A Study Examining Secondary Student Achievement in the Eleventh Grade Based on Large and Small High School Population Size in Virginia

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ABSTRACT

The study's purpose was to examine large and small high schools in Virginia to try to understand if the high school student population size influenced the student achievement of eleventh grade students based on identified predictor variables. Several studies were identified and included in the literature review. From the literature review, the predictor variables of socioeconomic status, student attendance, minority status, and teacher quality were identified to aid in the development of the main research question and five guiding questions. The main research question investigated if there was a relationship between a high school student population size and student achievement when statistically controlling for selected predictor variables.

From the literature review, the main research question, five guiding questions, and a methodology were developed that would best aid in the analysis of the data. Data were collected from the Virginia Department of Education for the 2012-2013 school year that consisted of eleventh grade Virginia Standards of Learning assessments, socioeconomic status, student attendance, minority population, and teacher quality. Hierarchical multiple regression was the statistical method used to analyze the data for the research questions.

The results of the study indicate there is a relationship between socioeconomic status and student achievement. However, when student population size was introduced, the result was not significant. The overall conclusion regarding socioeconomic status and student achievement is that the issue is not rooted in the size of a high school population. When student attendance was accounted for, a relationship existed between high school student population size and student achievement. When student attendance was accounted for, an indication existed that the high schools in the study with both large and small student populations had a higher percentage of student achievement when students attended on a regular basis. When the size of a high school student population, whether it was large or small, was taken into account, student achievement declined if a high school had a large percentage of minority students. Teacher quality was found to have a relationship with student achievement when high school student population size was taken into account. Overall, results of the study indicate that there was a relationship between a high school student population size and student achievement when statistically controlling for isolated variables.

Dedication

To my wife, Janette. I could not have done this without your encouragement and patience. Not only have you supported me during this latest educational endeavor, but throughout my educational journey from my undergraduate degree through the doctoral process. Without your support and understanding, none of these accomplishments would have been possible.

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CHAPTER 1
INTRODUCTION

The average number of schools per district has fallen in the United States since the 1940's (Lawrence, 2004, p. 41). Meanwhile, student population in the United States has increased steadily since 1985 and is projected to set new records every year from 2012 to 2021 (U.S. Department of Education, n.d.). The increase in student population since the 1940's has led to larger schools throughout the United States (Lawrence, 2004, p. 41). With an increase in student population size, educational administrators encounter numerous challenges in regards to providing optimal learning conditions and student achievement (Stewart, 2009, p. 20). Educational administrators are tasked with planning for and facilitating appropriate means in which to ensure success for the students they serve (Brown, Finch, & MacGregor, 2012, p. 207). Students' academic achievement as it relates to the size of a school population has been debated and studied by scholars for a number of years. A review of relevant literature notes some of the benefits and detriments of school population size as it relates to student achievement, curriculum, and cost–efficiency (Conant 1959; Fowler & Walberg, 199; Lee & Smith, 1997; Leithwood & Jantzi, 2009; Lindahl & Cain, Sr., 2012; Program Review & Investigations Committee, 2006; Roby, 2004; Stewart, 2009).

Raising student achievement and accountability has been at the forefront of education since 1993 in Virginia when Governor Allen initiated a standards based reform effort (Hover, Hicks, & Stoddard, 2010, p. 1). The Virginia Standards of Learning (SOL's) were developed and approved in the summer of 1995 and encompassed the core academic areas of English, math, science, history, and the social sciences (Virginia Department of Education, 2005). Virginia primary and secondary students were first tested using the newly developed SOL in 1998 (Virginia Department of Education, 2005). The results of that first year of testing were not encouraging with only 2 % of the schools reaching full accreditation (Virginia Department of Education, 2005). This initial result signaled that the education the students were receiving was not sufficient to transition them to the next level of academia or even to enter the workforce at a sufficient level to ensure future success. It was apparent that all stakeholders involved in education needed to make changes that would refocus resources and intervention strategies in order to assist students and schools meet higher accountability standards (Virginia Department of Education, 2005).

Haladyna, Haas, and Allison (1998) stated that standardized testing for grades K-12 is entrenched in the United States (p. 264). With the entrenchment of standardized testing, school leaders and policy makers are continuously looking for ways to improve standardized testing outcomes and improve student achievement. The reason, besides student achievement, is that policy makers and school leaders make decisions, such as the building of schools, and allocation of resources based on standardized test scores (Haladyna, Haas, & Allison, 1998, p. 262). Nationally, the debate in regards to resources and student achievement is increasing due to increasing school taxes, pressure from political and taxpayer groups, and shifting community populations (The Pennsylvania School Boards Association Education Research & Policy Center, 2009, p. 5).

Past research has indicated that various stakeholders support larger schools and student population sizes (Program Review & Investigations Committee, 2006; Leithwood & Jantzi, 2009). The reasons given in past research for larger schools and student populations are based on monetary considerations, diversity of population, student achievement, and larger selection of class offerings (Leithwood & Jantzi, 2009, pp. 464-465). Other solutions that attempt to remedy the aforementioned problems on school size are to consolidate schools, redefine school attendance lines, and build new larger schools (The Pennsylvania School Boards Association Education Research & Policy Center, 2009, p. 5).

However, research indicates that consolidation and the building of larger schools have had an adverse impact on student achievement while achieving little to no cost savings (The Pennsylvania School Boards Association Education Research & Policy Center, 2009, p. 14). According to Lawrence (2004), past research recognizes that there are advantages to smaller schools with student populations below 1,000 and the benefits they provide in relation to student achievement, particularly those children marginalized by low income and /or race (p. 42). Recently, the debate for smaller schools has resurfaced through various nonprofit organizations, such as the Bill and Melinda Gates Foundation's High School Initiative, which advocates for smaller schools (Werblow & Duesberry, 2009, p. 15). Debate for smaller schools has led to an increase in research that investigates school population size. Even with evidence pointing to the benefits of both large and small schools, the question that many policy makers and school divisions face currently is what constitutes the ideal school population size in which maximum student achievement is realized.

Statement of the Problem

An examination of the relevant research and data on school population size and student achievement reveals that there is a discrepancy of what constitutes an agreeable student population size for a school (Stewart, 2009; Greeney & Slate, 2012;Lindahl & Cain, Sr., 2012), especially when variables such as socioeconomic status, student attendance, minority population, and teacher quality are taken into account. In reviewing the research, it becomes apparent that no two-school divisions are alike. A few examples of the differences that exist include geographic size and location (urban versus rural), student population size, funding sources, and availability and retention of highly qualified teachers. The review of research further indicates that additional analysis of data were needed to assist policy makers and school divisions make informed decisions on what possibly could be an acceptable secondary student population size in relation to student achievement for their specific locality. Specifically, new data are needed as it relates to the identified variables in terms of allocation of monetary and educational resources in an era of decreased spending on education. Local school divisions are facing greater student accountability standards with fewer resources. In order to provide the best education to students, localities need current and diverse data that will assist their decision-making capabilities.

Purpose of the Study

The purpose of this study was to examine large and small secondary high school population size to try to understand what, if any, effects it has on student achievement in Virginia. The reason why large and small secondary high schools were chosen specifically was in an effort to add to the current data set and research on school population size and student achievement. Current research includes data on a wide array of what size school population is optimum for student achievement with no clear consensus among researchers. This study does not seek to definitively answer the overarching question of what constitutes the optimum school population size, but to offer new data that will possibly assist localities make better and more informed decisions.

This study investigated the possibility that high school student population size combined with variables such as socioeconomic status, student attendance, minority population, and teacher quality may influence student achievement. The results of this study provide new data on the levels of student achievement in both small and large high school student population in Virginia. In addition, the results of this study provide new data that adds to the existing research and possibly supports local school divisions and policy makers in Virginia make informed decisions on the allocation of resources based on current data. To guide this study, research questions have been developed that address the purpose of this study.

Research Questions

The main research question of this study consists of the following: What is the relationship between a high school student population size and student achievement when statistically controlling for selected variables? To examine the relationship that a high school student population may have with student achievement, the following research questions were utilized to guide this study:

1. What is the relationship between high school student population size and student achievement as measured by student performance on the Virginia Standards of Learning (SOL) in English reading and writing, U.S. History, Chemistry, and Algebra II assessments when socioeconomic status, student attendance, minority population, and teacher quality are statistically controlled?
2. What is the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only socioeconomic status is statistically controlled?
3. What is the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only student attendance is statistically controlled?
4. What is the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English

reading and writing, U.S. History, Chemistry, and Algebra II assessments when only minority population is statistically controlled?

