally, instructions at the top of the survey asked teachers who

taught math along with other subjects to respond to the survey from their experience in teaching solely mathematics.

The first section of the survey asked participants to respond to the following general demographic variable questions: gender, number of years of teaching experience, education level, school type (elementary, middle, or high), and environmental context of school (rural, suburban, and urban). Table 2 lists the demographic variables the study collected.

Table 2

Demographic Variables

Variables	Identifiers
Gender	i) Female ii) Male iii) Other
Race	i) White ii) Black iii) Hispanic iv) American Indian v) Asian or Pacific Islander vi) Mixed/Other
Education	i) Bachelor's degree ii) Master's degree iii) Doctorate degree
Teaching experience	i) 3 years or less of teaching experience ii) 4 - 9 years of teaching experience) iii) 10 -15 years of teaching experience iv) 16 20 years of teaching experience v) 20+ years of teaching experience
Age	i) 21 – 25 years old ii) 26 – 35 years old iii) 36 – 49 years old iv) 50 – 60 years old v) over 60 years old
School Type	i) Elementary (K-5th grade) ii) Middle School (6th- 8th grade) iii) High School (9th -12th grade)

Teachers' Sense of Efficacy Scale (TSES) Short Form

The second portion of the SurveyMonkey collected participants' responses to the TSES short form by Tschannen-Moran and Hoy (2001). Participants had the option to respond to the 12 questions TSES instrument using a 1- 9 drop down Likert-response option. The TSES by Tschannen-Moran and Hoy (2001) is a comprehensive Likert scale with three subdomains for assessing the self-efficacy of teachers.

Presently, the TSES is the most widely used teacher self-efficacy instrument (Page et al., 2014). This is primarily because of its high reliability and validity. In statistical analysis, instrument reliability is essential for obtaining accurate results that are void of random choices by participants (Bonett & Wright, 2015; McNeish, 2018). The reliability of the TSES was 0.91 for classroom management, 0.90 for instruction, and 0.87 for student engagement for the 24-item long form (Tschannen-Moran & Hoy, 2001). For the short form, reliability for classroom management and instruction was 0.86 and 0.81 for engagement (Tschannen-Moran & Hoy, 2001). The reliability values have been widely accepted as valid based on various research studies over the years (Gkolia et al., 2016; Klassen & Chiu, 2010; Klassen & Tze, 2014; McGee & Wang, 2014; Stevens et al., 2013). For this research, based on the responses of the 50 participants, the value for Cronbach's alpha for the TSES survey was $\alpha = .87$. A Cronbach's alpha of this value implies strong internal consistency (Croasmun & Ostrom, 2011).

In this study, participants completed the 12-question short form, designed to capture teachers' sense of self-efficacy by having participants respond to the questions using a dropdown menu from1 to 9. Respondents could select from nine possible responses on a 1-5 continuum scale: 1—Nothing, 3—Very Little, 5—Some Influence, 7—Quite A Bit, and 9—A Great Deal.

The researcher determined the overall self-efficacy score by calculating the mean of the respondent scores for all 12 questions. The researcher also calculated the mean of the four questions per subdomain (efficacy for classroom management, efficacy for instruction, and efficacy for student engagement).

Table 3 lists the questions on the TSES short form based on the three subdomains. Efficacy for instructional strategies measures how effective a teacher is in delivering a lesson. Efficacy for classroom management measure how a teacher deals with challenging student behavior situations, which are part of daily classroom experiences. Efficacy for student engagement measures teacher effectiveness in engaging students in the learning process.

Table 3

TSES Short Form Efficacy Subdomains and Corresponding Questions

Efficacy Subdomain	Questions
Efficacy in Instructional Strategies	5. To what extent can you craft good questions for your students? 9. To what extent can you use a variety of assessment strategies? 10. To what extent can you provide an alternative explanation or example when students are confused? 12. How well can you implement alternative teaching strategies in your classroom?
Efficacy in Classroom Management	1. How much can you do to control disruptive behavior in the classroom? 3. How much can you do to calm a student who is disruptive or noisy? 6. How much can you do to get children to follow classroom rules? 8. How well can you establish a classroom management system with each group of students?
Efficacy in Student Engagement	2. How much can you do to motivate students who show low interest in school work? 4. How much can you do to help your students value learning? 7. How much can you do to get students to believe they can do well in schoolwork? 11. How much can you assist families in helping their children do well in school?

Data Analysis

The data were analyzed using IBM SPSS Version 27 statistical software. Prior to data analysis, data cleaning was conducted to identify outliers, missing data, and duplicate data. After data cleaning, multiple Kruskal-Wallis tests were employed for data analysis since nonparametric analysis was the most appropriate for Likert scale ordinal measurements, such as the TSES. The Kruskal-Wallis test is based on analysis of difference in median among groups as opposed to ANOVA analysis, which is based on mean differences for interval and ratio data (Cronk, 2018;

Tolmie et al., 2011). The Kruskal-Wallis tests were used to determine whether statistically significant differences existed based on teachers' gender, teaching experience, education level, and school type.

Summary

The primary focus of this research was to understand the difference between group demographic variables, school type, and self-efficacy of inservice mathematics teachers at the K-12 level in a southeastern state in the United States. To analyze these relationships, the study utilized purposeful sampling. Participants selected for the research were elementary, middle school, and high school mathematics teachers in a southeastern state in the United States. Study participants completed a questionnaire through SurveyMonkey that had two components to it: seven researcher-developed demographic questions and 12 questions of the TSES short form (Tschannen-Moran & Hoy, 2001). The following chapter presents the results of the data analysis.

