THE RELATIONSHIP BETWEEN FLEXIBLE SEATING AND MATH SELF-EFFICACY FOR ELEMENTARY MATH TEACHERS IN NORTHEAST OHIO

by

Lorna-Marie Ailean Waters

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

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APPROVED BY:

Treg Hopkins, Ed. D, Committee Chair

Tyler Wallace Ed. D, Committee Member

ABSTRACT

The purpose of this paper is to examine flexible seating and how it can be used to improve achievement in math. Based on the constructivist theory, flexible seating is defined as providing a variety of furniture options for seating that can be easily reconfigured to meet a variety of educational needs, including collaborative work. The purpose of this causal-comparative study is to determine if a statistical difference exists between the use of flexible seating during math instruction (independent variable) and math teacher self-efficacy (dependent variable). This study employed the TSES, short to measure teacher self-efficacy of a teacher who uses one or two types of flexible seating arrangements, three or more types of flexible seating arrangements, and teachers who do not use flexible seating arrangements. A convenience sample of 126 elementary math teachers in Northeast Ohio was used to determine the self-efficacy difference between teachers who utilized various flexible seating arrangements and teachers who utilized traditional seating. A one-way between-groups analysis of covariance (ANOVA) was used to analyze the research question and decide if the null hypothesis was rejected. Results indicate that there is a statistical difference between the use of flexible seating during math instruction and teacher self-efficacy. Implications for using flexible seating and future studies are included in this study.

Keywords: flexible seating, Constructivist theory, Bronfenbrenner's ecological systems, stability balls, inflated cushions, standing tables, self-efficacy

Copyright Page

Dedication

I dedicate this dissertation, first, to my childhood tutor, [redacted], who looked past my dyslexia and deficiencies and saw me for who I am. We spent countless hours writing my spelling words in shaving cream and sending twinkies down the garbage disposal. I am forever indebted to her kindness and compassion.

Secondly, I dedicate this dissertation to my girls: [redacted] May you always acknowledge the gifts and talents the Lord has given you and strive for excellence in everything you do. Whether becoming a babysitter or a scientist, know that God has always had a plan for you to do great things in the lives of those around you!

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Finally, I want to acknowledge my husband, [redacted] This accomplishment is as much his as it is mine. He might not have written the papers, but he made it possible for me to write them. Countless hours he took on watching four little girls so that I could cross this off my bucket list. He never let me believe quitting was an option. His constant encouragement was the light that kept me going.

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List of Abbreviations

Analysis of Variance (ANOVA)

Institutional Review Board (IRB)

No Child Left Behind (NCLB)

Ohio State Teacher Efficacy Scale (OSTES)

Teacher Sense of Efficacy Scale, Short (TSES)

CHAPTER ONE: INTRODUCTION

Overview

The purpose of this quantitative, causal-comparative study is to determine if there is a difference in teacher efficacy between teachers who utilize flexible seating and those who utilize traditional seating in the elementary math classroom. This chapter provides an overview of the historical, social, and theoretical background of seating in the classroom, specifically looking at seating as it pertains to flexible seating in the elementary setting and self-efficacy. Additionally, this chapter provides problem and purpose statements, study significance, and research questions related to the gap in literature on the effects of flexible seating on teacher self-efficacy. Finally, the chapter concludes with a list of definitions relevant to the current study.

Background

In 1983, the Department of Education's report, A Nation at Risk, reported that the United States education system was failing in terms of student achievement as the United States was trailing other countries. Among the signs the education system in the United States was at risk was failing math skills. In the two decades to follow, concerns over achievement continued to increase, which partially necessitated and led to Public Law 107-110, or No Child Left Behind (NCLB) of 2001. This law catalyzed educational reforms emphasizing standard-based education and standardized testing to ensure achievement, including math (Jorgensen & Hoffmann, 2003). NCLB and present educational reforms require math teachers to employ the best teaching practices and classroom management to address standards and ensure achievement on standardized tests (Thompson, 2008). This reform not only affects upper-tested grades, but accountability pressures also impact earlier, non-tested grades, as NCLB reforms generate an amplified focus on learning outcomes across all grades (Bassok et al., 2016). One area a math

teacher should consider is the physical space of his or her classroom. Research shows the classroom's physical space, such as seating arrangements, can influence learning and teachers' and students' attitudes toward school (Gremmen et al., 2016). As an essential aspect of classroom management, teachers determine how to arrange classroom seating. The physical learning environments and classroom design features, such as furniture or orientation, can encourage or hinder knowledge construction and enhance or impede student academic progress (Barrett et al., 2015; Hao et al., 2021). This critical decision for math teachers can affect classroom climate, including student relationships and attitudes toward learning (Denton, 1992; McKeown et al., 2015; van den Berg et al., 2012).

Historical Context

Almost four decades ago, researchers' interest flourished regarding the influences of antecedent intervention (Weinstein, 1979). The antecedent intervention focuses on creating or structuring a classroom environment that prevents behavioral problems and enhances student motivation (Kern & Clemens, 2007). It is believed that by concentrating on stimulus conditions, such as the physical structure of a classroom, teachers can discreetly prevent undesirable behaviors before they happen and, therefore, avoid more intrusive interventions (Wannarka & Ruhl, 2008).

Researchers have found that seating arrangements are a stimulus condition with the potential to either promote desirable behavior or encourage misbehavior in students (Daniels, 1998). Furthermore, seating arrangements are unique from other behavioral interventions as it is subject to the teacher's control (Wannarka & Ruhl, 2008). Historically, the focus of research regarding seating has been proximity and seating arrangements as it relates to participation (Gremmen et al., 2016; Marx et al., 2000; Shernoff et al., 2017) and achievement (Gremmen et

al., 2016; Griffith, 1921; Kalinowski & Taper, 2007; Ngware et al., 2013; Parker et al., 2011; Shernoff et al., 2017).

In his seminal work, Griffith (1921) researched whether classroom seating location influences the academic achievement of college students. He found that front, centrally-seated students' achievement exceeded those seated in a peripheral location in a large classroom. Further research supported these findings, reporting that students sitting in the front center received higher grades and showed more considerable achievement gains than their peers seated in the back of the classroom (Ngware et al., 2013; Shernoff et al., 2017). Research also supports closer proximity promoting interaction and participation (Perkins & Wieman, 2005). Not only does research support proximity, but research also suggests that arrangements impact participation. Marx et al. (2000) found seats arranged in a semi-circle instead of rows and columns promoted engagement.

However, not all research supports the proximity effect. Also, in his seminal work, Griffith (1921) reported a diminished proximity effect in smaller classrooms and labs. Further research conducted since the Griffith (1921) experiment also supported smaller classrooms and appeared to support the proximity effect less than in large classrooms (Kalinowski & Taper, 2007).

Social Context

Recently, an emphasis on examining how student seating location impacts learning has shifted to the seating options available. In the contemporary classroom, an ever-increasing emphasis on 21st century skills has required teachers to address creativity, collaboration, innovation, teamwork decision-making, communication, critical thinking, problem-solving, and research fluency (Larson & Miller, 2011). To address these skills, teachers must create an

atmosphere and learning environment that allows for acquiring these skills (Lemley et al., 2014). The California Department of Education: School Facilities and Transportation Services Division (2016) called for teachers and administrators to reimagine student seating to support diverse teaching and learning needs. They stated that learning environments should provide student seating options that are mobile and flexible to meet the demands of 21st century learning. Flexible seating arrangements are defined as providing a variety of furniture options variably configured to facilitate seating choice and differential learning experiences (Kariippanon et al., 2018). Flexible seating options can appear differently, allowing students the ability to rock, shift position, rotate, and roll. Examples of these options range from adjustable tables and chairs with wheels to bean bag chairs (The California Department of Education: School Facilities and Transportation Services Division, 2016)

While flexible seating aims to provide students with several seating options, the majority of research to date only examined one type of available alternative seating options in a flexible seating classroom. Therefore, research involving flexible seating can be categorized by the individual type of seating option, such as therapy balls (Bagatell et al., 2010; Erwin et al., 2016; Fedewa et al., 2015; Gaston et al., 2016; Macphee, et al., 2019; Mead et al., 2016; Olson & Panahon, 2019;), inflated cushions (Pfeiffer et al., 2008; Seifert & Metz, 2017), and standing desks (Dornhecker et al., 2015; Koepp et al., 2012; Parry et al., 2019).

The most significant area of flexible seating research has focused on therapy balls as seats in the classroom (Bagatell et al., 2010; Fedewa et al., 2015; Gaston et al., 2016; Mead et al., 2016; Olson & Panahon, 2019). Therapy balls can be defined as large inflated balls made of elastic plastic or rubber (Olson & Panahon, 2019). Research on the use of therapy balls has elicited improved attention, reduced depression (Gaston et al., 2016), and academic growth

(Mead et al., 2016). Furthermore, when investigating a population of students with disabilities, research suggests therapy balls to increase in-seat behaviors and focus (Schilling & Schwartz., 2004).

While some research on using therapy balls has trended beneficial, other research has shown therapy balls to be ineffective. For example, Fedewa et al. (2015) reported that while therapy balls impacted disruptive behaviors, they did not influence behaviors and achievement. Olson and Panahon (2019) also noted that using therapy balls did not effect on-task and out-of-seat behaviors or writing fluency.

The use of inflated cushions as a form of alternative seating has also been a topic of education research (Pfeiffer et al., 2008; Seifert & Metz, 2017). Inflated cushions are described as inflated discs typically made of non-latex rubber, ranging in size from 12 to 15 inches and in height from three to four inches in height designed to be placed on the floor or chair to allow the student to wiggle or rock back and forth (Seifert & Metz, 2017). Researchers reported a statistically significant difference in the attention to task before and after intervention for students utilizing inflated seating cushions (Pfeiffer et al., 2008). Seifert and Metz (2017) also reported preschool students who utilized the inflated cushions were more likely to participate and less likely to display off-task behaviors.

In addition to therapy balls and inflated cushions, a third alternative seating option, standing desks, has been researched (Aminian et al., 2015; Dornhecker et al., 2015; Koepp et al., 2012; Parry et al., 2019). However, while Dornhecker et al. reported improved student engagement among those who utilized standing desks to the midpoint of their study, standing desks had no effect afterward. Furthermore, Koepp et al. (2012) and Parry et al. (2019), when

examining the impact standing desks have on behavior, both found standing desks to produce no significant effect.

Theoretical Framework

A teacher's classroom management and choice of physical organization results from one's beliefs, teaching methods, and conceptualizations of teaching (Denton, 1992). Proshansky and Wolfe (1974) further explained that the physical space should reflect the dynamic nature of learning. Since educational beliefs and philosophies are diverse, differences in goals for each classroom emerge. Along with these differences, diverse seating arrangements also arise (Gremmen et al., 2016). For example, student-oriented teachers will arrange their classrooms differently than subject-matter-orientated teachers (de Vries et al., 2013).

Flexible seating arrangement derives from a student-oriented belief that reflects constructivist theories of knowledge and learning by recognizing the differences of students and emphasizing collaboration (de Vries et al., 2013). Constructivism asserts that knowledge is accumulated through the process of active construction and, therefore, students do not passively receive input from a teacher (Parkay et al., 2014). The central assumption of constructivism is that students are active learners and self-develop knowledge. Additionally, another critical assumption of constructivism is that teachers should not approach education in the traditional sense of delivering information to a group of students; instead, teachers should create situations for students to learn that allow for active involvement in learning, manipulation of materials, and social interactions (Schunk, 2016).

Constructivism does not ascribe to a single viewpoint; instead, there are many different perspectives (Schunk, 2016). The progressive education theory of John Dewey creates a foundation for the constructivist learning theory to be applied to flexible seating. Dewey

proposed active learning principles in which students constructed their own knowledge and believed that students need to interact with their environments to learn (Pardjono, 2016). Furthermore, Dewey thought the role of the teacher and the student change to give students an active role in their education. This change requires the teacher's role in the classroom also to change, becoming more of a facilitator and, in effect, creating a student-centered approach (Tanner, 1997).

Since constructivism rejects the traditional delivery of instruction, the learning environments that reflect constructivist principles look vastly different from traditional classrooms (Brooks & Brooks, 1999). A constructivist learning environment should encourage learning through rich experiences. A curriculum in a constructivist learning environment focuses on big concepts and allows students to explore primary sources and manipulate materials. Teachers should interact with students to guide them to learning, not tell them information. Additionally, assessments are administered in something other than traditional paper and pencil test form. Instead, authentic assessments are conducted through observations and student portfolios (Schunk, 2016). Therefore, traditional seating arrangements do not provide the correct environment for interacting with materials, peers, and teachers. Cleveland (2016) asserts that when the physical environment of a classroom is effectively designed, that learning environment can facilitate constructivist pedagogy.

When considering flexible seating, it is also essential to consider contextual factors. Constructivism is a theory that emphasizes contextual factors, as does Bronfenbrenner's ecological systems (Schunk, 2016). Bronfenbrenner's (1979) theory sought to explain how the interaction of different environments affects the development of the individual. Bronfenbrenner recognized an individual's surroundings can influence and change his or her development.

Therefore, the context and environment of a classroom would affect the development of a student differently, which could create differences in academic achievement (Bronfenbrenner, 1979).

While flexible seating is grounded in the constructivist learning theory, self-efficacy is rooted in the social cognitive theory. First introduced by Albert Bandura, self-efficacy refers to one's personal beliefs about one's capabilities to achieve at certain levels (Bandura, 1977). In his contribution to the social cognitive theory, Bandura holds that there is a direct correlation between self-efficacy and behavior (Bandura, 1997). A person's self-efficacy influences one's motivation and effort by influencing thoughts and emotions one has during interactions with his or her environment (Bandura, 1986). Since high self-efficacy allows for effective management of situations, high self-efficacy can lead to increased effort and persistence. Conversely, poor self-efficacy can lead one to focus more on their perceived inadequacies and become more likely to give up when faced with a challenge (Bandura, 1986).