5. What is the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only teacher quality is statistically controlled?

Significance of the Study

School divisions in Virginia face circumstances that are beyond their control, such as available land area upon which to build school facilities, year-to-year budget fluctuations, student population growth or decline, and changes to standardized testing requirements. Issues that are a constant concern for school divisions include student achievement and accountability. To meet various federal and state requirements, local school divisions have to plan and implement strategies that address student achievement in the best possible way. To assist school divisions and superintendents in the constant planning of improving student achievement, relevant data need to be examined while extracting strategies that are based on sound research methodologies and results.

Previous studies have investigated various predictor variables that have been found to correlate with student achievement, including socioeconomic status, student attendance, minority population, and teacher quality (Leithwood & Jantzi, 2009; Stewart, 2009; Werblow & Duesbery, 2009). This study seeks to determine if a relationship exists between school population size and student achievement based the possible predictive ability of the four independent predictor variables (socioeconomic status, student attendance, minority population, and teacher quality) previously mentioned.

Additionally, this study seeks to aid school divisions in Virginia by providing data that may potentially assist them with formulating strategies in regards to student achievement and the optimal student population size based on local conditions. It is evident from the data on schools in Virginia that no two schools or school divisions are alike. There may exist some similarities between schools or even school divisions within Virginia, but no two exactly mirror each other. A few examples on how this study can assist state and local policy makers, division school boards and superintendents are usually given. A large school division in Virginia that is limited in available land to build new schools may use data from this study to assist with reformulating school attendance districts. A local school division that determines that student achievement is declining and student population is increasing may start looking to build another school facility. School divisions may investigate developing a school-within-school program that may allow larger high schools to recognize some of the benefits of smaller schools. School divisions that have small high school student populations may use the data contained in this study to examine demographics of both their students and teachers and make changes that will benefit student achievement. In addition, local school divisions can project population growth or lack thereof to plan what resources will be needed based on what constitutes an agreeable student population size, thus mitigating problems they may have encountered if this and related studies were not available. An example of this would be a school division that has two high schools with both experiencing population decline: would it be feasible to consolidate both schools or look to another solution based on data in this study.

Definitions

The following definitions pertain to and are used in this study:

1. *Average daily attendance* is defined by the aggregate number of days of attendance of all students during a school year divided by the number of days school is in session during the year (Department of Education, 2012).
2. *Average daily membership* is defined by the aggregate number of days of membership of all students during a school year divided by the number of days school is in session during the year (Department of Education, 2012).
3. *Block scheduling* is defined as a way of organizing the school day into blocks of time longer than the typical 50-minute class period; with the 4X4 block, students take four 90 minute classes each day allowing for completion of an entire course in one semester instead of a full year; with an A/B or rotating block, students take six to eight classes for an entire year but classes in each subject meet on alternate days for 90 minutes (Department of Education).
4. *Charter School* is defined as a school controlled by a local school board that provides free public elementary and/or secondary education to eligible students under a specific charter granted by the state legislature or other appropriate

authority, and designated by such authority to be a charter school (Department of Education).

5. *Class Period* is defined as a segment of time in the school day that is approximately 1/6 of the instructional day (Department of Education).

6. *Cohort* is defined as a particular group of people with something in common (Department of Education).

7. *Combined School* is defined as a public school that contains any combination of or all K-12 grade levels that are not considered an elementary, middle or secondary school (Department of Education).

8. *Economically Disadvantaged* is defined as a student who is a member of a household that meets the income eligibility guidelines for free or reduced-price school meals (less than or equal to 185% of Federal Poverty Guidelines) (Department of Education).

9. *Fall Membership Report* is defined as a Virginia Department of Education report that includes annually collected statistics on the number of students enrolled in public school on September 30. This report is submitted by each school in Virginia that officially enrolls students. (Student records are maintained on a Virginia teacher's register or automated system.) Data are collected at the student-level and are limited to one active record per student within the state. Aggregated totals reflect an unduplicated head count of all public school students (Department of Education, 2012).

10. *Large schools* are defined by using the Virginia High School League (VHSL) classification system based on March 31, 2013 average daily membership. VHSL conferences one through eight have the largest student populations and are designated as 6A South (conferences one through four) and 6A North (conferences five through eight). The number of schools for this study that meet the criteria designated as large is 51. The size range for large schools goes from 1,868 students to 2,906 students.

11. *Migrant Education* is defined as a program of instruction and services for children who move periodically with their families from one school to another in a different geographical area to secure seasonal employment (Department of Education).

12. *Minority population* is defined via the Federal Race Code as reported on the Fall Membership Report. The Federal Race Codes designate the racial categories that most clearly reflect the student's recognition of his or her community or with which the student most closely identifies (Department of Education, 2012). The Federal Race Code categories used for the Fall Membership Report are the following: American Indian or Alaska Native, Asian, Black or African American, Native Hawaiian or Other Pacific Islander, White (Department of Education, 2012).
13. *Regular school* year is defined as the period between the opening day of school in the fall and the closing day of school for that school term that is at minimum 180 teaching days or 990 teaching hours (Department of Education).
14. *Small schools* are defined by using the Virginia High School League (VHSL) classification system based on March 31, 2013 average daily membership. VHSL conferences 41 through 48 have the smallest student populations and are designated as 1A East (conferences 41 through 44) and 1A West (conferences 45 through 48). The number of schools for this study that meet the criteria designated as small is 51. The size range for small schools goes from 67 students to 473 students.
15. *Socioeconomic status* is defined as the percent of students who are eligible for any of the following services: free or reduced price meals, receives Temporary Assistance for Needy Families, eligible for Medicaid, or identified as either Migrant or experiencing Homelessness according to information provided by participating school divisions in Virginia (Department of Education, 2012).
16. *Standards of Quality (SOQ)* is defined as the minimum program that every public school division in Virginia must meet; a major portion of state funding for direct aid to public education is based on the SOQ; the standards are established in the Constitution of Virginia, defined in the Code of Virginia and prescribed by the Board of Education, subject to revision only by the General Assembly (Department of Education).
17. *Student achievement* is defined by the composite of mean scaled scores for large and small high schools on the 2012-2013 End-of-Course English reading and writing, U.S. History, Chemistry, and Algebra II assessments that were administered to eleventh grade students receiving a public education in Virginia.

18. *Student attendance* is defined by a percentage of attendance that equals the average daily attendance divided by the average daily membership (Department of Education, 2012).
19. *Student population size* is defined by using data from the Virginia Department of Education Fall Membership Report, which is submitted by each school in Virginia that officially enrolls students. The data for the Fall Membership Report is submitted on September 30 of each school year by local education agencies (Department of Education, 2012).
20. *Teacher quality* is defined by using the criteria for a highly qualified teacher as set forth by the federal government. The federal government considers a teacher highly qualified who has obtained full state certification as a teacher or passed the state teacher-licensing exam, holds a license to teach in the state and does not have certification or licensure requirements waived on an emergency, temporary, or provisional basis. A highly qualified teacher holds a minimum of a bachelor's degree and has demonstrated subject matter competency in each of the academic subjects in which he or she teaches in a manner determined by the state and in compliance with Section 9101(23) of No Child Left Behind (U.S. Department of Education, 2004).

Limitations

1. The data used for the variables listed in the research questions comes from the Virginia Department of Education from various reports that are compiled by the school divisions in Virginia. The report data are dependent on the correct interpretation and input by local school division personnel. The data are certified by local school superintendents to be accurate. However, the data may contain inaccuracies due to human error, incorrect input, or interpretation of Virginia Department of Education regulations detailing the reporting of data.
2. The definition of large and small schools used in this study may be a limitation in regards to the findings.
3. The findings of this study are limited only to Virginia and cannot be generalized to any other population.

Delimitations

1. This study is delimited in geographic area only to Virginia and the limited number of high schools contained therein.
2. The use of the Virginia High School League six-classification system in determining large and small high schools defined in this study.
3. This study is delimited by the fact that only eleventh grade students that attended public high schools in Virginia were included.

Organization of the Study

Chapter 1 of the study consists of an introduction followed by statement of the problem, purpose of the study, main research question and sub questions, significance of the study, definitions, limitations and delimitations of the study, concluding with an organization of the study.

Chapter 2 of the study includes a thorough review of the literature that examines student population size and the relationships that socioeconomic status, student attendance, minority population, and teacher quality have on student achievement.

Chapter 3 explains the methodology that will be used in this study. Further, this chapter will describe the population that will be examined in this study, the data that will be used and where it will be obtained, how data will be gathered for this study, and analysis of the data.

