A CAUSAL-COMPARATIVE STUDY: THE EFFECTS OF SCHOOL TYPE AND SCHOOL CLIMATE ON MATHEMATICAL ACHIEVEMENT

by

Rebekah Price

Liberty University

A Dissertation Presented in Partial Fulfillment

Of the Requirements for the Degree

Doctor of Education

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APPROVED BY:

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ABSTRACT

Academic achievement is the goal of education. Motivating students to meet achievement levels requires observing trends, analyzing data, and adjusting instruction, curriculum and pedagogy practices. People in every political arena and on every educational level are trying to contribute in making sure that achievement goals are met. From the teacher in the classroom to the politician in Washington D.C., ideas are constantly being thought up, laws are being passed, programs are being implemented and standards are being adapted, changed, or written. This study aimed to look at the academic achievement in high school math, particularly Algebra 1, and whether or not school climate or school type had an effect on the achievement. This study added to the existing body of literature and helped drive national, state, and local policies concerning school choice and academic achievement. The study was a non-experimental design that analyzed the data from End of Course scores in Algebra 1, school climate ratings, and school type. Seventy traditional public high schools and seventy public charter high schools in the state of Georgia were chosen for the sample. School climate ratings and end of Course scores are public information that was gathered from archived data on the Georgia Department of Education website. The data was analyzed using a two-way ANOVA. There was a statistically significant difference in the Algebra 1 EOC scores based on school climate ratings. However, there was not a statistically significant difference in Algebra 1 EOC scores based on school type or the interaction of school climate rating and school type. Future studies should consider including demographics, type of instruction and rigor of instruction.

Keywords: Public charter school, traditional public school, school climate rating, mathematical achievement, Georgia Milestone Achievement System, Algebra 1, End-of-Course Test

Copyright Page

Dedication

First and foremost, I want to dedicate this study to Jesus Christ. You saved me, placed the desire within me to do something big and gave me the ability to do a study of this magnitude. Thank you for Your faithfulness and new mercies every morning (Psalms 143:8). Thank You for walking with me through this journey, upholding me with your right hand (Isaiah 41:10) and showing me that I can do ALL things through YOU who strengthens me (Phil. 4:13). Thank you for showing me that I am capable and I am able to do hard things!

Second, I dedicate this study to my family. To my amazing children; Nathan & Christina, Hannah, Samuel and Esther, you were always there for me and always supported me through this seven-year process. You sacrificed your time and energy and encouraged me to never give up, even through all the ups and downs. We have walked some treacherous roads together the last several years and I could not have accomplished such a massive feat without you, your love and constant reminder that I am competent and strong. I hope I am proof that you can accomplish whatever you want, even when life is hard, as long as God is sustaining you. Reach for the stars my loves! Although, this is one of the most rewarding accomplishments of my life, YOU are my most cherished accomplishment. To my husband, Lee, thank you for encouraging me to follow my dreams, and pushing me to become the best version of myself. You believing in me and loving me as I fulfilled those dreams meant more than you know. I love you! To my parents, Skip and Karen, you showed me how to walk by faith and to never give up regardless of how messy life can get. This contributed to the persistent attitude that propelled me through this study. I hope I made you proud!

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List of Abbreviations

Adequate Yearly Progress (AYP)

American Educational Research Association (AERA)

American Psychology Association (APA)

Analysis of Variance (ANOVA)

Certified/Classified Personnel Information (CPI)

College and Career Ready Performance Index (CCRPI)

Criterion-Referenced Competency Test (CRCT)

Depth of Knowledge (DOK)

Elementary and Secondary Act (ESEA)

End of Course (EOC)

Every Student Succeeds Act (ESSA)

Expectancy Value Theory (EVT)

Full Time Equivalency (FTE)

Georgia Department of Education (GADoE)

Georgia Milestones Assessment System (GMAS)

Georgia Parent Survey (GPS)

Georgia School Personnel Survey (GSPS)

Georgia Standards of Excellence (GSE)

Georgia Student Health Survey (GSHS)

Governor's Office of Student Achievement (GOSA)

In-School Suspension (ISS)

Institutional Review Board (IRB)

International Association for Evaluation of Educational Achievement (IEA)

National Assessment of Educational Progress (NAEP)

National Center on Measurement in Education (NCME)

No Child Left Behind (NCLB)

Out-of-School Suspension (OSS)

Scholastic Aptitude Test (SAT)

School Climate Transformation Grant (SCGT)

Science, Technology, Engineering & Math (STEM)

The Trends in International Mathematics and Science Study (TIMSS)

Traditional Public School (TPS)

United National Educational Scientific and Cultural Organization (UNESCO)

Unites States Department of Education (USDoE)

CHAPTER ONE: INTRODUCTION

Overview

School choice and academic achievement have long been a topic for educators and politicians around the nation. The intent of this study is to provide information that will examine the effects that school type and school climate have on mathematics achievement. The researcher explores the gaps in the literature that precede the problem statement, purpose of the study, and the significance of the study. The research questions for this study are provided along with relevant definitions for terms that are essential to conduct research on the school type, both the traditional and the charter school, as well as the school climate rating and its effect or lack thereof, that they have on math achievement. The purpose of this study is to compare the effects that school type and school climate have on mathematical achievement.

Background

School choice for academic achievement has been a controversial subject in education and politics for many years (Mawene & Bal, 2018). In many places, parents are given alternative school choices outside of their districted school in order to meet the needs of their students. These choices include traditional public schools, public charter schools, virtual public schools, and several others Mawene & Bal, 2018). Parents should be able to make a determined and educated decision about the type of school that their students will attend and be informed about how that decision will affect their students' academic achievement.

The content of mathematics is considered the "enabling discipline" for STEM-related career fields, but also for many other areas of intellectual disciplines (Australian Academy of Science, 2016). The past two decades have seen a sharp decline and shortage in students going into STEM-related careers (Watt & Goos, 2017). This has precipitated research studies, both

internationally and domestically, to determine what influences students' mathematical achievement in the formative years of the students' academic career (Capraro et al., 2019; Edelen et al., 2020; Erickson et al., 2013; Lauermann et al., 2017; Lazarides et al., 2020; Watt et al., 2016; Watt & Goos, 2017; Watt et al., 2019). Students who lose interest, values, and perceived abilities in mathematics are less likely to select STEM-related careers. This trend was more evident in girls than boys (Watt & Goos, 2017). School and class climate have been distinguished as especially important for students' motivation (Fullarton, 2002). Understanding and increasing student engagement in mathematical education has become an important challenge for educators and policymakers (Watt & Goos, 2017). Fredricks et al. (2016) suggest that students' mathematical achievement is enhanced or diminished by their learning environment.

Sells (1980) classified the content of mathematics as the "critical filter" in high-income careers. An even better understanding of mathematics in today's STEM careers, as well as other intellectual career fields, has been attained through much research (Watt & Goos, 2017). There has been a growing focus on mathematics engagement as a prerequisite to students' success on national and international assessments (Thompson & Davis, 2013) and the participation in STEM-related disciplines (Watt et al., 2016). Students' mathematical interest, perceived importance of mathematics, mathematical self-efficacy, and actual mathematical performance play a critical role in the prediction of math-related career choices (Svoboda et al., 2016). This mathematical engagement starts in the student's high school years. High school is a decisive time when students choose whether or not to focus on STEM-related courses and eventually, STEM-related careers. Students' selections and achievement in courses can predict future educational careers and pathways (Svoboda et al., 2016).

In 2002 the Bush administration passed the No Child Left Behind Act (NCLB) which emphasized holding schools and teachers responsible for the achievement of their students (Klein, 2015). The goal for NCLB was to achieve 100% academic proficiency regardless of race, gender, or socio-economic status. In the state of Georgia, officials highlighted a gap in mathematical achievement prior to NCLB. In some cases, students were underachieving at two grade levels behind their peers by the time they entered eighth-grade math (National Center for Education Statistics, 2019).

States across our nation have been striving to improve math achievement among students. In the state of Georgia, historically, high school students have not performed well on the state-mandated test in mathematics, the Criterion-Referenced Competency Test (CRCT) (National Center for Education Statistics, 2010). In an effort to reform instruction in the classroom and close the math achievement gap, Georgia adopted the Georgia Standards of Excellence (GSE) which were initiated by government officials and state leaders and eventually adopted the Georgia Milestone Achievement System (GMAS) to assess the GSE. GSE mandated more clear and concise standards, coupled with rigorous assessments and classroom activities (Polikoff, 2015) to help students achieve better math scores.

In 2010, Georgia adopted the GSE, which was ~~were~~ derived from the Common Core State Standards, in an effort to increase instructional unity and rigor. Ultimately, the goal was to increase math achievement scores and move closer to the national public average. Additionally, the state of Georgia changed the state assessment to the GMAS. The GMAS aligned with the GSE and assessed student performance on content based on the new standards. Its first administration was in the spring of 2015. Due to the GMAS administration having been limited to the previous five years, data trends are just now being realized. Initial research demonstrates

that students did not perform as well as hoped on the GSE reform-based standards (Polikoff, 2015). There has not been any significant increase in math scores since 2015 (NAEP, 2019).

In an effort to increase academic achievement, alternative school options have been explored in the United States. Some of those options involve student and parent choice in schooling, including homeschool, magnet schools, and charter schools. Some options allowed for the use of school vouchers for private schools. These alternatives allow parents to educate their children by other means besides the traditional public school (School Choice in Georgia, n.d.). Defenders of the school choice programs argued that allowing parents the educational choice improves educational achievement. Critics of school choice argue that diverting funds from traditional schools is detrimental to them (School Choice in Georgia, n.d.).

Charter schools are semi-autonomous public schools that are either non-profit or for-profit and are independent of any school system. They are publicly funded but privately managed and are exempt from many of the traditional school requirements established by the state or local school boards (*Charter Schools in Georgia*, n.d.). There is more freedom to manage budgets, staffing, and curriculum. However, students are still required to take the state assessments.

In 1991, the first charter school law was passed in the state of Minnesota. Similarly, Georgia passed a charter school law in 1994. However, this was only for conversion charter schools, which meant that only established school districts could convert to a charter school. In 1998, Georgia passed a law allowing for the first charter school to open in the state of Georgia in 2000 (*Charter Schools in Georgia*, 2021). Currently, there are 115 charter schools in Georgia along with 32 charter school systems, which include 326 schools (*Georgia Charter School Association*, n.d.).

The second variable that could affect mathematics achievement is school climate. School climate has been defined as "the quality and character of school life" by the National School Climate Center (2021). Over the past century, there has been an increasing interest in school climate. The literature on school climate has suggested that there is empirical evidence addressing different aspects of school climate (Thapa et al., 2013; Tubbs & Garner, 2008). One of those aspects is student achievement. Previous studies have also been conducted on charter schools and their academic achievement (Booker et al., 2011; Davis & Raymond, 2012; Zimmer et al., 2003, 2009). However, there have not been many studies predicting the influence or impact that school type (traditional and charter) and school climate have on math achievement, specifically Algebra 1 and specifically in the state of Georgia.

The foundational theory supporting the environment of school setting affecting academic achievement stems from the work of Bronfenbrenner (1979a). Bronfenbrenner's ecological systems model includes four environmental levels: (a) the microsystem, (b) the mesosystem, (c) the exosystem, and (d) the macrosystem. Each level or system affects the individual differently (Onwuegbuze et al., 2013). Each system includes positive and negative participation (Masten et al., 2008). These positive and negative participations equate to experiences that contribute to an individual's development (Bronfenbrenner, 1994). Although ecological systems theory is known as a human development theory, it always describes the individual as someone who influenced or is being influenced by the~~ir~~ environment (Rosa & Tudge, 2013). The school environment falls within the most immediate and compact environment that a student interacts with daily, the microsystem (Bronfenbrenner, 1979a; Christensen, 2010; Edelen et al., 2020; Onwuegbuze et al., 2013).

Societal benefits of having a positive school environment include better academic achievement, particularly math achievement. When students have high math achievement, they are more likely to make decisions to continue in a math-related or STEM field in their college studies and career choices. Mathematics is one of the essential content areas that consume students' educational performance and their future career paths (Sharifi Saki et al., 2014). For students to achieve in mathematics, their school choice and school climate need to be accessed and chosen based on analytical data and educated decisions.

Problem Statement

In the education system today, there are many school choices for parents to choose between for their students. Some of the school-type choices are traditional public school, private school, magnet school, public charter school, and homeschool. Academic achievement, in addition to the school environment of each facility, can be a variable in the choice that parents make (Mawene & Bal, 2018). However, not all parents and families have multiple school options. Some parents are limited to the local traditional public school.

Parents who have greater economic means can choose schools because they can afford to move to affluent areas with high-quality schools or enroll their students in high-quality private schools (The Center for Education Reform, 2021). However, parents who do not have such economic means cannot afford to make moves of this kind and are forced to send their students to the local school in their district regardless of the quality or appropriateness of the school (The Center for Education Reform, 2021).

Healthy school climates have been positively associated with student academic achievement (Goddard et al., 2015; VanLone et al., 2019). Research has established that positive school climate correlates to enhanced outcomes for students in the areas of motivation and

behaviors (VanLone et al., 2019). As students spends most of their time at school during their educational years, the positive and negative experiences they experience from the school climate may have a consequential effect on the students' academic, development, and cognitive outcomes (Arslan, 2016).

A positive school climate consists of many different factors. Prothero (2020) suggested some academic factors, such as positive relationships between teachers and students, high academic expectations and support, consistency in behavior and discipline, and regular feedback. According to the Ministry of Education in Ontario, Canada (2022) a positive school climate consists of a positive environment where students, staff, and parents feel safe, included, and accepted. All stakeholders of the school demonstrate healthy relationships of mutual respect, kindness, and fairness without any bullying, discrimination, or harassment. They communicate openly and participate in engaging dialogue. Students are encouraged, inspired, supported, and expected to succeed. Instruction is given with high expectations and reflects the diversity of all learners.