CHAPTER 4

RESULTS

In the present study, the researcher examined the impact of demographic variables, and school level factors, on the self-efficacy of elementary, middle, and high school mathematics teachers in a southeastern state in the United States. Two rural school districts in the southeastern state gave consent for data collection. The researcher provided a survey for mathematics teachers to complete from mid-May to mid-August. After this timeframe, the survey was closed, and the researcher downloaded the data as a SPSS (*sav) file. To analyze the data, the researcher first conducted an exploratory investigation. The exploratory analysis showed that 63 individuals attempted the survey but only 50 participants completed the survey in its entirety.

Chapter 4 provides demographic information of the participants along with the statistical analysis performed. The first section discusses the Kruskal-Wallis tests of participants' responses based on gender and mathematics teachers' sense of self-efficacy. The analysis involved teachers' overall sense of sense of self-efficacy, which was based on the responses of participants to the 12 items of the TSES and the subscales efficacies of the instrument. The next section focuses on the Kruskal-Wallis tests, based on teaching experience, followed by education and school type. Lastly, the researcher provides a summary of the findings of the research.

Fidelity of Implementation

The researcher conducted the study as intended in terms of the instrumentation used and participants for the study. The researcher used the TSES to collect data from K-12 mathematics teachers from two rural schools in a southeastern state in the United States. The link for the survey was only shared with mathematics teachers in the school districts that agreed to

participate in the research. Additionally, Question-1 of the survey asked participants: “Are you currently teaching mathematics in K-12 setting in a southeastern state in the United States?” If participants responded “No” to this question, they could not move further with the survey. Furthermore, to promote fidelity, participants teaching multiple contents were asked to complete the survey solely from the perspective of teaching mathematics.

Data Cleaning

Upon transferring data into SPSS, the researcher carried out a frequency descriptive statistic to identify missing data. The analysis revealed that 13 participants did not provide any response to the demographic section and the TSES section of the survey. Thus, the researcher deleted these participants from the SPSS file. All remaining participants responded to all questions of the survey. There was no additional data cleaning procedure because the survey had a dropdown list; as such, participants could not have entered an invalid response.

Descriptive Statistics

The study consisted of 50 participants: 43 (86%) were female and 7 (14%) were male. The median overall TSES scores for females were 7.17, and the median TSES scores for males were 7.17. As for teaching experience of the participants, 12% had three years or less of teaching experience, 22% had 4-9 years of teaching experience, 20% had 10-15 years of teaching experience, 16% had 16-20 years of teaching experience, and 30% had 20 years or more of teaching experience. For the educational attainment variable, 64% of the participants reported post-bachelor’s degree (i.e., Master’s degree, EdS), and 36% had bachelor’s degree. Finally, for school type, 54% of the teachers taught at elementary schools, 18% taught in middle schools, and

28% taught in a high school setting. Table 4 displays the participants' demographics and median scores on the TSES.

Table 4

Participants' TSES Scores and Number of Participants Based on Demographic Variables

Demographic Variable	*N*	%	TSES	TSES Subscales		
				Student Engagement	Instructional Strategies	Classroom Management
Gender						
Male	7	14	7.42	7.00	8.00	7.50
Female	43	86	7.17	6.75	7.50	7.00
Teaching Experience						
3 years or less	6	12	7.05	7.13	7.00	6.88
4-9 years	11	22	7.17	6.50	7.75	7.00
10-15 years	10	20	7.17	6.88	7.63	7.25
16-20 years	8	16	7.29	6.63	7.63	7.75
20+ years	15	30	7.25	6.75	7.75	7.00
Education						
Bachelor's Degree	18	36	7.17	6.63	7.75	7.00
Master's/EdS Degree	32	64	7.21	7.00	7.63	7.38
School Type						
Elementary School (K-5th grade)	27	54	7.25	7.00	7.75	7.00
Middle School (6th- 8th grade)	9	18	6.83	6.25	8.00	6.75
High School (9th-12th grade)	14	28	7.21	6.63	7.50	7.50

Assumption Checking

This study utilized ordinal data. As such, assumption of normality tests, such as visual analysis of a Q-Q plot along with Kolmogorov–Smirnov test, Shapiro Wilk test, and other

normality analyses were not required. Additionally, the researcher checked data for duplicates by ensuring that each participant had a unique IP address.

Gender TSES

Of the 50 participants with usable data, 43 were female and 7 were male, In regard to the first research question, which sought to analyze difference in teachers' self-efficacy in teaching mathematics based on gender, the researcher hypothesized that there would not be a statistically significant difference in mathematics teachers' self-efficacy based on gender. To perform the Kruskal-Wallis test, the researcher first calculated the mean efficacy of participants' responses to the 12-item Teachers' Sense of Efficacy Scale (TSES) instrument developed by Tschannen-Moran and Hoy (2001). Then, the Kruskal-Wallis test was conducted comparing teachers' overall sense of self-efficacy based on gender. The analysis revealed, $H(1) = 1.22$, $p = .269$, implying that male and female teachers had a comparable sense of self-efficacy for teaching mathematics at the K-12 level. Based on this result, the initial hypothesis by the researcher was confirmed.