Chapter 4 of the study contains an introduction to the chapter. This is followed by an analysis of the data and presentation of the findings for each of the five research questions. The chapter concludes with a summary of the findings.

Chapter 5 presents an overview of the study. The next section of this chapter is the conclusions section, which serves to answer the main research question. This is followed by the discussions section where observations, thoughts, and implications will be presented. In the final section, recommendations, and information will be presented for further research. This chapter will conclude with a summary.

CHAPTER 2
REVIEW OF THE LITERATURE

The literature review for this study seeks evidence from past studies that examines the idea that potential relationships exist between student attendance, socioeconomic status, minority population, teacher quality, and how they influence student achievement in a high school population size. Students in the United States have been educated in everything from one-room schoolhouses to schools that are quite large and complex. Since the modern and more formal era of education was established in the early twentieth century, deemed as the progressive era, public high school populations began to grow in size (Education, 2003). The reason for the growth of public high school populations during this time was due to the second wave of immigrants entering the United States, the enactment of compulsory attendance laws, and abolishment of child labor in the manufacturing sector (United States Department of Education, 2003). According to Conant (1959), students attending high school doubled from 35% in 1910 to 70% in 1959 (p. 6). Increased immigration, compulsory attendance laws, and abolishing child labor brought about the growth of the modern comprehensive high school as student population grew. With student population growth in the high schools of this era, a paradigm shift began to emerge in the methodology of how school systems should be operated. High schools with larger student populations that had a robust curriculum, which encompassed a variety of courses, academic and vocational, were the new vehicles of educating youth.

Lindahl and Cain, Sr. (2012) stated that the debate regarding school population size is a result of the shift in population dynamics (p. 1). “Since 1940, the number of U.S. public schools has fallen by almost 70 percent, while the average school size has risen by 400 percent; during this period, urban growth has escalated greatly” (Lindahl & Cain, Sr., 2012, p. 1). Lee and Smith (1997) stated the issue of school consolidation motivated the debate among stakeholders following World War II on school population size, which often considered the economic side, rather than what was best for the student (p. 206). Conant (1959) had a slightly different view on high schools with large student populations. He believed that larger high schools were the best option for students in the mid-twentieth century because they offered the best chance for students to experience courses not economically feasible for smaller high schools. Several studies have examined what size school population promotes the best overall academic achievement when taken into context of various variables such as socioeconomic status, student attendance, minority population, and teacher quality (Fowler & Walberg, 1991; Lee & Smith, 1997; Program Review & Investigations Committee, 2006; Leithwood & Jantzi, 2009; Stewart, 2009). The following review of relevant literature examines the outcomes of those studies and variables as associated with school population size and student achievement.

School Population Size and Student Achievement

Fowler and Walberg (1991) examined school and district size as they pertain to educational outcomes associated with various variables. The 18 variables identified in the study, which included aspects of social, organizational, and financial situations, examined the influence of school achievement and school population size (Fowler & Walberg, 1991, p. 195). The data were investigated using the Statistical Analysis System utilizing stepwise regression procedures (p. 195). The data examined were obtained from the New Jersey Department of Education, Bureau of Information Services and the Bureau of Testing from the 1984-1985 school year. The study encompassed 293 schools in New Jersey with the largest school having a population of 1,070 students and the smallest school in the study having a population of 147 students. Students were tested using the Minimum Basics Skills Test and the High School Proficiency Test in reading and mathematics. Fowler and Walberg (1991) found that after performing the stepwise regression analyses on the 23 learning related outcomes, seven of those were shown to be significant. The seven that were shown to be statistically significant were the number of low-income students in a school, size of school, number of schools in the district, percentage of teachers with a bachelor's degree, pupil-teacher ratio, average teacher salary, and district socioeconomic status (p. 197). Fowler and Walberg (1991) found that student achievement suffered for the economically disadvantaged no matter what the student population size was across all variables measured with the exception of verbal SAT scores (p. 198). The second finding of the Fowler and Walberg (1991) study was that students did not do well on the Minimum Basic Skills Test in reading $R^2 = .6232$ $p < .05$ or the High School Proficiency Test in math $R^2 = .7422$ $p < .05$ when school size was taken into account (p. 198). While Fowler and Walberg (1991) found that an inverse relationship existed between school population size and academic achievement, they stated "…it does not explain why this effect occurs, although other studies provide preliminary evidence" (p. 200). While the Fowler and Walberg (1991) study indicated that school population size had a relationship with academic performance on standardized assessments, they did not state an optimal size range in which favorable outcomes in student achievement were realized. Fowler and Walberg (1997) stated that few studies examined what an optimal size was for a student population in relation to student achievement and other valuable educational outcomes (p. 199). Lee and Smith's (1997) study sought to examine and clarify the question of what is the optimal student population size in which positive student achievement is recognized.

Lee and Smith (1997) had three goals for their study: (a) what constituted the ideal high school population size in regards to student achievement?, (b) what is the optimal high school population size in terms of equitable distribution of learning?, (c) once the ideal size of a school population size is found, is it constant across different high schools as defined in terms of student social background (p. 208). The method in which the study was conducted involved data from the National Center for Education of 1988 (NELS: 88). The study sought to examine data in a longitudinal method that examined growth results from students in their 8th, 10th, and 12th grade years in math and reading. The study included 9,812 students in 789 public, Catholic, and private schools that, over the course of the study, remained in the same high school setting (p. 208). Lee and Smith (1997) used the item response theory to illustrate student patterns of performance, which were equated across grades and test forms (p. 208). This method allowed for a more consistent and reliable measurable outcome in information about student specific levels of performance in reading and mathematics.

Lee and Smith (1997) used a two-level hierarchical linear model (HLM) because of the nested structure of the research questions as they related to size effects on student learning (p. 209). In level 1 HLM, within schools, analysis sought to examine the learning gains of students over four years in reading and mathematics (p. 209). In the study, level 1 HLM included controls for socioeconomic status (SES), race / ethnicity, and gender (p.209). In level 2 HLM between schools, analysis sought to examine the average learning between reading and mathematics (p. 209). The controls employed in the level 2 HLM included statistical controls for not only size but also SES, minority concentration, and school type (public, private, and parochial based) (p. 209).

Results from the study on which size of high school works best indicate that optimal learning for reading and mathematics takes place in schools that have a population of 600 to 900 students (pp. 212-213). Schools that have a student population of below 300 students have smaller learning gains as well as schools that have student population of above 2,100 students (p. 209). In addition, results from the study on which size high school works best in regards to economically disadvantaged students and student achievement in reading and mathematics indicate that economically disadvantaged and non- economically disadvantaged students that attend high school with populations of 600 to 900 have the highest gains in student achievement (p. 214).

Although Lee and Smith (1997) provided evidence of what constituted an optimal school population, not all researchers agree with their findings. Two studies take Lee and Smith's (1997) findings to task and comment on what is perceived as limitations to the study. Howley and Howley (2004) stated that the conclusions are a misrepresentation of the findings because the methodology employed limits the generalizability of the findings (p. 7). Further, Howley and Howley (2004) were mainly concerned about the findings that might influence policy decisions for schools with smaller student populations in rural locations (p. 8). The second study that takes issue with Lee and Smith's (1997) findings is the one by Andrews, Duncombe, and Yinger (2002). Andrews, Duncombe, and Yinger (2002) stated that Lee and Smith's (1997) findings could be biased for the lack of school inputs and production functions, which could limit the general conclusions of the study (p. 255). Both Howley and Howley (2004) and Andrews et al. (2002) stated the Lee and Smith study was a good one, which provided foundational evidence to the study of school population size. However, Andrews et al. (2002) surmised that to make informed decisions on school population size, a longitudinal evaluation of data should be employed before school districts enact policy change. A study that takes a longitudinal look at school population data in regards to the variables that affect student achievement was conducted by the state of Kentucky.

The State of Kentucky's Legislative Research Commission commissioned the study in 2005. The purpose was to conduct a study of schools within the state to examine the question of how school size affects student achievement in Kentucky. The study used the Commonwealth Accountability Testing System (CATS) assessments for middle and high school students (p. 4). The data collected were from the 2001 through the 2005 school years and included results from the Kentucky Department of Education and the U.S. Department of Education's National Center for Education Statistics (p. 5). Additionally, data were collected for traditional schools and did not include alternative, private, or parochial schools. As a part of the study, school population size was compared with eight states that included West Virginia, Montana, Ohio, Kentucky, Indiana, Illinois, Tennessee, and Virginia. In average secondary school size, Kentucky ranked fourth lowest with an average of 800 students attending secondary schools. In average secondary school size, Virginia ranked the largest out of the eight with an average student population of 1,200 students.