The contemporary debate on school choice primarily focuses on public charter schools (Walters, 2018). The need to understand how public charter schools and traditional public schools compete in academic achievement has elicited concern in education (Mehta, 2017). There have been some studies on the academic achievement of charter schools, but most research focuses on the differences between charter and traditional public schools in individual states and urban cities (Adzima, 2017; Bardem & Lassmann, 2016; Zarecki, 2019) such as New York and Boston (Abdulkadiroglu et al., 2009; Angrist et al., 2011; Dobbie & Fryer, 2011; Hoxby & Murarka, 2017; Hoxby et al., 2009). However, minimal research has been conducted in the state of Georgia. The literature has not specifically addressed how school type or school climate

ratings affect math achievement in the state of Georgia. The problem is that where students attends school and the climate that they find themselves in, can affecting their math achievement.

Purpose Statement

The purpose of this quantitative causal-comparative study is to determine whether school type and school climate have an effect on mathematical achievement in the state of Georgia. This study will examine math achievement in Algebra 1 as the dependent variable and will be measured using the End of Course (EOC) achievement scores from each sample high school. The independent variables in this study are school type (traditional public school, public charter school) and school climate rating (positive or negative rating).

School type is the type of school that a student may attend. It is the result of school choice. School choice may include many types of schools such as traditional public schools, charter public schools, magnet schools, homeschool, private schools, (Berends, 2015). School climate is the physical, academic, and social environment that schools cultivate. This environment largely influences students, school staff, and families and it has been researched by many (Cohen et al., 2009; Epstein, 1991; Epstein et al., 2002). Mathematical achievement is the achievement students make in the content area of mathematics. Mathematics is one of the most important content areas of education because it dominates performance in all other content areas and can predicts students' career pathways (Sharifi Saki et al., 2014).

The study sample included seventy randomly selected traditional high schools and seventy randomly selected public charter schools from the state of Georgia. Each high school reported a 2018-2019 EOC achievement score for their Algebra 1 test. The school climate rating was figured by the Georgia Department of Education using mandatory surveys by students and staff, voluntary parental surveys, attendance and discipline data, and then posted on the website.

Data analysis was used to compare mathematical achievement among varying school types and school climate ratings.

Significance of the Study

Parents generally desire that their students are getting the best education. It is imperative that the parents fully understand their choice of school is governed by rigorous standards, maintains a positive school climate, and strives for maximum academic achievement. Society is watching to see if charter schools can uphold the same standards that traditional public schools hold in academic achievement or if they fall behind or surpass the traditional public school (Mehta, 2017). Additionally, it is necessary for parents to make educated decisions about the type of school their child attends and they want to be assured that it possesses a positive school climate to maintain their child's performance in mathematics.

Currently, there is a lack of research on school type, school climate, and mathematical achievement in the state of Georgia. This study will add to the growing body of research on student achievement, specifically math achievement. Math achievement is a critical prognosticator of academic attainment in the students' future (Shanley et al., 2019). This research will fill the gap of knowledge to show if the school type, traditional or charter, and the school climate rating have an effect on mathematic achievement. The results show that school climate and school type influence mathematical achievement, and the study will continue to add to the knowledge about Bronfenbrenner's ecological systems theory, especially as related to the classroom. It will also add to the literature of Eccles' expectancy-value theory which will show that students work hard and succeed at what makes them comfortable and motivated. Finally, it will add to the literature on market theory, showing that parents can and should shop around for the best educational environment for their children. The results will inform parents of the impact

that school type and school environment could have on their child's academic success. The results will also drive decisions for teachers and districts, and laws and policies for states and the federal government.

The study will be conducted in high schools in the state of Georgia, giving the parents in Georgia data that will drive their decisions in choosing the best school appropriate for their child. Additionally, it will help support the claims that school climate rating has an impact on academic achievement as well (Tubbs & Garner, 2008). Although this study is specific to the state of Georgia, the findings of this study could be beneficial to additional states that have similar demographics (Zimmer et al., 2011).

Research Question

RQ: Is there a difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school or public charter school) and the school climate rating?

Definitions

1. *Ecology* - Ecology signifies a modification between an individual and environment (Bronfenbrenner, 1975)
2. *Human Development* - the process in which an individual becomes keenly aware of their ecological environment and can engage in activities that influence that environment (Bronfenbrenner, 1979a)
3. *Microsystem* - "the most proximal setting, with particular physical characteristics, in which a person is situated, such as the home, child care, playground, and place of work, and in which the developing person can interact in a face-to-face way with others" (Rosa & Tudge, 2013, p. 246)

4. *Settings* - the environment in which an individual has a particular role and actively participates (Soyer, 2019)
5. *Charter School* - public schools operated independently of public-school systems (*Charter Schools in Georgia*, 2021)
6. *College and Career Performance Index* - the state of Georgia's educational accountability system (*Georgia Milestones Assessment System*, n.d.)
7. *Common Core State Standards* - high-quality academic standards that prepare students for college and career success (*Common Core State Standards Initiative*, 2021)
8. *Criterion Referenced Competency Test* - an academic test designed to measure the knowledge, concepts and skills of students (Cox, 2006)
9. *End of Course Test* - assessment taken at the end of a high school level course (Cox, 2006)
10. *Full Time Equivalency* - data collected on student enrollment for the purpose of providing educational services (Georgia Department of Education, 2020)
11. *Georgia Milestone Assessment System* - an assessment system designed to measure students' skills and knowledge as described in the state standards (Forte et al., 2017)
12. *Math achievement* - demonstrating proficiency in mathematics (Shanley et al., 2019)
13. *No Child Left Behind* - a 2002 update to the Elementary and Secondary Act (Klein, 2015)
14. *Positive Behavioral intervention and support* - evidence-based, three-tiered behavioral management system for schools (*Center on PBIS*, 2021)

15. *School Climate* - the quality and character of school life (*National School Climate Center*, 2021)
16. *Traditional Public School* - a free system of education to all children of the state. (Mewborn, 2017)

CHAPTER TWO: LITERATURE REVIEW

Overview

Educational researchers have long studied the impact of school-level structural characteristics on academic achievement. Researchers have attempted to explain why some students achieve at higher levels than other students and what variables influence these differences (Stewart, 2008). A variety of school-level factors have been identified as affecting students' achievement in all areas of academia such as school culture, school climate, school environment, school connectedness, and teacher qualifications. A review of literature was conducted to examine the effects that school type and school climate rating have on mathematic achievement. In the first section of the literature review, theoretical frameworks of ecology systems theory, expectancy-value theory and market theory provide a basis for understanding environmental and motivational elements that affect mathematic achievement. This section is followed by a discussion of related literature on the topics of school choice and public charter schools, school climate, and mathematical achievement and educational policy. Finally, the gap in literature will be identified and discussed using the aforementioned variables in the state of Georgia.

Theoretical Framework

The theoretical frameworks of this study provided insight into how theories of ecology systems, market theory, and expectancy-values could affect academic achievement, particularly, math achievement. In 1979 Bronfenbrenner developed the ecology systems theory which theorized that individuals were influenced positively or negatively by differing levels of environments. In 1983 John Eccles developed the expectancy-theory which stated that mathematics achievement was based on the expectancies and values that individuals held about

mathematics. Finally, in 1955 Milton Friedman began to relate the market theory to education, stating that parents should utilize freedom of choice to choose the schools their child attended, which should provide a competitive atmosphere for schools.

Ecological Systems Theory

Ecological systems theory is understood to be a human development theory in which all environments are analogous and context, culture, and history bind one's knowledge of human development (Darling, 2007). According to Bronfenbrenner's ecological model (1994), various ecological systems constructed an individual's environment. Each ecological system included positive and negative participation (Masten et al., 2008). These moments of positive and negative participation equated to experiences that contributed to an individual's development (Bronfenbrenner, 1994). Student development was constructed in surrounding levels of complex environments, also referred to as context or climate (Bronfenbrenner, 2004). Although ecological systems theory is known as a human development theory, it always described the individual as someone who influenced or was being influenced by the environment (Rosa & Tudge, 2013).

Bronfenbrenner (1917-2005) was a Russian psychologist who developed the ecology of human development (Bronfenbrenner, 1974, 1979b; Soyer, 2019). His early work was in response to demands by politicians for social policies applicable to children, adolescents, and families (Bronfenbrenner, 1973, 1979b; Rosa & Tudge, 2013). The ecology systems theory contributed significantly to the field of human development and led the way for the Head Start program in the United States (Soyer, 2019). Bronfenbrenner's work also contributed to interdisciplinary studies in human development (Ceci, 2006).

Bronfenbrenner's (1979b) ecological systems model included four environmental levels: (a) the microsystem, (b) the mesosystem, (c) the exosystem, and (d) the macrosystem. Each level

or system affected the individual differently (Onwuegbuze et al., 2013). Bronfenbrenner (1979b) described the ecology systems theory as comparable to Russian dolls, which nestled into each other (Abassian et al., 2020; Leonard, 2011). Bronfenbrenner regularly preceded the word "environment" with the introduction of "ecological" due to his belief that environment was intrinsically connected to inhabitants (Rosa & Tudge, 2013).

The microsystem was the most compact environmental layer. It was the setting that included a person's family, peers, school, neighborhood, religious institution, playground, recreation center, and friends' home (Abassian et al., 2020; Bronfenbrenner, 1979a; Christensen, 2010; Onwuegbuze et al., 2013). The microsystem was the most immediate environment that the individual interacted with daily (Christensen, 2010). The second environmental level of ecology was the mesosystem (Abassian et al., 2020; Bronfenbrenner, 1979a). This system identified relationships between two or more microsystems. Examples of mesosystems were family and school experiences or church and peer interactions (Bronfenbrenner, 1979b; Christensen, 2010). The characteristics of the mesosystem that were relative to development were similar to those of the microsystem. The main difference between the microsystem and the mesosystem was that activities and interpersonal roles and relationships occurred over several settings instead of within a single microsystem (Bronfenbrenner, 1979b; Rosa & Tudge, 2013,). The exosystem was the third environmental level (Abassian et al., 2020; Bronfenbrenner, 1979a). This system associates an individual's social setting in which the individual has no active participation with the individual's immediate context (Bronfenbrenner 1979a; Onwuegbuze et al., 2013). Finally, the macrosystem is the largest environmental system and it represents the societal culture in which an individual inhabits (Abassian et al., 2020; Bronfenbrenner, 1979b; Christenson, 2010). The macrosystem includes socio-economic status, poverty, ethnicity and cultural borders, laws

and rules (Bronfenbrenner, 1979b; Christensen, 2010). Macrosystems evolved over time and were shared by groups of the same cultural identity, heritage, and values (Bronfenbrenner, 1979a; Onwuegbuze et al., 2013).

The ecology systems theory differed from other development theories because it focused on development in a specific environment or context (Bild, 1986). Ecology systems theory could be applied to varying ages, spheres, and types of analysis. However, it was a theory that theorized the individual's ability to gain knowledge from his or her daily behavior (Smith & Thelen, 1994).

Bronfenbrenner's ecology systems theory evolved into the bioecological theory. Bronfenbrenner introduced a fifth level of the ecological systems theory in order to update its composition (Drankenberg & Malmgren, 2013). The fifth level and newest level was the chronosystem. The chronosystem was comprised of the aspect of time as it related to an individual's environment (Drankenberg & Malmgren, 2013). The new version of Bronfenbrenner's theory granted status to proximal processes which were the developmental processes between individual and environment interactions (Bronfenbrenner, 1994, 1995, 1999, 2000, 2001; Bronfenbrenner & Ceci, 1993,1994; Bronfenbrenner & Morris, 1998, 2007) and included the process-person-context-time model. This model informed how to conduct bioecological research (Bronfenbrenner, 1995, 1999, 2000, 2001; Bronfenbrenner & Morris, 1998, 2007). The bioecological theory stated that proximal processes were the best predictor of human development (Bronfenbrenner, 1994, 1999, 2000; Bronfenbrenner & Ceci, 1993, 1994; Bronfenbrenner & Evans, 2000; Bronfenbrenner & Morris, 1998). Proximal processes became the motivation behind human development (Rosa & Tudge, 2013).

Each of the five ecological systems have had different measures, precedents, and policies which configure student perspectives (Abassian et al., 2020). Students' impressions of their environment were more influential on development than physical existence and critically affected their academic, social, and emotional development (Arslan, 2016; Bronfenbrenner, 1979a). Studies have demonstrated that a negative school environment could diminish a student's ability to feel safe at school and succeed academically (Arslan, 2016; Drankenberg & Malmgren, 2013; Leonard, 2011). Conversely, a positive school environment was a strong predictor of student development and success (Arslan, 2016; Leonard, 2011). Bronfenbrenner's ecological systems theory (1979) described the microsystem of the school environment more precisely (Cipriano et al., 2018). Bronfenbrenner's ecology system theory (1979a) demonstrated how school and classroom environment could influence the academic achievement of students and thus, influenced specifically, the student's future mathematical achievement as well as their career path choices.

For the purpose of this study, the context of school environment, represented by school type and school climate, will be designated as a microsystem to determine the differences in development of students' mathematical achievement from Bronfenbrenner's ecology systems theory. When the school environment is a positive one, students should be able to thrive in that setting academically, thus having positive mathematics achievement. When the environment is a negative one, students will most likely be tense, stressed, overwhelmed, and not doing well academically, thus having slow or complacent mathematics achievement.