Teacher self-efficacy is defined as a teacher's belief in his or her ability to affect the expected outcome of student performance (Isbell & Szabo, 2015). Although Bandura (2012) found teacher self-efficacy does not directly correlate to student performance, it is a component of student outcomes. In addition, research shows high teacher self-efficacy can influence teacher performance through improved instructional strategies, better classroom management, and increased student engagement (Allinder, 1995; Ashton & Webb, 1986; Chu, 2011; Stein & Wang, 1988; Tschannen-Moran & Hoy, 2001). Furthermore, Allinder (1995) found a significant relationship between teachers with high self-efficacy and their students' scores on math achievement. However, it is essential to note this study only seeks to determine if a relationship between high teacher self-efficacy on student achievement, not a direct effect.

Problem Statement

Research demonstrates seating location (Gremmen et al., 2016; Shernoff et al., 2017) and seating type (Olson & Panahon, 2019; Parry et al., 2019; Seifert & Metz, 2017) can affect students in the classroom. However, research on flexible seating is relatively new and limited (Kariippanon et al., 2018). As states begin to encourage educators and administrators to redesign learning spaces to create flexible seating options (California Department of Education: School Facilities and Transportation Services Division, 2016), further research is needed on the effects of flexible seating.

Research lends to further exploration into alternative seating and its influence on academic scores (Olson & Panahon, 2019, 2019; Pfeiffer et al., 2008). Olson and Panahon (2019), in their study on the effects of therapy balls on class-wide behavior and writing productivity, found therapy balls not to have statistically significant effects on behavioral or writing productivity. However, with sample size and design limitations, further research is needed to examine subjects other than writing to determine the appropriateness of therapy balls to support academic performance. Pfeiffer et al. (2008) echoed this call in their research on the effects of inflated cushions stating that research is needed to determine the impact on school performance as measured by academic test scores in subject areas. Pfeiffer et al. (2008) explained that by exploring specific achievement in subject areas, researchers would be able to measure the ability to learn while attending. Therefore, it is clear that further research is needed on the effects of alternative seating with a focus on achievement.

Not only does research on individual types of alternative seating options present the need for further research, but research on the effects of alternative seating on math instruction is also limited. Only one study on an alternative seating option, therapy balls, considers the impact of

alternative seating on specifically math achievement (Mead et al., 2016). Furthermore, research has yet to examine the relationship between flexible seating and teacher self-efficacy. Although research on individual types of alternative seating options is available, quantitative research on flexible seating, which utilizes a variety of alternative seating options, is limited. In their research on student preference for seating type, Harvey and Kenyon (2013) found university students preferred nontraditional seating types to traditional ones, suggesting further research on other classroom seating options, designs, and layouts. Finally, the only peer-reviewed research available on flexible seating, a study conducted by Kariippanon et al. (2018), is qualitative instead of empirically evidenced. Therefore, while research clearly indicates the potential for seating location and seating type to impact student achievement, it remains unclear if the recent movement to flexible seating spaces will have the same potential to impact math teacher self-efficacy (Harvey & Kenyon, 3013; Kariippanon et al., 2018).

Purpose Statement

The purpose of this casual-comparative analysis is to determine if a relationship exists between the use of flexible seating during math instruction (independent variable) and teacher self-efficacy (dependent variable) for teachers in northeast Ohio. The dependent variable, teacher self-efficacy, was defined by The Teacher Sense of Efficacy Scale, Short (TSES, short), also known as the Ohio State Teacher Efficacy Scale (OSTES) (Tschannen-Moran & Hoy, 2001). Teacher self-efficacy is defined as a teacher's belief in his or her ability to affect the expected outcome of student performance (Isbell & Szabo, 2015). For this study, the independent variable, seating type, is defined as classroom arrangements containing an assortment of furniture options, such as bean bags, standing desks, and therapy balls, arranged in various ways to facilitate learning (Kariippanon et al., 2018).

This study seeks to add to the available literature on flexible seating. The current study builds upon research about the impact seating has on student achievement (Gremmen et al., 2016; Griffith, 1921; Kalinowski & Taper, 2007; Mead et al., 2016; Ngware et al., 2013; Olson & Panahon, 2019; Parker et al., 2011; Shernoff et al., 2017). This study aims to fill the gap of available research on flexible seating effects on instruction in the math classroom (Mead et al., 2016), specifically math teacher self-efficacy. This study utilizes a quantitative research design, specifically employing a correlational analysis design, and focuses on 126 math teachers from school districts in northeastern Ohio, using a convenience sample.

Significance of the Study

The present study is significant as it addresses gaps in literature by determining whether flexible seating arrangements have a relationship to the self-efficacy of math teachers in the primary classroom. Researchers have researched the effects of various seating arrangements on student achievement; however, they have yet to explore the relationship between flexible seating and teacher self-efficacy (Wannarka & Ruhl, 2008). Furthermore, research has been conducted on the use of individual flexible seating options such as therapy balls or inflated cushions (Aminian et al., 2015; Bagatell et al., 2010; Dornhecker et al., 2015; Fedewa et al., 2015; Gaston et al., 2016; Koepp et al., 2012; Mead et al., 2016; Olson & Panahon, 2019; Parry et al., 2019; Pfeiffer et al., 2008; Seifert & Metz, 2017). However, research on offering a variety of flexible seating options as a classroom arrangement is limited (Kariippanon et al., 2018).

The present study also poses a significant contribution to the constructivist learning theory as it has direct implications for the physical environment of the classroom. When effectively designed, the physical environment of a classroom, such as seating, can facilitate constructivist pedagogy (Cleveland, 2016). Dialectical constructivism states that knowledge

results from one's interaction with the environment (Schunk, 2016), and therefore, the physical environment, or seating, in a classroom could impact a student's learning.

Finally, this study adds to the mathematics education field, specifically elementary education. The results of this study could be generalizable for all primary classrooms as it provides quantifiable data either in support of or against using flexible seating within the elementary classroom during math instruction. Additionally, with an increased emphasis on 21st century skills that require teachers to teach and address skills such as creativity, collaboration, innovation, teamwork, decision-making, communication, critical thinking, problem-solving, and research fluency (Larson & Miller, 2011), teachers and administrators are faced with decisions of how best to allocate resources to address these needs. This study will aid teachers and administrators in decisions involving the allocation of resources to implement flexible seating arrangements in the primary classroom seating to further meet the needs of the 21st-century classroom.

Research Question

This study is based on the following research question:

RQ1: Is there a difference in teacher self-efficacy scores among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating, and those who do not?

Definitions

1. *Constructivism*- a philosophical perspective arguing individuals construct what they learn and understand, and therefore they construct their own knowledge (O'Donnell, 2012).

2. *Ecological Systems Theory*- In this theory, Bronfenbrenner (1979) sought to explain how the interaction of different environments affects the development of the individual, recognizing the individual's surroundings can influence and change his or her development.

3. *Flexible Seating* - arrangements that comprise of a variety of furniture with the ability to be arranged in different ways to facilitate desired learning experiences as well as create opportunities for both group and independent work (Kariippanon et al., 2018).

4. *Inflated Cushion*- inflated discs typically made on non-latex rubber, ranging in size from 12 to 15 inched and in height from three to four inches, placed on the floor or chair to allow the student to wiggle or rock back and forth (Seifert & Metz, 2017).

5. *Standing Tables*- height-appropriate workstations that allow students to stand while completing school-related tasks (Aminian et al., 2015)

6. *Teacher Self-Efficacy*- a teacher's belief in his or her ability to affect the expected outcome of student performance (Isbell & Szabo, 2015).

7. *Theory of Cognitive Development*- In this theory, Piaget proposed children progress through stages of cognitive development in the same sequence of four general steps or periods: sensorimotor (birth to two years), preoperational thought (two to seven years), concrete operations (seven to eleven years), and formal operations (11 to adulthood) (Crain, 2016).

8. *Therapy Balls* – large, inflated balls made of plastic or rubber that, while initially intended for strength training (Trunstall, 2009), can be used as an alternative seating option in the classroom (Olson & Panahon, 2019).

CHAPTER TWO: LITERATURE REVIEW

Overview

The following literature review will establish the theoretical and empirical frameworks for this study examining the relationship between flexible seating and teacher self-efficacy. To accomplish this goal, a comprehensive examination of constructivist learning theory will be established with particular attention to its connection to flexible seating. An exploration of the constructivist thinkers John Dewey and Jean Piaget will also create a foundation for the appropriateness of flexible seating in the classroom. Furthermore, Urie Bronfenbrenner's theory of ecological systems is briefly discussed to explore the importance of context on a student's academic achievement. Moreover, an exploration of Bandura's social cognitive theory will create a foundation for teacher self-efficacy. In addition, this literature review provides a thorough examination of the research available on the topic of flexible seating in the classroom. The topics of the history of student seating, location of seating, flexible seating options, and learning environment are examined as they relate to the overall body of literature available on student seating. This review of all available literature will effectively identify a gap in the literature dealing with flexible seating with respect to its impact on math teacher self-efficacy in the primary grades.

Theoretical Framework

Flexible seating arrangements are rooted in student-oriented beliefs that reflect constructivist theories of knowledge and learning by recognizing differences between students and emphasizing collaboration (de Vries et al., 2013). Constructivism is a philosophical perspective arguing individuals construct what they learn and understand, and therefore they construct their own knowledge (O'Donnell, 2012). Constructivists question the following

assumptions of classic information processing theories: thinking occurs in the mind and not in interactions with persons or situations, the process of learning and thinking are uniform across all persons, and thinking derives from formal instruction as opposed to experiences and innate abilities. Instead, constructivists believe that thinking is formed from situations and that cognitions are constructed individually. Furthermore, social constructivist theories emphasize social interactions when acquiring skills and knowledge (Schunk, 2016).

An essential assumption of constructivism is that students are active learners who accumulate knowledge for themselves through active construction, rejecting the passive assimilation of knowledge (Parkay, Hass, & Anctil, 2014). Another critical assumption of particular interest to this study is the rejection of the traditional approach to delivering information to a group of students. Instead, constructivism asserts that teachers should create situations for students to learn, allowing students to become actively involved in learning by manipulating materials and having social interactions. While constructivists agree on these main assumptions, they differ in the extent to how much they attribute the construction of knowledge to social interactions with peers, parents, teachers, and others (Schunk, 2016).

A learning environment that reflects constructivist assumptions should look different from the traditional classroom since constructivism rejects the traditional delivery of instruction (Brooks & Brooks, 1999). Traditional delivery of instruction promotes conformity and compliance, whereas education should encourage students to explore and understand the world and their talents (Robinson, 2018). In the constructivist classroom, teachers learn to guide students to arrive at information instead of dictating the information to them by creating environments that allow students to develop their own meaning (Glickman et al., 2017). The constructivist curriculum should encourage rich experiences, focus on major concepts, and allow

materials to be explored and manipulated. Assessments should not be administered as paper-and-pencil tests; instead, authentic assessments should be conducted through observations and student portfolios (Schunk, 2016).

Therefore, for the learning environment to appropriately reflect the constructivist pedagogy, traditional seating arrangements are not appropriate as they do not provide the correct environment for interaction with materials, peers, and teachers. The physical environment of a classroom must be effectively designed to facilitate constructivist pedagogy's needs (Cleveland, 2016).

John Dewey

Since different constructivists vary in their beliefs, this study focuses on the beliefs and theories of John Dewey. Dewey is often cited as the philosophical founder of constructivism. Dewey criticized traditional education, which relied on passive learning, whereby children receive knowledge from the teacher. Instead, Dewey proposed active learning principles in which students construct their own knowledge. He believed students need to interact with their environments to learn, the attainment of knowledge and skills through personal experiences, not a text or teacher (Pardjono, 2016). In Dewey's progressive education, the role of the teacher and the student changed. Since students have a more active role in their education, the teacher's role in the classroom becomes more of a facilitator creating a student-centered approach (Tanner, 1997). Since all students learn in differing ways, it is essential to teach in differing forms for these students, tailoring their education to meet their needs and interests, therefore, creating intrinsic motivation (Christensen et al., 2011).

Dewey and other progressive educators believed learning-by-doing as a central principle to schooling, arguing that elementary schools should be composed of various learning activities

in which students participate in the learning process. Furthermore, Dewey believed learning should focus on student choice. He maintained that the elementary curriculum should build on student interests and represent real life for students to enhance curiosity about disciplines and their environments. He believed the aim of education should be to develop self-control governing students' ability to make educational choices for themselves. By guiding experiences for students, the primary source of control is transferred from the teacher to the student (Wiles & Bondi, 2016). Therefore, meaningful instruction begins with teaching students to identify and become responsible for their own learning styles. Furthermore, effective instruction requires teachers to consider the whole student while teaching content in a cross-curricular manner (Daniels & Perry, 2010).

Dewey's beliefs created an argument for the use of flexible seating since research demonstrates that the quality of education is, in part, dependent on the alignment of pedagogies with the physical space (van Merrienboer, McKenney, Cullinan, & Heuer, 2017). Therefore, an educator needs to ensure the physical space of a room embodies the pedagogy. As teaching changes from traditional lecture-style learning to student-centered learning, educational spaces should also change. Robinson and Aronica (2015), in their book *Creative Schools: The Grassroots Revolution that's Transforming Education,* stated a highly personalized and organic approach should be used in the modern classroom. This approach should draw on modern technologies and professional resources that aim to engage all students and develop their love for learning while giving students the skills needed to face the challenges of the 21st century. This transition in teaching requires not just rethinking approaches in teaching delivery but also reshaping the physical space is essential for success, and seating, demonstrated by flexible

seating designs, should be arranged to allow collaboration and interaction to facilitate this pedagogy (Asino & Pulay, 2019).

