SCHOOL-LEVEL FACTORS AND ACADEMIC ACHIEVEMENT: HOW SES AND SETTING RELATE TO AVERAGE ACHIEVEMENT AND VARIABILITY IN ACHIEVEMENT

A Thesis

by

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ABSTRACT

This study explored how school level factors were related to academic achievement. Past research has primarily focused on average achievement. Thus, this study aimed to explore both average achievement and academic variability simultaneously using third grade data from one state. Results revealed that a school's Title 1 status and setting predicted achievement (i.e., both average achievement of schools and range of achievement in schools) and that the setting of the school moderated the relationship between the school's socioeconomic status and achievement.

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LITERATURE REVIEW

Many factors affect students and how well they perform in an academic setting. Although students do not have control over their demographics or the demographics of the school they attend, these characteristics of students and schools impact students' academic achievement. One such factor that impacts students' academic performance is socioeconomic status (SES). Student SES and school SES are related to students' academic achievement (Caldas & Bankston, 1997; Ewijka & Sleegers, 2010; Perry & McConney, 2010; Perry et al., 2022; Sirin, 2005). Similarly, the school's setting (i.e., rural, urban, suburban, and town) has been shown to predict how well students perform academically (e.g., Hernández-Torrano, 2018; Sun & Du, 2021; Wang et al., 2017; Zhang et al., 2018). Each school setting has its unique advantages and disadvantages. Thus, it is essential to be aware of some key differences between schools in a variety of settings as well as the SES of the school and how those play a role in educational outcomes.

Past research regarding academic achievement has almost exclusively focused on average achievement (e.g., Johnson et al., 2021; Liu et al., 2020; Sirin, 2005). However, only considering the average of a group of students has its limitations and only paints a small portion of the picture. A complimentary approach that enables a fuller understanding is to consider the range of achievement. For example, in one classroom, is a teacher only teaching to students performing equivalent to grade level, or are they teaching to students performing at various levels? Research suggests that a wide range of achievement levels are present within the same grade (e.g., Firmender et al., 2013; Peters et al., 2017). Therefore, exploring the range in academic achievement is beneficial and has unique benefits over and above solely focusing on the average because researchers will miss how high and low the top and bottom students perform within one environment.

SES and Academic Achievement

SES is a complex construct and does not comprise only one aspect. There are many aspects to consider when determining SES status, including income and education. While many definitions exist, the American Psychological Association (APA) currently defines SES as

> the position of an individual or group on the socioeconomic scale, which is determined by a combination of social and economic factors such as income, amount and kind of education, type and prestige of occupation, place of residence, and—in some societies or parts of society—ethnic origin or religious background (American Psychological Association, 2023, n.p.).

Thus, there are many factors to consider when considering a student's SES status as well as the collective SES of the school. A student’s SES is impacted by things largely outside of their control because their SES status is determined by their parent’s social and economic factors. Thus, a combination of individual student characteristics will dictate the SES status of the school that many children attend. Moreover, the school that a student attends is likely to be composed of children from similar SES backgrounds because children will come from the same neighborhoods.

Because SES includes many aspects, it can be measured in various ways and has changed over time. Broer et al. (2019) reviewed existing literature and identified how conceptualizing SES has changed throughout history. For example, over a century ago, SES was understood in terms of the father's occupation (Broer et al., 2019). However, over time the way of measuring SES has expanded to include family possessions, education, and income (Broer et al., 2019). However, all the necessary information can be difficult to obtain in educational settings for research purposes as some pieces of information will be inherently missing because they are not always collected on students due to privacy concerns and how accurately students might report the necessary information needed to understand their specific SES (Broer et al., 2019). Thus, researchers often use proxy variables (Broer et al., 2019) such as a student's free and reduced lunch status, which is measured dichotomously. The following are the current, official guidelines for qualifying for free or reduced lunch: "Children from families with incomes at or below 130 percent of the Federal poverty level are eligible for free meals. Those with incomes between 130 and 185 percent of the Federal poverty level are eligible for reduced price meals" (Benefits.gov, 2023, n.p.). When examining the impact of school SES, past research has used factors such as an aggregate of students' free and reduced lunch status as well as the education and occupation of a student's parents to determine the SES of a particular school (Caldas & Bankston, 1997).

SES can be measured with dichotomous variables or a composite of factors (Ewijka & Sleegers, 2010). A meta-analysis showed that depending on how SES is measured and how researchers design their statistical models impacts the results found. Essentially, it is better to use a composite SES measure than individual components (results in larger effect sizes) or more complicated models (Ewijka & Sleegers, 2010). Although, much of educational research is limited by what is collected and included in large-scale datasets. Therefore, what researchers have access to can limit how they can measure SES.

In general, SES is related to academic achievement. Having a higher SES status is related to better academic outcomes. In a meta-analytic study, Harwell et al. (2017) found a modest relationship between SES and achievement, which aligns with Sirin's (2005) findings of a similar relationship in students' SES and an even stronger relationship for school SES. Harwell et al. (2017) included and expanded upon the studies included in White's (1982) meta-analysis to see how more recent research compares to previous findings. By including studies from 1915 through 2010, the researchers found that the strength of this relationship between SES and achievement between K-12 students has been growing over time, particularly since the 1980s (Harwell et al., 2017).

Students from low SES environments may start at a disadvantage due to a higher likelihood of not being able to develop the prerequisite skills necessary to succeed in a classroom setting as fast as those from higher SES backgrounds (Morgan, 2009). For example, in a study of 5,522 U.S children, researchers found that for those from low SES backgrounds, the likelihood of experiencing learning-related problem behaviors was doubled by 24 months of age (Morgan, 2009). Thus, students from disadvantaged backgrounds may start school behind their peers from more affluent backgrounds. While individual student SES plays more of a role when starting school, school SES tends to play a more prominent role than student SES in academic achievement throughout a student's education (Aikens & Barbarin, 2008). For example, a longitudinal study following 17,401 children from kindergarten through third grade revealed that school and neighborhood SES compared to student SES, had more of an impact on the rate at which students learned to read (Aikens & Barbarin, 2008). Although, when students were beginning school in kindergarten, the students' individual SES had more of an impact (Aikens & Barbarin, 2008). Thus, these findings provide evidence that when students first begin school, student SES plays more of an essential role in achievement and learning. In contrast, as a student progresses in school, the SES of the school and neighborhood are more influential factors.

When considering SES, several approaches can be taken. For example, SES can be considered at both the student and school levels. Research has revealed that SES is related to academic achievement at both the student level (e.g., Sirin, 2005) and school level (e.g., Caldas & Bankston, 1997; Ewijka & Sleegers, 2010; Perry & McConney, 2010; Perry et al., 2022; Sirin, 2005). The SES level of a school plays a role in how well students achieve. The higher the school's SES, the higher the academic achievement (Perry & McConney, 2010). Thus, it is not just the students' personal backgrounds but the collective backgrounds of their peers that impact how well students will succeed academically. This phenomenon is happening across grades. For example, Caldas and Bankston (1997) found that in 10th-grade students, school SES was almost as impactful for achievement as student SES, with student SES being slightly more impactful. On the other hand, some research supports that class SES impacts achievement more than school SES (Ewijka & Sleegers, 2010). However, several studies suggest that compared to student SES, school SES better predicts a student's achievement (Aikens & Barbarin, 2008; Perry et al., 2022; Sirin, 2005). Moreover, school SES predicts achievement for all levels of achievement (Perry et al., 2022). Students at every achievement level are impacted similarly when considering the impact of school SES (Perry et al., 2022). In other words, it does not matter whether a student is low-achieving or high-achieving (Perry et al., 2022). Thus, students are part of a complex web with many different factors impacting their achievement, with both their SES backgrounds and that of their peers playing a role in how well they achieve across their schooling.

Furthermore, the relationship between SES and academic achievement is more robust when looking at individual subjects instead of overall achievement, particularly for mathematics (Sirin, 2005). Across various subjects, school SES can predict academic achievement (Liu et al., 2020; Perry et al., 2022); however, the results are mixed. For example, some research suggests that while mathematics, reading, and science achievement can all be better predicted by school SES than by student SES, the effects on mathematics are most noticeable compared to reading and science (Perry et al., 2022). However, a meta-analysis of Chinese children revealed a different relationship between how SES impacts various subjects (Liu et al., 2020). For example, the researchers found that SES plays less of a role in mathematics and science than in language (Liu et al., 2020).