Expectancy-Value Theory

The expectancy-value theory (EVT), developed by Eccles et al. (1983) extended a framework to explain achievement-related behaviors and choices. The theory was a cognitive

approach that described how individuals participated in activities that were highly valued and in which they expected to succeed (Lauermann et al., 2017; Sullins et al., 1995). The expectancy-value theory (EVT) provided the foundation to predict achievement-related choices and behaviors. These choices included academic success and the inquiry into advanced educational opportunities and career pathways (Eccles, 2005, 2009; Wang, 2012; Watt et al., 2012). Additionally, EVT was suitable to analyze academic and career-focused beliefs, given it has had a general focus on processes and beliefs that could be applied to many life domains and behaviors (Lauermann et al., 2017; Sullins et al., 1995).

The expectancy-value theory was initially developed to explain the gender difference in high school mathematics courses (Watt et al., 2019). High school years were important to study as they determined disparities in STEM fields for career paths (Watt et al., 2016). The beliefs, choices, and success of high school students' mathematics could provide an understanding of the career choices of students beyond the high school years (Watt et al., 2017). There has been much research focusing on EVT motivation in mathematics (Lazarides et al., 2016, 2018; Lazarides & Dietrich, 2019). Self-concept and values played a crucial role in students' decision to choose challenging mathematics courses that were above their mathematical ability (Crombie et al., 2005; Meece et al., 1990; Updegraff et al., 1996; Watt, 2006; Wigfield, 1994). According to Priess-Groben and Hyde (2016), mathematics achievement could be understood based on the values that people had about mathematics. There was growing evidence that mathematics achievement in the high school years could directly or indirectly predict math achievement and a STEM career path in university students (Guo et al., 2015).

The development of expectancies and values in a specific domain was influenced by many factors (Sullins et al., 1995). Socio-culture was the combination of social and cultural

factors and it had a significant impact on the motivation and values of students (Loh, 2019). It affected students' personal and social identities which affected their cooperation and commitment to their school work. This in turn affected students' dispositions about academic achievement and finally, career pathways (Loh, 2019). Loh (2019) also found that the roles of social agents such as teachers and peers had a significant impact on the academic motivation among students.

Research has found that teachers and learning environments have had a joint influence on the development of motivational beliefs (Eccles & Roeser, 2005). The climate that students perceive in the classroom was affected by the fairness and friendliness of the teacher. Students who reported that their teachers were fair, caring, and respectful, benefited from motivation and academic achievement (Eccles et al.,1993; Skinner & Belmont, 1993; Wang & Eccles, 2012; Wentzel, 1998). Negative stereotypes and challenges might weaken the value of schooling for students (Archambault et al., 2010). Loh (2019) stated that a supportive learning environment helped students to be consistent in having a positive and successful expectancy and value towards academic achievement. Some of the factors that influenced students' environments were class size, faculty contact, institution size, student-teacher ratio, student concern, student cooperation, a high expectation for academic success, a supportive community, and effective teaching (Sullins et al., 1995). All of these sociocultural factors influenced students' particular outcomes and personal expectations of success. When the positive forces outweighed the negative forces, a student would most likely choose to commence ~~in~~ with a particular academic task (Sullins et al., 1995).

While adults have had the opportunity to choose their courses and academic pathways, students in K−12 have limited options. Their general course of learning and curriculum was

decided by the state and national governments. Students were exposed to regular assessments and competitive learning environments as well as comparisons to peers in their own school, state, and nation (Loh, 2019). This was especially true in areas of learning deficiencies such as mathematics (Archambault et al., 2010).

Bronfenbrenner's ecological-systems theory stated that the microsystem that was closest to the students affected students the most. When that microsystem of the classroom and school was positive, the students would establish a system of motivational beliefs that would affect their work ethic and academic achievement. The student was more likely to make choices to succeed academically, pursue a more challenging career, and possibly go into a mathematics or STEM-related career field (Eccles, 2005, 2009; Wang, 2012; Watt et al., 2012). The expectancy-value theory (1983), along with Bronfenbrenner's ecology system theory (1979b), demonstrated how the school and classroom environment, also known as the microsystem, could influence the mathematical achievement of students. This microsystem influenced the student's future mathematical achievement as well as their career path choices.

Market Theory

Market theory is an economic theory that states that citizens make voluntary exchanges of money, goods, and services based on their personal preferences. If the freedom of exchange was truncated by government regulations and taxes, then citizens were worse off (Walberg, 2000). If personal preferences such as food, healthcare, entertainment, travel, and education contrasted with others, then individuals should be able to spend their money to suit their own preferences (Walberg, 2000). Walberg (2000) stated that the fundamental assumption of market theory was rational choice, especially individual choice over government. Market theory reveled in the idea of people using common sense and arranging their transactions and affairs to get the

most of what they value while lessening their costs, risks, and efforts (Walberg, 2000). This common-sense idea created a competition to increase the supply of high-quality goods and services. Hoxby (2003) explained that competitive pressures lead to quality improvement.

Market theory could be found in every area of life, but was largely absent in the public education system. The results of no competition in the schools could be seen in the academic achievement of students, especially students from urban areas (The Center for Education Reform, 2021). In the United States, the traditional public school system was a monopoly paid for by taxes (Merrifield, 2001). Families paid taxes that financed the traditional public schools in their district whether they attended those schools or not. If families were displeased with the local school district, then they had the option to move locations, or go to a private school, all the while, continuing to finance the local public school indirectly through their taxes (DeAngelis & Erickson, 2018). This left little motivation for the traditional public school to improve or innovate in order to meet the needs of the local families and students (DeAngelis & Erickson, 2018).

School choice programs lessened the monopoly that traditional public schools have had and increased the overall quality levels of education (Chubb & Moe, 1990, Friedman & Friedman, 1990). School choice drove quality of service through competition between schools and by giving parents multiple choices in schools (Reform, 2011). The competition factor attracted high- quality schools to open and forced low-quality schools to improve or close (DeAngelis & Erickson, 2018). The economic principle of market theory implied that schools will have to improve their outcome to maintain their student population and attract new students (Anderson et al., 2018). It gave parents the right to make choices about their children's education based on the needs and interests of the children, instead of being forced to attend a school based

on the location of their home (The Center for Education Reform, 2011). It forced accountability of the schools, and quality in education (The Center for Education Reform, 2011) Additionally, market theory claimed that increased school choice would produce autonomy, innovation, competition, and increased satisfaction and outcomes (Chubb & Moe, 1990; Handlin, 1963; Hess, 2002).

Friedman (1955) is believed to have started the national conversation about school choice in his essay, *The Role of Government in Education* (Grube & Anderson, 2018). Friedman suggested that education not only benefited the student and their parents, but society as a whole. A stable society was impossible without a minimum amount of education and values. Thus, there needed to be some governmental mandates and financial resources to set minimal education standards for all schools, however, the government should not be able to nationalize education (Grube & Anderson, 2018). Friedman's idea of school choice was centered around the idea of freedom to choose whichever school was best for the individual student (Friedman, 1962).

Market theory anticipated that students who chose charter schools would have greater achievement gains because the parents had the choice of choosing a school that best fits their children's needs (Berends, 2015). Additionally, parents who make informed decisions about their child's schools will choose schools that are more innovative, mission-driven, and have better school climate and culture (Berends, 2015).

Bronfenbrenner's ecological-systems theory is the overarching theory that will drive the research. Expectancy-value theory and market theory are supporting frameworks that show the results of a positive or negative school climate and environment. If the environment of the school and classroom is not positive (ecological-systems theory), then it will affect the students and their academic decisions, future educational opportunities, and career pathways (expectancy-

value theory). The environment of the school and classroom along with the students' adopted motivational belief system and academic success will also affect the parents' decisions as to where their students should attend school (market theory). The market theory framework will lead to the highest academic achievement possible for students.

Related Literature

School Choice and Charter Schools

School choice has been a disputatious subject in education and politics for many decades and is still a matter of on-going debate (Abdulkadiroglu et al., 2015; Mawene & Bal, 2018). School choice arguably propels schools to compete for students, thus improving the quality of education (Abdulkadiroglu et al., 2015; Betts & Tang, 2018 DeAngelis & Erickson, 2018; Foreman, 2017; Jabbar et al., 2019; Zimmer et al., 2019). School choices that are available to families include traditional public schools, charter public schools, private school, and homeschool (Mawene & Bal, 2018). In 2015, private schools accounted for 10.2% of student enrollment and homeschool accounted for approximately 1.7% in 2016 (Wang et al., 2019).

Another option for families was intra-district and inter-district school choices (Han & Keefe, 2020). Some districts have systems where families could attend another school in the district if they were scheduled to attend an underperforming school (Han & Keefe, 2020). In 2017 there were 23 states with mandatory inter-district school policies and 19 states with mandatary intra-district school policies (Han & Keefe, 2020). These policies allowed families to choose a better performing school within the district than the one that they were scheduled to attend. Other policies allowed families to attend a better-performing school in a neighboring district rather than the school they were scheduled to attend. However, this could cause difficulties for some families as transportation was not always available to travel to better-

performing schools. Discounting virtual education and homeschooling, public charter schools and private schools are the two preeminent alternatives to traditional public schools (TPS) to which families have access (Schwalback & DeAngelis, 2020) in the United States.

Other options for school choice were available in helping families indirectly be able to choose schools. A voucher program takes some of the funds allotted for the student to go to public school and allowed the parents to use the funds to send the student to a school of their choice. There were 28 voucher programs in sixteen states that served 230,000 students (The Center for Education Reform, 2021). However, voucher programs were restricted for some families depending on where they lived and their income. In a 2019 study of the Milwaukee Parental Choice Voucher Program, it was found that students who attended the voucher program had lower rates of criminal activity and were more likely to attend and graduate college (The Center for Education Reform, 2021). Students attending school on a voucher in the ninth grade in 2006 were 4 percentage points more likely to enroll in any type of college by 2017 (Wolf et al., 2019).

Tax-credit scholarships were another avenue for school choice. Individuals and businesses received a tax break if they contributed to organizations that financially helped families pay for their children's education. Twenty-four tax credit scholarship programs served 300,000 students in 19 states (The Center for Education Reform, 2021). Most tax-credit scholarships were limited to low-income families to help them receive the same school choice opportunities that wealthier families received (The Center for Education Reform, 2021). A study from Urban Institute found that 57% of students in Florida who were a part of the tax-credit scholarship were more likely to graduate from college versus 51% of students who were not in the tax-credit program (The Center for Education Reform, 2021).

Charter schools appeared to be a leading option of school choice (Goodridge, 2019). Over 7,000 charter schools in the United States serve 3.2 million students. Charter schools were located in 45 states in addition to Washington D.C. and Puerto Rico (Schwalback & DeAngelis, 2020). This was tremendous growth from the first charter school that opened up in 1992 in St. Paul, Minnesota (National Center for Educational Statistics, 2019).

Charter schools, also known as public schools of choice, were public schools where the families were not assigned to attend based on location (Schwalbach & DeAngelis, 2020). Charter schools were government-owned, but privately operated and possessed an autonomy that Traditional Public Schools (TPS) did not. These autonomous structures gave charter schools the catalyst and adaptability to confront issues that TPS struggled to meet such as safety priorities, safety strategies, and student behavior (Cheng et al., 2015). Charter schools utilized a lottery-based or open enrollment policy depending on the enrollment demand and capacity of the school. Charter schools were federally funded, and, therefore, must comply with federal education laws such as safety, special education, and civil rights laws (DeAngelis, 2020; Schwalback & DeAngelis, 2020). Due to charter schools being federally funded, this was a good option for families who had limited resources, yet wanted a better education for their children (Han & Keefe, 2020).

One of the prominent differences between charter schools and TPS was flexibility (Holley, 2021). Both the public charter schools and the TPS were open to the public and were regulated in different ways, but the charter schools had more flexibility and therefore could make faster progress than the TPS (Holley, 2021). The regulatory structures of the two schools were vastly different. The TPS had to pass everything through the local school district board of education. This could take time as the local board of education usually oversaw many schools in

the district and had to deal with the bureaucracy (Holley, 2021). This could make it difficult to pass more progressive measures for instruction and resources. Charter schools also had to have a board. However, the board for charter schools were usually independent and worked closely with the school leaders (Holley, 2021). Charter school boards did not have the red tape and bureaucracy that TPS have had. This leads them to be able to make decisions much quicker than TPS (Holley, 2021). The board of charter schools, although they could move faster on decisions, still had to uphold the charter agreement that was made with the state (Holley, 2021).

Another difference between charter schools and TPS was how the school received funding. Both schools were considered public schools and received funding. Charter school funding could vary depending on what state they were located in. Some schools received funding that was agreed upon by the school district that sponsored the school (Holley, 2021). Some charter schools received funding the same way that TPS did, by the number of students attending. Most charter schools also received private funding. Private funding was necessary because public funds could not be used for the school facilities. Therefore, private funds were needed to offset the public funds received for instruction and resources (Holley, 2021).

Enrollment and admission were other ways that charter schools and TPS differed. Both types of school had open admissions that was free to the public. However, charter schools had a cap on the number of students they could enroll whereas TPS did not have a limit of students they could enroll. This could lead to oversized classes and overworked teachers in the TPS (Holley, 2021). With the charter schools' cap on their enrollment, class sizes remained at an optimum number and students should be given the attention needed. Charter schools would usually have open enrollment unless the demand was greater than the number of enrollment

spots. If this was the case, then charter schools would usually implement a lottery system to decide who would be given the opportunity to enroll (Holley, 2021).

Finally, the learning programs were different in the charter schools and TPS. Due to the charter schools' flexibility, they have been able to get ahead of the curve when it comes to online education. Many charter schools have had online and individualized programs that helped the students be successful. They have had online classes for years and were not taken by surprise by the Covid-19 lockdown (Holley, 2021). Traditional Public Schools have been trying to master the online school platform since Covid-19 and have been trying to work out all the kinks as they were not prepared to transition to online instruction. Traditionally, TPS used face-to-face instruction, hands-on activities, group work, projects, etc., for their instruction and had had to transition to online instruction quickly (Holley, 2021).