Jean Piaget

Jean Piaget was considered to be the original constructivist and is known for his theory of cognitive development (Slavin, 2000), which reflected the fundamental ideas of constructivism (Schunk, 2016). In his theory, Piaget proposed children progress through stages of cognitive development in the same sequence of four general stages or periods: sensorimotor (birth to two years), preoperational thought (two to seven years), concrete operations (seven to eleven years), and formal operations (11 to adulthood). While Piaget contended all children progress through the stages in the same order, he recognized that not all children do so at the same rate. Therefore, while he assigned ages to each stage, he did not emphasize the ages defining each stage (Crain, 2016). For the purposes of this study, the focus of the research will be students transitioning from preoperational thought to concrete operations since the majority of elementary students are in this stage. These two stages allow for insight into the pattern of operation in which the participants of this study are able to perform when making decisions (Schunk, 2016), such as seating choices.

In the preoperational stage, students learn to think but are doing so in an unsystematic and illogical manner. Whereas in the concrete operational stage, students develop the capacity to think systematically by referring to concrete objects. Just as the stages of development refer to scientific thinking, Piaget believed there was a correspondence between scientific thinking and social thinking. Piaget believed preoperational children to be frequently egocentric and fail to consider more than one perspective (Crain, 2016), while concrete operational students display less egocentric behavior and become increasingly social (Schunk, 2016). Another area of

difference between preoperational and concrete operational students is morality. Piaget proposed there are two basic moral attitudes: moral heteronomy and autonomy. Moral heteronomy is blind obedience to rules instituted by an adult. Older children develop autonomy, where one begins to consider rules as a device to produce cooperation. Piaget believed moral heteronomy is related to egocentrism, considering children perceive from a single perspective. However, unlike egocentrism, which children overcome around the age of seven, moral heteronomy persists until approximately the age of ten (Cain, 2016).

When implementing flexible seating in a classroom, Piaget's cognitive development theory is important to consider as students are choosing where they can best learn and what seating option will benefit them. The egocentrism and moral development of preoperational and concrete operational students are of particular concern. Since children transition from an egocentric perspective to consider more than one significant development for elementary students (Schunk, 2016). Piaget understood egocentric children play alongside each other but interact more exclusively with adults. However, to overcome egocentrism, children learn to coordinate their actions as they play and interact more with one another and less with adults (Crain, 2016). This development is important when considering flexible seating in primary grades. Flexible seating encourages collaboration and cooperative learning; however, these are underdeveloped skills in students of this age.

Furthermore, students are theoretically transitioning into the concrete operational stage, where peer interaction has an important new role (Crain, 2016). As students overcome egocentrism and consider their peers' perspectives, their interactions become less adult-exclusive and more peer-focused. This can be problematic for teachers who do not possess strong

classroom management skills designed to guide students to engage in these interactions appropriately and when to focus on their learning.

Along with the development of egocentrism, students in the second grade are experiencing moral development. Particularly, students transitioning from preoperational to concrete operational stages are evolving from heteronomy, or blind obedience, to autonomy, or considering rules as a device for cooperation. When this occurs later in the preoperational stage, students need to engage in genuine cooperative play with peers in which they have the power to change rules to everyone's satisfaction to further develop autonomy (Crain, 2016). Flexible seating encourages collaborative learning, which catalyzes autonomy development. However, it is important for the teacher to understand this is a skill yet underdeveloped and, therefore, he or she be intentional in its development.

Ecological Systems Theory

When considering flexible classroom seating, it is important to understand the issue's contextual factors. While most learning theories address contextual factors, some theories emphasize the role of context. Constructivism is one of those theories, as is Bronfenbrenner's ecological systems theory (Schunk, 2016). Bronfenbrenner (1979) developed the ecological systems theory influenced by Piaget, a constructivist, believing students are active learners and thrive when encouraged to explore their environment instead of formal learning tasks such as lectures (Cook & Cook, 2001). Bronfenbrenner's (1979) theory not only included the role of the child and sought to explain how the interaction of different environments affects the development of the individual. In his theory, Bronfenbrenner recognized the individual's surroundings can affect and change his or her development.

Bronfenbrenner (1979) explained the ecological system consists of four interrelated mechanisms: process, person, context, and time. These elements, known as the process-person-context-time model, are the basis of the revised ecological systems theory (Rosa & Tudge, 2013). Of particular interest to this study is the mechanism of context. Context, for the purpose of this study, can be defined as the learning environment in which an individual is located (Cole, 2010). Contextual variables have the power to influence a student's learning. Within-school variables include teacher-student interaction, teacher expectations, school transitions, appropriate instruction, school climate, and classroom organization and structure (Schunk, 2106). Bronfenbrenner believed that individuals are heavily influenced by the context, or both immediate and remote environments, in which they operate (Cohen & Waite-Stupiansky, 2017).

Within the mechanism of context, Bronfenbrenner (1979) identified four environmental levels, the micro, meso, exo, and macrosystems, whose settings range from very specific to the least intimate connection. The first level, or microsystem, is composed of the individual and his or her immediate environment, such as their home, classroom, or church. The second level, or mesosystem, comprises the individual's interactions in two or more settings. The third level, or exosystem, encompasses one or more settings that do not directly influence a person. However, events that occur within this system may affect the individual indirectly. Finally, the fourth level, or macrosystem, includes the individual's underlying culture. Bronfenbrenner (1979) emphasized the importance of the interaction between an individual and his or her environment, stating the person can experience an effect on his or her environment, just as the environment affects the person, making the relationship reciprocal.

This study involves different microsystems classrooms, determined by the number of flexible seating options available. Since these three settings are different contexts, the relations

between the individuals and the environment will differ (Bronfenbrenner, 1979). Furthermore, according to the ecological systems theory, the differences in environments would affect the development of the different students differently, which could create differences in the academic achievement of the students (Bronfenbrenner, 1979).

In the contemporary classroom, teachers must address 21st century skills such as creativity, collaboration, innovation, teamwork decision-making, communication, critical thinking, problem-solving, and research fluency (Larson & Miller, 2011). To address these skills, teachers must create an atmosphere and learning environment based on the principles presented in the constructivist learning theory to allow for acquiring these skills (Lemley et al., 2014). By applying the theories of John Dewey and Jean Piaget to the environmental needs of a classroom, one can conclude that a shift from traditional classroom furniture to a more flexible environment is needed. Furthermore, an exploration of Urie Bronfenbrenner's theory of ecological systems highlights the importance of context on a student's achievement, further emphasizing the need to account for the environment whereby classroom furniture creates.

Teacher Self-Efficacy

The theory of self-efficacy is rooted in the locus of control theory (Rotter, 1966) and the social cognitive theory (Bandura, 1977). Both deriving theories emphasize human agency, or an individual's control over actions that affect their lives (Bandura, 1986). Rotter's attribution theory of locus of control asserts an individual perception of his or her abilities is contingent on either external control, luck or fate, or internal control, a result of his or her own action. These perceptions are largely based on transactions between a person and an environment that reinforce a behavior. For example, winning a prize for a successful performance can act as a powerful incentive for future behavior (Rotter, 1966).

Bandura (1977), in his social cognitive theory, further argued an individual's behavior is not only influenced by perceptions of control but also by perceptions of his or her own abilities. Bandura moved beyond perceived environmental contingencies to argue an individual may know an action to have a desired effect. Still, if that individual lacks the belief that he or she can produce such action, the information is useless. For example, if a teacher believes differentiation to increase student achievement (outcome expectation), this can motivate that teacher to implement differentiation. However, suppose the teacher does not believe he or she has the skills needed to implement differentiation in the classroom (self-efficacy) successfully. In that case, this strategy is unlikely to be initiated (Zee & Koomen, 2016).

Self-efficacy is the personal beliefs one holds about his or her capabilities to learn or perform at certain levels (Bandura, 1977). Therefore, teacher self-efficacy is the belief~~s~~ a teacher holds about his or her capabilities to impact student learning outcomes (Tschannen-Moran & Hoy, 1998). Furthermore, Bandura (1986) clarified that self-efficacy is only concerned with the judgments of an individual on his or her capabilities as opposed to the actual skills an individual possesses. Consequently, teacher self-efficacy views can have the power to produce empowering or discouraging feelings. Khan (2012) asserts that teacher self-efficacy plays a crucial part in determining the success of teachers.

Bandura (1986) explains teacher self-efficacy comprises both efficacy and outcome expectations. Efficacy expectation is the belief that one has the capability to perform at a certain level. Therefore, a teacher must perceive him or herself as capable of providing adequate instruction for student success. Secondly, outcome expectation is a person's belief that a behavior will result in a certain outcome (Bandura, 1977). Consequently, for a teacher, this is the belief that his or her instruction will produce student success (Bandura et al., 1996). This belief

and expectation act as a guide for a teacher's thoughts and feelings, determine appropriate learning activities, govern the amount of energy spent on instructing, and regulate the extent of perseverance applied to challenging situations (Chang, 2015). Research shows high teacher self-efficacy can influence teacher performance in improved instructional strategies, better classroom management, and increased student engagement (Allinder, 1995; Ashton & Webb, 1986; Chu, 2011; Stein & Wang, 1988; Tschannen-Moran & Hoy, 2001).

Influencing factors of Self-Efficacy

Several factors can influence a teacher's self-efficacy positively or negatively. Three influencing factors that have been highly researched are the experience a teacher has at the onset of their career, the leadership a teacher is under, and the level of freedom a teacher has in the decision-making process. Hoy's (2003) research suggests the most powerful influences on the development of one's self-efficacy as a teacher are the direct result of mastery experiences in his or her first-year teaching. While most first-year teachers experience a decline in teacher self-efficacy as the year progresses, research supports those teachers with principals who provide adequate support and mentorship do not experience this decline (Chester & Beaudin, 1996).

Secondly, research supports the leadership a teacher is under has a strong influence on his or her teacher self-efficacy (Hipp, 1996; Hipp & Bredeson, 1995; Lee et al., 1991). Hipp (1996) reported principals who model risk-taking and cooperation in their building have teachers with higher self-efficacy. Additionally, principals who modeled professional behavior while providing performance-based rewards had teachers with higher self-efficacy. Finally, principals who inspire a common, shared vision to create a student-centered environment have staff higher teacher self-efficacy (Hipp & Bredeson, 1995).

A teacher's level of freedom in the decision-making process at his or her school also impacts teacher self-efficacy (Goddard, 2001; Moore & Esselman, 1992). Research supports principals who share the decision-making process with teachers have teachers with higher self-efficacy, showing that the more freedom teachers were given in the process, the greater their self-efficacy (Moore & Esselman, 1992). This research is echoed by Goddard (2001), who found schools that had shared decision-making processes on school-wide issues had greater beliefs about the capability of its teachers and faculty to help students succeed.

Teacher self-efficacy and achievement

A large body of research has found teacher self-efficacy to impact student achievement (Chang, 2015; Hines, 2008; Ji-Won et al., 2016; Khan, 2012). Chang (2015) reported a relationship between the students' achievement and teacher self-efficacy in math, explaining that this relationship was mediated by the students' belief in their abilities. Therefore, teacher self-efficacy strengthens student self-efficacy, which in turn increases achievement. Furthermore, research supports teacher self-efficacy, increasing student self-efficacy and achievement. Hines (2008) found students with teachers who have higher levels of self-efficacy scored higher on benchmark exams than those whose teachers taught with lower levels of teacher self-efficacy. Researchers also found a positive correlation between high teacher self-efficacy and student achievement in math among eighth-grade students in Korea and the United States (Ji-Won et al., 2016). Finally, Khan (2012) supported these findings concluding both male and female teachers' self-efficacy was significantly related to achievement in both math and reading.

Research clearly defines a link between high teacher self-efficacy and student achievement (Bandura, 1997). However, recent literature indicates that early childhood teachers have low teacher self-efficacy in teaching math (Bates et al., 2013; Chen & McCray, 2013).

Research suggests a teacher's self-efficacy impacts one's methodology and approach to student learning. For example, teachers with high self-efficacy approach teaching optimistically, providing opportunities for in-depth learning and focusing on students' academic needs (Bandura, 1997). Conversely, teachers with low self-efficacy approach teaching negatively and don't always have the confidence to provide opportunities for in-depth learning (Bandura, 1997). Therefore, one could conclude that early childhood teachers may not be approaching math education with the self-efficacy needed for achievement. Therefore, considering ways to increase self-efficacy and achievement is necessary for elementary math teachers.

Related Literature

The physical classroom setting is important to the learners' behavior. Cornell (2002) explained that furniture in the learning environment is not only used as a tool but also creates an environment. Classroom furniture, like any other furniture, is designed and built with a purpose. Thus, it is important to consider the history of classroom seating and furniture to better understand the purpose and function of the learning environment. Historically, classroom furniture was built to enable a teacher to dictate a lesson to a large group. This furniture suited the industrial economy, as its purpose matched the times' social, economic, and technological needs. However, the constructivist learning theory demands a shift from industrial economy to knowledge economy. As a result, different kinds of seating and furniture are being used in the classroom to accommodate modern technology and information.