Under the CATS assessment, two different types of tests are administered. They were a norm-referenced test (NRT) that measured comparisons of achievement among students in reading, math, and language arts. The second test employed under the CATS assessment was the Kentucky Core Content Test (KCCT), which was a criterion-referenced test that measured standards of performance in reading, math, science, social studies, arts, writing, and vocational studies (Program Review and Investigations Committee, 2006, p. 18). For the purpose of the study, the scores from both the NRT and KCCT were examined with statistical controls for race / ethnicity, economic disadvantage, teacher quality, parents, and student characteristics to ascertain if school population size made a difference (p. 18).

The results of the analysis found that students overall performed better in schools with larger student populations. Reading and math scores were considerably higher in schools with student populations of 1,800 students or more. The scores for students that attended schools with student populations of 300 to 1,200 students were lower. The rationale that the researchers presented for this occurrence attributed the higher scores in the larger high schools to the fact that students may have access to greater resources such as specialized classes or lab equipment (Program Review and Investigations Committee, 2006, p. 22). When race was factored in and analyzed, the results indicated that African Americans, Hispanics, and Asians did not do as well as Caucasian students on both tests despite the student population size. The one exception to this was the outcome of the scores for Asians on the reading portion of both tests that attended schools with a student population of 901-1200.

In both studies (Fowler & Walberg, 1991; Program Review and Investigations Committee, 2006), school population size was the focus in regards to large versus small schools, with a concentration on student achievement in those settings, based on a multitude of variables. Fowler and Walberg's (1991) study and the Program Review and Investigations Committee's (2006) study produced conflicting results of what size school population is optimal. Lee and Smith's (1997) study sought to clarify that question and found that the optimal size of a high school population should be 600-900 students. Leithwood and Jantzi (2009) offered further evidence through meta-analysis, which examines the issue of school population size. Leithwood and Jantzi's (2009) examination of facts based on analysis of several studies further solidifies Andrew et al.'s (2002) recommendations that careful consideration should be paid to making decisions regarding school population size based on research prior to enacting policy change.

Leithwood and Jantzi (2009) examined the impact of school size based on policy decisions by various stakeholders. Policy makers justify their belief that larger school populations are beneficial to students because they allow for a greater diversity of students, teachers, and class selection over schools with a smaller population base. A similar viewpoint was also noted in the Kentucky-sponsored Program Review and Investigations Committee (2006) study that larger schools may have higher student achievement due to greater resources and specialized classes (p. 206). Leithwood and Jantzi (2009) stated that empirical evidence indicated that these types of justifications are not valid reasons for policy makers to advocate for larger student populations. Not only did the review of the selected studies aid policy makers and school divisions in making informed decisions about optimal school size and organization, but it also helped determine how students are affected by the size of a school population.

Leithwood and Jantzi (2009) included in the review of empirical evidence studies from the United States and eleven foreign countries. The eleven foreign countries represented were the following "…Canada (four studies), England (three studies), and New Zealand, Australia, and Norway with two studies each" (Leithwood & Jantzi, 2009, p. 466). Single studies were conducted in Wales, Iceland, Northern Ireland, Israel, Scotland, and the Netherlands (p. 466). Substantial amounts of the data were collected from large national or international data sets. (p. 466).

Leithwood and Jantzi (2009) systematically reviewed studies that included both elementary and secondary schools from 1990 to 2007. Typically, a systematic review will focus on a research question. After a thorough search of Leithwood and Jantzi's (2009) study, no specific research question was identified. What was identified was a host of assumptions by Leithwood and Jantzi (2009). They speculated policy makers and school divisions made decisions on school size based on uncertain data and budgetary constraints. After summation of why policy makers and school divisions make misinformed decisions, Leithwood and Jantzi (2009) then presented their theories of why smaller schools may have a positive impact on student achievement. The overall basis of Leithwood and Jantzi's (2009) analysis is that the theoretical arguments for the size of a school population do not hold up well or have not been examined thoroughly enough based on the empirical data that is available from the United States and other countries. Normally in a systematic review, a meta-analysis would be performed on the collected data. Leithwood and Jantzi (2009) stated "[t]he nature of the data reported across the 57 studies did not permit a meta-analysis without eliminating a significant number of studies, along with the useful information they provide" (p. 466).

Leithwood and Jantzi (2009) began by mining the Education Resources Information Center electronic database (p. 465). The year 1990 was used as a starting point for the search with the search terms of school size and school organization. Additional search terms were combined with school size and organization to identify various student outcomes; additional search terms included achievement, attendance, and student dropout rates (p. 465). Their search netted 280 studies. Of these 280 studies, Leithwood & Jantzi (2009) read the abstracts to solidify their intended target of qualified empirical research. The period of 1990 to 1999 produced 18 studies, with the remaining studies taking place from 2000 to 2007 (p. 465). Of the 57 studies that were selected, 40 studies provided information about middle- through high school with the remaining dealing with elementary education. Leithwood & Jantzi (2009) stated that the studies, while not being exhaustive, form a core of their review concerning post-1990 school size that reveals central propensities and important distinctions (p. 466).

Leithwood and Jantzi (2009) found that elementary students benefited academically if they were a part of a small school. Students that benefited the most at the elementary level were students that were in the lower socioeconomic range. Leithwood & Jantzi (2009) did not specifically describe or define what academic areas or what gender benefited the most or least in relation to school population size. The findings for middle- and secondary-size schools are rather vague. However, Leithwood & Jantzi (2009) stated that based on the studies that were synthesized, middle and secondary schools with smaller school populations showed beneficial results academically. A limitation that was noted was the lack of dropout rates and considerations of previous studies. This limitation led to a decline in their confidence concerning the results that the previous studies reported.

Leithwood and Jantzi (2009) stated that the students that benefit the most from smaller schools are disadvantaged and minority students in regards to equitable learning at both the elementary and secondary levels. The reasons that were stated are that the level of academic material is not as rigorous and is taught in a manner that is beneficial to lower socioeconomic students. The academic variety and breadth offered in larger schools is not always advantageous to student achievement. The academic offerings in smaller schools tend to focus on core subject areas such as English, math, and science. The focus on core subject areas allows a student to concentrate on what is necessary to graduate and focus on the fundamentals.

Leithwood and Jantzi (2009) found that teachers at smaller schools are better able to know their student population and identify with their needs better. In terms of truancy and attendance, smaller secondary schools fare better than larger schools. It may be hypothesized that students at this age (12 to 18 years old) are better able to care for themselves and not rely on their parents as much. Students that attend smaller schools also had better student engagement in extracurricular activities, which promoted stability. Engagement in academics and extracurricular activities is a quality that can be deficient at larger schools. Another reason could be that the staff and students may not know one another or the staff only knows the students that they serve.

Leithwood and Jantzi (2009) concluded that smaller schools in regards to fiscal responsibilities and policy considerations fare better than schools with larger student populations (p. 484). Leithwood and Jantzi (2009) stated that the optimal size for elementary schools serving lower socioeconomic student should be 300 – 500 students middle and high schools serving lower socioeconomic and diverse population should be between 600-1,000 students (p. 484-485). A fact that should be noted in the Leithwood and Jantzi (2009) study is that they did not specifically define what constituted a small school, medium-sized school, or a large school. However, their school population range for high schools of 600-1,000 students comports with the Lee and Smith (2007) study, which made the recommendation of a school population size between 600-900 students as optimal.

Leithwood and Jantzi (2009) make some strong arguments with evidence based on previous findings. The review of empirical evidence takes into account studies from 1990 to 2007. This builds on the foundation of previous empirical data and strengthens the findings prior to 1990 that a smaller school population size positively affects student achievement in certain areas. The emerging theme that was dominant in Leithwood and Jantzi's (2009) review of empirical evidence is that socioeconomic status impacts student achievement in smaller schools.

Leithwood and Jantzi's (2009) findings in regards to socioeconomic status and student achievement are also evidenced in Walberg's (1991) and Lee and Smith's (1997) studies, which indicated that school population size and socioeconomic status influences student achievement. Stewart's (2009) study sought to examine further the aspect of socioeconomic status and how it influences student achievement in regards to school population size.