As for the TSES subscales, the researcher first calculated the participants' efficacies in (i) Efficacy in Student Engagement, (ii) Efficacy in Instructional Strategies, and (iii) Efficacy in Classroom Management. This involved taking the mean of the appropriately defined items of the TSES instrument. Appendix D lists the particular items for each of the subscales, along with the SPSS variable labels. Three Kruskal-Wallis tests were conducted to compare teachers' gender and the TSES subscales: student engagement, instructional strategies, and classroom management. The results revealed a statistical insignificant difference by gender for student engagement, $H(1) = 0.18$, $p = .674$, instructional strategies, $H(1) = 0.74$, $p = .391$, or classroom management, $H(1) = 0.91$, $p = .339$. The results indicate that male and female teachers had a

similar sense of efficacy for student engagement, instructional strategies, and classroom management. Table 5 displays the Kruskal-Wallis *H* values and the *p* values of participants for the TSES scales, and Figure 2 illustrates the participants' TSES median efficacy scores based on gender.

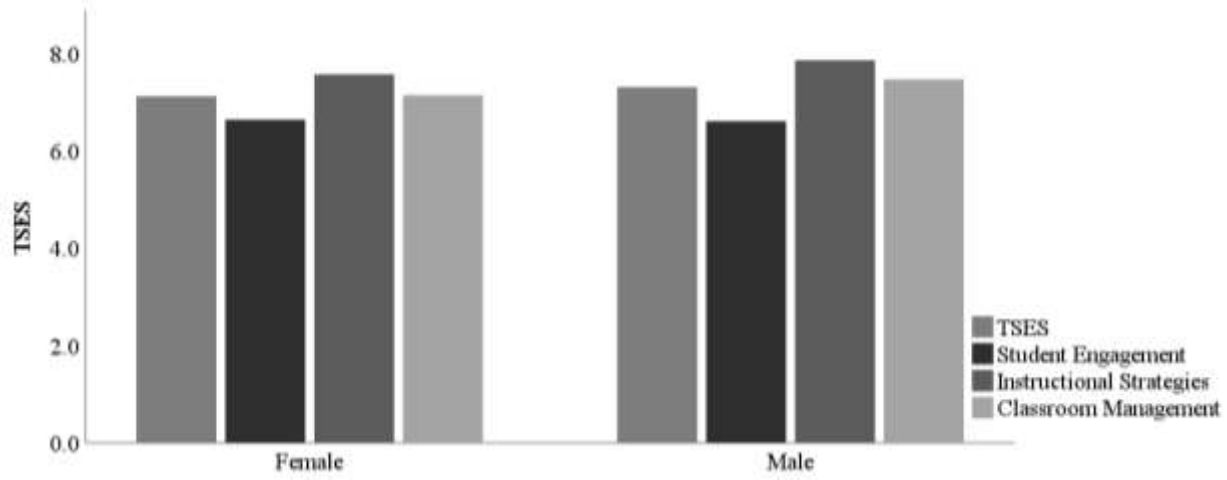
Table 5

Kruskal-Wallis Test Based on Gender

TSES SCALE	Kruskal-Wallis *H*	*p*-value
Overall Self-Efficacy	1.22	.269
Self-Efficacy of Student Engagement	0.18	.674
Self-Efficacy of Instructional Strategies	0.74	.391
Self-Efficacy of Classroom Management	0.91	.339

Figure 2

Overall TSES and Subscale Efficacy Scores of Participants Based on Gender



Teaching Experience TSES

In regards to teaching experience, of the participants with valid data, 12% had taught for three years or less; 22% had taught for 4-9 years; 20% had taught for 10-15 years; 16% had taught for 16-20 years, and 30% had taught for 20 or more years. As for the research question, which looked at analyzing differences in teachers' self-efficacy in teaching mathematics based on teaching experience, the researcher had hypothesized that teachers with over 10 years of teaching experience would have a statistically significant higher overall sense of teaching self-efficacy when compared to teachers with less than 10 years of teaching experience. To determine if this hypothesis was valid, the researcher first calculated the mean efficacy of participants' responses to the 12-item Teachers' Sense of Efficacy Scale (TSES) instrument developed by Tschannen-Moran and Hoy (2001). Afterward, a Kruskal-Wallis test was performed. The analysis revealed no statistical difference, $H(4) = 1.35$, $p = .852$ for teaching experience and teachers' sense of efficacy for teaching mathematics. As such, the initial hypothesis of the researcher was rejected. The result suggests that teachers with various levels of tenure had similar levels of self-efficacy for teaching mathematics at the K-12 level.

In regard to the TSES subscales efficacies analyses for teaching experience, the researcher first calculated the participants' subscales efficacies using the same procedure outlined under the TSES subscale efficacies analysis for gender. Then, three Kruskal-Wallis tests were performed to compare teachers' teaching experience and the TSES subscales: student engagement, instructional strategies, and classroom management. The results revealed no significant differences by teaching experience for student engagement, $H(1) = 2.97$, $p = .563$,

instructional strategies, $H(4) = 3.02$, $p = .555$, or classroom management, $H(4) = 3.67$, $p = .453$. Table 6 displays the Kruskal-Wallis H values and the p value of the teaching experience of participants for the TSES scales. Figure 3 illustrates the participants' TSES median efficacy scores, depicted by teaching experience in years.