History of Seating

Researchers have been interested in the influences of antecedent intervention for almost four decades (Weinstein, 1979). This type of intervention focuses on creating or structuring a classroom environment that prevents behavioral problems and enhances students' motivation

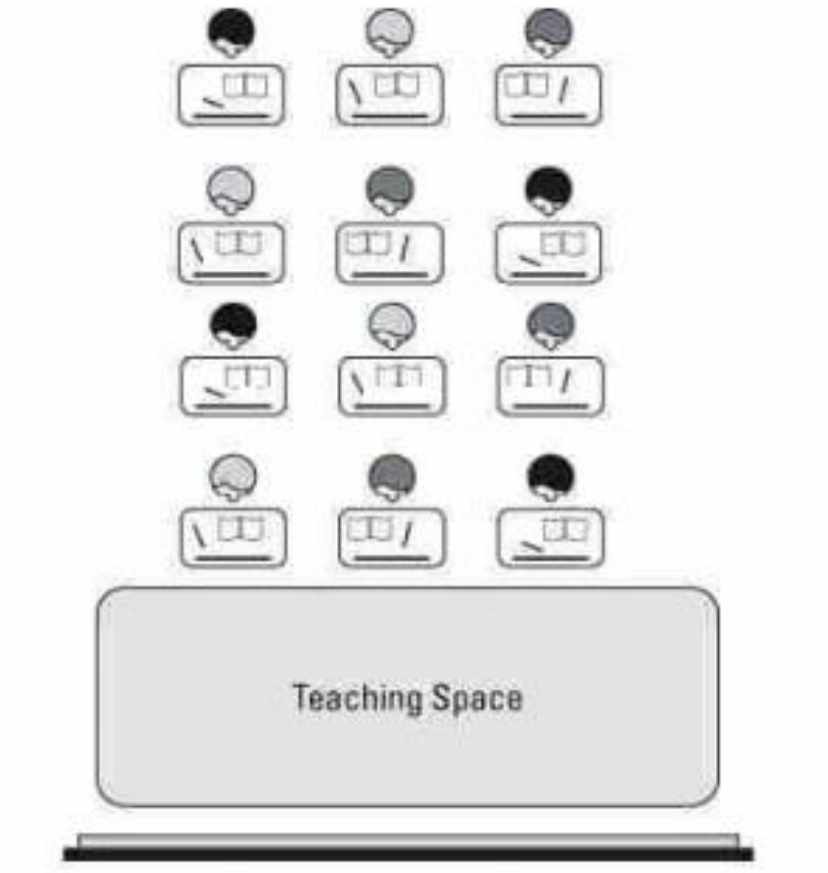
(Kern & Clemens, 2007). It is believed teachers can prevent undesirable behaviors before they happen discretely and, therefore, avoid more intrusive intervention by focusing stimulus conditions (Wannarka & Ruhl, 2008).

Historically, educational research has explored different types of seating arrangements that can be utilized in the classroom, each representing a different teacher goal (Gremmen et al., 2016). For example, if the goal of a teacher is to improve information dissemination, then the teacher is likely to arrange seats into rows. However, if a teacher wishes to promote student collaboration and communication, then seats will likely be arranged in groups (McCorskey & McVetta, 1978). Historically, three main configurations of seating have been utilized: rows, modular or group arrangement, and horseshoe arrangement (McCorskey & McVetta, 1978; Wannarka & Ruhl, 2008).

Rows are the most traditional form of seating arrangement (see figure 1) and evolved out of the need to make the best use of lighting in historical classrooms and allow for the teacher to be the primary focus (McCorskey & McVetta, 1978). “Typically, the traditional row arrangement for classrooms consists of about five or six perfectly straight rows, each containing five to seven chairs equidistant from each other” (Roy, 2014, p. 4). The use of rows is best suited for teacher-centered education philosophies where the purpose of education is to disseminate information from teacher to students. By arranging seats into rows, student-to-student interaction is minimized, and the focus remains on the teacher (McCorskey & McVetta, 1978).

Figure 1

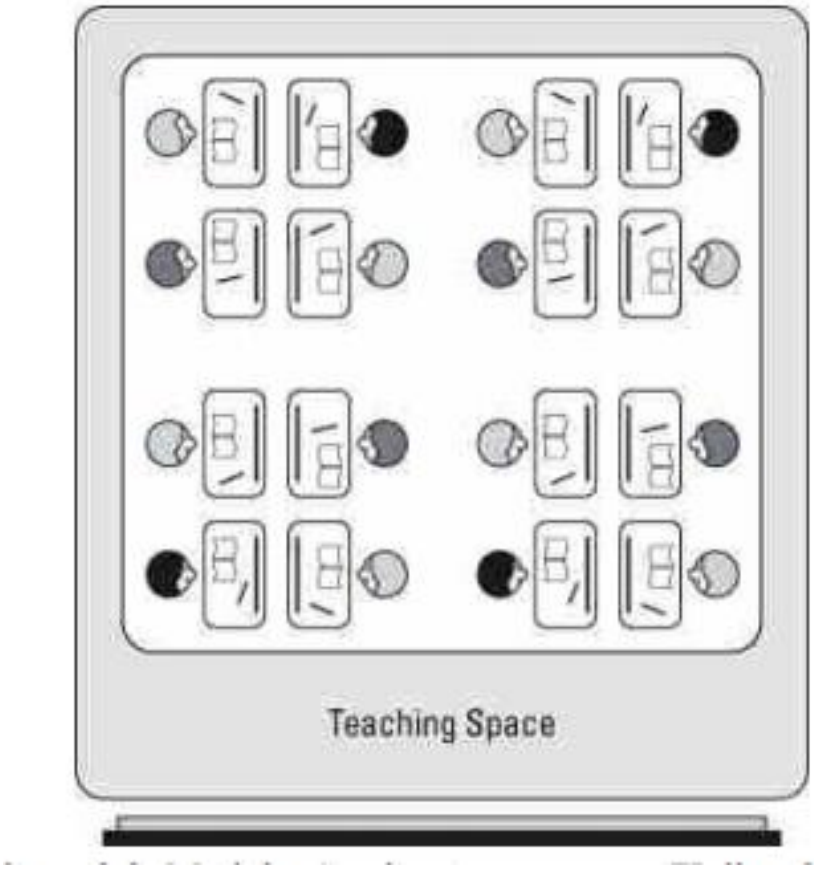
Row seating arrangement (Kelley, 2003)



Another traditionally utilized classroom seating arrangement is the modular or group seating arrangement (see figure 2). This arrangement utilizes combinations of desks to form clusters, groups, or tables. Traditionally found in specialized classrooms or lower elementary schools, this arrangement removes the teacher as the focal point (McCorskey & McVetta, 1978). Arranging seats into modular seating facilitates group interaction and is, theoretically, the best arrangement for student-to-student interaction (Harmer, 2007; Partin, 2009).

Figure 2

Modular seating arrangement (Kelley, 2003)



Finally, the traditional horseshoe seating arrangement (see figure 3) places seats in a semi-circular pattern creating with the teaching space in the middle (Roy, 2014). This arrangement is frequently employed in smaller classes as it requires a large space to create. Larger classes may not be as conducive to this arrangement "because of the 'dead space' in the middle" (Roy, 2014, p.5). Since the horseshoe arrangement requires such a large space, a double horseshoe is a variation frequently used where two horseshoe patterns are utilized, one inside the other (McCorskey & McVetta, 1978).

Figure 3

Horseshoe seating arrangement (Kelley, 2003)

While historically, the row, modular, and horseshoe classroom seating arrangements have been most prominent, recently, a movement to a more flexible seating arrangement has emerged (Gremmen et al., 2016). Flexible seating arrangements encompass various furniture options, configured in various ways. Seating arrangements are changed to best suit a range of learning experiences and facilitate individual and collaborative work opportunities when appropriate (Kariippanon et al., 2018). Classrooms and students are constantly evolving, as are their needs; therefore, there cannot be one ideal arrangement for every classroom (Roy, 2014). Jones (1987) confirmed this concept stating that the best classroom seating arrangement is one that produces the fewest learning barriers between teachers and students.

A teacher's choice of physical organization and, ultimately, classroom management results from one's beliefs, teaching methods, and conceptualizations of teaching (Denton, 1992). When arranging a classroom, decisions should be made based on the teacher's beliefs about his or her role and pedagogy (Rosenfield et al. , 1985). Since the field of education contains diverse educational beliefs and philosophies, differences emerge in goals for each classroom. Along with these differences, diverse seating arrangements also arise (Gremmen et al., 2016). Student-

oriented teachers will arrange their classrooms differently than subject-matter orientated teachers (de Vries et al., 2013). Constructivist learning theory demands a shift to a more student-oriented approach. As a result, different kinds of seating arrangements and furniture are being used in the classroom to accommodate modern technology and information (Cornell, 2002).

Location of Seating

The classroom environment and seating location contribute to the overall classroom atmosphere. Fernandes et al. (2011) found a strong relationship between student choice in seating and his or her class participation and interaction with the curriculum. Studies on the location of seating have, historically, examined student choice in seating location and its effect on two major categories, participation (Cinar, 2010; Gremmen et al., 2016; Marx et al., 2000; Perkins & Wieman, 2005; Shernoff et al., 2017) and achievement (Griffith, 1921; Kalinowski & Taper, 2007; Ngware et al., 2013; Parker et al., 2011; Shernoff et al., 2017). Also of interest is research on teacher positioning and gaze in relation to student seating (Barnard, 1854; Martinez-Maldonado et al., 2020; Otteson & Otteson, 1980; Rubin et al., 1974)

Participation

With regard to participation, Perkins and Wieman (2005) found that college students who sat in the front center of the classroom participated more than other students. Students attributed closer proximity to the professor promoting greater interaction in the class. Furthermore, Cinar (2010), Parker et al. (2011), and Shernoff et al. (2017) all found student participation depended on seating location. Cinar (2010) and Shernoff et al. (2017) reported students who sat in the front of the classroom demonstrated the highest levels of participation. Conversely, students who sat in the back of the classroom showed the lowest levels of participation. Parker et al. (2011) reported that students trended towards more participation when a fixed seating assignment was

not employed, making more observed comments though the difference did not reach significance ($p = 0.054$). Not only does proximity affect participation, but desk arrangement also impacts participation. Marx et al. (2000) reported that fourth-grade students participated and asked significantly more questions when seats were arranged in a semi-circle as opposed to rows and columns, finding that seating arrangement affected question-asking that was both statistically significant, $F(1, 25) = 5.28$, $p < 0.05$, and substantial, $R^2 = 17.4\%$. Furthermore, Gremmen et al. (2016) stated those with whom students chose to sit impacted their engagement levels. They reported a negative, significant effect of near-seated non-friends (Est. = −0.17), indicating students' engagement worsened when their near-seated non-friends improved or their engagement improved when their near-seated non-friends declined.

Achievement

According to Bronfenbrenner's (1979) ecological systems theory, differences in environments, such as seating arrangements, affect the development of different students differently, which could create differences in the student's academic achievement. This is supported by research exploring seating location and achievement (Griffith, 1921; Ngware et al., 2013; Shernoff et al., 2017). Griffith (1921), in his seminal work, conducted research to determine if classroom seating location influenced the academic achievement of college students. He found that front, centrally-seated students' achievement exceeded those seating in outlying areas of a large classroom. However, no significance tests were performed in his study, and a small subset of the data was presented, calling to question these results. Montello (1988) explained that Griffith's conclusions are, however, accepted on the grounds that the large database has presumably been misplaced. Further research supported these findings in that

students seated in the front center received higher grades and displayed larger achievement gains than their peers seated in the rear of the classroom (Ngware et al., 2013; Shernoff et al., 2017).

However, not all research supports the proximity effect. In his seminal work, Griffith (1921) also reported the idea of the proximity effect diminished in smaller classrooms and labs. Parker et al. (2011), while focused on student participation and seating arrangement, noted that there existed no significant difference in the final grades of high school students seated in the front versus those seated in the rear for both a group assigned permanent seats (p=0.81) as well as a group assigned rotating seats (p=0.99). Furthermore, Griffith (1921) reported that further research conducted in smaller classrooms did not significantly support the proximity effect in large classrooms (Kalinowski & Taper, 2007). As with participation, research also supports the notion that with whom a student chooses to sit can also impact his or her achievement. Gremmen et al. (2016) reported a negative, significant effect (Est. = −0.59). Results indicated that students received lower achievement scores when their near-seated non-friends received higher achievement, and conversely, they received higher scores when their near-seated non-friends worsened.

Teacher Positioning and Gaze

Research investigating the relationship between learning spaces and pedagogy dates back to the 19th century (Martinez-Maldonado et al., 2020). In his seminal work, Barnard (1854) described a series of classroom arrangements based on classroom observations to evaluate teacher surveillance and student attention. These observations led Bernard to prescribe the “traditional” lecture-based seating arrangement best suited for surveillance and student attention. Barnard began a body of research focused on learning spaces architecture. Rubin et al. (1974) examined the teacher's location in relation to the classroom furniture and how it can affect the

communication processes between the teacher and students. Through classroom observations and students' questionnaires, Rubin et al. (1974) found teacher position affected subjects' performance, attitudes, and behavior. Research also suggested that where a teacher gazes regarding seating location can affect learning. Otteson and Otteson (1980) compared the story recall of 24 male and 22 female primary-school students. Students were read stories both in the presence of a teacher's gaze and in the absence of a teacher's gaze. The research concluded a significant positive relationship between gaze and recall, especially among male students.

Flexible Seating Options

Although educational research has thoroughly examined the impact of student seating regarding method and configuration, the research addressing flexible classroom seating is relatively modern, with most studies conducted in the past 20 years. Flexible seating aims to provide students with several seating options; however, the majority of research only examines one type of alternative seating option. In his study, Cornell (2002) discussed the need to shift thinking regarding classroom furniture and seating as student learning needs have moved from an "industrial economy" to a "knowledge economy" (p. 33). Cornell (2002) further explained that the overall purpose of the learning environment has not changed. However, everything else has. While the learning environment is still meant to prepare students to be productive citizens, society no longer just requires literate citizens; instead, society needs citizens who can adapt and continuously learn. To accommodate these changes in societal needs, the physical environment needs to be more flexible to promote more interactive and collaborative learning, reflecting more constructivist ideals. Thus, the research on flexible seating has focused on pieces of furniture designed to accomplish these.