Student Population Size, Student Achievement, and Socioeconomic Status

Stewart (2009) sought to examine student achievement as it is related to student population size and socioeconomic levels in all secondary schools in Texas. The Texas Assessment of Knowledge and Skills (TAKS) test was used because it is aligned with the Texas State curriculum. The relationship between the TAKS test and state curriculum allows for a more effective comparison of urban, suburban, and rural schools (p. 21). Specifically, Stewart (2009) wanted to investigate the eleventh grade male and female student pass rate on the TAKS test in reading, writing, math, and science (p. 22). The study used Texas high schools that had comparable socioeconomic status (SES) levels (p. 23). In order to achieve this, Stewart (2009) divided the high schools in Texas into four quartiles "…based on the percentage of economically disadvantaged students in the school district which the high school was located" (p. 23). The method that Stewart (2009) used to calculate comparable socioeconomic status levels was the same manner that the Texas Education Agency (TEA) used to define SES students that received free or reduced lunches or students families that were eligible for other public assistance (p. 23).

Stewart (2009) included all the traditional high schools in Texas that reported data for the 2005-2006 school year. The school population size was defined by using the University Interscholastic League (UIL), based on 2007 information, which details the five categories of student population in Texas high schools (p. 22). The five categories of secondary school student population as defined by UIL are 5A at 1,985 students or more, 4A at 950 – 1,984 students, 3A at 415-949 students, 2A at 195-414 students, and 1A at less than 195 students (p. 22). The specific ethnic composition of the 4,505,572 students that were enrolled in Texas high schools for 2005-2006 "…was 14.7% African Americans, 45.3.6% Hispanics, 36.5% Whites, 3.1% Asian/Pacific Islanders, and 0.3% Native Americans" (Stewart, 2009, p. 23). Stewart (2009) stated that out of the 4,505,572 students enrolled for the 2005-2006 school year, 55.6% were economically disadvantaged (p. 23).

Stewart (2009) used a quantitative, non-experimental, ex post facto design based on available information from the TEA Academic Excellence Indicator System. The data set that was generated came from the 2005 TAKS test. Prior to analysis, the data were disaggregated by extracting non-traditional high schools and leaving only traditional high schools. Stewart (2009) explained that excluding non-traditional high schools would allow for a stronger data set (p. 23). In addition, excluding non-traditional high schools would allow a more accurate comparison of larger urban and suburban schools with the smaller rural schools (p. 23). The data set was then placed into school population categories based on criteria set forth by UIL and further categorized by SES quartiles (p.23). The use of SES quartiles allowed comparison of similar SES levels of schools. Stewart (2009) then used a one-way analysis of variance and a Scheffè analyses to test for significant differences between the mean passing rates of the students who passed all four parts of the TAKS for the five different size schools, which were compared to the SES quartiles (p.23).

Stewart (2009) indicated that there was a relationship between student achievement in Texas as measured by the TAKS test and high school population size at different socioeconomic levels (p. 23). All but one SES quartile had better scores in the TAKS test on all four parts. Traditional high school students that scored higher were enrolled in smaller high schools located in Texas. However, those smaller schools that did better on the TAKS test were in rural parts of Texas. Stewart (2009) concluded that larger high schools were located in the urban parts of Texas and that the smaller schools tended to be located in the rural eastern parts of Texas (p. 25).

Stewart (2009) concluded that further research is needed to explain why smaller rural schools in Texas tend to do better on standardized tests (p. 25). The second recommendation for further research addressed the policy side of the study. Stewart (2009) advocated that policy makers should not consolidate smaller schools into larger ones (p. 25). Stewart stated that no economic benefits came from consolidation of smaller schools and student's needs are being met at smaller 1A and 2A schools (p. 25).

Stewart (2009) outlined ways that school leaders can use the information contained in the implication section of the study. Stewart (209) proposed that larger urban schools send teachers and administrators to smaller rural schools to investigate why they are successful (p. 25). Stewart (2009) further encouraged smaller rural Texas schools to perform some action research on their own and question why they are successful as opposed to their larger urban counterparts (p. 25).

In addition to funding shortfalls, school leaders and policy makers also have to contend with the SES of students. Shaefer and Edin (in press) stated that since 1996, the economically disadvantaged rate has increased in the United States due to welfare reform and the great recession (p. 3). Shaefer and Edin (in press) estimated that 3.55 million children, on a monthly basis, were economically disadvantaged in mid-2011 (p. 12). Shaefer and Edin's measure in regards to economic disadvantage was based upon the World Banks measure of $2 per person, per day (p. 7). Ready (2010) stated that "…the least disputed conclusion to emerge from educational research over the past half-century is that socioeconomically disadvantaged children are less likely to experience school success" (p. 271). According to Ready (2010), economically disadvantaged children are more likely to be constantly absent from school (p. 272). With so many economically disadvantaged students, according to Ready (2010), scholars do not dispute the fact that school attendance has the potential to influence student achievement. One would assume that student attendance and student achievement would receive a great amount of attention. According to Lamdin (1996), this is not the case (p. 155). One such study that examined school attendance and student achievement is one by Roby (2004).

Student Population Size, Student Achievement, and Student Attendance

Roby (2004) examined school buildings in Ohio in which students attended grades four, six, nine, and twelve and participated in the Ohio Proficiency Tests (OPT). The OPT assessment measured the level of student achievement in their respective grade setting in relation to student attendance to determine to what extent a statistical correlation may exist. The Ohio Department of Education (ODE) set a standard of 93% of the population present as a minimum as an acceptable rate of student attendance. Roby (2004) stated that only 79% of public schools in Ohio met this benchmark during the 1998-1999 school year (p. 3). Roby (2004) developed four research questions for the study; they included: (1) Does a significant positive relationship exist between student attendance and achievement as measured by the Ohio Proficiency Tests? (2) Does a statistically significant difference exist between student achievement of the top ten percent and bottom ten percent when ranked by all tests passed at the fourth, sixth, ninth, and twelfth grade levels? (3) Does a statistically significant difference exist for student attendance averages between the top ten percent and bottom ten percent as measured by all tests passed in the fourth, sixth, ninth, and twelfth grades on the Ohio Proficiency Tests? (4) Does a statistically significant difference exist in student achievement between large urban district schools when ranked by highest and lowest attendance categories? (pp. 4-5).

In terms of methodology, Roby (2004) utilized the Pearson's *r* correlation statistic separately for fourth, sixth, ninth and twelfth grade proficiency test averages and building student attendance averages (p. 5). To obtain a more accurate representation of the variance between school attendance and student achievement, a coefficient of determination (r^2) was used (Roby, 2004, p. 5). The data for the study included 3,171 schools and were obtained from the ODE website which utilized the most current information for the OPT and student attendance. Of the 3,171 schools in the sample, the grade level breakdown included 1,946 fourth grade schools, 1,292 sixth grade schools, 711 ninth grade schools, and 691 twelfth grade schools (p. 6).

For the first research question, Roby (2004) found moderate to strong indications that student achievement and student attendance were correlated. The specific findings were (a) fourth grade $r = 0.57$; (b) sixth grade $r = 0.54$; (c) ninth grade $r = 0.78$; and (d) twelfth grade $r = 0.55$ (p. 6). Upon observation of the results, the ninth grade indicated the strongest positive relationship in regards to student achievement and student attendance. When the coefficient of determination was performed to gauge the variance that the two variables had in common, the results indicated the following: (a) fourth grade $r^2 = 0.32$; (b) sixth grade $r^2 = 0.29$; (c) ninth grade $r^2 = 0.60$; and (d) twelfth grade $r^2 = 0.29$ (p. 6). Out of the four results, the most substantial was the ninth grade calculations, which indicated a strong common variance of 60 percent between student attendance and student achievement (Roby, 2004, p. 7). In other words, the measured variance allows the prediction of students attendance; the more students attend school, the better their academic performance will be.

For the second research question, Roby (2004) examined the differences between the top and bottom ten percent of schools in Ohio that took the OPT in grades four, six, nine, and twelve. To achieve this, Roby (2004) employed a one tailed *t* test with a significance level set at $p < .05$. The findings indicated the following: (a) fourth grade $t = 9.70$; (b) sixth grade $t = 2.19$; (c) ninth grade $t = 6.32$; and (d) twelfth grade $t = 1.68$. Roby (2004) noted that even though the twelfth grade variance of 1.68 was not as large as the results from the fourth, sixth, or ninth grade results the differences were still noteworthy (p. 7). It should also be noted that the pass rate for the top ten percent of twelfth graders was 47.4 percent on the OPT and 37.45 percent for the bottom ten percent of twelfth graders. Overall for the second research question, Roby (2004) found a statistically significant difference when examining schools in Ohio that ranked in the top ten and bottom ten percent based on the OPT scores when compared to student achievement in the fourth, sixth, and ninth grade levels (p.7).