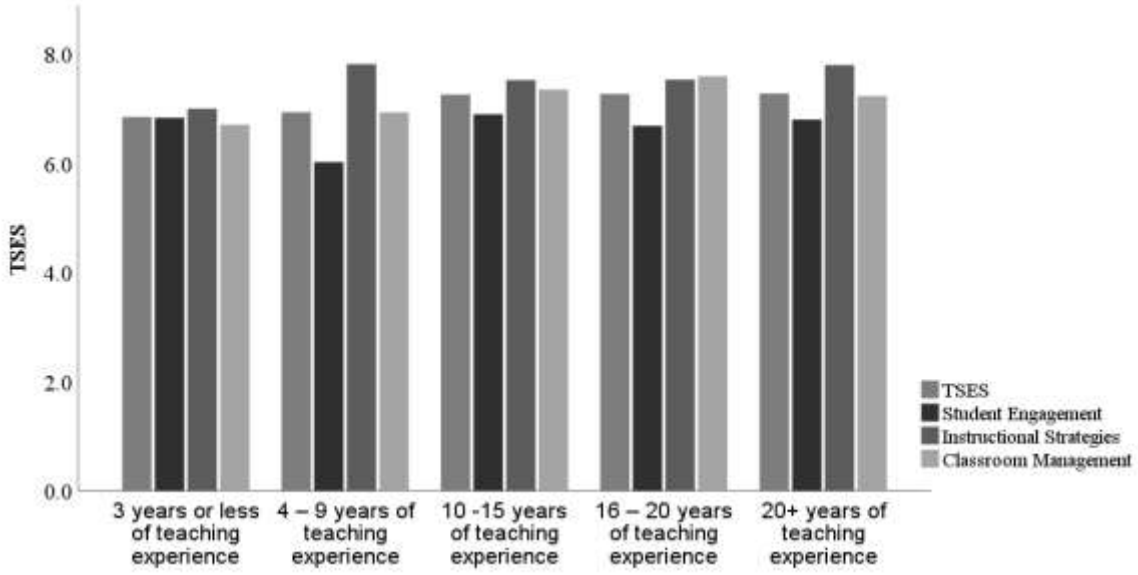
Table 6

Kruskal-Wallis Test Based on Teaching Experience

TSES SCALE	Kruskal-Wallis *H*	*p*-value
Overall Self-Efficacy	1.35	.852
Self-Efficacy of Student Engagement	2.97	.563
Self-Efficacy of Student Engagement	3.02	.555
Self-Efficacy Efficacy of Classroom Management	3.67	.453

Figure 3

Overall TSES and Subscale Efficacy Scores of Participants Based on Teaching Experience



Education Level TSES

As for education level, 36% of the participants had a bachelor's degree, and 64% had a post-bachelor degree. As for the research question, which sought to analyze the difference in teachers' self-efficacy in teaching mathematics based on education level, the researcher had hypothesized that teachers with post-bachelor's degrees would have a statistically significant higher sense of teaching self-efficacy when compared to teachers with bachelor's degrees. To determine if this assumption was valid, a Kruskal-Wallis test was performed by comparing the TSES scores of teachers to their education levels (bachelors' degree vs. post-bachelor's degree). Based on the Kruskal-Wallis test, $H(1) = 0.71$, $p = .401$, the hypothesis of the researcher was not supported. The finding of the test suggests that teachers with bachelor's degrees had a comparable sense of teaching mathematics to teachers with master's degrees at the K-12 level.

Concerning the subscales efficacies analyses based on teachers' education levels, the researcher first calculated the participants' subscales efficacies using the same procedure highlighted in the TSES subscale efficacies analysis for gender. Thereafter, three Kruskal-Wallis tests were performed by comparing teachers' education levels to the three TSES subscales: student engagement, instructional strategies, and classroom management. The results revealed no statistical differences by teaching experience for student engagement, $H(1) = 0.83$, $p = .361$, $H(1) = 0.02$, $p = .895$ instructional strategies, or classroom management, $H(1) = 2.32$, $p = .127$. Table 7 displays the Kruskal-Wallis H values and the p value for the TSES scales, and Figure 4 illustrates the participants' TSES median efficacy scores based on teachers' education levels.