A fundamental position on school choice was that parents could make wise school decisions (Abdulkadiroglu et al., 2017). Choosing an alternative to TPS could be a challenging and daunting task. Preparation and assistance were necessary to make the best possible decision. There were several documented reasons why parents chose charter schools for educational services. Safety was one of the top three considerations for 36% of families in choosing an alternative to TPS (Bedrick & Burke, 2018). Maslow (1943) suggested that outcomes such as academics and citizenship training could not be prioritized until the fundamental need for safety was met. Over the past three decades, school choice has broadened in urban areas where crime and violence are prevalent (Brinig & Garnett, 2012; Epple et al., 2016; Viteritti, 2014). Cities and urban areas house 57% of charter schools (Han & Keefe, 2020). Students who resided in these areas were more likely to be regionally assigned to an unsafe TPS. Parents could choose an

alternative source of education, such as charter school, in order to keep their children safe (Erickson, 2017; Prieto et al., 2018)..

Several studies have suggested that school choice could improve safety and school climate (DeAngelis et al., 2020; DeAngelis & Wolf, 2019; Deming, 2011; Dills & Hernadez-Julian, 2011; Dobbie & Fryer, 2015; McEachin et al., 2020). In a recent study conducted by Hamlin and Li (2019), results showed that there was a large descriptive difference in incidents of crime and violence between public charter and traditional public schools with an average of 41 incidents in traditional public schools and 17 incidents in public charter schools. These statistics were derived from five years of the School Survey of Crime and Safety conducted by the United States Department of Education. A safer school environment has also been connected to better academic achievement (Kutsyuruba et al., 2015). Barrett (2003) suggested that safety was key to a healthy classroom environment. If students did not feel safe, student academic performance would decrease.

Discipline was another reason for choosing a charter school. Georgia families listed school safety and improved student discipline as the top two reasons for choosing alternative education (Kelly & Scafidi, 2013). Nineteen percent of schools in the United States found that the government's policies on discipline limited their ability to reduce crimes (DeBray et al., 2019). Charter schools had autonomy with discipline policies and could effectively reduce crime and safety problems (Shakeel & De Angelis, 2016).

Garen (2014) suggested that school choice should help address discipline issues in schools. School discipline policies were usually passed and handed down to the school districts by the state government. These policies varied from state to state. Rules and regulations addressed in-school-suspension (ISS), out-of-school suspension (OSS), expulsion, and restraint.

State disciplinary laws also addressed serious issues such as weapons, truancy, bullying harassment, and chronic disciplinary issues. Many of the rules were a fixed zero-tolerance policy and required a mandated punishment regardless of circumstances that may surround the offense. Discretion was not a part of the discipline process. Not only did states pass these laws, but they also governed the monitoring process and held each school accountable for its discipline reporting. States monitored aspects of discipline such as parent notifications, police involvements, and school records that indicated disciplinary action. In the state of Georgia, the number of disciplinary write-ups factored into the school's grade. There was a large bureaucratic approach to discipline in the schools, restricting the schools from modifying the rules and maintaining local control regardless of the location of the school or the specifics of the school. Some said the lack of discretion was creating a direct pipeline from school to prison (Garen, 2014).

Edmonds (1979) suggested that schools needed to be effective in maintaining safe and secure school environments without being rigid. The question was how to maintain order in each school when each school was so different. Schools were located in different locations in the state and catered to different demographics (Garen, 2014). It became apparent that schools should have some autonomy in the discipline process at the local level.

Charter schools have had autonomy in the discipline process at their individual schools. Charter schools were usually exempt from disciplinary standards, although there were still some state and federal disciplinary laws that they had to follow (Garen, 2014). Charter schools might design their own discipline standards. Imberman (2011) reported that charter schools had less disciplinary referrals and attendance issues than the TPS. This created a competitive edge for charter schools. Schools received funding for each student who sat in their classrooms. If charter

schools could apply their autonomy to utilize discretion in the discipline process and create a school environment and climate that had less discipline and attendance issues, then parents were inclined to send their students to a school of such caliber. The money followed the students, giving the charter schools more funding and giving the students a better academic experience (Garen, 2014).

Charter school competition was a term that was often used to describe the competition that charter schools and TPS had with one another (Han & Keefe, 2020). This included academic achievement, student enrollment, and economics. Proponents of charter schools claimed that they created an environment that shocked the TPS into improving the students' educational experience and academic achievement (Han & Keefe, 2020). However, there were studies that could not completely substantiate those claims. States that have seen a positive impact on TPS student achievement due to charter schools were Arizona (Hoxby, 2003), Michigan (Hoxby, 2003), Massachusetts (Ridley & Terrier, 2018), and Texas (Bohte, 2004). Other studies that were conducted showed that charter school competition produced no effect on TPS. Those studies were conducted in California (Zimmer & Buddin, 2009), Chicago, Denver, Milwaukee, Philadelphia, San Diego, Ohio, Texas, (Zimmer et al., 2019), Michigan (Bettinger, 2005), and New York City (Winters, 2012). Some studies demonstrated mixed effects of charter school competition. These were conducted in Florida (Sass, 2006) and North Carolina (Bifulco & Ladd, 2006; Holmes et al., 2003). Finally, negative effects of charter school competition on TPS have been reported in Ohio (Carr & Ritter, 2007) and in Michigan (Ni, 2009).

According to Goodridge (2019), student outcomes from the charter sector varied considerably as well. There was a lack of compelling evidence on academic gains among charter schools versus TPS (Goodridge, 2019). The Center for Research of Education Outcomes (2019)

found that 23% of charter schools underperformed TPS on improving reading test scores and 32% of charter schools underperformed TPS on improving math test scores (DeAngelis, 2020), although the results differed according to school year grade level, location, and demographics (DeAngelis, 2020). The Center for Research of Education Outcomes (2019) also found that public charter schools in Pennsylvania had 4% of a standard deviation increase in reading scores and no difference in math scores. Despite the lack of evidence that charter schools outperformed TPS, charter school enrollment is still growing (Goodridge, 2019; National Center for Educational Statistics, 2019; Schwalback & DeAngelis, 2020). Some scholars believed that the growth was due to factors other than academic achievement, as evidenced by performance on standardized assessments. Some families did not have sufficient information about the schools and their educational outcomes (Harris, 2017), and some families might experience excessive information about school choice (Greifeneder et al., 2010). Lubienski (2007) suggested that some charter schools might only advertise their positive qualities and withhold information about their least attractive qualities. Families might also choose a charter school based on other qualities such as moral education, location, discipline, demographics, teacher-to-student ratio, and safety (Abdulkadiroglu et al., 2017; Altenhofen et al., 2016; Catt & Rhinesmith, 2017; Erickson, 2017; Prieto et al., 2018).

There have been scores of research on school choice programs and they showed that when students were allowed to attend the school of their choice, it boosted their chances for academic success (The Center for Education Reform, 2021).

In 2021 the National School Choice Poll sponsored by the American Federation for Children found that there was strong support for school choice among politicians of both parties and minorities (The Center for Education Reform, 2021). Sixty-five percent of parents of K−12

students were fully supportive of school choice programs including 66% of public-school parents. Additionally, 72% of parents who worked full-time and had middle or high school students were fully supportive of school choice programs (The Center for Education Reform, 2021). In the political arena, bipartisan support was evident. Eighty-two percent of Republicans supported school choice while 69% of Independents and 55% of Democrats supported school choice programs (The Center for Education Reform, 2021). African-Americans and Latinos were eager about the school choice programs, with 74% of African-Americans and 71% of Latinos supporting school choice (The Center of Education Reform, 2021). In fact, the charter school option of school choice served more minority students and more low-income students than district schools (The Center for Education Reform, 2021). White and Snydman (2021) stated that charter schools served 68.7% of minority students while the local school districts served 52.4%. The same was true for economically disadvantaged students. Charter schools served 59.3% of student who were economically disadvantaged while the local school districts served 54.3%.

School choice has proven to be beneficial for students with disabilities as well. In one study, students with disabilities in the Florida McKay voucher program were surveyed. They reported that only 30% of students with disabilities received all their federally mandated accommodations and services from their public school. However, 86% of students with disabilities reported that they received all of their federally mandated accommodations and services from their school of choice (EdChoice, 2021).

A study conducted by Harvard Scholars and published by Peterson (2020) found that most voucher and tax credit programs have had a positive effect on academic achievement. Some studies have reported null effects of voucher and tax credit programs. Parental satisfaction of school choice programs such as vouchers and tax-credit programs were substantially higher than

the satisfaction of parents assigned to the local district school. Schools in the choice program have been reported to adapt more quickly to adverse situations such as Hurricane Katrina and Covid-19. Positive or null effects on civic values such as political tolerance, participation, knowledge and skills, volunteering, and social capital have been reported for students who attended a private school with or without school choice programs (Peterson, 2020).

School Climate

School climate is a multi-dimensional and complex construct (Maxwell et al., 2017). School climate has been defined as the physical, academic, and social environment that schools cultivated. It has also been defined as the unrecorded setting of the school including patterns, values, and expectations (Brookover et al., 1978; Haynes et al., 1997, Maxwell et al., 2017; Petrie, 2014). More specifically, school climate has been defined as the "quality and character of school life" (Cohen et al., 2009, p. 182). School climate has been researched by many (Bear et al., 2014; Brand et al., 2008; Brookover et al., 1978; Chen & Weikart, 2008; Cohen et al., 2009; Collins & Parson, 2010; Epstein, 1991; Epstein et al., 2002; Haynes et al., 1997; Johnson & Stevens, 2006; Lubenski et al., 2008; Petrie, 2014; Reyes et al., 2012) and focused on the "psychosocial school atmosphere, and the inter-group interactions that affect student learning and school functioning" (Maxwell et al., 2017, p. 2). However, due to the agglomeration of definitions and descriptions of school climate, confusion has limited the research process and school climate has been inadequately measured on a consistent basis (Hoy & Hannum, 1997; Lee et al., 2017; Thapa et al., 2013). Assorted scales and sub-scales have been used to research and measure school climate thus giving various results about the construct (Maxwell et al., 2017). Despite the impediment, three sub-factors of school climate have consistently presented themselves in the literature and measuring scales, thus bringing some clarity to the construct

(Maxwell et al., 2017). The first was a school's academic focus; "the extent to which a school is driven by a quest for academic excellence" (Hoy et al., 1993, p. 71). Second was the consistency and quality of personal relationships within the school (Haynes et al., 1997). Finally, the last was the common and accepted behavior, norms, goals, and values within the school (Frederickson, 1968).

The difference in academic achievement among schools has been attributed to the school climate rating when other factors such as socio-economic status had been filtered out (Brand et al., 2008; Collins & Parson, 2010; Hoy & Hannum, 1997). Brookover et al. (1978) did a study that created the student-climate-achievement relationship. The authors found that school climate attributed to a significant amount of the school variance in academic achievement. Other studies conducted later supported these findings (Goddard et al., 2000; Heck, 2000; Thapa et al., 2013). After controlling for socio-economic status, Hoy and Hannum (1997) and Tschannen-Moran et al. (2006) found that positive school climate was significantly associated with academic achievement. In contrast, Chen and Weikart (2008) found that a negative school climate was associated with lower participation in school activities and student learning.

School climate was measured by the unique perspectives of students (Fan et al., 2011), school staff (Bear et al., 20114; Brand et al., 2008; Johnson & Stevens, 2006), school administration (Brookover et al., 1978) and families (Esposito, 1999). The particular groups reported their perspective of the school climate because each group perceived the school climate differently based on their role at the school (Maxwell et al., 2017). Students tended to rate teacher-student relationships more negatively (Raviv et al., 1990). Students were also more conscious of school-level factors whereas teachers were more conscious of classroom-level factors (Mitchell et al., 2010; Wang & Eccles, 2012). The individual perspectives of each party,

in the state of Georgia, were all documented through annual surveys. The results of all the surveys were collected along with data from discipline and attendance. The results were calculated and translated into a numerical grade. The grade was then translated into a rating of 1−5. The translation of the grades were as follows: 1 = (school grade < 71.2), 2 = (71.2 ≤ school grade < 77.3), 3 = (77.3 ≤ school grade < 83.4), 4 = (83.4 ≤ school grade < 89.5), and 5 = (school grade ≥ 89.5).

Ecological systems theory is a roadmap to school climate factors. School climate is not limited to the classroom specifically. All areas of a school building were examined in the Georgia Student Health Survey and were considered factors in the school environment. Although the classroom environment was important, the surrounding environments of the classroom such as the media center, the cafeteria, the hallways, outside areas, and facilities were all important in the process of self-development for students. The relationships that students build within the school building also contributed to their perceived school climate (Arifin & Mat Teh, 2019).

The largest impact on student learning outcomes was the teaching staff (Heck, 2000; Lindjord, 2003; Schacter & Thum, 2004). Strong teacher-student relationships (Crosnoe et al., 2004; Tschannen-Moran et al., 2006) along with academic emphasis (Hoy & Sabo 1998) and academic optimism (Smith & Hoy, 2007) influenced academic achievement. All of these factors were teacher-led. Studies have shown that the teacher's perception of the school climate as a working environment affected the student's outcomes (Esposito, 1999; Moos, 1987). Additionally, Johnson and Stevens (2006) conducted a study that found that teachers' perception of school climate positively impacted standardized test scores. More specifically, Brand et al. (2008) conducted a study on the impact of staff climate perception on student academic achievement. The authors found that school climate perceptions were significantly associated

with the reading and mathematics scores of eighth-grade students. The authors also found that teachers' school climate perceptions were significant predictors of a students' GPA and academic efficacy.