The relationship between SES and academic achievement is complex and influenced by many factors, such as grade level, minority status, and school setting (Sirin, 2005). In a meta-analysis, Sirin (2005) found that the school setting moderated the relationship between student SES and achievement. Specifically, the relationship between student SES and achievement was stronger for non-urban schools, particularly for suburban schools (Sirin, 2005). Moreover, while comparing the three settings, the only significant difference existed between suburban and rural (Sirin, 2005). While findings support that school SES predicts academic achievement (e.g., Caldas & Bankston, 1997; Ewijka & Sleegers, 2010; Perry & McConney, 2010; Perry et al., 2022; Sirin, 2005), this current study will expand on this understanding by seeking to replicate findings as well as to expand this relationship from average academic achievement by also incorporating range in achievement. Thus, the current study will explore whether this moderation effect holds for school SES. Next, I will review research that examines the impact that school setting has on academic achievement followed by a discussion on the limited research that exists regarding variability in achievement.

School Setting and Academic Achievement

Similar to SES, the setting in which the school is located impacts students' academic achievement. Schools are located in various settings, such as urban, rural, town, and suburban. Based on where a school is located can impact what resources are available for teachers and students. Rural schools tend to have fewer resources, which ultimately can affect student educational outcomes. Thus, it is important to understand the urban-rural gap in achievement and its implications for education so that educators and policymakers can make meaningful changes to impact students positively. Research on rural students' academic achievement is lacking (Johnson et al., 2021). Moreover, the research that exists is of limited quality due to a lack of inferential statistical methods and is dated, thus, lacking current trends (Johnson et al., 2021).

Rural School Challenges

Rural schools face their own unique set of advantages and disadvantages compared to urban schools. Notably, rural schools lack some of the resources afforded to urban schools. Johnson et al. (2021) identified, from the educational literature, some of the limited resources, including funding, teacher quality, curriculum and course offerings, facilities, transportation, and community resources. For example, schools in rural areas receive less funding than those in urban areas (Johnson et al., 2021). Another concern is the quality of teachers in rural environments due to the challenges related to finding and retaining quality applicants for such jobs, not to mention the lack of professional development opportunities (Johnson et al., 2021). Moreover, students in rural areas do not have access to the same array of curriculum and the specific course options that are offered to urban students (Johnson et al., 2021). Similarly, urban schools have more physical resources, such as additional facilities (Johnson et al., 2021). Furthermore, these rural areas lack the same transportation resources afforded to urban areas. Rural students may spend less time learning than urban students due to the longer commute times required to attend school (Johnson et al., 2021). Finally, rural students often have less access to educational-related community resources than students in urban settings (Johnson et al., 2021). For example, students living in urban areas may have access to museums and other similar resources in their community (Johnson et al., 2021). Not having as many resources as urban schools can impact the quality of education that students receive, which can negatively impact the educational outcomes of such students.

Rural School Advantages

However, rural schools are not at a total disadvantage as living in these communities has advantages that urban schools may lack. Johnson et al. (2021) also identified several advantages rural schools experience. Students tend to find themselves in a more closely connected and supportive environment due to the schools' smaller nature (Johnson et al., 2021). Furthermore, rural schools tend to involve the community at large more than schools in urban environments through the various school functions (Johnson et al., 2021). Thus, a wide range of generations is engaged in a student's development (Johnson et al., 2021). Moreover, students in rural environments are not as prone to experience violence in their communities (Johnson et al., 2021). Consequently, living in a safer environment may aid learning as too much stress can impede learning because students' attention would be on stressors instead of on the educational content at hand. Taken together, rural and urban schools both have advantages and disadvantages that can positively and negatively impact academic performance.

Differences in Achievement

These environments differentially affect how well students perform academically. Some findings are mixed regarding whether achievement is better for rural or urban students, as research supports both findings. However, there is strong support that students from urban environments perform better academically than students from rural environments (Hernández-Torrano, 2018; Sun & Du, 2021; Wang et al., 2017; Zhang et al., 2018). For example, in Chinese seventh through ninth grade students, researchers found that urban students outperformed rural students, particularly in language subjects and mathematics (Sun & Du, 2021; Zhang et al., 2018). Similarly, a researcher in Spain also found that urban students outperform rural students in a sample of seventh through tenth-grade gifted students (Hernández-Torrano, 2018). This was particularly the case for verbal reasoning, numerical reasoning, and divergent thinking (Hernández-Torrano, 2018). The researcher speculated that the achievement differences resulted from the lack of opportunities available to gifted students (Hernández-Torrano, 2018). Similarly, these findings can be seen in younger students. For example, a study of first, second, and fifth-grade Chinese students showed that students in rural areas had lower literacy achievement than students in urban areas (Wang et al., 2017). However, several factors relating to the student's family explain this relationship (Wang et al., 2017). Parents' education and literacy can partly explain this relationship between rural and urban settings and achievement (Wang et al., 2017).

However, some findings are mixed as not all research supports a universal achievement advantage for urban students. For example, a study that examined 8,898 year-four Pakistani students across four provinces revealed mixed results (Tayyaba, 2012). In some cases, urban and rural students had similar achievements, whereas in other cases, different settings resulted in better academic performance in various subjects (Tayyaba, 2012). Rural students outperformed urban students in some provinces in most tested subjects (Tayyaba, 2012). Urban students outperformed rural students in different provinces, particularly in language and social studies (Tayyaba, 2012). Various school and home characteristics can help explain the differences between urban and rural achievement across various provinces (Tayyaba, 2012).

While most research has been concerned with the urban-rural achievement gap, some research has explored the effect of suburban school location on achievement. Graham and Provost (2012) found that suburban students, in kindergarten and eighth grade, outperformed rural and urban students in mathematics and that the achievement gap grew from kindergarten to eighth grade. Thus, by eighth grade, the suburban students had even better achievement than their rural and urban counterparts.

It is essential to understand that whether a student comes from a rural or urban environment can impact how well they succeed when they first begin college (Zhao, 2022). One crucial school-related factor that impacts outcomes for students is the quality of education that the students receive. The school's setting can impact the quality of education and how experienced or qualified teachers are. Researchers have found that students who receive a high-quality education by being in a smaller class are more likely to attend college (Chetty et al., 2011). Furthermore, the quality of teachers tends to help explain the urban-rural differences in academic performance (Zhang et al., 2018). For example, if both settings had the same quality teachers, achievement would be more comparable across settings (Zhang et al., 2018). Some researchers were interested in how teacher training impacted this rural-urban achievement gap (Sun & Du, 2021). In a study of 10,628 Chinese seventh and ninth grade students, the researchers found that urban students particularly benefited from teacher training (Sun & Du, 2021). Similarly, incorporating teacher training positively impacted students in both settings who had an average performance or above (Sun & Du, 2021). However, there was no benefit for average to lower-performing rural students (Sun & Du, 2021). Research has shown that in a sample of Chinese university students, the school setting from where students completed high school, along with family characteristics, had an impact on the first two years of their performance while attending a university (Zhao, 2022). Those from rural environments had lower academic performance in STEM, arts, and humanities-related majors during the first half of their studies (Zhao, 2022). Thus, the school setting that a student attends growing up has a significant and lasting impact on a student’s academic trajectory.

Variability in Academic Achievement

There seems to be an understanding that variability in achievement exists in schools and classrooms because there are discussions surrounding how teachers can best differentiate their teaching to meet the needs of various students (e.g., low-achievers and high-achievers) within their classes (e.g., Smale-Jacobse et al., 2019). However, the research regarding the range of achievement is lacking as most research focuses on average student achievement. While it is important to understand average achievement, the complete picture is missed when taking this approach. Schools and teachers are required to provide education for many children at various levels of achievement, so it is important to understand how similar students are regarding their level of performance. Past research has revealed that teachers are not only required to teach one grade but, in actuality, many because there can be the equivalent of up to approximately 12 years of variability in reading (Firmender et al., 2013) and five years of variability in mathematics (Peters et al., 2017) present within one grade level. The research covering this topic is lacking and has only been considered empirically over approximately the past 50 years (e.g., Rubin, 1975). Much more research is needed to understand this ever-pressing issue.

The idea of differentiation in the literature is longstanding (e.g., Tomlinson, 2000). In other words, there is an understanding that differentiation is needed and useful and that a wide range of student achievement levels exists within one classroom or grade level. However, only a handful of researchers have attempted to quantify how much teachers are required to differentiate in terms of achievement levels (i.e., Gagné, 2005; Firmender et al., 2013; Pedersen et al., in press; Peters et al., 2017; Rubin, 1975). Thus, more research is needed to see if the ranges in achievement can be replicated.

Researchers have identified that students within one grade level tend to be heterogenous in terms of academic abilities and that this variability among students' performance increases as students age. For example, Iowa Tests of Basic Skills data has revealed that between lower-achieving and higher-achieving students, an equivalent of an eight-year gap exists within one grade level (Gagné, 2005). Moreover, the variability in achievement increases as students progress from first to ninth grade by 145% (Gagné, 2005).