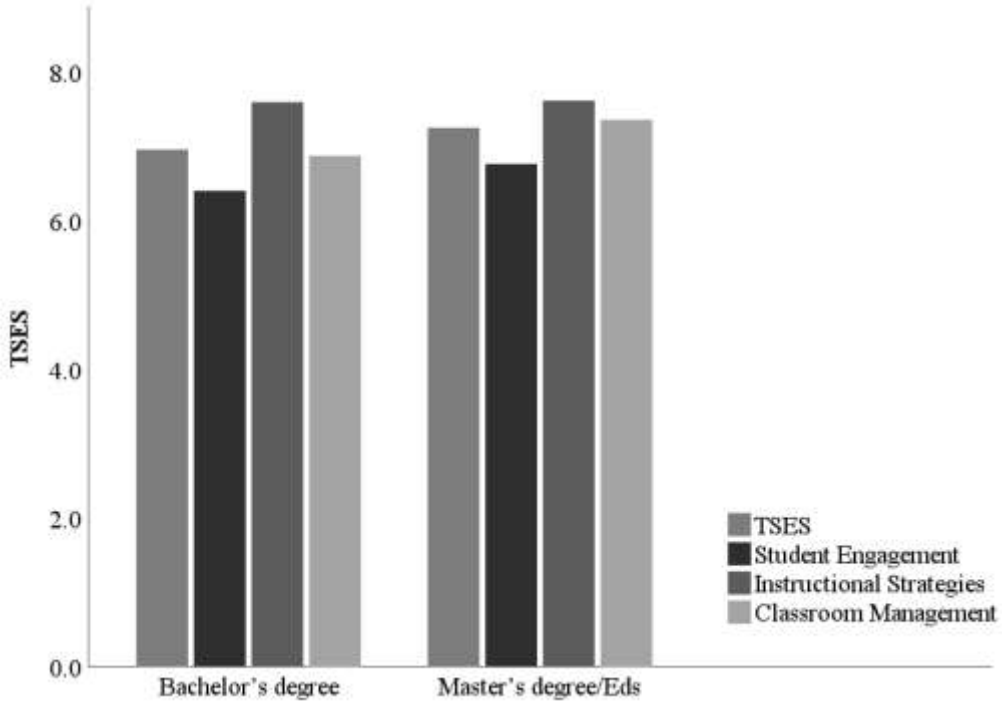
Table 7

Kruskal-Wallis Test Based on Education Level

TSES SCALE	Kruskal-Wallis *H*	*p*-value
Overall Self-Efficacy	0.71	.401
Self-Efficacy of Student Engagement	0.83	.361
Self-Efficacy of Instructional Strategies	0.02	.895
Self-Efficacy of Classroom Management	2.33	.127

Figure 4

Overall TSES and Subscale Efficacy Scores of Participants Based on Education Level



School Type TSES

Of the 50 participants who completed the survey in its entirety, 54% were elementary school teachers, 18% were middle school teachers, and 28% were high school teachers. In regards to the research question that sought to analyze difference in teachers' self-efficacy in teaching mathematics based on school type (elementary school, middle school, high school), the researcher had hypothesized that elementary school teachers would have an overall higher sense of self-efficacy when compared to middle and high school teachers. However, based on the Kruskal-Wallis test, $H(2) = 1.88$, $p = .390$, researcher's hypothesis was not supported. In the

context of this study, it appears that teachers had a similar sense of teaching mathematics across different school types (elementary school, middle school, high school).

As for the relationship between school type and TSES subscales efficacies, three Kruskal-Wallis tests were performed: student engagement, instructional strategies, and classroom management. The results revealed statistical insignificant differences by school type for student engagement, $H(2) = 2.87$, $p = .238$, $H(2) = 1.55$, $p = .461$, instructional strategies, and classroom management, $H(2) = 3.07$, $p = .215$. Table 8 shows the Kruskal-Wallis H values and the p value for the TSES scales, and Figure 5 illustrates the participants' TSES median efficacy scores based on school type.

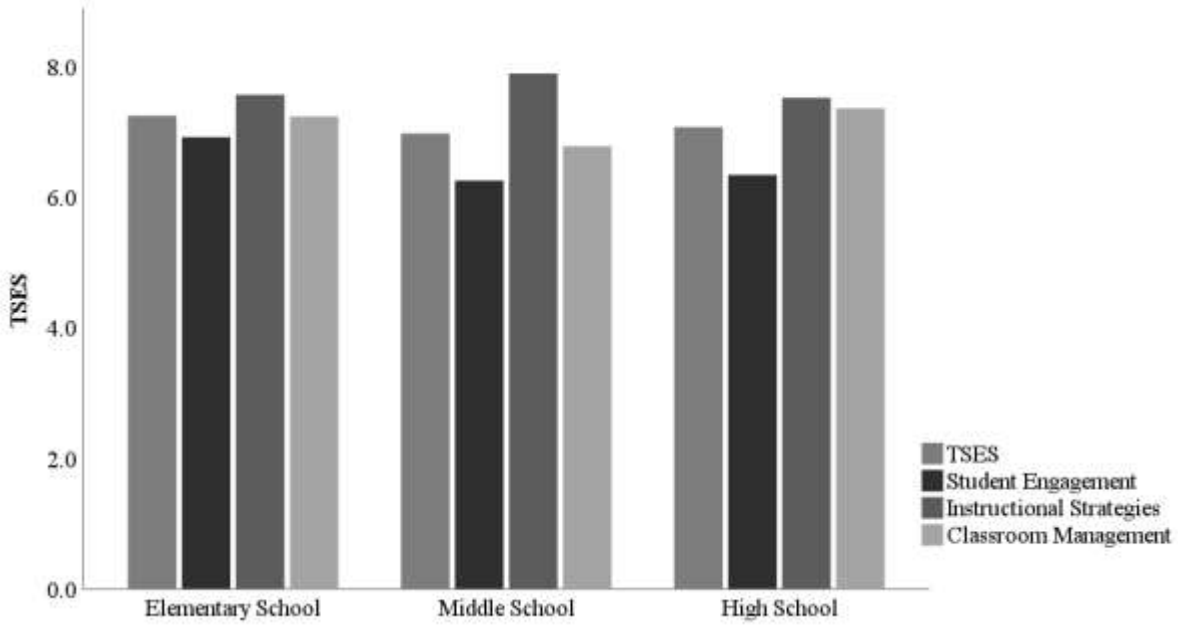
Table 8

Kruskal-Wallis Test Based on School Type

TSES SCALE	Kruskal-Wallis *H*	*p*-value
Overall Self-Efficacy	1.88	.390
Self-Efficacy of Student Engagement	2.87	.238
Self-Efficacy of Instructional Strategies	1.55	.461
Self-Efficacy of Classroom Management	3.07	.215