Researchers, school administration, and staff have concentrated on the role of positive school climate in implementing school-wide improvement for students and teachers (US Department of Education [USDoE], 2015). Leadership style, student expectations, community, and a variety of outcomes are collectively influenced by school climate (Goddard et al., 2000; Gottfredson et al., 2005; Sweetland & Hoy, 2000). Funding was granted in 2014 to state and local education agencies that created safe schools, a positive school climate, and positive academic outcomes for students. This funding was made possible through the School Climate Transformation Grant (SCTG) (VanLone et al., 2019). In 2015, Congress passed Every Student Succeeds Act (ESSA) and directly mentioned school climate as a major component for successful schools and states were required to provide data on school climate in their annual reports (VanLone et al., 2019).

The US DOE created a school climate model that included several domains with 13 subdomains. The domains included safety, engagement, and environment (Hampden-Thompson, & Galindo, 2016; VanLone et al., 2019). Under the domain of safety, the subdomains included emotional and physical substance abuse, bullying, and emergency readiness management. This domain referred to the extent of physical safety in the school and social-emotional support for students (Hampden-Thompson & Galindo, 2016; VanLone et al., 2019). The subdomains under the domain of engagement were cultural and linguistic competence, relationships, and participation (VanLone et al., 2019). This domain alluded to teaching and learning, instruction quality, leadership, professional development, respect for diversity, and collaboration (Hampden-

Thompson, & Galindo, 2016; VanLone et al., 2019). Finally, the third domain of environment included the subdomains of physical and instructional environments, physical and mental health, and discipline (VanLone et al., 2019). This domain implied a clean and suitable space as well as resources for learning (Hampden-Thompson & Galindo, 2016; VanLone et al., 2019). The domains and subdomains were used as an effective way to improve school climate (VanLone et al., 2019).

School climate has been identified as a leading predictor of students' emotional, behavioral and academic outcomes (Brand et al., 2008; Brookover et al., 1978; Maxwell et al., 2017). Mental health (Brand et al., 2003; Roeser et al., 2000), self-esteem (Way et al., 2007), student aggression and bullying (Espelage et al., 2014; Turner et al., 2014), student criminal activity (Gottfredson et al., 2005), and drug and alcohol abuse (Brand et al., 2008) all have been found to influence school climate.

Math Achievement

Mathematics is one of the essential content areas that consume students' educational performance and their future career paths (Shariff Saki et al., 2014). The content of mathematics has attracted world-wide attention as the demands for proficient mathematicians were recognized world-wide. Mathematics has become so important over the years that the United Nations Educational, Scientific and Cultural Organization (UNESCO) named 2000 the year of mathematics. The International Association for Evaluation of Educational Achievement (IEA) has explored mathematic performance in many countries around the world (Sharifi Saki et al., 2014). In many Western countries, there has been a continual shortage of students choosing careers in the fields of math, science, technology, and engineering (STEM) (Piesch et al., 2020).

Success in the area of mathematics has been identified as a factor for positive outcomes and accomplishments in the future such as educational success, career success, and leadership roles (Lubinski et al., 2014). According to Adelman (2006), in a United States Department of Education report, the successful completion of an advanced math class in high school was the greatest predictor of a student's ability to acquire a bachelor's degree. However, according to the National Center for Education Statistics (2019), the United States was behind other countries in mathematical achievement.

Every four years, an international comparative study called The Trends in International Mathematics and Science Study (TIMSS) is conducted to measure the trends in mathematics and science of countries around the world (National Center for Education Statistics, 2019). TIMSS was designed to broadly reflect the mathematics and science curriculum in 4th grade and 8th grade that is taught across international lines, to provide valuable information on how students compare in mathematics and science achievement across the world. The scores are on a scale of 0−1000. The United States has participated in every TIMSS study since 1995 (National Center for Education Statistics, 2019). The last study conducted was in 2019. During the 2019 study sixty-four countries participated at the 4th-grade level and 46 participated at the 8th-grade level.

In 2019, the United States average score for 4th graders was 535. The score was 15th among the 64 participants at the 4th-grade level. Fourteen countries scored higher than the United States and 42 countries scored lower than the United States. The United States score was not significantly different than the average scores of students in seven other countries. Average scores for 4th-graders in the TIMSS ranged from 297 to 625 (National Center for Education Statistics, 2019). The lowest score was from the Philippines while the highest score came from Singapore.

In the 2019 study of 8th-grade students, the United States scored an average score of 515. This was 11th among the 46 countries participating in the study. The United States scored higher than 28 countries and lower than 10 countries. The average score ranged from 388 in Morocco to 616 in Singapore (National Center for Education Statistics, 2019).

The TIMSS scores for the United States have increased over time, but there has not been a significant increase from the last administration of the TIMSS which was in 2015. From the 1995 administration of the TIMSS to the 2019 administration of the TIMSS on the 4th-grade level, the United States score increased from 518 to 535. From the 2015 administration of the TIMSS to the 2019 administration of the TIMSS, the United States score decreased from 539 to 535.

On the 8th grade level, the score for the United States increased 23 points, but the score between 2015 and 2019 was not significantly different. From the 1995 administration of the TIMSS to the 2019 administration of the TIMSS, the United States increased its score from 492 to 515. From the 2015 administration of the TIMSS to the 2019 administration of the TIMSS, the United States decreased from 518 to 515 (National Center for Education Statistics, 2019).

The National Center for Education Statistics administers another assessment nationally. This assessment is similar to TIMSS in that it measures mathematics at the 4th grade and 8th grade levels. The assessment is the National Assessment of Educational Progress (NAEP). The NAEP is an assessment that is mandated by Congress. It is the largest assessment given nationally to assess students' knowledge in select subjects and it is scored on a range of 0−500 (National Center for Education Statistics, 1992). The test does not change from administration to administration, so it allows for accurate and reliable data to view American students' progress over time. The first administration of the NAEP was in 1990. The NAEP is administered

digitally as well as on paper. The results of the NAEP are published as a score for the overall nation and for individual states (National Center for Education Statistics, 1992).

The state of Georgia scored a 216 on the 4th grade level in 1992 at the first administration in which it participated. The national score in 1992 was 219. In 2017, Georgia students scored 236 while the national average was 239. In 2019, Georgia students scored 238, while the national average was 240. On the 8th grade level in 1990, Georgia students scored 259, while the national average was 262. In 2017, Georgia students scored 281 while the national average was 282. Finally, in 2019 Georgia students scored 279 while the national average was 281 (National Center for Education Statistics, 1992). As a nation, the United States was far behind several countries in mathematics. Even more so, the state of Georgia was behind other states in their mathematics scores.

The National Math Advisory Panel (2008) stated that American students would not be able to compete on an international scale in mathematics based on the data from the NAEP. Students who went to college and were required to take remedial math classes jumped in 2008 from 25% to 40% (Bahr, 2008). Additionally, the number of students who were going into STEM-related fields were not as significant as in other countries (Lowell & Salzman, 2007).

Educational Policy

In 1965 the Elementary and Secondary Education Act (ESEA) was passed by President Lyndon Johnson's administration. The ESEA allowed the federal government to be involved in education policy from K−12 grade. The ESEA also offered a collective $1 billion a year to schools that serviced disadvantaged students. This was the beginning of Title 1 schools. The ESEA has been updated many times, allowing for more of a federal role in education (Klein, 2015).

In 2002 President George Bush signed into law the No Child Left Behind Act (NCLB), replacing the ESEA. This law stemmed from a concern that American students were no longer academically competitive on the international stage. This law gave the federal government more control over the accountability of schools and the academic achievement of their students. More specifically, the NCLB focused on increasing the academic achievement of specific student groups that were typically known for having low academic achievement. These specific student groups included English-language learners, special education students, economically disadvantaged students, and minority students. States had to test their students in grades 3 through 8 and then once while students were in high school. The results were reported to the state for the whole student population as well as the specific student sub-groups. The goal was to get 100% of all the students, including the student sub-groups, to a proficient level. However, in 2015, which was the deadline, not one state had reached the goal (Klein, 2015).

NCLB kept schools accountable by a process known as Adequate Yearly Progress (AYP). AYP was the federally mandated target of proficiency. If a school missed AYP two years in a row, they had to allow their students to transfer to a better performing school which became known as school choice. If the school missed AYP three years in a row, the school had to offer free tutoring. Schools that missed AYP and were at the point of offering school choice or free tutoring had to set aside 10% of their Title 1 money to pay for the tutoring. However, many students did not take advantage of the options of school choice or free tutoring (Klein, 2015).

Another part of NCLB was that teachers had to be highly qualified by being certified in the area they were teaching. The problem that arose with this part of NCLB was that highly qualified teachers were hard to entice to schools of low economic means. The highly qualified

teachers went to the wealthier schools, leaving the poor schools with little choice for teachers, much less highly-qualified teachers (Klein, 2015).

According to the AYP report released by the Georgia Department of Education (2011), the state of Georgia had varying success with its AYP scores over the years 2006−2011. In 2007 the state as a whole scored 82% AYP, while specifically, the high schools in the state of Georgia scored much less, at 52.6%. In 2008 Georgia's AYP dropped to 79.4%, while the high schools in Georgia increased to 56%. In 2009 Georgia has its highest overall AYP year at 84%, while the high schools AYP dropped to 49.4%. In 2010 Georgia's AYP scores dropped to 77.2% and the high schools AYP fell to its lowest year of 40.9%. For the final year of AYP, 2011, Georgia's overall score was at its lowest of 72.7%, while Georgia high schools increase to 41.5%. Georgia never met the 100% AYP mark that was set forth by NCLB.

In 2015 the Every Student Succeeds Act (ESSA) was passed under President Barack Obama, replacing NCLB. This is currently the main federal law concerning K−12 general education. This law gave states the responsibility of holding their schools accountable for student achievement. States were still required to test their students from 3rd grade through 8th grade and once in high school. However, the amount of standardized testing has been diminished. Academic factors other than test scores were considered for school quality such as high school graduation, attendance, school climate, college readiness, and completion of advanced coursework. States were still required to break down test scores and academic achievement by students' subgroups, allowing for states to focus on the subgroups that are not achieving academically. States were required to get input from parents and families as they made school and academic plans (Team, 2021). In Georgia, the parent and family input that ESSA required was gathered through school climate surveys.

Schools influenced the decisions of students and their academic performance through their structure, organization resources, and climate (Stewart, 2008). The type of school was a factor in academic achievement as well (Stewart, 2008). According to Stewart (2008), it was the school climate that facilitated or constrained academic learning in the classroom. Mathematics, being the highly sought-after content, and its achievement was highly influenced by the same factors.

Summary

A student's mathematics achievement can be influenced by many factors. Some of the factors that this study has looked at are the types of school that the student attends, the passion and motivation that the teachers have towards mathematics, the climate and environment of the school, and the education policies that have been and will be implemented. The competition that schools engage in for students and academic success is also another major factor.

Bronfenbrenner's ecological systems theory contributed to the understanding of the immediate context or climate that surrounds an individual (Christensen, 2010). It is within this theoretical context that young people learn, grow, and develop in a multiple nested system, and is affected by the microsystem of school type and school climate in which they attend (Hampden-Thompson & Galindo, 2016). The school type and school climate affect the academic achievement of students and encourage or discourage positive motivational belief systems, work ethic, and academic success. It is within this nested system that students find their academic identity and are influenced positively or negatively by those that are closest to them.

The theoretical framework of expectancy-value theory plays a part in how students perceive mathematics and how they develop those perceptions. When teachers have a passion for the subject that they teach, that passion becomes contagious and is passed on to the students.

However, if teachers are not satisfied with the climate and environment of their school, then that negative perspective can be passed on to the students through their teaching. If this happens in the math classroom, then this can negatively affect the student's attitude towards mathematics and thus negatively impact students from going into STEM careers.

The theoretical framework of market theory, when applied to education, explains how schools can and should compete for the students that they serve. The competition for students is fueled by the opportunities that parents have to choose which school is best for their children regardless of where they live or their socio-economic status. Only the best performing schools will attract students and the low performing schools will be forced to improve or shut down. This choice of schools that parents have also allowed for parents to choose which school will best meet the needs of their individual child if there are disabilities present. It increases the likelihood that federally mandated accommodations will be met.

The existing body of literature and research studies how academic achievement is affected by school type and school climate. There are multiple studies on each variable and the effect it has on academic achievement. In order to contribute to the existing body of research, the researcher will compare the effects, or lack thereof, of school type and school climates on math achievement specifically, individually, and combined. The study will narrow the research to high schools in the state of Georgia and use Algebra 1 end-of-course achievement scores and school climate scores to analyze the differences that school climate and school type have on students' mathematics achievement.

CHAPTER THREE: METHODS

Overview

This quantitative, non-experimental, causal-comparative study will examine the effects of school climate rating and the type of school on math achievement among high school students in the state of Georgia. Chapter three discusses the design and methodology of the study. The chapter also discusses the design structure, research questions, participants, setting, instrumentation, procedures, and data analysis used in the study.

Design

The design for this study is a quantitative, causal-comparative research design. Causal-comparative research is a non-experimental approach to examining ex post facto data (Schenker & Rumrill, Jr., 2004). According to Gall et al. (2007), the purpose of causal-comparative research is to identify cause-and-effect relationships between two or more pre-existing groups, within the independent groups. Similar to experimental designs, causal-comparative employs independent variables that are nominal or categorical and dependent variables that are continuous (Schenker & Rumrill, Jr., 2004).

Causal-comparative design is used when experiments cannot be conducted by manipulating the independent variables (Gall et al., 2007). Another reason causal-comparative design research is conducted is to avoid the costly and timely experiments that experimental research requires. The design is used in initial exploratory investigations to determine if a cause-and-effect relationship exists, therefore, determining if further experimental research should be conducted (Gall et al., 2007). In a causal-comparative design the cause is presumed and is identified as the independent variable. The presumed effect is the dependent variable (Gall et al., 2007).