Reading

Similar patterns exist across subjects, with research examining these patterns in reading, mathematics, and ELA. In reading, a wide range of achievement levels are present within a single grade. A study on 1,149 third through fifth grade revealed great diversity in reading comprehension and fluency within a single grade level (Firmender et al., 2013). Essentially, approximately between nine and 11 grades are present within one grade level in third through fifth grade (Firmender et al., 2013). This range increased as grade levels increased (Firmender et al., 2013). In third grade, there were 9.2 grade levels present (Firmender et al., 2013). However, the range increased to 11.3 in fourth grade and 11.6 in fifth grade (Firmender et al., 2013). Thus, teachers are presented with a difficult task as they are required to ensure a wide range of abilities are getting their needs met. Similarly, data from the Stanford Achievement Test revealed that in both grades one and two, achievement spans three grade levels in paragraph meaning (Rubin, 1975). For paragraph and word meaning, the achievement level spans over six years, whereas in fourth and fifth grade, this span increases to over seven years (Rubin, 1975).

Mathematics

Students enter kindergarten with various skill levels in mathematics, with some students beginning school already knowing how to do what is being taught to them (Engel et al., 2013). A study using ECLS-K data of 11,517 kindergarten students from 1998-1999 revealed that most students are already meeting various levels of proficiencies before the start of kindergarten (Engel et al., 2013). Of concern, on approximately half the days each month, teachers are teaching this already mastered content for 95% of students (Engel et al., 2013). Thus, many students are not benefiting from formal instruction because these students are spending their time essentially reviewing content they already know (Engel et al., 2013). Only a small percentage of students, who have not mastered the content, benefit from the current instruction (Engel et al., 2013). In contrast, most students require more advanced content to benefit academically (Engel et al., 2013).

This heterogeneity in achievement is also observed as students' progress in their studies. For example, a study of four different datasets (i.e., Smarter Balanced in Wisconsin and California, STAAR, and MAP) across three states examining third through eighth-grade students in mathematics and ELA revealed that a moderate number of students are performing at least a year above where they are expected (Peters et al., 2017). Specifically, between 14% to 37% of students are performing above grade level in mathematics, whereas 20% to 49% are performing above grade level in ELA (Peters et al., 2017). Some of these students were even performing several years above grade level in mathematics and reading, particularly in ELA (Peters et al., 2017). For example, in fifth grade, 10% of students in ELA and 2% in mathematics were performing four years ahead of grade level (Peters et al., 2017). Thus, in some classrooms, a wide range of levels of achievement is represented. That means the teacher may be tasked with teaching five different grade levels in a typical fifth-grade class. However, that is not taking into account how far below grade level other students are performing. Thus, this range of "grade-level" abilities in one classroom is likely larger.

Pedersen et al. (in press) expanded on this idea of achievement variability within classrooms by examining both above-level and below level students using TIMSS data. The dataset included 8,776 fourth grade and 8,698 eighth-grade students and revealed that there are students at many different achievement levels present in one classroom. Approximately 38% of fourth grade and 49% of eighth-grade students perform at either low or high levels. Thus, there is a substantial amount of achievement variability within one classroom. Thus, many students are not receiving adequate instruction to meet their unique needs and may not be benefiting to the same degree as more average-performing students.

Thus, it is evident that there is a wide range of variability in achievement across various subjects. It is not just the average achievement that should be considered but also how much variability is present within a grade-level. The variability in achievement is present at various levels. For example, according to TIMSS data from 1999, approximately 35% of the variance in mathematics scores for 13-year-old students lies between schools in the United States (Huang, 2009). The focus of the current study is concerned with school-level factors and achievement. Thus, the current study will examine the variability present at the school level and how it varies by school SES and school setting. Furthermore, this study will examine whether the relationship between SES and variability is different across school settings.

The Current Study

This study explored how school-level factors impact academic achievement. Specifically, the goal of this study was to examine how school SES and school setting impacts academic achievement (i.e., average and range). Past research has focused mainly on average academic achievement. Thus, this study also included average achievement; however, this study expanded the focus and additionally explored the variability in mathematics and reading achievement by examining the range of scores. Specifically in this study, I examine data from third grade in a single state. The following four research questions were addressed: (1) How is school SES related to both mathematics and reading achievement (i.e., both average and range) in schools? (2) How is school setting related to both mathematics and reading achievement (i.e., both average and range) in schools? (3) How are both school SES and school setting related mathematics and reading achievement (i.e., both average and range) in schools? (4) How does school setting moderate the relationship between school SES and mathematics and reading achievement (i.e., both average and range) in schools? Terms were operationalized as follows: (1) school SES referred to a school's Title 1 status, (2) school setting referred to whether a school was located in a rural area, town, suburban area, or urban area (3) average achievement referred to the mean achievement at one school, and (4) range in achievement referred to the middle 50% (75th percentile - 25th percentile).

METHODS

Participants & Procedures

Because the goal was to compare schools, participants consisted of individual schools. To be included, schools needed to have at least 10 students. Only third graders from the fall semester of 2019 from one state were included. To make comparisons between schools, additional variables were created by taking the average scores of students at a particular school. Thus, four new variables were created for each school: (1) a school's average mathematics achievement, (2) a school's average reading achievement, (3) a school's range of mathematics achievement, and (4) a school's range of reading achievement. Average achievement was calculated by taking the mean of all students at a particular school. The range was calculated by subtracting the 75th percentile from the 25th percentile, allowing for comparisons of the middle 50% of students across schools. By comparing the middle 50% of students across schools, it helped to reduce outliers (e.g., students who performed extremely low or extremely high) and noise in the data.

Schools were located in one of four settings (i.e., urban, suburban, town, and rural). The definitions of each of these settings primarily align with NCES locale classifications, with urban being more akin to the city code. Thus, (a) urban (i.e., city locale code) was defined as "territory inside an urbanized are and inside a principal city," (b) suburban was defined as "territory outside a principal city and inside and urbanized area," (c) town was defined as "territory inside an urban cluster," and (d) rural was defined as "census-defined rural territory" various distances away from "an urbanized area, as well as rural territory that is" various distances away from "an urban cluster " (NCES, 2023).

First, schools were dropped if the setting location was unknown (mathematics *n* = 129; reading *n* = 130) and if schools had less than 10 students (mathematics *n* = 120; reading *n* = 99). After removing these schools from the dataset, there were on average 57 students (*SD* = 64.67) per school in mathematics and 62 students (*SD* = 66.15) per school in reading. On average, in mathematics there were 42 (*SD* = 38.41) students per rural school, 67 students (SD = 52.72) per town school, 55 students (SD = 62.91) per suburban school, and 59 students (SD = 70.54) per urban school. Similarly, in mathematics, there were 45 students (SD = 74.73) in non-Title 1 schools and 73 students (SD = 43.64) in Title 1 schools on average. On the other hand, in reading there were, on average, 45 students (SD = 41.69) per rural school, 72 students (SD = 54.78) per town school, 61 students (SD = 64.75) per suburban school, and 62 students (SD = 71.64) per urban school. Similarly, in reading, there were 48 students (SD = 76.70) in non-Title 1 schools and 79 students (SD = 43.47) in Title 1 schools on average. Before running each model, I adjusted for school size. Thus, the final dataset consisted of 1,244 schools for mathematics data and 1,266 schools for reading data.

Measures

Renaissance Star reading and mathematics data was used. This adaptive assessment was developed for use in K-12 student populations and was designed to measure both reading and mathematics achievement (Renaissance Learning, 2022a; Renaissance Learning, 2022b). Two versions of this assessment have existed (a) a full-length test (i.e., 34 items for both subjects) and (b) a shorter version (i.e., 24 items for mathematics and 25 items for reading) designed to monitor progress. Data from both versions were included in the dataset that was used in this study. The mathematics test measured various domains such as data analysis, geometry, algebra, and operations, whereas the reading test measured various domains such as comprehension, argument analysis, and word knowledge. Scores from this assessment have been shown to have been both reliable and valid. For grade 3, the internal consistency for the full-length mathematics test was .91 and .80 for the shorter version (Renaissance Learning, 2022a; Renaissance Learning, 2022b). Whereas the reading test had an internal consistency of .95 for the full-length test and .89 for the shorter version (Renaissance Learning, 2022a; Renaissance Learning, 2022b). Furthermore, concurrent validity for both the grade 3 mathematics and reading test was .72 with several tests such as the Iowa Test of Basic Skills and the Stanford Achievement Test (Renaissance Learning, 2022a; Renaissance Learning, 2022b). Similarly, the Star test was correlated at .86 in mathematics and .78 in reading with the Smarter Balanced Assessment Consortium Test (Renaissance Learning, 2022a; Renaissance Learning, 2022b). Finally, the Star test correctly predicted overall classification for the PARCC consortium assessment 89% of the time in mathematics and 86% of the time in reading (Renaissance Learning, 2022a; Renaissance Learning, 2022b).