For the third research question, Roby (2004) found a statistically significant indication that students that attended school in a consistent manner had higher test score averages (pp. 8-9). This finding was true for students in the fourth, sixth, and twelfth grades. For research question three the analysis was similar to research question two, but the annual building attendance of the same sample was used. Specifically, the findings indicated the following: (a) fourth grade $t = 7.12$; (b) sixth grade $t = 3.16$; (c) ninth grade $t = 1.38$; and (d) twelfth grade $t = 5.68$.

The fourth research question addressed student attendance and student achievement in the six largest school districts in Ohio (Roby, 2004, p. 9). Roby (2004) included schools from the school districts in Cleveland, Cincinnati, Columbus, Dayton, Akron, and Toledo (p. 9). Roby (2004) chose six elementary schools, three of the highest and lowest based on OPT scores. Roby (2004) examined student achievement and student attendance to see if there was a statistically significant difference based on annual attendance averages (p. 9). Again, Roby (2004) used a t test with a significance level set at .05. The results were (a) Cleveland $t = 2.27$; (b) Cincinnati $t = -12.23$; (c) Columbus $t = 2.50$; (d) Dayton $t = -11.10$; (e) Akron $t = -7.18$; and (f) Toledo $t = -20.41$ (p.10). The results for both Cleveland and Columbus were found not to be statistically significant in regards to their annual attendance averages.

Roby (2004) concluded that there was a significant relationship between attendance and student achievement in the grades examined for this study (p. 12). The relationship was found to be moderate to strong with the highest relationship at the ninth grade level at 0.78 (Roby, 2004, p. 12). Roby (2004) indicated that the reason for the robust ninth grade finding might be because the freshman year is an important year in a student's academic career and school officials may have placed more emphasis on academic achievement. Roby (2004) suggested that future studies examine socioeconomic status as a part of the student attendance and student achievement equation to gauge the ramifications it may have on overall student attendance (p. 13). Roby (2004) also suggested the examination in future studies of schools with smaller student populations to see if there was a relationship with student attendance and student achievement (p. 12).

A study conducted prior to Roby's (2004) study that did examine socioeconomic status, student attendance, and student achievement was one by Lamdin (1996). Lamdin (1996) examined 97 public elementary schools in the city of Baltimore. The data for the study were obtained from Baltimore Citizens Planning and Housing Association report conducted in 1990. Lamdin noted the use of one school division's data as a delimitation to the study; this, according to Lamdin (1996), mitigated reliability problems due to fact that teacher background and curriculum would vary less than if multiple districts data were used. Lamdin (1996) used the percentage of students that did not qualify for free and reduced lunch as a measure for socioeconomic status. Lamdin obtained the data from the enrollment by race / ethnic categories from the Maryland Department of Education. For the dependent variable, Lamdin (1996) used student performance data from the California Achievement Test (CAT) that was administered in the spring of 1989. In terms of input measures for the study, Lamdin (1996) used teacher / pupil ratio, professional staff / pupil ratio, and expenditure per pupil.

Lamdin's (1996) results indicated that there was a negative correlation between teacher / pupil ratio, professional staff / pupil ratio, and expenditure per student. Lamdin (1996) noted that there was a strong correlation between socioeconomic status and student attendance (p. 157). Lamdin (1996) performed further regression analysis on the data to examine attendance and student performance and other input measures (p. 158). The coefficient in regards to attendance was significant at both the $p<.01$ and $p<.05$ levels (p. 158). The coefficient in relation to socioeconomic status was positive and significant at the $p<.01$ level. When regression analysis was performed on the school input measures (teacher / pupil ratio, professional staff / pupil ratio, and expenditure per pupil), all variables were found not to be significant. Lamdin (1996) concluded that student attendance does have a positive influence on student achievement (p. 161). Lamdin (1996) noted that this finding was consistent with previous studies. It should also be noted that Roby's (2004) findings are similar in nature to Lamdin's and support the fact that there is a relationship between school attendance and student achievement.

One variable that was examined very little, or not at all, in both studies was the relationship between minority students, student attendance, and student performance. Lamdin (1996) briefly touched on the subject by stating that "…other things being equal, schools with a larger minority enrollment will have lower mathematics scores, but no discernible difference in reading scores" (p.160). Lamdin reached this conclusion after adding minority students into regression models three through five. Roby (2004) did not examine or discuss minority students in relation to student attendance and student achievement.

A study by Greeney and Slate (2012) did examine data on minority students and school attendance in relation to school climate. The study examined public secondary schools in Texas. Data were obtained for the 2003 though 2009 school years. There were three research questions that were a part of the study: (a) What is the difference in attendance rates as a function of school size among Texas high schools for Hispanic students?; (b) What is the difference in dropout rates as a function of school size among Texas high schools for Hispanic students?; (c) What is the difference in completion rates as a function of school size among Texas high schools for Hispanic students? (Greeney & Slate, 2012, p. 29). Greeney and Slate (2012) described the size of the schools in the study as large = 1,500 or more students, medium = 401-1,499 students, and small = 400 or fewer students.

The results of the study indicated that student population size did not influence Hispanic student attendance. It should be noted that a Bonferroni correction was made to the *P* values of the analysis. The Bonferroni correction is used to prevent type one errors when multiple analyses are being performed concurrently on a data set. Usually the *P* values are divided by the number of cases to achieve the new significance level. For this study, Greeney and Slate (2012) did not indicate their base *P* level, so it is difficult to determine what the new level of significance was for each of the cases once the Bonferroni correction is applied. The ANOVA conducted for each of the school years in the study showed no statistical significance in regards to attendance rates or dropout rates for Hispanic students as a function of high school size. In terms of completion rates of Hispanic students, a small effect size was found for the 2007-2008 and 2008-2009 school years. Greeney and Slate (2012) stated that the results for those two school years indicated Hispanic students enrolled in smaller schools had higher completion rates than Hispanic students in large and medium sized schools (p. 36). Overall, Greeney and Slate (2012) stated "…the results of their study call into question the small school movement" (p. 41). It should be noted that the Greeney and Slates (2012) study only examined Hispanic students in Texas schools and not a wide range of the minority populations represented in the schools in the United States. A study that delves deeper in the question of student population size, student achievement, and minority population is a study by Werblow and Duesberry (2009).

Student Population Size, Student Achievement, and Minority Population

Werblow and Duesbery (2009) explored how a school population size affects student mathematics achievement and dropout rates (p.14). The research on school population size was mixed with results that show benefits for differing sized student populations. Werblow and Duesbery (2009) stated that these mixed results were a product of methodological and design weaknesses of the studies (p. 15). Many variables affect student achievement in both large and small schools such as socioeconomic status and the bureaucracy of governmental agencies at the Federal, state, and local levels. Werblow and Duesbery (2009) address the many variables and limitations of past studies by incorporating a large data set and statistical methods that control the structure of the data set (p.16).

Werblow and Duesbery (2009) utilized a population that was generated from the Educational Longitudinal Study of 2002 (ELS: 2002). ELS: 2002 is sponsored by the United States Department of Education and conducted by the National Center for Education Statistics (NCES). The ELS: 2002 is a national study that includes both public and private schools in the United States. The ELS: 2002 study followed 16,081 students in 752 schools from their 10th grade year to their 12th grade year in high school (p.16). To create a stratified sample, NCES asked administrators of high schools that participated in the ELS: 2002 study to answer questions about their schools that dealt with student population, school location, and whether the school was a private or public high school (p. 16).

Werblow and Duesbery (2009) used a dataset based on a national sample of twenty six 10th grade students that were randomly selected by NCES from each school based on math scores (p. 16). The independent variable was school size for the 2001-2002 school year. One dependent variable was student math achievement. Student math achievement was established by using scaled NCES scores by subtracting the student sophomore scores in 2002 from their senior year scores in 2004 (p.17). The second dependent variable was student dropout, which "…was constructed by recoding the ELS: 2002 variable follow-up year student status into a dichotomous variable, coded (1) for drop-out and (0) for non-dropout" (Werblow & Duesberry, 2009, p. 17).