The causal-comparative research design is appropriate for this study because the goal of this study is to identify how school type and school climate rating affect mathematic achievement among high school students in Algebra 1. The independent variables, school type and school climate, cannot be manipulated. The data collected among these naturally occurring groups are ex post facto. The dependent variable in this study cannot be manipulated either as it is pre-existing data as well. Gall et al. (2007) suggested that in a causal-comparative design, the researcher creates groups among individuals where the independent variables are present or absent. In this study, mathematical achievement scores from various schools from Georgia will be grouped by school type and school climate rating.

The first independent variable in this study is school type. This variable consists of two categories: traditional public school and public charter school. The traditional public school is a tax-funded, kindergarten through twelfth grade system that is managed by local education boards. Charter schools are public schools that are managed by private boards. The charter schools are publicly funded and hold a contract, or charter, which allows the school freedom in areas such as curriculum, budget, and staff in exchange for positive student achievement (Clark et al., 2015). Charter schools are primarily considered hybrid public schools that allow for independent thinking, decision-making and development by the board, staff, and students (Baude et al., 2020).

The second independent variable is school climate rating. According to the National School Climate Center (2021), school climate is the "quality and character of school life." School climate rating in Georgia is a measure of the school climate based on surveys completed by students, parents and teachers that is administered by the individual schools (School Choice in Georgia, n.d.). The results of the surveys are made public by the Georgia Department of

Education. The dependent variable in this study is math achievement. According to Shanley et al. (2019), mathematics achievement is math proficiency. Math achievement was analyzed using the EOC scores of Algebra 1.

Research Question

The following research question will guide this study.

RQ: Is there a difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school or public charter school) and the school climate rating?

Hypotheses

$H_0$1: There is no difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school and public charter school).

$H_0$2: There is no difference in Algebra I end-of-course achievement scores among high school students based on school climate rating where 1 = (school grade < 71.2), 2 = (71.2 $\leq$ school grade < 77.3), 3 = (77.3 $\leq$ school grade < 83.4), 4 = (83.4 $\leq$ school grade < 89.5), and 5 = (school grade $\geq$ 89.5)?

$H_0$3: There is no interaction in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school and public charter school) and the school climate rating where 1 = (school grade < 71.2), 2 = (71.2 $\leq$ school grade < 77.3), 3 = (77.3 $\leq$ school grade < 83.4), 4 = (83.4 $\leq$ school grade < 89.5), and 5 = (school grade $\geq$ 89.5)?

Participants and Setting

Georgia is located in the southeastern United States. The average income of Georgia residents is $29,668 (*Where Does Georgia Place in the U.S. News Best States Rankings?*, n.d.). It is estimated that 60% of Georgia's population is white and 32% is African American. The other 8% consists of individuals of Latino, Asian, and Native American descent (*U.S. Census Bureau QuickFacts*, n.d.). There is a population of 10,297,534 with 5,012,248 being male residents and 5,285,286 being female residents. There is a mean average of three people per household with the median age being 39. Employees in Georgia are 76.2% white-collar and 23.7% blue-collar employees (Point2homes, 2020).

There are 525 public high schools in Georgia and 115 charter schools with 32 charter systems. The graduation rate for 2019-2020 Georgia high schools was 83.8%, an all-time high. Georgia uses the federally-mandated adjusted cohort calculation to calculate the graduation rate. The calculation consists of a four-year adjusted cohort graduation rate. The rate is attained by dividing the number of students who graduated in four years with a high school diploma by the number of students who were considered to be in the adjusted cohort group of the graduating class. There has been a steady increase in the graduation rate since 2012, when the rate was at 69.7% state-wide (Georgia Department of Education, 2020).

Georgia high school's violence rate is cause for concern. The bullying rate among high school students is 14.5%. Bullying online occurred with 10.6% of students. Fighting on school property was reported in 9.8% of students. Weapons were used to threaten or injure 6% of students in Georgia high schools while on school property. Nearly 20% of students in Georgia high schools experienced suicidal ideation while 11.8% attempted suicide (Benson, 2020).

High schools were selected via a simple random sample to include traditional public and public charter high schools located in the state of Georgia during the 2018-2019 academic school year. The names and information about each high school will be accessed through public information listed on the Georgia Department of Education (GaDOE) website but will be assigned pseudonyms in the study to ensure confidentiality. A total of 70 traditional schools and 70 charter schools were selected by a computerized randomizer as participants in this study. The high school math course that was studied for math achievement will be Algebra 1. Algebra 1 was the only math course that has a required End-of-Course (EOC) passing score to fulfill high school graduation requirements. All high schools studied are required to teach Algebra 1.

The data for this study were the Algebra 1 composite test scores from a combination of traditional and charter high schools located in the state of Georgia. The participants were drawn using a simple random selection out of the population of schools in Georgia. There was 70 traditional public schools studied and 70 public charter schools included. The sample size exceeded the required minimum when assuming a medium effect size. According to Gall et al. (2007), 140 subjects is the required minimum for a medium effect size for a two-way ANOVA with statistical power of 0.7 at the 0.05 alpha level.

The demographic averages for the randomly selected traditional public high schools were 47.13% white, 33.65% African American, 12.21% Hispanic, and 2.74% Asian/Pacific Islander, .19% Native American, 3.25% multi-racial, 61.41% economically disadvantaged, 3.19% English Learners, and 12.07% students with disabilities. The demographic averages for the randomly selected public charter high schools were 41.56% white, 40.20% African American, 11.70% Hispanic, and 2.18% Asian/Pacific Islander, .26% Native American, 2.46% multi-racial, 69.90% economically disadvantaged, 3.63% English Learners, and 11.54% students with disabilities.

Each high school earned an achievement score of Algebra 1 EOC scores. The state accountability system gives points for each level of proficiency. The Beginning level received 0 points. The Developing level received 0.5 points. The Proficient level received 1.0 point. The Distinguished level received 1.5 points. The percentage of students that scored in each level is multiplied by the number of points that represents that group. The sum of the products is the composite score for the school in that particular content. The ESSA required that 95% of all students enrolled in a course and 95% of all subgroups participated in the EOC. However, the state accountability system accounts for schools that do not meet the participation requirement by dividing the actual participation rate by 95%. The grade level of the students taking the Algebra 1 EOC is mixed. Individual student grades were not considered as EOC composite scores and were not used for data. However, traditionally ninth-grade students take Algebra 1 (Georgia Department of Education, 2018b).

Instrumentation

Two instruments were used to measure the effects of each independent variable on math achievement. The first instrument was the End-of-Course test (EOC) for Algebra 1. The second instrument was the School Climate Rating survey. The purpose of using the EOC scores as an instrument for this study was to measure the math achievement in Algebra 1 courses in both traditional and charter schools.

End-of-Course Test

The EOC for Algebra 1 is a part of the Georgia Milestone Assessment System. The test is a "comprehensive summative assessment" that is administered at the end of each Algebra 1 course regardless of grade level. The administering of the EOC is in a testing window that is decided by the local district for traditional public schools and by the individual school for public

charter schools. The date is based on the end of the course and their school calendar. The EOC is administered to assess student skills, growth, and achievement as mandated by the Georgia Performance Standards, the state-adopted instructional standards (*Georgia Milestones Assessment System*, 2021). The EOC test is administered in a controlled environment by a certified educator to ensure test security. The Algebra 1 EOC test consisted of two sections, each section allowing 60 to 85 minutes for completion. See appendix A for the EOC testing administration manual. The EOC served as students' final assessment for the Algebra 1 course and carried a 20% weight of their final course grade. Students earned a scale score which was converted to a grade score for the purposes of averaging final course grades. Score ranges and grade conversion scores are as follows:

Table 1

GDoE Descriptors for Each Level of EOC Scores

	Level 1: Beginning Learner	Level 2: Developing Learner	Level 3: Proficient Learner	Level 4: Distinguished Learner
Algebra 1	215–474 (0–67)	475–524 (68–79)	525–593 (80–91)	594–790 (92–100)

End of Course tests in Georgia are scored in various ways. Computer software scored the multiple choice and selected response items. Data Recognition Corporation, a temporary contractor, scored the constructed response questions. Georgia Milestone tests are graded in Indiana, Ohio, and Wisconsin (Downey, 2016). The EOC tests were developed by the state of Georgia and are considered valid and reliable (Cox, 2006).

Algebra 1

The Algebra 1 EOC test consists of 50 items and a total of 58 points. The Algebra 1 EOC test includes two item categories. The first item category is selected response with technology-enhanced items. This item type counts 1 point each and consists of multiple part selected response, multiple-select, drag and drop, drop-down, graphing and keypad input. The second item type found on the Algebra 1 EOC are technology-enhanced items that are worth 2 points each. The content found on the Algebra 1 EOC consists of 30% equations, 20% expressions, 35% functions, and 15% statistics and probability (*Algebra 1 EOC Blueprint*, 2019). See Appendix B for an Algebra 1 EOC practice test.

Depth of Knowledge (DOK) is measured by levels one to four. This measurement referred to the level of cognitive demand that the student needed to complete an assessment item. The following table shows the four DOK levels and the percentages of each DOK level on the Algebra 1 EOC test.

Table 2

DOK levels for Algebra 1 EOC

Depth of Knowledge	Approximate # of Points	Approximate % of Test
Level 1	12 to 20	25% to 35%
Level 2	26 to 32	45% to 55%
Level 3	9 to 15	15% to 25%
Level 4	N/A	N/A

The Algebra 1 scale score ranges from 215, being the lowest score, to 790, being the highest score. Each student's score was categorized in one of four ways depending on the student's scale

score: *beginning learner* (student did not demonstrate proficiency), *developing learner* (student demonstrates partial proficiency), *proficient learner* (student demonstrates proficiency), or *distinguished learner* (student demonstrates advanced proficiency) (*Georgia Milestone Achievement Level Descriptors*, 2021).

The reliability of the Algebra 1 EOC test is illustrated by the following table.

Table 3

Reliability of Algebra 1 EOC test

Course	# of Forms	Items per Form	Raw Score Points per Form	Average Reliability	Minimum Reliability	Maximum Reliability
Algebra 1	4	52	58	0.91	0.90	0.91

Validity

According to the Standards for Educational and Psychological Testing (2014), "validity refers to the degree to which evidence and theory support the interpretations of test scores entailed by proposed uses of tests" (p. 11). The EOC tests meet the standards mandated by the Standards for Educational and Psychological Testing (2014) which were established by the American Educational Research Association (AERA), the American Psychological Association (APA), and the National Council on Measurement in Education (NCME). To establish validity, a clear indication of the purpose of the test has to be established (Georgia Department of Education, 2020). The Georgia legislature has identified the purpose of the Georgia Milestones Assessment System (GMAS) as measuring how well students master the state's content standards in English language arts, mathematics, science, and social studies for grades three through eight and in selected high school courses. The Georgia Milestones Assessment reveals information about student achievement and academic growth at the student, class, school,

system, and state levels. Validity for the Georgia Milestones Assessment System depends on how well the EOC test meets the content standards and how well the score reports inform stakeholders of the students' academic achievement and academic growth (Georgia Department of Education, 2020).

The Georgia Department of Education (GaDOE) oversees the development of the EOC along with the assessment contractor, curricular specialists, and committees of Georgia educators (Georgia Department of Education, 2020). The first step in developing the EOC is to identify the content standards that will be assessed. Committees of Georgia educators are formed to establish what standards will be assessed and how they will be assessed. The decisions on the standards that are assessed will translate into several documents that will guide the test development. The first document is the test specifications which lists the standards to be assessed and how they will be assessed. The domain specifications and testing blueprints show how standards are grouped together for reporting purposes. Finally, the test item specifications identify the item format, content scope, and cognitive complexity of the test items (Georgia Department of Education, 2020). All stakeholders in the state of Georgia are informed of the content and methods of the EOC test by the Georgia Milestones Assessment guides. This publicly printed document lists all the specifications of each test (Georgia Department of Education, 2020).

All items for the EOC are written by committees of qualified and professional assessment specialists. Once items are written, the committee reviews the items to ensure alignment to the content standards, and the absence of potential bias and sensitivity issues. Items can be accepted, rejected, or revised (Georgia Department of Education, 2020). Accepted test items are included in a field test. The field test items are embedded in an operational test. Embedding test items into operational tests is a commonly used and a well-accepted practice (Georgia Department of

Education, 2019). The data from the field test items are reviewed by a second committee of Georgia educators. The committee will review the number of correct responses and the number of incorrect responses from the field test data. Potential biases are identified by reviewing field test item data of student subgroups. All accepted test items are banked for future use on EOC tests (Georgia Department of Education, 2019).

Multiple forms for each EOC test are created using the accepted test items from the bank. Content data and statistical data are considered to ensure each form has the same attributes and equal difficulty. This process is called equating, which is a statistical procedure ensuring that all student who are administered the tests are held to the same standard. Equating also allows for the interpretation of differences in test performance and not fluctuation of test forms (Georgia Department of Education, 2019).

After the EOC has been administered, the results are reported using the scale score, which is based on the raw score and performance levels. The raw score is the total points earned based on the number of test items the student completed correctly. Scale scores are converted to performance levels and grade scores. These alternative converted scores are used for purposes such as averaging course grades and determining level of content-specific achievement. The scale score is used in large assessments such as the most common college entrance exam, the SAT (Georgia Department of Education, 2019). Reporting scale scores allows for stakeholders to have a consistent and meaningful way to interpret academic achievement and growth.