To date, most of these studies have focused on one type of seating option. Therefore, research involving flexible seating can be categorized by the individual type of seating option, such as therapy balls (Bagatell et al., 2010; Erwin et al., 2016; Fedewa et al., 2015; Gaston et al., 2016; Macphee, et al., 2019; Mead et al., 2016; Olson & Panahon, 2019;), inflated cushions (Pfeiffer et al., 2008; Seifert & Metz, 2017), and standing desks (Dornhecker et al., 2015; Koepp et al., 2012; Parry et al., 2019).

Therapy Balls

The most significant area of research into flexible seating options has focused on using therapy balls in the classroom (Bagatell et al., 2010; Fedewa et al., 2015; Gaston et al., 2016; Mead et al., 2016; Olson & Panahon, 2019). Therapy balls can be defined as large inflated balls made of elastic plastic or rubber (Olson & Panahon, 2019). In their study involving second-grade students, Gaston et al. (2016) reported that students who sat on therapy balls had improved attention spans after eight weeks and five months. They also reported reduced anxiety and depression after eight weeks. Furthermore, teachers and students reported positive social validity, as defined as a preference for therapy balls over traditional seating.

Schilling & Schwartz (2004) also explored the use of therapy balls in the classroom with students with disabilities, specifically exploring students with attention deficit disorder. In their experiment, during baseline and withdrawal phases, students utilized typical classroom seating devices, while participants utilized therapy balls during the intervention phase. Schilling et al. (2003) found students with attention deficit disorder had more in-seat behavior, as defined as connecting between participants' buttocks and the ball, the ball to the floor, and a minimum of one foot with the floor when utilizing the therapy balls. Participants also reported better focus on instruction due to the limitation of movement when seated on a stability ball. Not only has

research shown improved attention span and reduced anxiety, but research also supports academic achievement.

Mead et al. (2016) reported academic growth evidenced by student performance on pre- and post-standardized math scores as measured by the MAP and the Minnesota Comprehensive Assessment. Researchers found that students who utilized therapy balls exhibited greater academic gains than those utilizing traditional seating. Results indicated on the MAP test there was a significant difference between pre and post-scores, $F(2, 76) = 4.1$, $p = .021$. Further, a Tukey post hoc analysis showed the difference scores were significantly higher ($p = .016$) for the stability ball class (STAB; $M = 11.6$, $SD = 6.9$) when compared to the sedentary class ($M = 5.5$, $SD = 7.0$), concluding that the use of therapy balls impacted standardized test scores in mathematics.

While some research on the use of therapy balls has shown positive benefits, other research has not. Fedewa et al. (2015) reported that therapy balls impacted the disruptive behaviors of second-grade students, as evidenced by the number of discipline referrals. They found that discipline referrals decreased for the classrooms that replaced traditional seating with therapy balls and tapered off to approximately 20 referrals mid-intervention. Conversely, there was no change in discipline referrals in the classroom with traditional seating, averaging 20 to 30 discipline referrals. However, Fedewa et al. (2015) noted that the therapy ball classrooms began the intervention with higher discipline referrals than the control classrooms. While discipline referrals were impacted, in this same study, researchers found no significant difference in on-task behaviors, stating students in the traditional seating classrooms were on task more frequently than in the therapy ball classrooms (87% in the traditional seating classrooms versus 77% in the therapy ball classrooms). Results also indicated no significant improvement in achievement for

classrooms that utilized therapy balls and those that did not. Olson and Panahon (2019) also investigated class-wide effects of therapy balls. They reported that therapy balls did not effect on-task and out-of-seat behaviors or writing fluency. Students demonstrated similar behaviors and achievements when utilizing therapy balls compared to traditional seating. Finally, when researching the effectiveness of therapy balls with students with autism spectrum disorders, Bagatell et al. (2010) reported that therapy balls positively affected in-seat behaviors for students with extreme vestibular-proprioceptive-seeking behaviors; however, children who suffered from poor stability were less engaged when utilizing the stability ball.

Inflated Cushions

The use of inflated cushions as a form of alternative seating has also been the topic of education research (Pfeiffer et al., 2008; Seifert & Metz, 2017). Inflated cushions are typically non-latex rubber inflated discs typically, ranging in size from 12 to 15 inches and 3 to 4 inches in height when placed on the floor or chair to allow students to wiggle or rock (Seifert & Metz, 2017). Pfeiffer et al. (2008) investigated the effectiveness of inflated seating cushions on the attention spans of second-grade students who had reported attention difficulties. After an intervention period of two weeks, the researchers reported a statistically significant difference ($F[1, 59] = 28.31$, $p < .05$) in attention to task before and after intervention for students utilizing inflated seating cushions.

Furthermore, Seifert and Metz (2017) reported that preschool students who utilized inflated cushions were likelier to participate and less likely to display off-task behaviors. Their study revealed that students who used wiggle cushions had statistically significant improvements in attention and persistence subscales ($p = .002, .026$, respectively). Seifert and Metz (2017) also noted the teachers involved in the study reported social validity in the use of inflated cushions, as

defined as positive response to the use, reporting that once students were initially exposed to the cushions, their response to the cushions was similar to standard classroom seating.

Standing Tables

In addition to therapy balls and inflated cushions, a third alternative seating option often researched is standing desks (Aminian et al., 2015; Dornhecker et al., 2015; Koepp et al., 2012). While Dornhecker et al. reported improved student engagement among those who utilized standing desks. In this study of students in grades second through fourth, the 158 students who were fitted with standing desks had higher levels of academic engagement at the fall and spring semesters compared with 124 students who were fitted with traditional desks. Researchers noted a statistically significant difference of the average total engagement score of 4.21 ($p = 0.003$) in the fall and with the difference of the score being 4.21–3.49 = 0.72 in the spring. However, Koepp et al. et al. (2012), when examining the effect of standing desks on behavior, found standing desks did not produce a significant effect. Koepp et al. (2012) reported changes in classroom behavior of the eight sixth graders in the study were realized. However, variables failed to be statistically significant (classroom management, $P < .5$ [z test]; concentration, $P < .81$ [z test]; discomfort, $P < .06$ [z test]).

Echoing these findings, Aminian et al. (2015) also affirmed standing desks to have no effect on the behaviors of students with attention deficit hyperactivity disorder (ADHD). In their study, Aminian et al. (2015) used an intervention class, which utilized height-appropriate workstations for 22 weeks, and a control class, which retained traditional desks and chairs. During the study, students sitting and standing were measured at three time points, examining pain, inattention, and hyperactivity. Findings showed there were no substantial differences between the control and intervention classrooms in pain and inattention-hyperactivity mean

scores, and although the experimental class reported a greater reduction in inattention and hyperactivity–impulsivity, there were no significant differences ($t = 1.59$, $p = .16$; $t = 1.58$, $p = .13$ respectively) between the two classes.

Multiple Forms of Seating

While knowledge can be gained from individual seating options, the usage of various seating options is questionable. In 2016, the California Department of Education called for educators and administrators to rethink the classroom's physical environment and create flexible seating arrangements to meet the needs of 21st century learning (California Department of Education: School Facilities and Transportation Services Division, 2016). However, research gaps exist on the effects of flexible seating and must be addressed to better understand its potential. Therefore, the work of McEwen (2014), Byers et al. (2017), Flippin et al. (2021), and Byers et al. (2014) are of particular significance to the study, as they are some of the only known studies considering the effects of multiple types of alternative classroom seating. In his study, McEwen (2014) investigated 30 special education students from three different classes. These 30 students were provided a variety of flexible seating options: therapy balls, bean bags, T-stools, therapy cushions, and stand-up desks. The goal of this study was to determine if the use of flexible seating increased student on-task behavior by analyzing the students' math achievement scores. While results did not indicate a statistically significant improvement from math achievement pretest to posttest score, teachers reported improved classroom behavior efforts (McEwen, 2014). These findings are critical to framing the current study examining the effects of flexible seating on math achievement. However, the results are not widely generalizable. McEwen (2014) only considered a sample from the special education population. Therefore,

research into the effects of alternative classroom seating options on typical students, particularly those at the elementary level, is sparse.

Flippin et al. (2021) examined the effects of utilizing a kinesthetic classroom on second-grade students' on-task behaviors during a five-week intervention using an ABAB withdrawal design. During baseline and withdrawal weeks, students' traditional classroom desks or tables and chairs were offered in the classroom. During intervention and generalization weeks, kinesthetic equipment (such as exercise balls, standing desks, kneel-and-spin desks, under-desk pedals, and bouncy bands) was offered in the classroom. The researchers concluded differences in the proportion of student on-task behavior between baseline and the first intervention ($z = -2.81$, $p = 0.00$), second intervention ($z = -4.16$, $p = 0.00$), and the generalization week ($z = -3.84$, $p = 0.00$) were all statistically significantly different, with students demonstrating a lower proportion of on-task behaviors in the baseline week. Therefore, reporting kinesthetic equipment positively impacts on-task behaviors in elementary classrooms.

Byers et al. (2017) conducted a quasi-experiment with a single-subject research design in open and flexible classroom arrangements with an infusion of one-on-one technologies. The research concluded student perceptions of the quality of teaching and students' engagement levels were improved, with reliability criteria reached ($0.8 \leq \alpha \leq 0.95$). Additionally, a separate statistical analysis indicated significant differences in students' performance in mathematics compared to like peers in traditional classrooms, with the difference between the means statistically significant ($p < 0.05$) in each of the three modes, which was supported by 'very large' effect sizes. However, Byers et al. (2017) warn that while it appears to be a link that exists between classroom space and positive academic outcomes, the findings of this study do not indicate causality.

In their research on flexible seating, Byers et al. (2014) conducted a quasi-experiment examining the differences in two settings, a traditional classroom and a flexible seating classroom, over a year. Results indicated the configurations of learning spaces did have a measurable effect on students' perceived learning experiences and engagement levels, linking improvements to flexible seating configurations. Likewise, comparative analyses of standardized assessment data in English and mathematics indicated a similar effect for the same participants, with the null hypothesis, rejected due to nine out of the twelve results showing a statistically significant improvement in student learning achievement outcomes.

Finally, Attai et al. (2021) conducted a study where the primary purpose was to determine whether flexible seating used after appropriate professional development enhanced elementary students' active learning and/or enhanced the students' perceptions of the learning environment. The researchers utilized ten third and fourth grade classrooms observed biweekly for eight weeks. The classrooms were assigned to either group A (who received professional development and used flexible furniture) or group B (who maintained traditional furniture). Three students were randomly selected from each classroom and monitored continuously throughout each observation. Researchers reported students who experienced flexible seating reported greater satisfaction with the learning environment than did peers with traditional furniture with $F(1,160)=9.89$, $p=0.02$. Researchers also reported classrooms with flexible seating provided more opportunities for student autonomy $t(139)=21.031$, $p=0.00$. and use of furniture for learning $t(103)=14.99$, $p=0.00$.

Learning Environment

An ever-increasing emphasis on 21st century skills in the modern classroom has required teachers to address creativity, collaboration, innovation, teamwork, decision-making,

communication, critical thinking, problem-solving, and research fluency (Larson & Miller, 2011). To address these skills, teachers must create a learning environment adequately aligned to address these skills (Lemley et al., 2014). Traditional education practices such as lecture-style classes are insufficient for the 21st century classroom, as teachers must design experiences in which students are engaged and successful (Schlechty, 2011).

When creating a 21st century classroom environment that reflects the student-centered pedagogy of constructivist learning theory, it is important to consider how the classroom context affects the student. Cole et al. (2021) conducted a qualitative study to examine how the physical environment of a classroom is utilized and how the classroom's physical space impacts interactions between students and teachers. By utilizing classroom maps and recording logs to gather data from students in second and fifth grade classrooms, the researchers found many common trends to emerge. Common themes found by researchers included student preference towards a specific seating choice, flexible seating options being preferred over traditional seating options, and the need for direct teacher instruction on seating choice or reminders of the proper use of specific seating choices.

As learning environment research progresses, there have been innovations in classroom designs. The design of conventional classrooms with immobile seats all facing the front of the room might not be ideal for interactive and collaborative activities (Whiteside et al., 2010). Instead, researchers propose the use of active learning classrooms as alternatives to conventional classrooms. Active learning classrooms are described as having open learning spaces, mobile tables, seats, and learning technologies (Oliver-Hoyo et al., 2004) that provide a foundation for a student-centered approach and cooperative learning activities (Norazman, Ismail, Ja-afar, Khoiry, & Che-ani, 2019). The use of these spaces is supported by many learning environment

researchers who claim the physical learning environments can either encourage or inhibit learning activities (Brooks, 2011). The idea that learning environments can either encourage or hinder knowledge construction (Whiteside et al., 2010) is well accepted by many educators, as active learning and teaching are more easily accomplished in an active learning classroom than in a traditional lecture hall. However, Hao et al. (2021) conducted a study to separate the effects of learning environments from pedagogical approaches. The study concluded that active learning and teaching significantly benefited academic performance. However, when controlling other variables, such as pedagogical approach, learning environments did not show a significant influence on student gains. Hao et al. (2021) note that while physical learning environments have the capability to encourage or hinder knowledge construction, this capability is very limited. Instead, educators need to understand active learning classrooms might not bring intended effects unless paired with an appropriate active learning pedagogical approach.

In their study, Barrett et al. (2015) found that classroom design features, such as furniture or orientation, can either enhance or impede a student's academic progress by up to 25% during a year. In that same study, Barrett et al.(2015) reported that an important factor in improving student comprehension was granting teachers the freedom to rearrange furniture to better accommodate different learning activities. In his study of college students, Richards (2006) discussed how flexibility in seating location and classroom configuration could also impact student academic performance. According to his study, seating arrangements and classroom configurations impacted student behavior, stating that the furniture placement and classroom arrangement have the potential to foster negative or positive behavior among students (Richards, 2006). Furthermore, Asino and Pulay (2019) examined university-level students and professors' attitudes toward higher education classroom furniture and concluded the classroom environment

can potentially influence student academic success; however, the classroom size and physical appearance were more influential than the choice of furniture. Finally, Neill and Etheridge (2008) discovered that students and faculty perceived flexible learning spaces contributed to engagement, collaboration, and achievement. These studies suggest that modifying classroom seating arrangements could be a possible strategy to improve college students' academic performance and student behavior.