Plan of Analysis

Prior to addressing the research questions, I conducted some data transformations. Because school size was a continuous variable, it was grand mean centered. Thus, 0 indicated a school of average size. Because SES was a categorical variable, it was simple contrast coded into one variable with Title 1 schools as the focal group and non-Title 1 schools as the reference group. Similarly, setting was a categorical variable and was simple contrast coded into three variables with rural as the reference group and suburban, urban, and town as the focal groups. Town was a unique NWEA distinction, so it was also included for the sake of completeness. There were four different dependent variables (a) average mathematics achievement, (b) average reading achievement, (c) range of mathematics achievement, and (d) range of reading achievement.

Research Question 1

Research question 1 examined the relationship between school SES and achievement (i.e., average and range) in reading and mathematics after adjusting for school size. To answer research question 1, the following regression equation was be used:

$$y = \beta_0 + \beta_1(\text{school size}) + \beta_2(\text{school SES}) + \text{e}.$$

The achievement (e.g., average mathematics achievement, average reading achievement, range of mathematics achievement, and range of reading achievement) was the dependent variable, y; β_0 was the grand mean of achievement (e.g., average mathematics achievement); β_1, which was a control variable, was the change in the dependent variable for every one unit change in school size; and β_2 was the difference in achievement between Title 1 and non-Title 1 schools of average size.

Research Question 2

Research question 2 examined the relationship between school setting and achievement (i.e., average and range) in reading and mathematics after adjusting for school size. To answer research question 2, the following regression equation was used:

$$y = \beta_0 + \beta_1(\text{school size}) + \beta_2(\text{town}) + \beta_3(\text{suburban}) + \beta_4(\text{urban}) + \text{e}.$$

The dependent variable, y, was one of the four achievement types; β_0 was the grand mean of achievement (e.g., of average mathematics achievement); β_1, which was a control variable, was the change in the dependent variable for every one unit change in school size; β_2 was the difference in the dependent variable between average sized town and rural schools; β_3 was the difference in the dependent variable between average sized suburban urban and rural schools; β_4 was the difference in the dependent variable between average sized urban and rural schools.

Research Question 3

Research question 3 examined the relationship between school SES and school setting on achievement (i.e., average and range) in reading and mathematics after adjusting for school size. To answer research question 3 the following regression equation was used:

$$y = \beta_0+\beta_1(\text{school size})+\beta_2(\text{school SES}) +\beta_3(\text{town})+\beta_4(\text{suburban})+\beta_5(\text{urban}) + e.$$

This regression equation added school SES and school setting into the same model and could be altered to predict average or range in mathematics or reading achievement. Adding both school SES and school setting into the same model allowed for testing the unique effects of school SES and setting. Thus, the dependent variable, y, could be substituted to predict the various types of achievement; β_0 was the grand mean of achievement; β_1, which was a control variable, was the change in the dependent variable for every one unit change in school size. After controlling for school setting, β_2 was the difference in achievement between Title 1 and non-Title 1 schools of average size. After controlling for school SES, β_3 was the difference in the dependent variable between average sized town and rural schools, β_4 was the difference in the dependent variable between average sized suburban and rural schools, and β_5 was the difference in the dependent variable between average sized urban and rural schools.

Research Question 4

Finally, research question 4 examined whether school setting moderated the relationship between school SES on achievement (i.e., average and range) in reading and mathematics after adjusting for school size. To answer research question 4 the following regression equation was used:

$$y = \beta_0+\beta_1(\text{school size})+\beta_2(\text{SES})+\beta_3(\text{town})+\beta_4(\text{suburban})+\beta_5(\text{urban})+\beta_6(\text{SESxTown})$$
$$+\beta_7(\text{SESxSuburban})+\beta_8(\text{SESxUrban}) + \text{e}.$$

This regression equation tested whether school setting moderated the relationship between SES and achievement. Thus, the dependent variable, y, was achievement (e.g., range in reading achievement); β_0 was the grand mean of achievement (e.g., range in reading achievement); and β_1, which was a control variable, was the change in the dependent variable for every one unit change in school size. After adjusting for school setting, β_2 was the difference in achievement between Title 1 and non-Title 1 schools of average size. For a school with average school SES, β_3 was the difference in the dependent variable between average sized town and rural schools; β_4 was the difference in the dependent variable between average sized suburban and rural schools; β_5 was the difference in the dependent variable between average sized urban and rural schools. For the moderation terms, β_6 was the difference in the effect of SES on the dependent variable between average sized town and rural schools; β_7 was the difference in the effect of SES on the dependent variable between average sized suburban and rural schools; and β_8 was the difference in the effect of SES on the dependent variable between average sized urban and rural schools.

RESULTS

Descriptive Statistics

Overall, prior to accounting for setting or Title 1 status, the mean average mathematics achievement was 923.45 (*SD* = 29.03), average reading achievement was 932.10 (*SD* = 41.43), range of mathematics achievement scores was 65.41 (*SD* = 17.25), and range of reading achievement scores was 92.29 (*SD* = 25.65). Table 1 displays the average achievement by school setting and Title 1 status. Overall, scores from non-Title 1 schools appear to be higher than Title 1 schools. However, there is also a greater range of achievement scores for Title 1 schools compared to non-Title 1 schools. Compared to rural and town schools, suburban and urban schools had more students on average. Regardless of Title 1 status, the range of reading achievement scores was larger than that of mathematics. Finally, schools in suburban settings tended to have the highest achievement. The results will be presented separately by the various achievement types. First, all four research questions will be addressed for average mathematics achievement. Thus, I will examine how this achievement type is predicted by Title 1 status (RQ1), school setting (RQ2), both Title 1 status and school setting together (RQ3), and Title 1 status, school setting, and the moderation of Title 1 status by school setting. This process will then be repeated for average reading achievement, the range of mathematics achievement scores, and the range of reading achievement scores.

Table 1

School Achievement by Setting and Title 1 Status

Variable	Rural		Town		Suburban		Urban	
	N	*M(SD)*	*N*	*M(SD)*	*N*	*M(SD)*	*N*	*M(SD)*
Non-Title 1 School								
Average Math	25	930.14 (19.51)	26	916.32 (25.17)	325	940.41 (23.12)	338	939.46 (25.33)
Average Reading	25	937.61 (33.19)	27	931.84 (34.10)	326	960.01 (30.13)	339	956.42 (33.86)
Range Math	25	66.84 (17.92)	26	62.44 (20.65)	325	57.77 (15.09)	338	58.54 (15.39)
Range Reading	25	103.96 (58.91)	27	96.96 (35.46)	326	82.55 (21.50)	339	81.72 (23.26)
Title 1 School								
Average Math	51	906.13 (22.46)	86	899.50 (18.57)	166	904.85 (22.35)	227	901.98 (19.60)
Average Reading	54	901.87 (31.69)	86	898.82 (26.45)	178	902.83 (28.14	231	898.46 (27.68)
Range Math	51	70.27 (16.87)	86	73.83 (15.89)	166	74.32 (15.50)	227	75.95 (13.59)
Range Reading	54	105.06 (24.31)	86	105.23 (19.63)	178	102.61 (22.33)	231	103.96 (19.19)

Average Mathematics Achievement

Prior to running to the analyses, I examined the effect of school size on average mathematics achievement. School size explained 2.48% of the variability in average mathematics achievement. See Table 2 for parameter estimates.

Research Question 1

After adjusting for school size, Title 1 status explains 34.94% of the variability in average mathematics achievement, $\Delta F(1,1241) = 692.87$, $\Delta R^2 = .349$, $p < .001$. The grand mean of average mathematics achievement for someone attending an average sized school was 919.78 points. Title 1 schools scored 35.46 points statistically significantly lower than non-Title 1 schools on average mathematics achievement. Given that the original standard deviation of the distribution was 29.03, this was a substantial effect (i.e., the achievement difference is larger than a standard deviation).

Research Question 2

After adjusting for school size, school setting explains 5.95% of the variability in average mathematics achievement, $\Delta F(3,1239) = 26.82$, $\Delta R^2 = .06$, $p < .001$. The grand mean of average mathematics achievement for someone attending an average sized school was 912.47 points. Average sized rural schools scored 8.94 points statistically significantly higher than average sized town schools, 15.23 points statistically significantly lower than average sized suburban schools, and 11.55 points statistically significantly lower than average sized urban schools on average mathematics achievement.

Research Question 3

After adjusting for school size, both Title 1 status and school setting explain 35.80% of the variability in average mathematics achievement, $\Delta F(4,1238) = 179.50$, $\Delta R^2 = .358$, $p < .001$.