Werblow and Duesbery (2009) used student outcome in mathematic achievement and dropout rate to investigate the two research questions that were posed (p.17). The research questions that this study addressed were "Is smaller school size associated with increased growth rate in high school math achievement?" and "Is smaller school size associated with reduced high school dropout rate?" (Werblow & Duesberry, 2009, p. 16). Two multi-level hierarchical models were conducted using a three-step process that investigated student dropout rates and math achievement. Step one consisted of an unconditional model with no specific predictors at the student level or school level and served as a baseline for the two multi-level hierarchical models (p.17). The second step used a random-coefficients regression model that included student control variables such as race, ethnicity, gender, and SES (p.17). Deviance testing was used to check for any differences in the unconditional model in step one and the model used in step two (p.17). Step three modeled the variability of intercepts of math achievement or dropout rate across the various schools (p.17). Further variables were added to the step three model that included control variables of school population size, school location, SES, and limited English proficient (p.17). Deviance testing was performed on the step three model to try to explain the variability in outcome versus the outcome in the step one and two models (p.17).

Werblow and Duesbery (2009) found that schools with both large and small student populations showed some gains in terms of math achievement (p. 18-21). Schools with medium sized school populations did not show any significant increase in math scores (p. 18-21). Statistical analysis revealed that race and ethnicity as related to math achievement indicated that Asians experienced the largest gain in math achievement of 14% over Whites (p. 18). "Blacks (-10%), Hispanics (-5%), and Native Americans (-13%) gained less" in math achievement (Werblow & Duesberry, 2009, p. 18). The strongest predictor was SES in regards to math achievement. Students that experienced a higher level of economic disadvantage did not do as well as students from middle income families in mathematics over the period studied, regardless of the size of the student population. Where smaller school populations made a difference was in student dropout rate. Werblow and Duesberry (2009) stated that "…small schools have a far greater influence on dropout rate than math learning." (p. 21). Gender, race, and ethnicity played a part in a student's likelihood of dropping out of school. Females were less likely to drop out of school with Black, Hispanic, and Multi-ethnic students dropping out at higher rates than their White counterparts (p. 19). Location of a school also played a part in student dropout rate. Despite the school student population size, rural schools experienced a 30% greater dropout rate with every 10% increase in free and reduced lunch rates versus urban and suburban schools (p.19).

In the Werblow and Duesbery (2009) study, there were findings that came as a surprise. The fact that both small and large schools did better in math achievement than schools whose population fell in the middle was unexpected. Areas of the data analysis that were not surprising were that schools with a smaller student population, despite their location, have fewer dropouts than their larger counterparts. The fact that rural schools with an increased economically disadvantaged rate, despite their student population size, experienced higher student dropout rates was not expected.

The Werblow and Duesbery (2009) study lends to the overall body of literature that deals with school size and student achievement; however, some questions emerge that need further investigation. It is understandable that a school population size plays a part in student achievement in some way. According to Werblow and Duesbery (2009), how significant of a role that school population size relates to student achievement seems to be debatable. In addition, it appears that several other factors have an influence as well. A student's economic disadvantage level within a community appears to be a factor that influences student achievement. Another factor that researchers have identified that has the potential to influence student achievement was a teacher's quality as it relates to their credentials. "Nearly all observers of the education process, including scholars, school administrators, policymakers, and parents, point to teacher quality as the most significant institutional determinant of student achievement" (Clotfelter, Ladd & Vigdor, 2010, p. 655). Buddin and Zamarro (2009) stated that concerns over teacher quality in urban areas as it relates to at-risk students, unequal distribution of quality teachers, and limited opportunities has become a priority of all stake holders to improve teacher quality in at-risk areas (p. 103). A report by the Joint Legislative Audit and Review Commission (2004) commissioned by the Virginia General Assembly examined factors that may influence academic success, which included teacher quality.

Student Population Size, Student Achievement, and Teacher Quality

The Joint Legislative Audit and Review Commission (2004) study examined best practices, demographic, and SOL assessment data at both high and low performing public schools in Virginia (pp. 14-15). The population for the study included 548,494 elementary students, 238,310 middle school students, and 324,938 high school students in 1,737 school buildings. The data set used came from both the 2001-2002 and 2002-2003 SOL assessments administered to all public school-age children in Virginia. No data were used from alternative, special education, charter, and Governor's schools (p.15). Joint Legislative Audit and Review Commission (2004) also visited 61 high and low performing schools, interviewed 11 superintendents, 61 principals, and core subject teachers from 56 schools (pp. 15-16). In addition, teacher surveys and a literature review were also included in the study.

Joint Legislative Audit and Review Commission (2004) used several statistical methods, which included correlation analysis, regression analysis, and hierarchical linear modeling (p. 15). The first step in the data analysis involved the examination of potential relationships using correlation analysis across several variables (SOL test scores and other performance measures, student and family demographics, teacher qualifications and experience, and school and division characteristics). The next step in the data analysis portion of the study included regression analysis to determine which factors had the strongest association with SOL test scores (p.15). As a third step, Hierarchical Linear Modeling was employed as an alternative approach to examine factors nested within school data such as economic disadvantage, race, and adult educational attainment.

The results of the Joint Legislative Audit and Review Commission (2004) study indicated economic disadvantage, race, and adult educational attainment were strong predictors for SOL assessment scores (p. 40). These three factors when statistically analyzed accounted for two-thirds of the variance in SOL test scores (p. 40).

> However, when the percentage of provisionally licensed teachers (teachers who do not meet the requirements for full licensure) is substituted for race, the statistical model explains nearly as much of the variation in test scores, suggesting that the association between student race and SOL test scores may be partly explained by teacher qualifications. (Joint Legislative Audit and Review Commission, 2004, p. 40)

To provide a more complete picture of what variables influence SOL test scores, a regression analysis was performed. The results indicated that as economic disadvantage and the proportion of Black students increased, SOL assessment scores decreased (p. 42). In addition, "a strong relationship appears to exist between race and teacher qualifications and levels of experience" (Joint Legislative Audit and Review Commission, 2004, p. 42). The Joint Legislative Audit and Review Commission (2004) report stated that their findings were consistent with national studies on academic achievement (p. 42).

Hierarchical Linear Modeling was used as an alternative approach to regression analysis to see how well other factors could predict SOL assessment scores. The results indicated that the amount of variation in test scores included economic disadvantage, race, and the education level of students parents (p. 43). Again, when provisionally licensed teachers were substituted in the analysis for race, the results indicated that, in divisions with a large proportion of Black students, a higher number of provisionally licensed and less experienced teachers were employed (p. 43). The Joint Legislative Audit and Review Commission (2004) offered that this might be the reason why SOL assessment scores may be lower in those divisions (p. 43). A study that examines teacher credentials and student achievement and builds on the information presented in the Joint Legislative Audit, Review Commission (2004) study is one by Clotfelter, Ladd, and Vigdor conducted in 2010.

The purpose of Clotfelter, Ladd, and Vigdor's (2010) study was to examine teacher credentials and qualifications on student achievement at the high school level (p. 656). The data for the study were obtained from End-of-Course assessments that were administered in the ninth and tenth grades from 1999 through 2003. The population included both ninth and tenth grade students enrolled in public schools in the state of North Carolina. The final sample included only those students that could be matched to at least three teachers or test proctors and the End-of-Course assessment that was given (p. 658). The percentages of students that were matched to at least three teachers or test proctors and the End-of-Course assessment were (a) 72.6 percent, (b) 77.3 percent, (c) 76.1 percent, and (d) 73.2 percent (p. 658). The End-of-Course assessments that are part of the study included core area classes such as English, algebra, and biology.

One of the limitations noted in the study was the fact that teachers were not randomly assigned to classrooms. Clotfelter et al. (2010) stated that teachers with stronger credentials are assigned to classes with students with unmeasured academic abilities, or put another way; stronger students have teachers with stronger teaching credentials (p. 659). The reason this may occur is the fact that students at the high school level are able to select their teachers (p. 659). Clotfelter et al. (2010) found that this could cause bias in the study that, if not controlled by statistical methods, could produce results that are not conducive to true academic achievement. The method in which Clotfelter et al. (2010) control for the potential of bias was through the use of a statistical method known as fixed effects, which means that relevant coefficients are identified based on the student variation across subjects (p. 659). The use of the fixed effects method in addition allows for observations in terms of explanatory variables and treats those quantities as if they were nonrandom. Explanatory variables in this study would include factors such as a teacher's race, gender, credentials (years of experience, educational background, licensure test scores, type of license, and National Board Certification)(pp. 659-663). "In this case, that means they are based only on the variation in teacher credentials across the subjects for each individual student" (Clotfelter et al., 2010, p. 660). Clotfelter et al. (2010) findings were broken down into seven sections that examine various variables that were a part of the study. The results of those observations are presented below.