The Georgia Department of Education enlisted edCount, LLC to conduct external studies to determine validity of the EOCs. edCount, LLC conducted six studies including a thorough review of design and development. edCount, LLC found that “GaDOE has engaged in test and item development process that meets professional standards for quality, rigor and adequately

reflects Georgia content standards" (Forte et al., 2017, p. 4). The Georgia Department of Education can ensure validity of EOC's for the uses of which the test was developed by attending to each phase of test development (Georgia Department of Education, 2019).

Reliability

Reliability is defined by the Georgia Department of Education (2019) as "the degree to which test scores for a group of test takers are consistent and stable over time" (p. 4). A test should produce stable scores if the same group of students took the test multiple times without any external factors such as fatigue or memory effects (Georgia Department of Education, 2019). Cronbach's alpha reliability coefficient (1951) is used as a reliability measure for the EOCs. Cronbach measures internal consistency among a set of test item responses and expresses the reliability as a ratio of true score variance to observed total score variance (Georgia Department of Education, 2020). Reliability is measured on a scale from zero to one. Georgia Milestones EOC tests have consistently measured reliable across forms and administrations (Georgia Department of Education, 2020; 2021). The Georgia Department of Education reported that all EOC tests have a reliability range of .86 to .94 (Cox, 2006) and were deemed a reliable instrument for the purpose of measuring academic achievement.

EOC scores have been used as an instrument in numerous other studies (Brent-Willis, 2017; Phillipp, 2014) and are a valid and reliable instrument to measure academic achievement.

School Climate Rating

The second instrument used in this study is the School Climate Rating. The state of Georgia was the first state in the nation to implement school climate ratings as an indicator of positive and negative school environments in their accountability system, College and Career Ready Performance Index (CCRPI). CCRPI is Georgia's accountability system under the

Elementary and Secondary Education Act (ESEA) (Georgia Department of Education, 2018a). The rating is a five-star rating used as a diagnostic tool to ascertain school progress toward improvement (School Climate Star Rating, n.d.). The rating is a comprised of school-level data derived from the "Georgia Student Health Survey, Georgia School Personnel Survey, Georgia Parent Survey, student discipline data and attendance records from students, teachers, staff and administrators" (*School Climate Star Rating*, n.d.). The data from these sources are disaggregated into four domains: *Surveys, School Discipline, Safe and Substance-Free Learning Environment, and School Wide Attendance* (Georgia Department of Education, 2019).

The survey domain portion of the rating consists of surveys completed by students, parents and teachers. The surveys are annual surveys given to students, parents, and teachers by their local schools. The results of the surveys are published on the Georgia Department of Education website annually. The results are listed by school district and then further, by individual school. The surveys measure the perceptions of the climate at each school. All schools in the state of Georgia are required to participate in the Georgia Student Health Survey (GSHS) and the Georgia School Personnel Survey (GSPS), with at least 75% of students in each grade level and 75% of all teachers participating (*School Climate Star Rating*, n.d.). There is not a required minimum participation rate for the Georgia Parent Survey (GPS). The survey is administered annually through a digital platform, between October and February. Individual schools can determine how the students and teachers participate in the survey as there is no mandated criteria for the administration of the survey.

The online surveys are self-reported and consist of various numbers of questions about topics ranging from safety, bullying, drugs, and alcohol to depression, anxiety, behaviors, and personalities. The GSHS includes 70 calculatable questions, while the GSPS includes 31

questions and the GPS consists of 24 questions. The surveys use a 4-point Likert-type scale. The high school version of the survey is rated as: *1 = Strongly Disagree, 2 = Disagree, 3 = Agree, and 4 = Strongly Agree.* The parent and personnel survey is rated as: *1 = Strongly Agree, 2 =Agree, 3 =Disagree, and 4 = Strongly Disagree* (Georgia Department of Education, 2019). To obtain a final survey average for the survey domain of the School Climate Rating, the data from all the surveys are recoded, aggregated, and then calculated by the Georgia Department of Education. Participants of all the surveys are anonymous but the final results are made public by the Georgia department of Education (Georgia Student Health Survey, 2021).

For the School Discipline domain of the School Climate Rating, the Student Discipline Rate is considered along with the student enrollment, full-time equivalency (FTE), at each school. A weighted suspension rate is used for the school discipline data reported to the state by each school. Each level of offense equals a point value that when summed, defines the discipline rating. The following is the discipline suspense rating; *ISS (Inner school suspension) = 0.5 points, 1-2 OSS (Out of school suspension) = 1.0 points, 3-4 OSS = 3.0 points, 5-9 OSS = 5 points, 10 or more OSS = 7.0 points, Alternative School Assignment = 6.0 points, and Expulsion = 7.0 points* (Georgia Department of Education, 2019).

The Safe and Substance-Free Learning Environment domain is calculated using the Student Discipline Record, FTE, and the second part of the Georgia Student Health Survey. The Student Discipline Record is categorized as four incident categories; *Drug Related Incidents, Bullying and Harassment Incidents, Violent Incidents, and total number of incidents*. All schools will be assigned an incident score based on a ratio of total incidents-to-FTE. This score is derived from the school discipline data reported to the state. The second part of the GSHS is composed of 17 specific questions for middle and high school students that are related to drugs

and alcohol, bullying, and violent incidents and are specific to the personal nature of drug and alcohol use, bullying, and violent incidents. Students record how many times they have personally engaged in these types of activities. The data are calculated by aggregating the score for each category and then devising an average (Georgia Department of Education, 2019).

For the last domain, School Wide Attendance, the attendance records of students, staff, teachers, and administrators are aggregated and then averaged for a total attendance score. The attendance of the teachers, staff, and administrators are derived from the Certified/Classified Personal Information (CPI). Student attendance is calculated using the Student Record enrollment data. For both categories the days absent are used for calculation purposes (Georgia Department of Education, 2019).

The School Climate Rating Score is calculated by averaging the scores of the four domains *Survey, School Discipline, Safe and Substance-Free Learning Environment, and School Wide Attendance.* If a school participated in the Positive Behavioral Interventions and Supports (PBIS) program, the school will receive an additional five points to their initial score. This score translates into a star rating comparing the score to the state average. The star determination is defined as; *5 = school final score* $\geq$ *one standard deviation above the state average, 4 = state average* $\leq$ *school final score < one standard deviation above the state average, 3 = one standard deviation below the state mean* $\leq$ *school final score < state average, 2 = two standard deviation below the state mean* $\leq$ *school final score < one standard deviation below the state mean,* and *1 = school final score < two standard deviation below the state average* (Georgia Department of Education, 2019).

The Georgia Health Student Survey (GSHS) was developed by the GaDOE, Georgia Department of Public Health and Georgia State University therefore, the GSHS along with the

data that is collected from schools for the School Climate Rating is deemed both valid and reliable to measure the climate of traditional public and charter school climate (Kramer et al., 2013; LaSalle, 2019). Multiple studies have employed the student surveys as an instrument of research (Hanover Research, 2013, La Salle et al., 2016, Wang et al., 2018).

Procedures

Due to using data that is public information, approval from the GaDOE was not required. Therefore, the researcher applied for approval from the Liberty University Institutional Review Board (IRB). Upon approval from the IRB (See appendix C), the researcher collected the school achievement EOC scores from the designated course of Algebra 1 as well as the School Climate Rating of each selected high school for the 2018-2019 school year. To collect the quantitative data, the researcher retrieved it online from the Georgia Department of Education (GaDOE) and the Governor's Office of Student Achievement (GOSA). The 140 high schools were assigned pseudonyms such as Traditional High School, (THS) and Charter High School, (CHS). Each high school was assigned a dummy code to ensure confidentiality. The researcher established groups based on THS and CHS as well as the school climate rating.

Data collected from the GaDOE and the GOSA was entered into a Microsoft Excel spreadsheet and maintained in Google Drive. Data was entered into SPSS, version 27 software for analysis. Due to the data being archived and publicly accessible, introduction to the study and participation permission were not necessary.

Data Analysis

The statistical analysis technique that was used to test the null hypotheses for this study was a two-way analysis of variance (ANOVA). A two-way ANOVA is used when two independent variables are measured in combination to see how they affect the dependent variable. The rationale for the two-way ANOVA is that it is considered to be the statistical analysis tool for measuring cause-and-effect relationship between two categorical independent variables and one continuous dependent variable (Gall et al., 2007). The continuous dependent variable in this study was math achievement exemplified by the achievement score of each school. The math achievement in Algebra 1 was a continuous dependent variable measured in terms of high school EOC scores. The independent variables were school type (traditional and charter) and school climate rating, which is a categorical rating. This study examined potential differences between the independent variables and the dependent variable, thus confirming the appropriateness of a two-way ANOVA.

The two-way ANOVA was used to test the null hypothesis to determine if there were statistical differences between school type, school climate, and mathematical achievement. The data were screened for missing and incorrect data. The descriptive statistics of mean and standard deviation were calculated to determine central tendency and reported. A second screening was conducted for extreme outliers using box and whisker plots on each independent variable. A significance level of $p < 0.05$ was required to reject the null hypothesis. Effect size was measured and interpreted using partial eta-squared ($\eta^{2)}$. The two-way ANOVA assumes that the data will be normally distributed. Therefore, a Kolmogorov-Smirnov test was conducted to test the data normality since the sample size was greater than 50 ($N = 140$). Finally, a Levene's

Test of Equality of Error Variance was conducted to test the assumption of equal variance. Equal variance was assumed at $p > 0.05$.

CHAPTER FOUR: FINDINGS

Overview

The current study investigated the effect that school type and school climate rating had on mathematical achievement in Algebra 1 in the state of Georgia. This chapter contains the research question, null hypotheses, and the data analysis results pertaining to the study.

Research Question

The research question for this study was:

RQ: Is there a difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school or public charter school) and school climate rating?

Null Hypotheses

$H_0$1: There is no difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school and public charter school).

$H_0$2: There is no difference in Algebra I end-of-course achievement scores among high school students based on school climate rating where 1 = (school grade < 71.2), 2 = (71.2 $\leq$ school grade < 77.3), 3 = (77.3 $\leq$ school grade < 83.4), 4 = (83.4 $\leq$ school grade < 89.5), and 5 = (school grade $\geq$ 89.5)?

$H_0$3: There is no interaction of Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school and public charter school) and school climate rating where 1 = (school grade < 71.2), 2 = (71.2 $\leq$ school grade < 77.3), 3 = (77.3 $\leq$ school grade < 83.4), 4 = (83.4 $\leq$ school grade < 89.5), and 5 = (school grade $\geq$ 89.5)?

Descriptive Statistics

Data obtained for the dependent variable school climate rating of level 1, 2, 3, 4, and 5 can be found in Table 4. The different levels of school climate rating were then analyzed. See Table 4 for the Descriptive Statistics.

Table 4

Descriptive Statistics

Dependent Variable: School Climate Rating

Type	Climate	*M*	*SD*	*N*
C	1	9.4	9.5	2
	2	9.8	2.9	3
	3	39.1	15.7	13
	4	57.0	22.9	37
	5	59.6	24.0	15
	Total	50.8	24.9	70
T	1*			
	2	19.8	9.9	4
	3	47.1	15.9	13
	4	61.1	21.4	37
	5	72.8	21.0	16
	Total	58.8	23.4	70
Total	1	9.4	9.5	2
	2	15.5	9.0	7
	3	43.1	15.9	26
	4	59.0	22.1	74
	5	66.4	23.1	31
	Total	54.8	24.4	140

*Not enough data to populate for Level 1 of Traditional Public Schools
C = Public Charter School, T = Traditional Public school

Results

Data Screening

Data screening was conducted on each group's dependent variables of school climate rating regarding inconsistencies, outliers, and normality. The researcher identified no data errors or inconsistencies. The researcher used a box and whisker plot to identify outliers on each

dependent variable and identified no outliers. See Figure 1 for the box and whisper plot that shows the school type and school climate rating.

Figure 1

Box and Whisker Plots

*C = Public Charter School, T = Traditional Public School

Assumption Testing

Normality was examined using a Kolmogorov-Smirnov test, due to the size sample population. Two tests were conducted in order to look at both the normality for School Type and School Climate Rating. Based on the results of the test for normality for School Type, no violations were found for Public Charter School (p = .200), and no violations were found for Traditional Public school (p = .200). See Table 5a for Kolmogorov-Smirnov test for School Type. The test for normality for School Climate Rating indicated a violation of normality for the schools who scored a rating of 1 (p < .001), no violation for schools who scored a rating of 2 (p =

.200), no violation of school who scored a rating of 4 (p = .200), and schools who scored a rating of 5 (p = .200). However, a violation of normality was indicated in schools who scored a rating of 3 (p = .019). See Table 5b for Kolmogorov-Smirnov test for School Climate Rating. Because the ANOVA is considered a robust test against this assumption, the researcher continued with the analysis.

Table 5a

Tests of Normality

Test of Normality for School Type

		Kolomogrov-Smirnov		
	Type	Statistic	*df*	Sig.
EOC	Public	.065	70	.200*
	Charter	.060	70	.200*

*This is a lower bound of the true significance.

Table 5b

Tests of Normality for School Climate Rating

		Kolomogrov-Smirnov		
	Climate	Statistic	*df*	Sig.
EOC	1	.260	2	
	2	.201	7	.200*
	3	.187	26	.019
	4	.056	74	.200*
	5	.107	31	.200*

*This is a lower bound of the true significance.
*Not enough data to populate Test of Normality for Rating 1

A two-way Analysis of Variance (ANOVA) was used to test the null hypothesis that examined the interaction among school climate rating levels 1, 2, 3, 4, and 5 among traditional public schools and public charter schools. The two-way ANOVA required that the assumptions of normality and homogeneity of variance were met. The Levene's test examined the assumption

of homogeneity of variance and indicated there was no violation (p = .240). Therefore, the assumption of homogeneity was met. See Table 6 for Levene's Test.