Table 2

Model Parameter Estimates for Average Mathematics Achievement in Schools

	Baseline Model	Model 1	Model 2	Model 3	Model 4
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Constant (β_0)	918.28 (1.22)***	919.78 (.98)***	912.46 (1.45)***	917.98 (1.21)***	916.38 (1.27)***
School size (β_1)	-.07 (.01)***	-.01 (.01)	-.07 (.01)***	-.01 (.01)	-.01 (.01)
Title 1 status (β_2)		-35.46 (1.35)***		-34.05 (1.39)***	-28.20 (2.03)***
Town (β_3)			-8.94 (4.15)*	-6.97 (3.41)*	-10.04 (3.76)**
Suburban (β_4)			15.23 (3.43)***	3.21 (2.86)	4.69 (2.98)
Urban (β_5)			11.55 (3.41)***	1.46 (2.83)	2.83 (2.95)
Title1XTown (β_6)					7.78 (7.54)
Title1XSuburban (β_7)					-11.05 (5.97)
Title1XUrban (β_8)					-12.84 (5.90)*
R^2	.02***	.37***	.08***	.38***	.39***
ΔR^2		.35***	.06***	.36***	.01***
Comparison		Baseline	Baseline	Baseline	Model 3

Note. N = 1,244.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

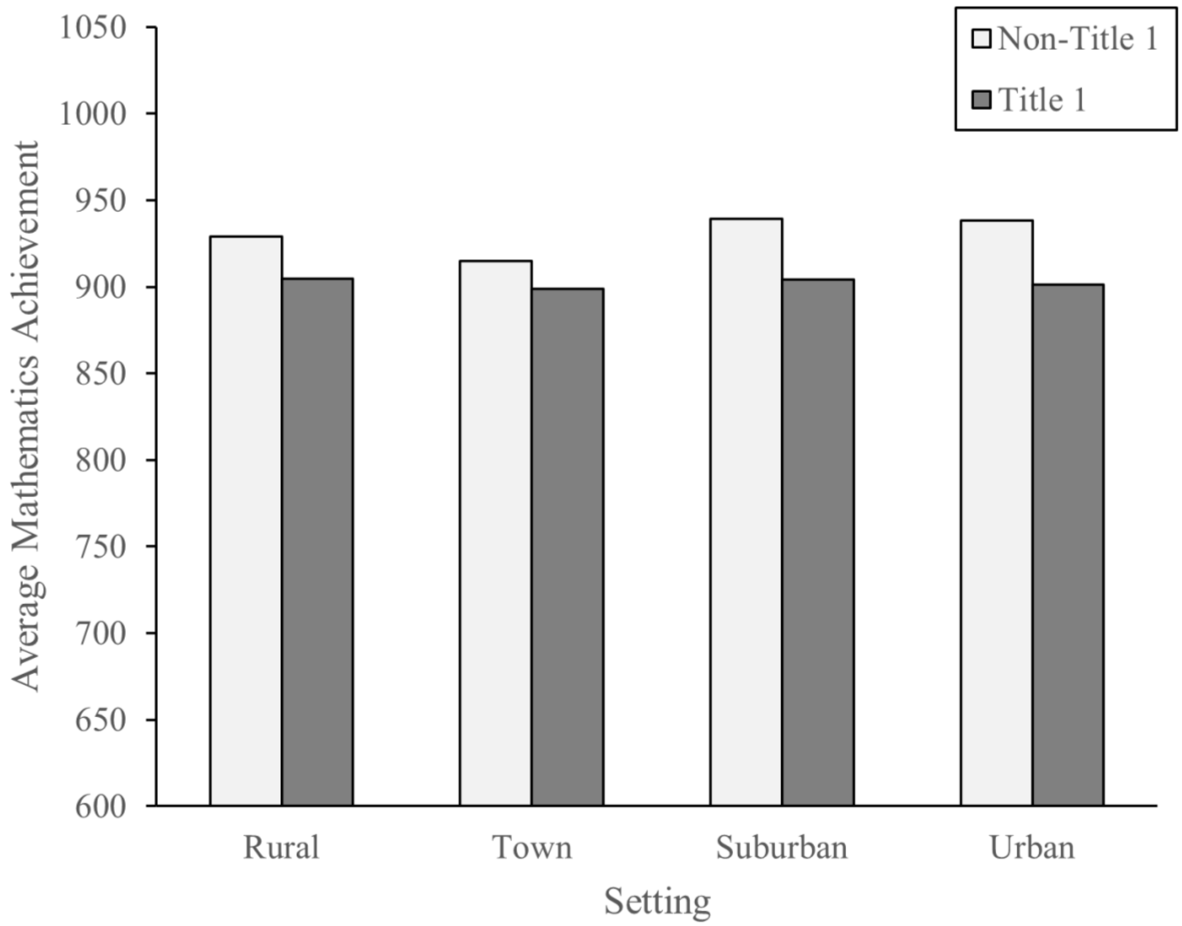
The grand mean of average mathematics achievement for someone attending an average sized school was 917.98 points. Holding school setting constant and for schools of average size, Title 1 schools scored 34.05 points statistically significantly lower than non-Title 1 schools. Holding Title 1 status constant, average sized rural schools scored 6.97 points statistically significantly higher than average sized town schools. None of the other comparisons were statistically significant (e.g., no difference in achievement between rural and urban).

Research Question 4

Finally, after adjusting for school size, school setting moderates the relationship between Title 1 status and average mathematics achievement, $\Delta F(3,1235) = 5.94$, $\Delta R^2 = .009$, $p < .001$. Specifically, the difference between Title 1 schools and non-Title 1 schools on average mathematics achievement was 12.84 points smaller for rural schools compared to urban schools. This difference can be seen in Figure 1. The difference in achievement between Title 1 schools and non-Title 1 schools was larger in urban schools than in rural schools. None of the other interactions between Title 1 status and setting were statistically significant predictors of mathematics achievement. However, similar to the results from model 3 after adjusting for Title 1 status, average sized rural schools scored 10.05 points higher than average size town schools. There were no other statistically significant differences between settings in terms of average mathematics achievement. Also similar to the prior results after adjusting for school setting, Title 1 schools of average size scored 28.20 points lower than non-Title 1 schools of average size on average mathematics achievement.

Figure 1

Average School Mathematics Achievement by Setting and Title 1 Status



Average Reading Achievement

Similar to average mathematics achievement, the first thing I did before running any analysis was to examine the effect of school size on average reading achievement. School size explained 3.74% of the variability in average reading achievement. See Table 3 for parameter estimates.

Research Question 1

After adjusting for school size, Title 1 status explains 41.44% of the variability in average reading achievement, $\Delta F(1,1263) = 954.90$, $\Delta R^2 = .414$, $p < .001$. The grand mean of average

Table 3

Model Parameter Estimates for Average Reading Achievement in Schools

	Baseline Model	Model 1	Model 2	Model 3	Model 4
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Constant (β_0)	923.47 (1.68)***	926.51 (1.27)***	914.39 (1.99)***	923.74 (1.57)***	921.55 (1.65)***
School size (β_1)	-.12 (.02)***	-.03 (.01)*	-.12 (.02)***	-.03 (.01)*	-.03 (.01)*
Title 1 status (β_2)		-55.38 (1.79)***		-53.62 (1.85)***	-45.35 (2.69)***
Town (β_3)			-3.19 (5.81)	-1.52 (4.51)	-4.00 (4.99)
Suburban (β_4)			28.60 (4.79)***	9.40 (3.77)*	12.18 (3.95)**
Urban (β_5)			21.79 (4.75)***	5.33 (3.73)	8.19 (3.91)*
Title1XTown (β_6)					4.00 (9.99)
Title1XSuburban (β_7)					-20.23 (7.91)*
Title1XUrban (β_8)					-20.89 (7.84)**
R^2	.04***	.45***	.10***	.46***	.47***
ΔR^2		.41***	.06***	.42***	.01***
Comparison		Baseline	Baseline	Baseline	Model 3

Note. N = 1,266.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

reading achievement for someone attending an average sized school was 926.51 points. Title 1 schools scored 55.38 points statistically significantly lower than non-Title 1 schools on average reading achievement. Given that the original standard deviation of the distribution was 41.43, this was also a substantial effect (i.e., the achievement difference is larger than a standard deviation).

Research Question 2

After adjusting for school size, school setting explains 5.98% of the variability in average reading achievement, $\Delta F(3,1261) = 27.83$, $\Delta R^2 = .060$, $p < .001$. The grand mean of average reading achievement for someone attending an average sized school was 914.39 points. Average sized rural schools scored 28.60 points statistically significantly lower than average sized suburban schools and 21.79 points statistically significantly lower than average sized urban schools on average reading achievement. No statistically significant differences existed between town and rural schools on average reading achievement.