Flexible Seating and COVID-19

With the spread of the COVID-19 virus, strategies for preventing the spread of the virus have become important for schools to consider. During the COVID-19 pandemic, schools worldwide experienced closures to promote social distancing and keep in line with lockdown orders or many cities and states (Tunahan & Altamirano, 2022). As the number of virus cases lowered, schools began to reopen with newly applied social distancing measures (Fantini et al., 2020). Qualls, Levitt, Kanade, et al. (2017) note that when in a communicable disease outbreak, social distancing interventions that increase the space between people and minimize interactions play a crucial role in the containment of the virus. Since COVID-19 social distancing measures impact classroom spaces and seating arrangement, studying the effects of seating is of particular urgency (Tobia et al., 2022).

Tobia et al. (2022) conducted a study to determine what seating is the best for students, considering the social distancing measures put into place in schools since COVID-19. In this experimental study, researchers investigated the effects of seating arrangements (single desks vs. clusters) on logical reasoning, theory of mind, and creativity in 77 elementary students. The researchers also analyzed individual characteristics such as gender, loneliness, and popularity as potential moderators. They found that when children were seated in single desks in rows and

columns, their score in logical thinking was significantly higher, $F(1, 75)=4.486$, $p=.037$. Furthermore, they reported when seated in a row and column formation, girls showed significantly higher scores in the theory of mind ($p=.013$, $d=.48$), and lonelier children scored significantly higher on the theory of mind, $F(1,75=4.367$, $p=.040$, and creativity, $F(1,75=6.368$, $p=.014$. However, no other significance was shown in groups for logical reasoning, theory of mind, and creativity. The researchers concluded that the study suggests the importance of considering both the nature of the task and the student's characteristics when choosing a seating arrangement.

Furthermore, they suggested their study has implications for using flexible seating and mobile furniture in a classroom, as these seating modes allow for quick rearrangement to fit each learning activity throughout the day. The researcher concluded by citing the potential for COVID-19 social distancing to have a positive impact on some types of students. However, these measures should only be maintained as needed to allow flexibility in the organization of classroom spaces that meet all students' and didactic needs.

Summary

Chapter two provided a discussion of flexible seating and the theoretical framework supporting correlating ideas. Flexible searing is rooted in constructivist learning theory central to the ideas of John Dewey and Jean Piaget. Dewey proposed active learning principles in which students construct their own knowledge and believed that students need to interact with their environments to learn (Pardjono, 2016). To accommodate this pedagogy, the physical space of a room also embodies a constructivist approach. As the modern classroom demands a change from traditional lecture-style learning to student-centered learning, educational spaces should also change. As a result, different kinds of seating arrangements and furniture should be used in the

classroom to accommodate the student-oriented principles of constructivism (Cornell, 2002). Urie Bronfenbrenner's theory of ecological systems also explains the impact of the classroom context on student achievement. Bronfenbrenner recognized an individual's surroundings can affect and change his or her development. Therefore, the context and environment of a classroom would affect the development of a student differently, which could create differences in academic achievement (Bronfenbrenner, 1979).

In addition to a theoretical framework, a thorough examination of the available research on flexible seating was provided. Since traditional education practices such as lecture-style classes are insufficient for the 21st century classroom, teachers must design experiences and environments where students are engaged and successful (Schlechty, 2011). Therefore, the review of the literature concluded by exploring the topics of how student seating, location of seating, flexible seating options, and learning environment relate to the overall body of literature available on flexible seating. As the educational system requires teachers to transition from the industrial economy of education to the knowledge economy, it is important to recognize the importance of classroom furniture and seating (Cornell, 2002). Therefore, to contribute to the existing body of knowledge and address the gap in the literature, the current study examined the effect of flexible seating on teacher self-efficacy in math instruction.

CHAPTER THREE: METHODS

Overview

This causal-comparative analysis analyzed the strength of the relationship between the use of flexible seating and teacher self-efficacy among elementary math teachers in northeast Ohio. The independent variable for this study was the use of flexible seating, and the dependent variable was teacher self-efficacy as measured by the Teacher Sense of Efficacy Scale, Short (TSES, short), also known as the Ohio State Teacher Efficacy Scale (OSTES) (Tschannen-Moran & Hoy, 2001). This chapter presents the research methodology used in the study. Below are the research design, research question, null hypothesis, data collection procedures, and data analysis procedures.

Design

The researcher used a quantitative, causal-comparative design to explore the relationship between flexible seating and teacher self-efficacy. The purpose of a causal-comparative study is to explain an educational phenomenon through the study of cause-and-effect relationships. In this design, the independent variable was the presumed cause, and the dependent variable was the presumed effect. This design is also limited to observing naturally occurring variations instead of experiments that involve the researcher manipulating the independent variable (Gall et al., 2003). The dependent variable for this study was teacher self-efficacy, defined by The Teacher Sense of Efficacy Scale, Short (TSES, short) (Tschannen-Moran & Hoy, 2001). Teacher self-efficacy is defined as a teacher's belief in his or her ability to affect the expected outcome of

student performance (Isbell & Szabo, 2015). For this study, the independent variable, seating type, was defined as classroom arrangements containing an assortment of furniture options, such as bean bags, standing desks, and therapy balls, arranged in various ways to facilitate learning (Kariippanon et al., 2018). In this correlational study, the researcher was interested in the strength and direction of association between the variables (Creswell, 2015). To do this, the present study utilized a one-way between-groups analysis of variance (ANOVA) to determine if the null hypothesis can be rejected.

Research Question

This study is based on the following research question:

RQ1: Is there a difference in teacher self-efficacy scores among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating, and those who do not?

Hypothesis

The null hypotheses for this study are:

$H_0$1:: There is no difference in teacher self-efficacy scores, as measured by The Teacher Sense of Self Efficacy Scale, Short, among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating arrangement, and those who do not.

Participants and Setting

The participants for the correlational study were drawn from a convenience sample. Convenience sampling is defined as sampling that is convenient to the researcher and suits the purposes of the study (Gall et al., 2003). This sample was a convenience sampling due to the proximity and accessibility of the population (Warner, 2013). The sample used for this study

comprised of elementary school math teachers located in northeastern Ohio school districts during the 2021-2022 and 2022-2023 school years.

For this study, the sample size was 126 participants, which meets the required minimum of 126 participants for a one-way ANOVA with three groups when assuming a medium effect size with a statistical power of .7 and alpha level, $\alpha = .05$ (Gall et al., 2003, p. 145). This sample came from 56 school districts in Northeast Ohio. As this study utilized elementary level math teachers, all teachers had a minimum of a college education. Teachers' education level and experience are detailed below. 6% of the participants were male, and 94% of the participants were female. The ethnic makeup of the participants was 0.7% Hispanic teachers and 99.3% Caucasian teachers.

Table 1

Teacher Population Data

Seating Type	Number of Teacher Participants	Number of Teachers with highest education of Bachelor's Degree	Number of Teachers with highest education of some graduate work	Number of Teachers with highest education of Master's Degree	Number of Teachers with highest education of beyond Master's Degree	Average Years Experience
Traditional	58	6	12	25	15	16.48
1-2 Types of Seating	35	6	5	10	14	14.22
3 or More Types of Seating	34	5	4	10	15	16.33

Instrumentation

To measure the dependent variable, self-efficacy, the present study employed The Teacher Sense of Efficacy Scale, Short (TSES, short) also known as the Ohio State Teacher Efficacy Scale (OSTES) (Tschannen-Moran & Hoy, 2001) (see Appendix A). The TSES was

developed by Tschannen-Moran and Hoy (2001) at Ohio State University. Following an investigation of existing self-efficacy assessments, Tschannen-Moran and Hoy (2001) found previous self-efficacy instruments, such as Gibson and Dembo's teacher efficacy scale and the RAND measure, were not widely accepted by teachers and contained ambiguous language. Therefore, Tschannen-Moran and Hoy (2001) developed the TSES in response to the need for a more effective tool to measure teacher efficacy.

The TSES short measures teacher self-efficacy with the purpose of providing a measure of teacher self-efficacy in the areas of student engagement, instructional strategies, and classroom management based on the work of Bandura (Tschannen-Moran & Hoy, 2001). The TSES, short, consists of 12 questions on a nine-point Likert-type scale that ranges from one (none) to nine (a great deal) that aim to measure what teachers feel create the most difficulty in teaching. The highest possible score is 108 points, which indicates a high level of teacher efficacy. Conversely, a score of 12 points is the lowest possible score, indicating low sense of teacher efficacy. The questionnaire is divided into three subscales: engagement, instruction, and classroom management. For each subscale in the TSES, short is measured using four items, and the scores for each subscale range from 4 to 36. In addition to self-efficacy questions, questions regarding demographics are also addressed. The questions include racial identity, sex, subjects taught, grades and levels taught, years of teaching experience, school context, and percentage of free and reduced lunch students (Tschannen-Moran & Hoy, 2001).

The TSES short is considered a reliable and valid instrument, ranging from moderate to highly reliable for the short form of the Teachers' Sense of Efficacy Scale. The reliability of the overall short form was calculated with the Cronbach's alpha score of α reliability = .90, the subscales of engagement, instruction, and management had the following reliability scores:

engagement α reliability = .81, instruction α reliability = .86, and management α reliability = .86 (Tschannen-Moran & Hoy, 2001). The validity of this instrument was reported in a study conducted by Tschannen-Moran and Hoy (2001). In this study, the results of the TSES were correlated with previously accepted measures of the Gibson and Dembo test and the Rand survey. The data was positively correlated to the previous instruments with an output of 0.18 and 0.53 for both Rand data sets, $p<0.01$. Additionally, the teaching efficacy was related to the Gibson and Dembo at .64 relatability ($p<0.01$). In the present study, the TSES short will be used to measure the self-efficacy of teachers who use flexible seating compared to the self-efficacy of teachers who do not use flexible seating. This is an appropriate instrument for the present study as it is both a reliable and valid means of measuring self-efficacy (Tschannen-Moran & Hoy, 2001). Furthermore, the instrument was used in other studies to measure teacher self-efficacy (Fives & Buehl, 2009; Skaalvik & Skaalvik, 2007; Tschannen-Moran & Hoy, 2007). Permission to use the TSES was granted, and written permission can be found in Appendix B.

Procedures

The present research study was conducted with the following procedures. The researcher acquired the appropriate approval, through written permission, from the superintendents of the school districts in which the convenience sample is drawn. Once approval from the superintendent was granted, the researcher gained approval from the Liberty University Institutional Review Board (IRB) (see Appendix C). After permission was granted by the IRB, the instrument, TSES, was combined with demographic and flexible seating questions in SurveyMonkey, an online survey and cloud-based data collection program.

An initial email was sent to all elementary math teachers in the participating districts, including the purpose of the study, instructions for completing the survey, a link to the consent

form, and a link to surveys. Consent was obtained upon receiving the email and was required before being given access to the survey. After giving consent, the participants were granted permission to continue the survey, where participants answered questions from the instrument. When enough surveys were obtained, the survey link closed, and data analysis began. The survey link ensured all participants remained anonymous. Upon completion of the surveys, the instrument was scored, and totals were exported to a Microsoft Excel Sheet (see Appendix D). The time required to complete the questionnaire was, on average, three minutes.

Surveys indicated if math instruction was administered in either flexible or traditional seating. In order to better identify seating type, a definition of flexible seating was provided, as well as a list of possible flexible seating options for teachers to reference. If flexible seating was chosen, the amount of different flexible seating options made available was also specified. Teachers who teach in traditional seating classrooms acted as a grouping of the independent variable. In these classrooms, the seating available is traditional in the sense that only desks and chairs are offered to the children in a fixed seating arrangement. Furthermore, students are not provided the freedom to move seats as needed; instead, students are assigned a fixed seat that is consistent throughout the day. While arrangements of desks may vary, ranging from rows or grouping desks, this arrangement is maintained for an extended period of time, with a minimum of one month, and does not change with the learning activities. Conversely, teachers who utilize between one and two types of flexible seating classrooms acted as another grouping of the independent variable. Finally, teachers who utilize three or more types of flexible seating classrooms acted as another grouping of the independent variable. In these classrooms, the seating available is flexible in the sense that a variety of seating options are offered to the children in manipulatable arrangements. Flexible seating is defined as classroom arrangements

that contain an assortment of furniture options, such as bean bags, standing desks, and therapy balls, that are arranged in a variety of ways to facilitate learning (Kariippanon et al., 2018). Furthermore, students must have the freedom to move seats as needed as the learning activities change.

Data Analysis

Once all participants completed the survey and instrument data was exported to an excel sheet, data was then analyzed using IBM SPSS version 29. The researcher utilized a one-way between-groups analysis of variance (ANOVA) to analyze the research question and accept or reject the null hypothesis. The one-way ANOVA was an appropriate choice to analyze the data according to group because the study utilized one independent variable, seating type, which will consist of three categorical and independent groups, teachers not utilizing flexible seating, teachers utilizing one or two types of traditional seating, and teachers utilizing three or more types of flexible seating (Gall et al., 2003). The research question and hypothesis for this study compared three groups, with a sample of 126 teacher participants, to ensure the required minimum when assuming a medium effect size with a statistical power of .7 at the .05 alpha level. Alpha level .05 was selected to ensure a rigorous test of the null hypothesis is done in order to minimize the risk of Type I error (Gall et al., 2003).