Table 6

Levene's Test of Equality of Error Variances

Dependent Variable: End of Course Algebra 1 Scores.

F	*df1*	*df2*	Sig.
1.318	8	131	.240

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

a. Dependent variable: EOC

b. Design: Intercept + Type + Climate + Type * Climate

Hypotheses

A two-way ANOVA was used to test the three null hypotheses. For the first null hypothesis concerning the School type, the researcher failed to reject the null hypothesis at the 95% confidence level F = (1, 131) = 3.14, p = .08, η^2 = .023. The partial η^2 confirmed a small effect size. For the second null hypothesis concerning the school climate rating of 1 = (school grade < 71.2), 2 = (school grade ≥ 71.2), 3 = (school grade ≥ 77.3), 4 = (school grade ≥ 83.4), and 5 = (school grade ≥ 89.5), the researcher rejected the null hypothesis F = (4, 131) = 13.54, p < .001, η^2 = .293. The partial η^2 confirmed a very large effect size. For the third hypothesis concerning the interaction of school type and the school climate rating of 1 = (school grade < 71.2), 2 = (school grade ≥ 71.2), 3 = (school grade ≥ 77.3), 4 = (school grade ≥ 83.4), and 5 = (school grade ≥ 89.5), the researcher failed to reject the null hypothesis F = (3, 131) = .36, p = .78, η^2 = .008. The partial η^2 confirmed a small effect size. Based on the results of the two-way ANOVA, the researcher elected to run a Post Hoc Analysis test. See Table 7 for the Tests of Between-Subject Effects.

Table 7

Tests of Between-Subject Effects

Dependent Variable: End of Course Algebra 1 Score.

Source	Type III Sum of Squares	*df*	Mean Square	*F*	Sig.	Partial Eta-Squared
Corrected Model	26219.71	8	3277.46	7.61	<.001	.317
Intercept	76459.75	1	76459.75	177.41	<.001	.575
Type	1352.83	1	1352.83	3.14	.079	.023
Climate	23347.18	4	5836.80	13.54	<.001	.293
Type*Climate	470.51	3	156.83	.36	.779	.008
Error	56459.02	131	430.99			
Total	503302.73	140				
Corrected Total	82678.73	139				

a. *R*-Squared = .317 (Adjusted *R*-Squared = .275)

Post hoc analysis was conducted using a Tukey Test. There was a significant difference between the end-of-course Algebra 1 test scores for schools who scored a 1 ($M = 9.4$, $SD = 9.5$) in school climate rating and a 4 ($M = 59.02$, $SD = 22.13$) where $p = .010$, and a 5 ($M = 66.38$, $SD = 23.10$) where $p = .002$. There was a significant difference in end-of-course Algebra 1 test scores for schools who scored a 2 ($M = 15.47$, $SD = 8.99$) in school climate rating and a 3 ($M = 43.12$, $SD = 15.93$) where $p = .018$, a 4 ($M = 59.02$, $SD = 22.13$) where $p < .001$, and a 5 ($M = 66.38$, $SD = 23.10$) where $p < .001$. There was a significant difference between the end-of-course Algebra 1 test scores for schools who scored a 3 ($M = 43.12$, $SD = 15.93$) in school climate rating and a 4 ($M = 59.02$, $SD = 22.13$) where $p = .009$, and a 5 ($M = 66.38$, $SD = 23.10$) where $p < .001$. No significant difference occurred between the end-of-course Algebra 1 test scores for schools who scored a 1 ($M = 9.4$, $SD = 9.5$) in school climate rating and a 2 ($M = 15.47$, $SD = 9.0$) where $p = .996$, and a 3 ($M = 43.12$, $SD = 15.93$) where $p = .181$. No significant difference in scores appeared between the end-of-course Algebra 1 test scores for schools who scored a 4 ($M = 59.02$, $SD = 22.13$) in school climate rating and a 5 ($M = 66.38$, $SD = 23.10$) where $p = .464$. See Table 8 for multiple comparisons.

Table 8

Multiple Comparisons

Dependent Variable: End-of-Course Algebra 1 Test Score

	(I) Climate	(J) Climate	Mean Difference	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Tukey HSD.	1	1					
		2	-6.081	16.645	.996	-52.14	39.96
		3	-33.704	15.234	.181	-75.87	8.41
		4	-49.633*	14.877	.010	-90.78	-8.48
		5	-56.115*	15.146	.002	-98.89	-15.10
	2	1	6.081	16.645	.996	-39.96	52.12
		2					
		3	-27.652*	8.840	.018	-52.11	-3.20
		4	-43.551*	8.209	<.001	-66.26	-20.84
		5	-50.910*	8.687	<.001	-74.94	-26.88
	3	1	33.734	15.234	.181	-8.41	75.87
		2	27.652*	8.840	.018	3.20	52.11
		3					
		4	-15.899*	4.733	.009	-29.00	-2.81
		5	-23.257*	5.521	<.001	-38.53	-7.99
	4	1	49.633*	14.877	.010	8.48	90.78
		2	43.551*	8.209	<.001	20.84	66.26
		3	15.900*	4.733	.009	2.81	28.99
		4					
		5	-7.359	4.441	.464	-19.64	4.93
	5	1	56.991*	15.146	.002	15.10	98.89
		2	50.910*	8.687	<.001	26.88	74.94
		3	23.257	5.521	<.001	7.99	38.53
		4	7.359	4.441	.464	-4.93	19.64
		5					

*Blank cells are indicative of repeating data

CHAPTER FIVE: CONCLUSIONS

Overview

This chapter begins with a discussion of the analysis results pertaining to the research questions and null hypotheses of the effects of school type and school climate rating on mathematical achievement. The study's findings, limitations, and recommendations for future research follow the discussion. The current study found that there was not a statistically significant effect on school type on mathematical achievement. The findings also found that there was a statistically significant effect of school climate rating on mathematical achievement. Finally, the research findings found that there was not a statistically significant effect of school type and school climate rating on mathematical achievement. The finding correlates to previous research findings and theories, and it adds to the existing body of literature regarding school type and school climate rating.

Discussion

The purpose of this study was to investigate the effect that school type, traditional public and public charter, and school climate rating have on mathematical achievement. A quantitative causal-comparative design was used to determine the effect, as well as the interaction, among school type and school climate rating on mathematical achievement. The mathematics EOC composite scores were used to determine mathematical achievement and analyzed based on the type of school attended: traditional public or public charter and the school climate rating of the sample of 140 high schools in the state of Georgia. The results of this study suggest that decision makers should focus on the climate and environment of their schools, in order to reach a higher level of mathematical achievement.

The current study was designed to research the following questions and corresponding null hypotheses related to mathematical achievement:

RQ: Is there a difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school or public charter school) and the school climate rating?

$H_0$1: There is no difference in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school and public charter school).

$H_0$2: There is no difference in Algebra I end-of-course achievement scores among high school students based on school climate rating where 1 = (school grade < 71.2), 2 = (71.2 $\leq$ school grade < 77.3), 3 = (77.3 $\leq$ school grade < 83.4), 4 = (83.4 $\leq$ school grade < 89.5), and 5 = (school grade $\geq$ 89.5)?

$H_0$3: There is no interaction in Algebra I end-of-course achievement scores among high school students based on type of school attended (traditional public school and public charter school) and the school climate rating where 1 = (school grade < 71.2), 2 = (71.2 $\leq$ school grade < 77.3), 3 = (77.3 $\leq$ school grade < 83.4), 4 = (83.4 $\leq$ school grade < 89.5), and 5 = (school grade $\geq$ 89.5)?

The results for the research question of this study indicated there was a statistically significant difference in Algebra 1 end-of-course achievement scores based on the school climate rating. The results indicated that there was not a statistically significant difference in Algebra 1 end-of-course scores for the type of school attended, be it traditional public or public charter.

There has been a sharp decline over the past two decades in students going into STEM-related careers (Watt & Goos, 2017). This has precipitated international and domestic research

studies focused on determining what influences students' mathematical achievement in the formative years of the students' academic career (Capraro et al., 2019; Edelen et al., 2020; Erickson et al., 2013; Piesch et al., 2020; Lauermann et al., 2017; Lazarides et al., 2020; Watt et al., 2016; Watt & Goos, 2017; Watt et al., 2019). The researcher chose to look at school climate and school type to see if either had an effect on mathematical achievement. The current study supports research concerning school climate rating affecting academic achievement. School climate has been identified as a leading predictor of students' emotional, behavioral and academic outcomes (Brand et al., 2008; Brookover et al., 1978; Maxwell et al., 2017).

The results showed that school climate rating has a statistically significant effect on mathematical achievement based on the composite EOC scores gathered from random high schools in the state of Georgia. Results for the effect of school type on mathematical achievement supported previous research which found that school climate rating had a significant impact on academic achievement. Studies on the effect of school type on academic achievement have been conducted in Arizona (Hoxby, 2003), Michigan (Hoxby, 2003), Massachusetts (Ridley & Terrier, 2018), New York City (Cordes, 2018), Texas (Bohte, 2004), California (Zimmer & Buddin, 2009), Chicago, Denver, Milwaukee, Philadelphia, San Diego, Ohio, Texas, (Zimmer et al., 2009), Michigan (Bettinger, 2005), New York City (Winters, 2012), Florida (Sass, 2006), North Carolina (Bifulco & Ladd, 2006; Holmes et al., 2003), Ohio (Carr & Ritter, 2007) and in Michigan (Ni, 2009). These studies have had mixed results some showing a positive effect and others negative effects on academic achievement. Goodridge (2019) stated there was a lack of compelling evidence on academic gains among charter schools versus TPS. The results from this study confirm and support those studies.

The results of this study also support the overarching theoretical framework of Bronfenbrenner, the ecological systems theory. This theory states that individuals are influenced positively or negatively by differing levels of environments. The school classroom is in the microsystem and is one of the most influential places to influence a person. The results of this study show that school climate rating was statistically significant in influencing mathematical achievement. This supports Bronfenbrenner's ecological systems theory. If the school climate is a positive one, then students will build value for their academic achievement. This is where expectancy-value theory could be applied to academics. When individuals value something or expect to succeed, they participate to their fullest and do well (Lauermann et al., 2017; Sullins et al., 1995). Achievement-related choices and behaviors are predicted by the expectancy-value theory. These choices include academic success, the inquiry of advanced educational opportunities, and career pathways (Eccles, 2005, 2009; Wang, 2012; Watt et al., 2012). The results of this study support this theory as schools with higher school climate ratings have more effect on mathematical achievement.

Implications

The research conducted in the present study is important because it provides school administrators, school boards, lawmakers, parents, and other decision makers with information that could affect decisions about the type of schools offered to students and the school climate that is present in both types of schools. There is much literature that points to the importance of school climate. The results of several studies found that the difference in academic achievement among schools has been attributed to school climate rating when other factors such as socio-economic status have been filtered out (Brand et al., 2008; Collins & Parson, 2010; Hoy & Hannum, 1997). The present study follows that trend. However, there was not a statistically

significant difference in mathematical achievement, as evidenced by EOC scores, in the type of school a student may attend. The present study follows the trend of studies that have mixed reviews on whether or not traditional public or public charter and the competition they engage in to attract students has any effect on their mathematical achievement. When parents are making decisions about the school their child attends, information about what to consider and what to value in a school should be readily available.

Limitations

Several limitations need to be addressed regarding the internal and external validity of the study. The internal validity was threatened due to the use of archival data that could not be manipulated by the researcher. Furthermore, the dependent variable was a composite score that did not include raw data. Individual scores of students were not considered in the study. External threats to the validity include the lack of corresponding demographics among the sample high schools. The sample high schools were chosen randomly and demographics were not considered in the random sampling. The results may have been different if the demographics were corresponding between the charter and traditional public schools.

Recommendations for Future Research

The results of the present study offer several recommendations for future research. In the present study, the researcher only considered high school students who took the Algebra 1 end-of-course test. Future research could expand to include 7th- and 8th-grade students who participated in accelerated learning and who took the Algebra 1 EOC. In the present study, the researcher did not take into consideration the rigor of the courses. Some students took Algebra 1 while others took Algebra 1 Honors. Future research could consider the differences in the two courses' EOC scores. Another recommendation that could be considered in future research is the

difference in face-to-face Algebra 1 classes versus online Algebra 1 classes. The present-day study did not distinguish between the two class delivery methods. Finally, in the present-day study, demographics were not considered in the statistical analysis. Future research could compare the demographics to see if school type or school climate rating affected mathematical achievement in one demographic over another.

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APPENDICES

Appendix A

EOC Testing Administration Manual, 2021−2022

https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Documents/For%20Educators/2021-2022_Assessment_Admin_Protocol_Manual.pdf#search=EOC%202019%20administration%20manual

Appendix B

EOC Algebra 1 practice test

https://www.gadoe.org/Curriculum-Instruction-and-Assessment/Assessment/Documents/Milestones/Study-Resource%20Guides/EGA135_GRHS_ALG1_SG_0001_20200928.pdf

Appendix C

IRB Approval letter

February 22, 2022

Rebekah Price
Sarah Hutter

Re: IRB Application - IRB-FY21-22-777 The Effects of School Type and School Climate on Math Achievement

Dear Rebekah Price and Sarah Hutter,

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 does not classify as human subjects research. This means you may begin your project with the data safeguarding methods mentioned in your IRB application.

Decision: No Human Subjects Research

Explanation: Your study is not considered human subjects research for the following reason:

It will not involve the collection of identifiable, private information from or about living individuals (45 CFR 46.102).

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

Also, although you are welcome to use our recruitment and consent templates, you are not required to do so. **If you choose to use our documents, please replace the word *research* with the word *project* throughout both documents.**

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

Sincerely,

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