Research Question 3

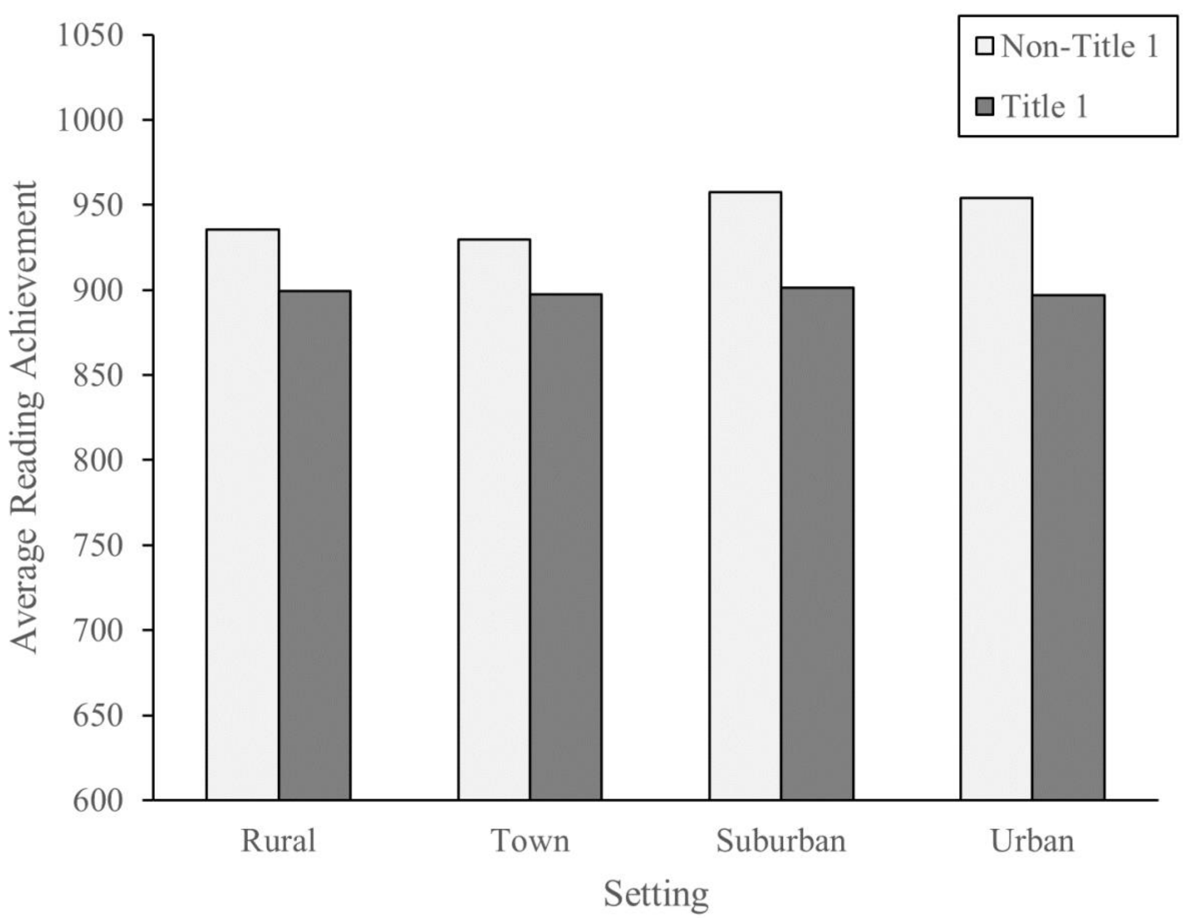
After adjusting for school size, both Title 1 status and school setting explain 42.10% of the variability in average reading achievement, $\Delta F(4,1260) = 244.89$, $\Delta R^2 = .421$, $p < .001$. The grand mean of average reading achievement for someone attending an average sized school was 923.74 points. Holding school setting constant and for schools of average size, Title 1 schools scored 53.62 points statistically significantly lower than non-Title 1 schools. Holding Title 1 status constant, average sized suburban schools scored 9.40 points statistically significantly higher than rural schools. None of the other comparisons were statistically significant (e.g., no difference in achievement between rural and town).

Research Question 4

Finally, after adjusting for school size, school setting moderates the relationship between Title 1 status and average reading achievement, $\Delta F(3,1257) = 6.16$, $\Delta R^2 = .008$, $p <$ $.001$. Specifically, the difference between Title 1 schools and non-Title schools on average reading achievement was 20.23 points statistically significantly smaller for rural schools compared to suburban schools and 20.89 points statistically significantly larger for rural schools compared to urban schools. These differences can be seen in Figure 2. The difference in

Figure 2

Average School Reading Achievement by Setting and Title 1 Status



achievement between Title 1 schools and non-Title 1 schools was larger in urban and suburban schools than in rural schools. No statistically significant interaction existed between town and Title 1 status in regards to predicting average reading achievement. After adjusting for Title 1 status, average sized rural schools scored 12.18 points statistically significantly lower than average size suburban schools and 8.19 points statistically significantly lower than average size urban schools and 8.19 points statistically significantly lower than average size urban schools. There were no statistically significant differences between town and rural school average reading achievement. Similar to model 3, after adjusting for school setting, Title 1 schools of average size scored 45.35 points lower than non-Title 1 schools of average size on average reading achievement.

Range of Mathematics Achievement

Before running the models, the effect of school size on the range of mathematics achievement scores was examined. School size explained 4.58% of the variability in the range of mathematics achievement scores. See Table 4 for parameter estimates.

Research Question 1

After adjusting for school size, Title 1 status explains 17.75% of the variability in the range of mathematics achievement scores, $\Delta F(1,1241) = 283.64$, $\Delta R^2 = .178$, $p < .001$. The grand mean of the range of mathematics achievement scores for someone attending an average sized school was 68.95 points. Title 1 schools had a 15.02 point statistically significantly greater range in mathematics achievement scores than non-Title 1 schools. Because the original standard deviation of the distribution was 17.25, this was not a substantial effect.

Research Question 2

After adjusting for school size, school setting explains 1.75% of the variability in the

Table 4

Model Parameter Estimates for Range of Mathematics Achievement in Schools

	Baseline Model	Model 1	Model 2	Model 3	Model 4
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Constant (β_0)	69.59 (.72)***	68.95 (.65)***	71.54 (.87)***	69.13 (.80)***	69.85 (.84)***
School size (β_1)	.06 (.01)***	.03 (.01)***	.06 (.01)***	.03 (.01)***	.03 (.01)***
Title 1 status (β_2)		15.02 (.89)***		14.86 (.93)***	11.55 (1.35)***
Town (β_3)			.64 (2.49)	-.22 (2.27)	-.86 (2.51)
Suburban (β_4)			-6.50 (2.06)**	-1.25 (1.91)	-2.98 (1.99)
Urban (β_5)			-4.58 (2.05)*	-.18 (1.88)	-1.90 (1.97)
Title1XTown (β_6)					6.55 (5.03)
Title1XSuburban (β_7)					11.91 (3.98)**
Title1XUrban (β_8)					12.46 (3.94)**
R^2	.05***	.22***	.06***	.22***	.23***
ΔR^2		.18***	.02***	.18***	.01**
Comparison		Baseline	Baseline	Baseline	Model 3

Note. $N = 1,244$.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

range of mathematics achievement scores, $\Delta F(3,1239) = 7.70$, $\Delta R^2 = .018$, $p < .001$. The grand mean of the range of mathematics achievement scores for someone attending an average sized school was 71.54 points. Average sized rural schools had a 6.50 point statistically significantly greater range in mathematics achievement scores than average sized suburban schools and a 4.58 statistically significantly points greater range in mathematics achievement scores than average sized urban schools. There was no statistically significant difference between town and rural schools in terms of the range in mathematics achievement scores.