To analyze the data in this study, the researcher used a significance level of $p < 0.05$ to reject the null hypothesis. The measures of central tendency, mean, median, and mode were determined. A Box and Whisker plot was used for each group to identify extreme outliers. Assumption testing was conducted to ensure all assumptions of the ANOVA were met. To validate the assumption that the data collected was normally distributed in each group, the Kolmogorov-Smirnov normality test was used. The Kolmogorov-Smirnov normality test is

appropriate for this sample size since the sample was greater than fifty (Warner, 2013). The assumption of normality was confirmed at a statistical significance level greater than .05. Next, to confirm the assumption of homogeneity of variance, Levene's Test of Equality of Variance was conducted to evaluate the assumption of equal variance. The equal variance was confirmed at a significance level less than .05 (Gall et al., 2003). Finally, the effect size was calculated using partial eta squared (η_p^2) and interpreted using Cohen's d (Warner, 2013). Since a difference was found, following the ANOVA, a posthoc Tukey test was run to determine where differences in the groups occurred (Gall et al., 2003).

CHAPTER FOUR: FINDINGS

Overview

This chapter presents the quantitative results of the study. The purpose of the study was to determine if a relationship exists between the use of flexible seating during math instruction (independent variable) and teacher self-efficacy (dependent variable) for teachers in northeast Ohio. This causal-comparative analysis analyzed the strength of the relationship between the use of flexible seating and teacher self-efficacy among elementary math teachers in northeast Ohio. In this chapter, descriptive statistics will be presented, as well as specific results from data analysis. These specific results include assumption testing, the one-way analysis of variance (ANOVA) testing, and post hoc testing results.

Research Question(s)

RQ1: Is there a difference in teacher self-efficacy scores among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating, and those who do not?

Null Hypothesis(es)

$H_0$1:: There is no difference in teacher self-efficacy scores, as measured by The Teacher Sense of Self Efficacy Scale, Short, among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating arrangement, and those who do not.

Descriptive Statistics

Descriptive statistics were obtained for the dependent variable, self-efficacy scores, based on the independent variable, seating type. The sample consisted of 126 participants from three groups. Descriptive statistics can be found in Table 2. The statistics reported below exclude the

extreme outliers detected by the Box and Whisker Plot.

Table 2

Descriptive Statistics for TSES Scores and Seating Type

Grouping	*M*	*SD*	*N*
Traditional Seating	84.41	9.931	58
1-2 Types of Seating	86.24	9.449	34
3 or More Types of Seating	91.47	9.802	34
Total	86.81	10.128	126

Results

A one-way analysis of variance (ANOVA) was conducted to determine if there was a statistical significance between the dependent variable, self-efficacy score, and the independent variable, seating type. The following section presents a description of the assumption testing and results from the data screening for the research question.

Data Screening

Prior to analysis, all data were screened to ensure the completeness of the TSES tool. A total of 175 teachers responded to the survey. However, twenty surveys were immediately excluded due to incomplete surveys. The researcher utilized all the surveys where the participants reported using flexible seating with one or two seating types (36 participants) and three or more seating types (36 participants). However, to keep the groups similar, the researcher did not use all the traditional seating participants. Instead, the researcher used the first 58 surveys collected. A box and whiskers plot was used to check for extreme outliers. Five outliers were detected and removed (see Figure 4). In order to meet the required minimum of 126 participants for a one-way ANOVA with three groups when assuming a medium effect size

with a statistical power of .7 and alpha level, α = .05 (Gall et al., 2003, p. 145), two additional surveys were randomly selected from the traditional seating participants. Therefore, participants reported using flexible seating with one or two seating types group was comprised of 35 participants, participants reported using three or more seating types group was comprised of 34 participants, and participants reported using traditional seating group was comprised of 58 participants. A new Box and Whisker was then created to check for any new outliers (see Figure 5). No new outliers were detected, resulting in the *N*=126 for RQ1. All data were retained.

Figure 4

Box and Whiskers Plot for *TSES Scores and Seating Type*

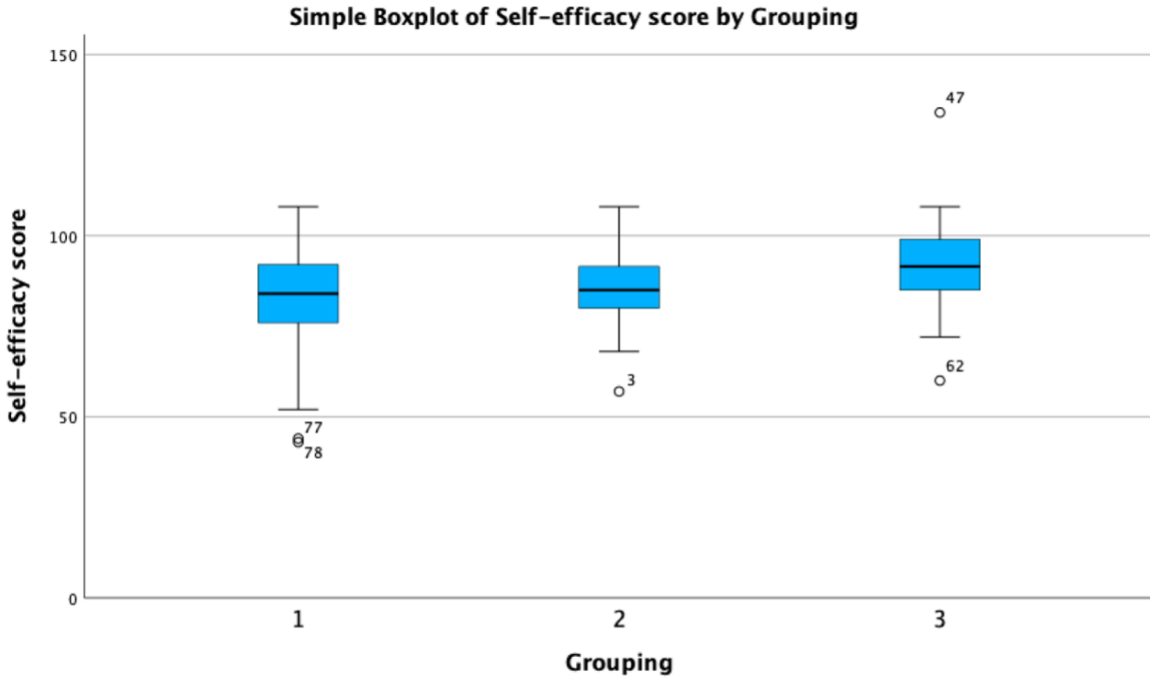
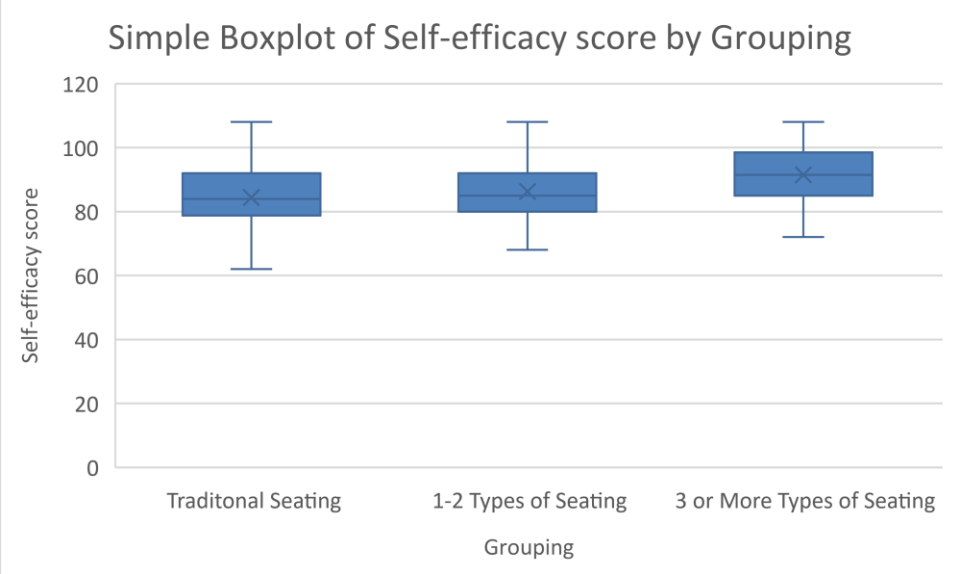


Figure 5

Box and Whisker Plot for TSES Scores and Seating Type with Outliers Removed



Assumption Testing

An ANOVA was used to test the null hypothesis, which requires the assumption of normality and homogeneity of variance to be met. The assumption of normality was tested using the Kolmogorov-Smirnov test due to the sample size exceeding 50 (*N*=100) (Gall et al., 2003). The assumption was tenable (Table 3).

Table 3

Kolmogorov-Smirnov Test of Normality for Teacher TSES Scores

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	*df*	Sig.	Statistic	*df*	Sig.
Self-efficacy score	.064	126	.200*	.983	126	.127

*. This is a lower bound of the true significance.
a. Lilliefors Significance Correction

The assumption of homogeneity of variance was then examined using Levene's test. The assumption was tenable where *p*=.96 (Table 4).

Table 4

Levene's Test of Equality of Error Variances

		Levene Statistic	*df1*	*df2*	Sig.
Self-efficacy score	Based on Mean	.034	2	123	.967
	Based on Median	.052	2	123	.950
	Based on Median and with adjusted df	.052	2	122.351	.950
	Based on trimmed mean	.040	2	123	.960

Tests the null hypothesis that the error variance of the dependent variable is equal across groups.

a. Dependent variable: Self-efficacy score

b. Design: Intercept + Grouping

Results

Since each assumption was tenable, the ANOVA was used to test the null hypothesis: There is no difference in teacher self-efficacy scores, as measured by The Teacher Sense of Self Efficacy Scale, Short, among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating arrangement, and those who do not. The researcher rejected the null hypothesis at the 95% confidence level where $F(2, 123)= 5.67$, $p=.004$. Partial eta squared equaled ($\eta p\ 2 = .084$). The effect size was medium. The alpha level used was $\alpha=0.05$. This result indicates that significant differences existed between teachers' self-efficacy scores as measured by TSES and seating type (see Table 5).

Table 5

Test of Between-Subjects Effects

Source	Type III Sum of Squares	*df*	*MS*	*F*	Sig.	Partial Eta Squared
Corrected Model	1082.771[a]	2	541.386	5.673	.004	.084
Intercept	903264.402	1	903264.402	9464.585	<.001	.987
Grouping	1082.771	2	541.386	5.673	.004	.084
Error	11738.657	123	95.436			
Total	962344.000	126				
Corrected Total	12821.429	125				

a. R Squared = .084 (Adjusted R Squared = .070)

Since the researcher rejected the null, post hoc analysis was required to determine where these differences lie. A Tukey test was performed to compare all possible pairs of group means among the seating types. Based on this test, it was found that teachers utilizing traditional seating (M = 84.4, SD = 9.9) had significantly lower self-efficacy scores than teachers who utilize three or more types of flexible seating (M = 91.4, SD = 9.8) where p= 0.003. There was no significant difference between teachers who utilize traditional seating (M = 84.4, SD = 9.9) and teachers who utilize one or two types of flexible seating (M = 86.3, SD = 9.4), where p=0.664. Furthermore, there is no significant difference between teachers who utilize one or two flexible seating types (M = 86.3, SD = 9.4) and teachers who utilize three or more types of flexible seating (M = 91.4, SD = 9.8) where p= 0.074. See Table 6 for multiple comparisons.

Table 6

Multiple Comparisons

Dependent Variable: Self-efficacy score

	(I) Grouping	(J) Grouping	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
Tukey HSD	Traditional Seating	1-2 Types of Seating	-1.82	2.110	.664	-6.83	3.18
		3 or More Types of Seating	-7.06*	2.110	.003	-12.06	-2.05
	1-2 Types of Seating	Traditional Seating	1.82	2.110	.664	-3.18	6.83
		3 or More Types of Seating	-5.24	2.369	.074	-10.86	.39
	3 or More Types of Seating	Traditional Seating	7.06*	2.110	.003	2.05	12.06
		1-2 Types of Seating	5.24	2.369	.074	-.39	10.86
Dunnett C	Traditional Seating	1-2 Types of Seating	-1.82	2.080		-6.89	3.24
		3 or More Types of Seating	-7.06*	2.128		-12.24	-1.87
	1-2 Types of Seating	Traditional Seating	1.82	2.080		-3.24	6.89
		3 or More Types of Seating	-5.24	2.335		-10.96	.49
	3 or More Types of Seating	Traditional Seating	7.06*	2.128		1.87	12.24
		1-2 Types of Seating	5.24	2.335		-.49	10.96

Based on observed means.
The error term is Mean Square(Error) = 95.436.

*. The mean difference is significant at the .05 level.

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter presents the results of the data collected to determine if there is a difference in teacher efficacy between teachers who utilize flexible seating and those who utilize traditional seating in the elementary math classroom. This chapter begins with a discussion of how the results of the study are aligned with previous literature and theoretical framework. Furthermore, the chapter will outline the implications of the study and research as well as the potential impact on education stakeholders. Finally, the chapter concludes with the study's limitations and areas for further research.

Discussion

The purpose of this quantitative, casual-comparative study was to determine if there is a difference in teacher efficacy between teachers who utilize flexible seating and those who utilize traditional seating in the elementary math classroom. These variables were measured using The Teacher Sense of Efficacy Scale, Short (TSES, short) (Tschannen-Moran & Hoy, 2001).

Research Question

RQ1: Is there a difference in teacher self-efficacy scores among teachers in northeast Ohio who utilize one or two types of flexible seating arrangements, three or more types of flexible seating, and those who do not?