Figure 5

Overall TSES and Subscale Efficacy Scores of Participants Based on School Type



Summary

The results of this research reveal the unique contextual nature of teachers' self-efficacy at the K-12 level. According to the results, male teachers had a slightly higher sense of overall self-efficacy, as well as a higher sense of self-efficacy for all three subscales of the TSES. However, these results turned out to be statistically insignificant. As for teaching experience, on average, teachers with 10 or more years of teaching had a TSES score of 7.27, as compared to 6.89 for teachers with less than 10 years of teaching experience. But similar to gender, these differences in TSES were statistically insignificant. Concerning the difference in teachers' self-efficacy in teaching mathematics based on education level, the analysis of this study discovered that teachers with post-bachelor's degree had a higher overall TSES score and higher TSES score

in self-efficacy of student engagement and self-efficacy of classroom management. Nevertheless, the Kruskal-Wallis tests showed the difference in teachers' self-efficacy in teaching mathematics based on education level to be statistically insignificant. As for the last research question which looked at the interaction between school type (elementary school, middle school, high school) and mathematics teachers' self-efficacy, the findings of this research showed that elementary school teachers had the highest overall TSES score and the highest TSES score for self-efficacy of classroom management. Middle school teachers had the highest TSES for self-efficacy for instructional strategies, while high school teachers had the highest TSES for self-efficacy of classroom management. However, these differences proved to be statistically insignificant.

This chapter provided an overview of the study's data analysis and the results from the SPSS statistical analysis. Chapter 5 provides a detailed discussion of the findings by comparing the results of this research to other studies that have examined teachers' sense of self-efficacy in K-12 settings.

CHAPTER 5

DISCUSSION

The purpose of this quantitative research was to analyze the differences in self-efficacy of elementary, middle, and high school mathematics teachers in a southeastern state in the United States based on school-level factors on the self-efficacy The research revealed insightful findings about teachers' sense of self-efficacy for teaching mathematics at the K-12 level. According to the results, male and female mathematics teachers had a similar sense of self-efficacy. This finding differs from studies around the world, which have noted a difference in teachers' sense of self-efficacy based on gender (Gkolia et al., 2016; Manzar-Abbas & Lu, 2015; Shaukat et al., 2019).

The finding of this research that teachers had similar levels of self-efficacy regardless of seniority is contrary to other studies that reported teachers with seniority had a higher sense of self-efficacy when compared to teachers with less seniority (Bellibas & Liu, 2017; Gkolia et al., 2016; Klassen & Chiu, 2010). Interestingly, this study discovered that teachers with three years or less of teaching experience had the highest median TSES score in the subscale of efficacy in student engagement when compared to seasoned teachers with three or more years of tenure. Such a finding is interesting because it shows that new teachers have unique abilities and skills that they can share with experienced teachers when it comes to implementing engaging activities for students.

Regarding the relationship between teachers' educational level and teachers' sense of self-efficacy, the findings revealed that teachers with post-bachelor's degrees had similar sense of self-efficacy when compared to teachers with only bachelor's degrees. This result was also the

same for the three subscale efficacies. The findings of no difference in the subscale efficacies differ from the finding of Shoulders and Keri (2015), which noted teachers with advanced degrees and over 15 years of teaching experience as having higher levels of self-efficacy for classroom management and instructional strategies.

As for the research question that addressed the differences between school type (elementary school, middle school, high school) and mathematics teachers' self-efficacy, no statistical difference was noted based on this variable. The result differs from the findings by the research of Ryan and colleagues (2015) which reported elementary school teachers as having a higher sense of self-efficacy when compared to middle school and high school teachers, although no statistical significance was noted for the overall TSES scores.

In conclusion, considering that teachers from two rural school districts comprised the sample of this study, the positive working environment (Preston & Barnes, 2018) and the dual role of principals, which is characteristic of schools in rural settings (Abel & Sewell, 1999' Parson et al., 2016), might be possible reasons for the findings of this research, which discovered comparable teachers' sense of efficacy for teaching mathematics at the K-12 in spite of differences in demographic variables and school factors such as gender, education level, teaching experience. According to the literature, rural teachers and administrators tend to have amicable and cooperative relationships among staff and school administration (Preston & Barnes, 2018). Also, principals tend to have dual roles such as teaching along with serving as school administrators (Abel & Sewell, 1999). The amicable working environment among teachers and school principals sometimes serving the role of a teacher, might be an exemplar for other teachers on best pedagogical practices (Versland & Erickson, 2017). Research has shown that a

principal's leadership can have a positive influence on teachers' self-efficacy (Sehgal et al., 2017; Versland & Erickson, 2017). The combination of a positive working environment and principal's hands-on leadership style in rural school settings, might be acting as a mediating factor in strengthening the collective efficacy of teachers. Research on the collective efficacies of teachers, has discovered rural teachers to have a higher sense of collective efficacy when compared to teachers in urban school settings (Eckert, 2019). The higher sense of collective efficacy of teachers, in rural school environment, has been attributed "to small staff numbers and rich social and professional networks," this in turn creates, "an ideal position to build trust among staff, promote collaboration among staff, and support student achievement goals" for school principals (Preston & Barnes, 2018, p. 8). According to Tschannen-Moran et al. (1998), "Schools where teachers work together to find ways to address the learning, motivation, and behavior problems of their students are likely to enhance teachers' feelings of efficacy" (p. 221). Other studies have also shown collective efficacy to have a positive influence on an individual teacher's self-efficacy (Goddard & Goddard, 2001; Skaalvik & Skaalvik, 2007; Veiskarami et al., 2017).