Research Question 3

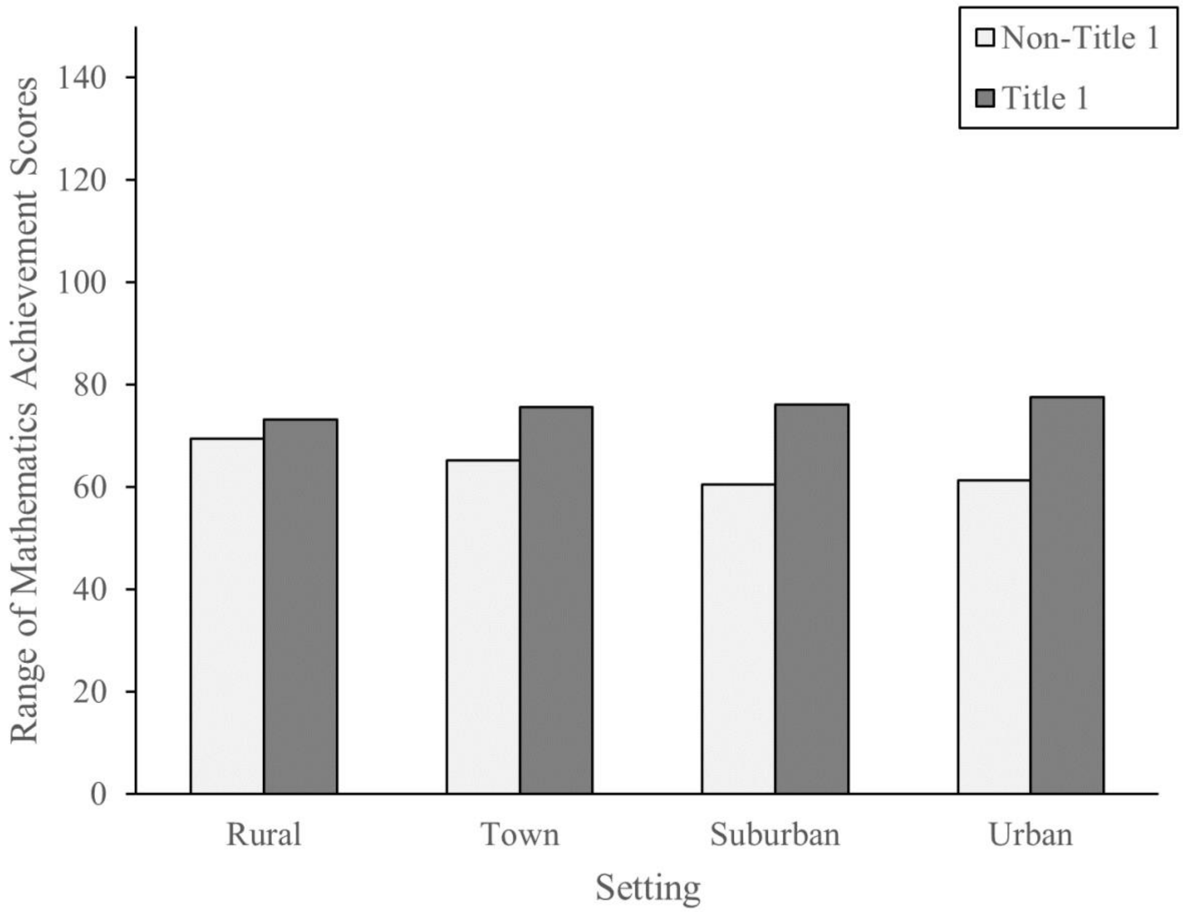
After adjusting for school size, both Title 1 status and school setting explain 17.84% of the variability in the range in mathematics achievement scores, $\Delta F(4,1238) = 71.20$, $\Delta R^2 = .178$, $p < .01$. The grand mean of the range in mathematics achievement scores for someone attending an average sized school was 69.13 points. Holding school setting constant and for schools of average size, Title 1 schools had a 14.86 point statistically significantly greater range in mathematics achievement scores than non-Title 1 schools. No statistically significant differences existed between rural setting and other settings.

Research Question 4

Finally, after adjusting for school size, school setting moderates the relationship between Title 1 status and the range in mathematics achievement scores, $\Delta F(3,1235) = 4.04$, $\Delta R^2 = .008$, $p < .01$. Specifically, the difference between Title 1 schools and non-Title 1 schools on the range of mathematics achievement scores was 11.91 points statistically significantly larger for suburban schools compared to rural schools and 12.46 points statistically significantly larger for urban schools compared to urban schools. These differences can be seen in Figure 3. The difference in range of achievement scores between Title 1 schools and non-Title 1 schools was

Figure 3

Range of School Mathematics Achievement Scores by Setting and Title 1 Status



Note. Range was calculated by subtracting the 25th percentile from the 75th percentile.

larger in urban and suburban schools than in rural schools. The interaction between town and Title 1 status was not a statistically significant predictor of the range in mathematics achievement scores. Similar to model 3, after adjusting for Title 1 status, setting was not a statistically significant predictor of the range of mathematics achievement scores. After adjusting for school setting, Title 1 schools of average size had a 11.55 point statistically significantly greater range of scores than non-Title 1 schools of average size on mathematics achievement.

Range of Reading Achievement

Before running any analysis, I examined the effect of school size on reading range achievement. School size explained 2.27% of the variability in the range of reading achievement scores. See Table 5 for parameter estimates.

Research Question 1

After adjusting for school size, Title 1 status explains 13.64% of the variability in the range of reading achievement scores, $\Delta F(1,1263) = 204.94$, $\Delta R^2 = .136$, $p < .001$. The grand mean of the range in reading achievement scores for someone attending an average sized school was 95.36 points. Title 1 schools had a 19.63 point statistically significantly greater range of reading scores than non-Title 1 schools. Because the original standard deviation of the distribution was 25.65, this was also not a substantial effect.

Research Question 2

After adjusting for school size, school setting explains 3.75% of the variability in the range of reading achievement scores, $\Delta F(3,1261) = 16.76$, $\Delta R^2 = .038 p < .001$. The grand mean of the range of reading achievement scores for someone attending an average sized school was 1-101.39 points. Average sized rural schools had a 16.04 point statistically significantly greater range in reading achievement scores than average sized suburban schools and had a14.98 point statistically significantly greater range in reading achievement scores than average sized urban schools. No statistically significant differences existed between town and rural schools on the range of reading achievement scores.

Research Question 3

After adjusting for school size, both Title 1 status and school setting explain 14.69% of the variability in the range of reading achievement scores, $\Delta F(4,1260) = 55.74$, $\Delta R^2 = .147$,

Table 5

Model Parameter Estimates for Range of Reading Achievement in Schools

	Baseline Model	Model 1	Model 2	Model 3	Model 4
	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)	Estimate (*SE*)
Constant (β_0)	96.44 (1.05)***	95.36 (.97)***	101.39 (1.25)***	98.21 (1.20)***	99.60 (1.26)***
School size (β_1)	.06 (.01)***	.02 (.01)*	.06 (.01)***	.03 (.01)**	.03 (.01)*
Title 1 status (β_2)		19.63 (1.37)***		18.23 (1.41)***	12.33 (2.06)***
Town (β_3)			-3.07 (3.66)	-3.64 (3.45)	-3.81 (3.82)
Suburban (β_4)			-16.04 (3.02)***	-9.52 (2.88)***	-12.41 (3.03)***
Urban (β_5)			-14.98 (3.00)***	-9.39 (2.85)***	-12.14 (2.99)***
Title1XTown (β_6)					5.94 (7.65)
Title1XSuburban (β_7)					17.81 (6.06)**
Title1XUrban (β_8)					19.88 (6.00)***
R^2	.02***	.16***	.06***	.17***	.18***
ΔR^2		.14***	.04***	.15***	.01**
Comparison		Baseline	Baseline	Baseline	Model 3

Note. N = 1,266.

$^{*}p < .05$. $^{**}p < .01$. $^{***}p < .001$.

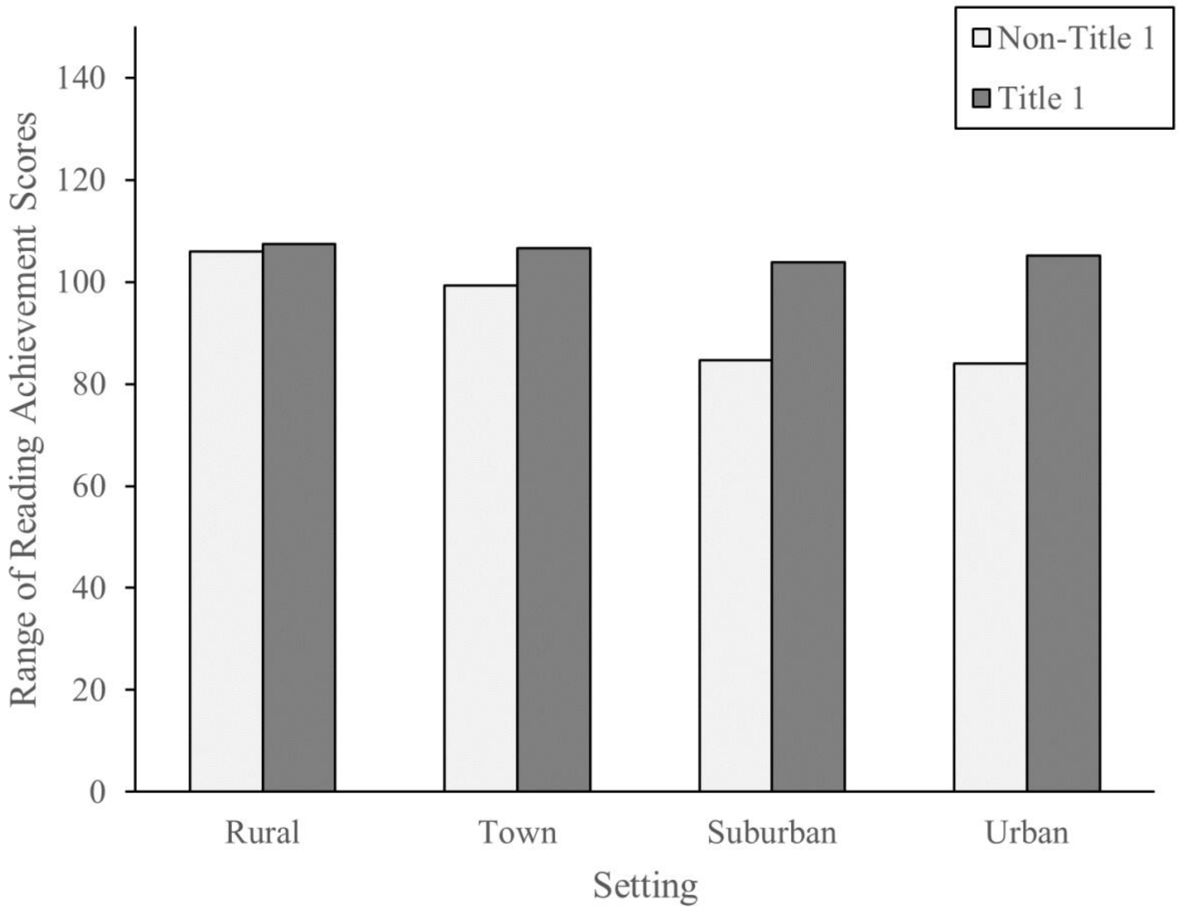
$p < .001$. The grand mean of the range of reading achievement scores for someone attending an average sized school was 98.21 points. Holding school setting constant and for schools of average size, Title 1 schools had a 18.23 point statistically significantly greater range in reading achievement scores than non-Title 1 schools. Holding Title 1 status constant, average sized rural schools had a 9.52 point statistically significantly greater pange in reading achievement scroes than average sized suburban schools and a 9.39 point statistically significantly greater range in reading achievement scores than average sized urban schools. No statistically significant differences existed between town and rural schools on the range of reading achievement scores.