The findings addressed the research question by determining that there was a significant difference in teacher efficacy between teachers who utilize flexible seating and those who utilize traditional seating in the elementary math classroom. This significance was found where $F(2,$

123) = 5.67 p = 0.004, ηp 2 = 0.08, and the null hypothesis was rejected. When comparing the independent variables of seating types, there is a significant difference between the groups of teachers who utilize traditional seating (M = 84.41, SD = 9.93) and teachers who utilize three or more seating types M = 91.47, SD = 9.80). It was found that teachers utilizing traditional seating had significantly lower self-efficacy scores than teachers who utilize three or more types of flexible seating (M = 91.47, SD = 9.80), where p= 0.003. However, there was no significant difference between teachers who utilize traditional seating (M = 84.41, SD = 9.93) and teachers who utilize one or two types of flexible seating (M = 86.34, SD = 9.43), where p=0.664. Furthermore, there is no significant difference between teachers who utilize one or two flexible seating types (M = 86.34, SD = 9.43) and teachers who utilize three or more types of flexible seating (M = 91.47, SD = 9.8)0 where p= 0.074.

In this study, the relationship between seating and teacher self-efficacy was examined. Teacher self-efficacy is the beliefs a teacher holds about his or her capabilities to impact student learning outcomes (Tschannen-Moran & Hoy, 1998). Furthermore, research supports the self-efficacy of a teacher can be influenced either positively or negatively by several factors. Three influencing factors that affect a teacher's self-efficacy are: the experience a teacher has at the onset of their career, the leadership a teacher is under, and the level of freedom a teacher has in the decision-making process (Hoy, 2003). This study aligns with the third factor affecting a teacher's self-efficacy: freedom in decision-making. Research supports that the more freedom teachers are given in the education process, the greater their self-efficacy (Moore & Esselman, 1992). When implementing flexible seating, especially using three or more seating options, teachers are faced with deciding what seating arrangements best match the learning pedagogy (Lemley et al., 2014). The current study, therefore, illustrates the factors that can impact teacher

self-efficacy, as teachers who displayed significantly higher levels of self-efficacy are empowered to make these decisions about seating arrangements in their flexible seating environment.

Since there has been limited research on the relationship between flexible seating and teacher self-efficacy, there are no previous studies that directly align with the current study to compare it with. However, since a large body of research has found that teacher self-efficacy impacts student achievement (Chang, 2015; Hines, 2008; Ji-Won et al., 2016; Khan, 2012), it can be concluded that considering ways to increase math teacher self-efficacy can, therefore, increase achievement. Thus, the current study could support Barrett et al. (2015)'s findings that classroom design features, such as furniture or orientation, can either enhance or impede students' academic progress. The current study also supports the research of Byers et al. (2017), that found a significant difference between in flexible seating classrooms students' performance in mathematics compared to like peers in traditional classrooms. Finally, the current study supports the research of Byers et al. (2014). In their study, looking at the impact of flexible seating on standardized assessment data in English and mathematics, results showed a statistically significant improvement in student learning achievement outcomes.

Conversely, the current study did not support the research of McEwen (2014). In his analysis of 30 special education students from three different classes were provided a variety of flexible seating options: therapy balls, bean bags, T-stools, therapy cushions, and stand-up desks. The goal of this study was to determine if the use of flexible seating increased student on-task behavior by analyzing the students' math achievement scores. No statistical significance was found when comparing math achievement from the pretest and posttest study. However, it is essential to note that these results are not widely generalizable as the sample of this study was

solely derived from the special education population and was no specifically analyzing teacher self-efficacy.

Implications

The present study is significant as it addresses gaps in literature by determining whether flexible seating arrangements have a relationship to the self-efficacy of math teachers in the primary classroom. In addition, the significant difference that was found illustrates the need to explore further the relationship between seating and teacher self-efficacy and seating potential to increase self-efficacy.

Recently, an emphasis on examining how student seating location impacts learning has shifted to the seating options available. The California Department of Education: School Facilities and Transportation Services Division (2016) called for teachers and administrators to reimagine student seating to support diverse teaching and learning needs. They stated that learning environments should provide student seating options that are mobile and flexible to meet the demands of 21st century learning. However, educators are left to question following safety protocols implemented after the COVID-19 pandemic such as social distancing (Fantini et al., 2020) and what seating arrangement is best. This study provides insight that begins to fill the gap of available research on flexible seating effects on instruction in the math classroom (Mead et al., 2016), specifically math teacher self-efficacy.

This study adds to the mathematics education field, particularly elementary math education. With an increased emphasis on 21st century skills (Larson & Miller, 2011) as well as health and safety concerns (Fantini et al., 2020), teachers and administrators are faced with decisions on how best to allocate resources to address seating and classroom arrangement needs. This study's significant results, suggesting teachers who offer three or more flexible seating

options have higher self-efficacy, can guide teachers and administrators in decisions involving allocating resources to implementing flexible seating arrangements in the primary classroom seating to further meet the needs of the 21st century classroom.

Finally, this study opens the door to further research into the relationship between self-efficacy and flexible seating. While the study reported a significant relationship between elementary math teacher self-efficacy and the use of three or more flexible seating options, the study did not point to a cause. The study leaves the question if flexible seating of three or more options increases a teacher's self-efficacy, if teachers with higher self-efficacy levels are more likely to try flexible seating, or if there is yet a third variable impacting both the seating and teacher self-efficacy. Therefore, the significant relationship points to the relevance of further research in this field.

Limitations

As with any study, there are certain limitations and factors to consider for both external and internal validity. One external validity threat to this study is the use of a convenience sample. The sample utilized for this study is derived from 56 schools in Northeastern Ohio. This limited geographic sample does not allow the results to be generalized on a broader scale to encompass all teachers in the United States. Furthermore, a larger population in order to include more data in the control group would have strengthened the results. A larger population size derived from various regions throughout the United States would have promoted more robust results. Furthermore, the population is limited to elementary math teachers and cannot be generalized to other subjects or grade levels.

Another limitation of this study is the type of flexible seating. While the researcher defined flexible seating for teachers, teacher self-reported their use of flexible seating in the math

classroom. The fact that no two flexible seating classrooms are the same poses an internal threat to validity. Since flexible seating is defined as arrangements that comprise of a variety of furniture with the ability to be arranged in different ways to facilitate desired learning experiences as well as create opportunities for both group and independent work (Kariippanon et al., 2018), a wide variety of interpretations of flexible seating is taken by teachers. Furthermore, factors such as availability of alternative seating options, classroom square footage, furniture arrangements, and teacher implementation of flexible seating contribute to differing levels of success with flexible seating and, therefore, can impact teacher self-efficacy.

The final internal threat to validity that created a limitation to the study is the time period in which the study took place. The study was conducted during the 2021-2022 and 2022-2023 school years, during and directly after the COVID-19 pandemic. The COVID-19 pandemic altered many dynamics of education, including the physical arrangement of students, in an effort to combat the spread of the virus. These factors could have skewed results compared to results from a school year without restrictions caused by COVID-19.

Recommendations for Future Research

The following recommendations are suggested to enhance the findings of this study and further increase understanding of the use of flexible seating in the math classroom:

1. To address the limited geographic sample and generalize the results on a broader scale to encompass all teachers in the United States, a larger population size derived from various regions throughout the United States with equal groups in each category would produce more robust results.
2. An experimental study could be conducted where the same teachers teach with a classroom set up to accommodate each seating category in this study, traditional, one

or two flexible seating options, and three or more seating options, and evaluate their self-efficacy in each seating situation.

3. A qualitative study could be completed to determine how seating affects a teacher's self-efficacy. Allowing teachers to offer a narrative response could provide more insight into the relationship between self-efficacy and flexible seating, explicitly pointing to if flexible seating of three or more options increases a teacher's self-efficacy or if teachers with higher self-efficacy levels are more likely to try flexible seating.
4. To address the internal threat to validity caused by the fact that no two flexible seating classrooms are the same a study comparing similar types of flexible seating could be conducted. The aim of this study would be to see if the type of flexible seating is important or if it is just the options that flexible seating provides that are important.
5. As the education world continues to emerge from the COVID-19 pandemic, repeating this study when classrooms are not under restrictions of social distancing. This would ensure results were not skewed compared to results from a school year without restrictions caused by COVID-19.

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APPENDIX A

INSTRUMENTATION TSES, SHORT

Teacher Efficacy Scale (Short Form)*

A number of statements about organizations, people, and teaching are presented below. The purpose is to gather information regarding the actual attitudes of educators concerning these statements. There are no correct or incorrect answers. We are interested only in your frank opinions. Your responses will remain confidential.

INSTRUCTIONS: Please indicate your personal opinion about each statement by circling the appropriate response at the right of each statement.

KEY: 1=Strongly Agree 2=Moderately Agree 3=Agree slightly more than disagree 4=Disagree slightly more than agree 5=Moderately Disagree 6=Strongly Disagree

1.	The amount a student can learn is primarily related to family background.	1 2 3 4 5 6
2.	If students aren't disciplined at home, they aren't likely to accept any discipline.	1 2 3 4 5 6
3.	When I really try, I can get through to most difficult students.	1 2 3 4 5 6
4.	A teacher is very limited in what he/she can achieve because a student's home environment is a large influence on his/her achievement.	1 2 3 4 5 6
5.	If parents would do more for their children, I could do more.	1 2 3 4 5 6
6.	If a student did not remember information I gave in a previous lesson, I would know how to increase his/her retention in the next lesson.	1 2 3 4 5 6
7.	If a student in my class becomes disruptive and noisy, I feel assured that I know some techniques to redirect him/her quickly.	1 2 3 4 5 6
8.	If one of my students couldn't do a class assignment, I would be able to accurately assess whether the assignment was at the correct level of difficulty.	1 2 3 4 5 6
9.	If I really try hard, I can get through to even the most difficult or unmotivated students.	1 2 3 4 5 6
1O.	When it comes right down to it, a teacher really can't do much because most of a student's motivation and performance depends on his or her home environment.	1 2 3 4 5 6

*In Hoy, W.K. & Woolfolk, A.E. (1993). Teachers' sense of efficacy and the organizational health of schools. *The Elementary School Journal 93*, 356-372.

APPENDIX B

PERMISSION TO USE TSES, SHORT

[redacted]

Dear

You have my permission to use the *Teachers' Sense of Efficacy Scale* in your research. A copy the scoring instructions can be found at:

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

Best wishes in your work,

[redacted]

[redacted]

APPENDIX C

IRB APPROVAL

LIBERTY UNIVERSITY.
INSTITUTIONAL REVIEW BOARD

November 24, 2021

[redacted]

Re: IRB Exemption - IRB-FY21-22-335 THE RELATIONSHIP BETWEEN FLEXIBLE SEATING AND MATH SELF-EFFICACY FOR ELEMENTARY MATH TEACHERS IN NORTHEAST OHIO

Dear Lorna-Marie Waters, Treg Hopkins,

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

Your study falls under the following exemption category, which identifies specific situations in which human participants research is exempt from the policy set forth in 45 CFR 46:104(d):

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

Your stamped consent form(s) and final versions of your study documents can be found under the Attachments tab within the Submission Details section of your study on Cayuse IRB. Your stamped consent form(s) should be copied and used to gain the consent of your research participants. If you plan to provide your consent information electronically, the contents of the attached consent document(s) should be made available without alteration.

Please note that this exemption only applies to your current research application, and any modifications to your protocol must be reported to the Liberty University IRB for verification of continued exemption status. You may report these changes by completing a modification submission through your Cayuse IRB account.

If you have any questions about this exemption or need assistance in determining whether possible modifications to your protocol would change your exemption status, please email us at irb@liberty.edu.

Sincerely,

[redacted]

APPENDIX D

INSTRUMENT SCORING RECORD

ID	Grouping	Self-efficacy score
1001	2	88
1002	2	103
1004	2	90
1005	2	70
1006	2	82
1007	2	80
1008	2	85
1009	2	68
1010	2	80
1011	2	108
1012	2	78
1013	2	100
1014	2	95
1015	2	88
1016	2	76
1017	2	82
1018	2	92
1019	2	86
1020	2	75
1021	2	94
1022	2	91
1023	2	106
1024	2	83
1025	2	92
1026	2	90
1027	2	81
1028	2	80
1029	2	86
1030	2	85
1031	2	96
1032	2	76
1033	2	84
1034	2	82
1035	2	80
1036	3	75
1037	3	98
1038	3	77
1039	3	81
1040	3	80
1041	3	105
1042	3	104
1043	3	104
1044	3	72
1045	3	108

1046	3	100
1048	3	80
1049	3	106
1050	3	85
1051	3	85
1052	3	85
1053	3	88
1054	3	80
1055	3	93
1056	3	88
1057	3	94
1058	3	94
1059	3	96
1060	3	92
1061	3	90
1063	3	106
1064	3	90
1065	3	87
1066	3	94
1067	3	108
1068	3	93
1069	3	92
1070	3	91
1071	3	89
1072	1	62
1074	1	79
1075	1	86
1076	1	84
1079	1	84
1080	1	81
1081	1	76
1082	1	83
1083	1	92
1084	1	84
1085	1	93
1086	1	88
1087	1	65
1088	1	86
1089	1	94
1090	1	96
1091	1	89
1092	1	88
1093	1	93
1094	1	104
1095	1	92

1096	1	86
1097	1	83
1098	1	101
1099	1	80
1100	1	78
1101	1	98
1102	1	85
1103	1	96
1104	1	80
1105	1	84
1106	1	82
1107	1	99
1108	1	81
1109	1	82
1110	1	75
1111	1	83
1112	1	68
1113	1	88
1114	1	75
1115	1	73
1116	1	87
1117	1	93
1118	1	70
1119	1	84
1120	1	104
1121	1	82
1122	1	108
1123	1	74
1124	1	75
1125	1	99
1126	1	81
1127	1	87
1128	1	76
1129	1	72
1130	1	81
1131	1	68
1132	1	79