Overall, it is important for research such as this to have looked at teachers' sense of self-efficacy because studies have shown that teachers' self-efficacy affects instructional quality (Holzberger et al., 2013) and students' academic achievement (Chang, 2015; Tschannen-Moran et al., 1998). Instructional quality, which deals with delivering of content to students, is a key critical foundation of teaching; in order for students to succeed academically in the long run, they need consistent quality instruction. Furthermore, Perera and John (2020) explained:

> Teacher self-efficacy is associated with a range of favorable (a) cognitive-affective teacher outcomes (e.g., higher job satisfaction, lower burnout), (b) classroom processes (e.g., better instructional management and support for students), and (c) student outcomes (e.g., greater student motivation and achievement). (p. 1)

It is clear from the literature that teachers' sense of self-efficacy plays a crucial mediating role in desirable teachers' outcomes.

Limitations of the Study

The participants of this study were all K-12 teachers currently employed in rural schools in a southeastern state in the United States. As such, caution should be taken in generalizing this finding to schools in different environmental contexts. Participants of this study may have shared cultural background that differs from the cultural makeup of teachers in a suburban or urban school district. For example, in the study carried out by Page et al. (2014), it was reported that teachers in urban school districts were discovered to have a lower sense of self-efficacy when compared to rural and suburban teachers. In addition, instrumentation errors, false perception of participants on their true efficacy, and the time frame which data were collected may have posed additional limitations.

Recommendations

Future studies might want to examine the influence of suburban and urban environments on teachers' sense of efficacy for teaching mathematics in K-12 settings. Rural environments might have unique characteristics in terms of the professional and cultural experience of teachers, and teachers-students relationship that might be influencing teachers' sense of self-efficacy uniformly. Based on the results of this study, it might be beneficial for future studies to

analyze teachers' sense of efficacy for teaching mathematics in rural settings by doing focus groups and or interviews to understand the cause of the uniform nature of teachers' sense of efficacy in such school environments. Lastly, based on the result of this research which discovered teachers with three years or less of teaching experience to have the highest TSES median score in the subscale of student engagement when compared to seasoned teachers with more than three years of teaching, it might be prudent for education policymakers and school administrators to incorporate ideas from new teachers when developing professional developments (PD) dealing with student engagement for staff.

Summary of the Study

This research, which focused on teachers' sense of teaching mathematics at the K-12 level in a southeastern state in the United States, discovered unique findings when compared to other studies around the globe that have looked at teachers' sense of efficacy at the K-12 level. For example, results of this research revealed that gender did not have a statistically significant impact on teachers' sense of efficacy. This finding of comparable sense in teachers' efficacy based on gender differs from studies around the world that have reported differences in teachers' sense of efficacy based on gender (Gkolia et al., 2016; Manzar-Abbas & Lu, 2015; Shaukat et al., 2019). Another significant discovery of this research is that other demographic and school factors, such as teaching experience, education, and school type, did not impact teachers' sense of efficacy for teaching mathematics significantly statistically. This finding contradicts studies cited in the literature review, which noted differences in teachers' sense of efficacy based on demographic and school factor variables. In conclusion, the findings of this study validate the point made by Tschannen-Moran and Hoy (2001) that teacher self-efficacy is context and

subject-matter-specific. For this research, which was carried out in a southeastern state in the United States, it appears that the rural geographic context in which study participants taught, had a significant mediating role on the overall sense of teachers' sense of self-efficacy uniformly.

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APPENDICES

APPENDIX A

IRB APPROVAL

MERCER
UNIVERSITY

Institutional Review Board
For Research Involving Human Subjects

Wednesday, May 5, 2021

Mr. Omar Sillah
3001 Mercer University Drive,
Educational Leadership
Atlanta, GA 30341

RE: The Effect of Teacher's Characteristics and School Factors on the Self Efficacy (H2105087)

Dear Mr. Sillah:

On behalf of Mercer University's Institutional Review Board for Human Subjects Research, your application submitted on 03-May-2021 for the above referenced protocol was reviewed in accordance with the 2018 Federal Regulations 21 CFR 56.110(b) and 45 CFR 46.110(b) (for expedited review) and was approved under category(ies) _7 per 63 FR 60364.

Your application was approved for one year of study on 05-May-2021. The protocol expires on 04-May-2022. If the study continues beyond one year, it must be re-evaluated by the IRB Committee.

Item(s) Approved:
The purpose of this online research study is to examine the effect of teacher's characteristics and school factors on the self efficacy of K-12 math teachers as measured by the Teacher Sense of Efficacy Scale of Tschannen-Moran and Hoy (2001)

NOTE: You **MUST** report to the committee when the protocol is initiated. Report to the Committee immediately any changes in the protocol or consent form and **ALL** accidents, injuries, and serious or unexpected adverse events that occur to your subjects as a result of this study.

We at the IRB and the Office of Research Compliance are dedicated to providing the best service to our research community. As one of our investigators, we value your feedback and ask that you please take a moment to complete our Satisfaction Survey and help us to improve the quality of our service.

It has been a pleasure working with you and we wish you much success with your project! If you need any further assistance, please feel free to contact our office.

Respectfully,

Ava Chambliss-Richardson, Ph.D., CIP, CIM.
Director of Research Compliance
Member
Institutional Review Board

"Mercer University has adopted and agrees to conduct its clinical research studies in accordance with the International Conference on Harmonization's (ICH) Guidelines for Good Clinical Practice."