Research Question 4

Finally, after adjusting for school size, school setting moderates the relationship between Title 1 status and the range in reading achievement scores, $\Delta F(3,1257) = 5.29$, $\Delta R^2 = .010$, $p < .01$. Specifically, the difference between Title 1 schools and non-Title schools on reading range achievement was 5.94 points statistically significantly larger for suburban schools compared to rural schools and 19.88 points statistically significantly larger for urban schools compared to rural schools. These differences can be seen in Figure 4. The difference in range of achievement scores between Title 1 schools and non-Title 1 schools was larger in urban and suburban schools than in rural schools. No interaction existed between town and Title 1 status in regards to statistically significantly predicting the range in reading achievement scores. Similar to model 3, after adjusting for Title 1 status, average sized rural schools had a 12.41 point statistically significantly greater range in reading achievement scores than average sized suburban schools and a 12.14 point statistically significantly greater range in reading achievement scores than average sized urban schools. There were no statistically significant differences between the range in reading achievement scores for average sized town and rural schools. After adjusting for school setting, Title 1 schools of average size had a 12.33 point statistically significantly greater range in reading achievement scores than non-Title 1 schools.

Figure 4

Range of School Reading Achievement Scores by Setting and Title 1 Status



Note. Range was calculated by subtracting the 25th percentile from the 75th percentile.

DISCUSSION

Researchers have identified that academic achievement is related to later outcomes such as high school graduation rates (e.g., Lesnick et al., 2010), college attendance (e.g., Lesnick et al., 2010), and future economic earnings (e.g., Watts, 2020). Thus, exploring factors that predict achievement is important. Therefore, the purpose of this paper was to explore how school level factors are related to academic achievement, specifically reading and mathematics achievement. Past research has explored these factors using average achievement. However, this paper also sought to expand upon the limited research exploring the range of variability that exists within an educational context. Because the size of the school can vary depending on setting, this was controlled for prior to running any models and answering research questions by adjusting for school size. Specifically, the setting and SES of the school were used as predictors to examine if school level factors explain variability in four different types of achievement: average mathematics achievement, average reading achievement, range of mathematics achievement, and range of reading achievement. Results from the current study reveal that: (a) SES was related to both average achievement and the range of achievement in schools, (b) setting was related to both average achievement and the range of achievement in schools, (c) in some instances, setting moderates the relationship between SES and achievement in schools, and (d) there was larger variability in reading achievement than mathematics achievement.

School SES and Academic Achievement

The current study examined achievement using data of third graders. Researchers have established a connection between school level SES and achievement and shown that higher SES relates to higher achievement (e.g., Caldas & Bankston, 1997; Ewijka & Sleegers, 2010; Perry &

McConney, 2010; Perry et al., 2022; Sirin, 2005). The results of the current study align. For example, Title 1 schools, which would indicate lower SES, had lower achievement and greater variability in achievement. Thus, this study adds to the existing literature by incorporating variability in achievement and provides evidence that it is not just average achievement but that also the schools SES can impact how much academic variability is present at schools.

School Setting and Academic Achievement

The current study provides evidence that achievement levels differ based on where the school is located. Most of the previous research has focused largely on the differences between rural and urban schools (e.g., Sun & Du, 2021; Wang et al., 2017). When comparing rural and urban schools in the current study, urban schools outperformed rural schools in both subjects, which aligns with past research (e.g., Sun & Du, 2021; Wang et al., 2017). Furthermore, consistent with Provost (2012) findings of suburban students outperforming urban and rural students in mathematics, the current study saw similar trends with suburban schools having the highest average mathematics and reading achievement. There appears to be a lack of research addressing towns, however. The current research addressed this gap and found that, in mathematics, rural schools outperformed town schools. Similarly, research regarding achievement variability is limited and does not appear to have been explored outside of quantifying the size of the range. Thus, the current study incorporated this concept of academic variability and found that rural schools have a wider range of achievement scores in both subjects than schools when compared with suburban and urban areas.

Moderation of SES on Academic Achievement by Setting

The setting of a school has an impact of the relationship between SES and academic achievement, particularly in suburban (i.e., reading) and urban settings (i.e., mathematics and reading) when compared to rural schools. Specifically, the difference between Title 1 schools and non-Title 1 schools' average achievement was smaller in rural settings when compared with suburban (i.e., reading) and urban (i.e., mathematics and reading) settings; similarly, the difference between Title 1 schools and non-Title 1 schools achievement range was smaller in rural settings when compared to suburban and urban settings. These findings align with Sirin (2005) findings of setting moderating the relationship between SES and achievement, particularly when comparing suburban and rural schools. In the present study, the relationship between SES and achievement was moderated by setting, specifically for suburban (except for average mathematics achievement) and urban setting when compared with a rural setting. Specifically, there was a greater difference between Title 1 school and non-Title 1 schools' average achievement and smaller range of achievement in rural settings. The current findings expand on Sirin (2005) research by incorporating school level SES instead of student level as well as academic variability.

Differences in Reading and Mathematics Achievement Variability

While not the focus of the current project, it appears that the range in reading is larger than the range in mathematics. Further research could explore this finding using inferential statistics to compare reading and mathematics variability instead of descriptive statistics as in the present study. Therefore, caution should be taken regarding that specific finding as further analysis would need to be conducted to see if differences exist. However, the finding that the range is larger in reading than in mathematics aligns with past research looking at variability in achievement. For example, Firmender et al. (2013) identified that achievement in reading spanned up to approximately 12 years within grades in schools whereas Peters et al. (2017) identified that achievement in mathematics in a single grade spanned approximately five years.

Limitations

Because the data for this study was collected pre-covid, the results might not reflect current educational trends. Current findings suggest that the Covid-19 pandemic has impacted academic achievement with students not performing as high as pre-pandemic years (e.g., Domina et al. 2022; Kuhfeld, 2022). Future research could replicate this study using data using a Covid-19 cohort.

Similarly, SES is multifaceted, so only using Title 1 status might not capture all aspects of SES. Other datasets may provide access to other SES related variables. Thus, if the current study was replicated with a more nuanced variable for school SES, the results might differ. Future research could explore how other SES related variables (e.g., free and reduced lunch status) are related to achievement and if the school setting changes the relationship between those variables and achievement.

Previous research has shown that as students grow older, the school SES is more influential for learning than individual SES (Aikens & Barbarin, 2008). While the current study only looked at school level SES and did not compare this to student SES, these results align with the finding that school SES is influential because these students have been in school for some time, so it would be expected that the school SES would predict achievement.

Furthermore, data from only one state was used in analysis. Thus, results may not generalize to the remainder of the United States. Future research could explore these patterns across various regions. It is quite possible that the trends that emerged in this present study could differ in other regions.

Finally, the data was observational. Thus, there is no way to establish cause and effect relationships. However, studying these variables in an experimental setting is not feasible. For instance, it would be unethical and impossible to randomly assign students to live in lower SES environments.

Conclusion

The results of this study provide evidence that school level factors impact academic achievement. Thus, what school a child attends is related to how well they achieve in mathematics and reading. Future researchers should consider exploring these patterns in other subjects. The findings from this study provide insightful information regarding how achievement differs based on the setting and SES. Understanding these differences can aid policy makers in their decisions regarding schools. For example, differences exist between the absolute achievement and the range of achievement, and Title 1 schools have both the lowest achievement and largest range of achievement. This continues to highlight the need for additional resources and interventions for students at these schools.

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