Mercer University IRB & Office of Research Compliance
Phone: 478-301-4101 | Email: ORC_Mercer@Mercer.Edu | Fax: 478-301-2329
1501 Mercer University Drive, Macon, Georgia 31207-0001

APPENDIX B

PARTICIPANT RECRUITMENT EMAIL

Tift College of Education

Dear Respondent,

My name is Omar Sillah. I am a graduate student at Mercer University. I am conducting a research study about the relationship between demographic and school variables of math teachers' self-efficacy as measured by the Teacher Sense of Efficacy Scale (TSES) of Tschannen-Moran and Hoy (2001). I am emailing to ask if you would like to participate by completing a survey for this research project.

Mercer University's IRB requires investigators to provide informed consent to the research participants. If you would be interested in taking this survey, please click the following link for more information on how to participate: [Insert SurveyMonkey Live Link].

If you have any questions about the study, contact the Principal Investigator Zahn by phone, , or by sending an email to

Mercer University's Institutional Review Board (IRB) reviewed study **#[Assigned Protocol (H) Number]** and approved it on **[Approval Date (DD-Mon-YYYY)]**.

Questions about your rights as a research participant:

If you have questions about your rights as a research participant of if you are at any time dissatisfied with any part of this study, you may contact, anonymously if you wish, the Mercer University Institutional Review Board (IRB) by phone at (478) 301-4101 or by email at ORC_Research@Mercer.Edu.

Thank you in advance for your time and participation!

APPENDIX C

TSES 12-QUESTION SHORT FORM

Teacher Beliefs

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

Directions: Please indicate your opinion about each of the questions below by marking any one of the nine responses in the columns on the right side, ranging from (1) "None at all" to (9) "A Great Deal" as each represents a degree on the continuum.

Please respond to each of the questions by considering the combination of your *current* ability, resources, and opportunity to do each of the following in your present position.

	None at all		Very Little		Some Degree		Quite A Bit		A Great Deal
1. How much can you do to control disruptive behavior in the classroom?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
2. How much can you do to motivate students who show low interest in school work?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
3. How much can you do to calm a student who is disruptive or noisy?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
4. How much can you do to help your students value learning?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
5. To what extent can you craft good questions for your students?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
6. How much can you do to get children to follow classroom rules?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
7. How much can you do to get students to believe they can do well in school work?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
8. How well can you establish a classroom management system with each group of students?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
9. To what extent can you use a variety of assessment strategies?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
10. To what extent can you provide an alternative explanation or example when students are confused?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
11. How much can you assist families in helping their children do well in school?	①	②	③	④	⑤	⑥	⑦	⑧	⑨
12. How well can you implement alternative teaching strategies in your classroom?	①	②	③	④	⑤	⑥	⑦	⑧	⑨

13. What is your gender?
- O Male
- O Female

14. What is your racial identity?
- O African American
- O White, Non-Hispanic
- O Other

15. What subject matter do you teach? (as many as apply)
- O All (Elementary/ Self-contained)
- O Math
- O Science
- O Language Arts
- O Social Studies

16. What level do you teach?
- O Elementary
- O Middle
- O High

17. What is the context of your school?
- O Urban
- O Suburban
- O Rural

18. What is the approximate proportion of students who receive free and reduced lunches at your school?
- O 0-20%
- O 21-40%
- O 41-60%
- O 61-80%
- O 81-100%

19. What grade level(s) do you teach? ⓚ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

20. How many years have you taught? ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

For office use only. ⓪ ① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨

APPENDIX D

CODEBOOK

TABLE D

Code Book of IBM-SPSS Analysis

Variable Code	Meaning	Label
Gender	Sex of participants	Other = 0 Female = 1 Male = 2
Education	Highest degree obtained by participant	1 = bachelor's degree 2 = master's degree 3 = doctorate degree
Teaching_Experience	Tenure as a teacher	1 = 3 years or less of teaching experience 2 = 4 – 9 years of teaching experience 3 = 10 – 15 years of teaching experience 4 = 16 – 20 years of teaching experience 5 = 20+ years of teaching experience
School_Type	Environment teacher is currently teaching at.	1 = Elementary School (K-5th grade) 2 = Middle School (6th-8th grade) 3 = High School (9th -12th grade
Total_SelfEfficacy	Mean Efficacy of a participant response to the 12-items TSES instrument	N/A
Efficacy_Student_Engagement	Mean subscale efficacy in student engagement based on items 2, 4, 7, 11 of the TSES instrument.	N/A
Efficacy_Instructional_Strategies	Mean subscale efficacy of in instructional strategies based on items 5, 9, 10, 12 of the TSES instrument.	N/A
Efficacy_Classroom_Management	Mean subscale efficacy of in classroom management based on items 1, 3, 6, 8 of the TSES instrument.	N/A

APPENDIX E

PERMISSIONS

From: Omar Sillah <Omar.Sillah@live.mercer.edu>
Sent: Wednesday, February 24, 2021 8:14 AM
To: Albert Bandura <bandura@stanford.edu>
Subject: Permission

Good morning Dr. Bandura,

My name is Omar Sillah, a doctoral student at Mercer University. My dissertation interest is in analyzing the self-efficacy of K-12 teachers in the State of Georgia. I was writing to seek permission to reference/included the figure below in my literature review.

Note: (Bandura, 1977, p. 193) Diagrammatic representation of the difference between efficacy expectations and outcome expectations

Thank you for your time. I look forward to your response.

Sincerely,

Omar

From: Albert Bandura <bandura@stanford.edu>
Sent: Friday, February 26, 2021 10:35 PM
To: Omar Sillah <Omar.Sillah@live.mercer.edu>
Subject: Re: Permission

Permission granted, AB

Albert Bandura