Clotfelter et al. (2010) measure of teaching experience included all the years of teaching experience, including years a teacher may have taught outside of North Carolina (p. 666). Their findings indicated that all gains in academic achievement occurred within the first five years of the teacher entering the profession with an average effect size of 0.0548, which was proven statistically significant. Clotfelter et al. (2010) stated that teachers with up to five years' experience promote academic success better than novice teachers do.

Clotfelter et al. (2010) measure of a teacher's advanced degree status on students academic achievement indicated it did not matter if a teacher had an advanced degree or not (p. 667). However, teachers who obtained their advanced degree after starting teaching did appear to be somewhat more effective than teachers who obtained their degree prior to starting a teaching career (p. 667). Another surprising finding in relation to a teacher's degree was the fact that if a teacher had a Ph.D., it was more likely to have a negative effect of 0.09. However, Clotfelter et al. (2010) cautioned that this result might be spurious as the sample number was quite small.

Clotfelter et al. (2010) measure of a teacher's test scores on such tests as the Praxis I and Praxis II indicated these were significant predictors of student achievement (p. 668). Clotfelter et al. (2010) disaggregated the test scores by the subject in which the teacher taught. This allowed Clotfelter et al. (2010) to determine the extent a teacher's content knowledge had on student achievement (p. 668). Clotfelter et al. (2010) found that two subject areas where teacher test scores played the biggest part were math and biology (p. 669). "A one standard deviation difference in a teacher's math test score (Praxis I and Praxis II) is associated with a quite large and statistically significant 0.0472 standard deviation difference in student achievement in either algebra or geometry" (Clotfelter et al., 2010, p. 669). The score for a teacher's biology licensure test was found to be significant at 0.0165 (p. 669).

Clotfelter et al. (2010) used teacher licensure type, certification by subject area, and National Board Certification as measures of student academic achievement on End-of-Course assessments. North Carolina uses three different types of licensure for their teachers. Regular teachers are ones that graduate from a college that offers a teacher preparation program, perform ten weeks of student teaching, and pass the required licensure exam such as Praxis I and II. Alternate licensed teachers have graduated from an accredited college in the field for which they teach; they have to complete a college program over a two-year period that is geared toward teaching as a profession. Teachers that enter teaching through the alternative method have two to three years to complete the required courses. The third category for licensure is reserved for provisional, temporary, and emergency license holders.

The findings show that teachers that hold both alternate and emergency type licenses were more likely to have students with lower scores on the End-of-Course assessments by 0.06 standard deviations lower than teachers with regular licenses (p. 670). Alternate and emergency licensed teachers were more likely to leave the teaching profession than regularly licensed teachers. Teachers with certification in the area in which they teach have students that do significantly better on the End-of-Course assessments. This is especially true for math students in both algebra and geometry by 0.11 standard deviations (p. 671). In regards to National Board Certification, Clotfelter et al. (2010) found that teachers appear to become better teachers because of this certification process (p. 672).

Clotfelter et al. (2010) examined various teacher and classroom characteristics as they relate to student achievement and the End-of-Course assessments. Clotfelter et al. (2010) found that smaller student populations in classrooms did have an influence on student achievement, but only by a small amount. The effect size for smaller classrooms with an average of five fewer students only raises student achievement by 0.0127 standard deviations (p. 673). Additionally, when teacher gender was examined, it was found that male teachers with female students generated a negative effect of -0.105 (p. 673). In terms of a teacher race’s, it was determined that negative coefficients for Black teachers teaching White students existed. However, it was found that Black teachers who taught Black students were more successful in terms of student achievement (p. 673).

Clotfelter et al. (2010) concluded their study by stating that teacher credentials, especially in math and English, generate higher student achievement (p. 675). It also appears that teachers who graduate from an accredited college with an approved teacher preparation program are more successful in the classroom as well. Students who experience high levels of economic disadvantage are more likely to have a teacher that is less qualified or is new to the profession. This finding was similar to the finding of the Joint Legislative Audit and Review Commission (2004) study that was conducted in Virginia. While the Joint Legislative Audit and Review Commission (2004) and Clotfelter et al. (2010) studies present evidence in regards to teachers qualifications and student achievement, they only briefly or did not examine teacher quality and student achievement as if they were related to student population size. A study that examined these variables was one by Lindahl and Cain, Sr. (2012).

The purpose of Lindahl and Cain, Sr. (2012) study was to examine the relationship between the size of public high schools in the state of Alabama and variables that include school quality, financial indicators, and performance on standardized tests (p. 2). The study was guided by seven research questions: (a) student demographics by school size; (b) student attendance, student computer access, student internet access, and teacher qualifications by school size; (c) financial indicators by school size; (d) student performance on the Alabama High School Graduation Exam (AHSGE) by school size; (e) variation and relationship of variables (student demographics, student attendance, student computer access, student internet access, teacher qualifications, student performance on AHSGE) by school size; (f) how do school quality indicators and school size predict student performance on the AHSGE; and (g) what relationship exists between student performance and the AHSGE, school size, and student socioeconomic backgrounds (p. 2).

The population for the study consisted of 85 public high schools that reported data for the AHSGE on reading and math for eleventh grade students between the school years of 2003 through 2007 (pp. 8-9). The population included both regular and special education students. The study did not include students that attended church based, private, or alternative schools. The data for the study was obtained from the Alabama State Department of Education website. Lindahl and Cain, Sr. (2012) did note one limitation for the data; it was the fact that "…as the demographic characteristics of the schools, school quality indicators, and financial indicators were all for school year 2006–2007, whereas the test score data came from school years 2003–2004, 2004–2005, 2005–2006, and 2006–2007" (p. 9). The eleventh grade was chosen for the study because students in Alabama are expected to be academically proficient by this time in their academic careers.

Lindahl and Cain, Sr. (2012) found that all schools in the study had high percentage of attendance that ranged from 94 to 95 percent, highly qualified teachers ranged from 88 to 94 percent, and that school expenditures were very close between the different sized schools $7,322 to $7, 829 per student (p. 10). When Lindahl and Cain, Sr. (2012) examined the math and reading scores of the AHSGE, they found that both regular and special education students scored higher on the math than the reading assessments (p. 10). Lindahl and Cain, Sr. (2012) found that as the size of the high school population increased so did the scores on both the reading and math AHSGE (p. 10). There was a moderate positive relationship of highly qualified teachers $r = .516$ with regular education students on the reading AHSGE (p.10). Teachers who had advanced degrees only showed a weak relationship with both the math and reading AHSGE assessment (p. 10). Lindahl and Cain, Sr. (2012) found that school size did not play a part in student achievement when all variables were considered with the exception of math scores, of which exhibited an $r = .422$ for regular students and $r = .312$ for special education students (p. 11).

When Lindahl and Cain, Sr. (2012) examined the school quality variables (average daily attendance, number of students with computer, internet access, and teacher qualifications) with school size and student achievement, they found that high school size had very little to do with reading and math scores on the AHSGE assessments (p. 11). When stepwise regression was performed, Lindahl and Cain, Sr. (2012) found that school size failed to enter into the equation ($p \leq .05$ for entry) for reading scores for both regular and special education students (p. 11). In terms of socioeconomic status and student achievement, Lindahl and Cain, Sr. (2012) found that school size had relatively little influence on math and reading scores of the AHSGE assessments (p. 13). Lindahl and Cain, Sr. (2012) stated that when the results of their study were examined against the studies in their literature review, the fact that their results mirrored some and conflicted with other studies could be the nature of the methodologies employed across the various studies (p. 13).

Synthesis and Conclusion

Since the beginning of the progressive era in education, stakeholders have advocated for both large and small school populations based on a litany of variables in the name of student achievement. School population size has increased since the turn of the twentieth century while the number of school buildings has decreased by 70 percent since 1940 in the United States (Lawrence, 2004, p. 41). As Conant (1959) stated, larger schools can offer more in the way of student interests such as better class offerings on an economic scale that is beneficial to both the student and school division. Other researchers suggest that larger economies of scale in terms of class offerings are not beneficial to student achievement, especially when student population sizes are large. Recently, supporters of school reform, such as the Bill and Melinda Gates Foundation, whose focus is on student achievement, have advocated for smaller school population size (Werblow & Duesberry, 2009, p. 15). Smaller high schools, it is believed, tend to have school populations whose students are more engaged, share a connection with their peers and school staff, and have higher academic achievement. A conflict to the belief that smaller school population promotes student achievement is the reality of funding shortfalls that seem to be a challenge to our nation's schools. Another issue that school leaders face is standardized testing of students and the pressure to achieve accountability standards as set forth by the Federal government and state requirements.

With standardized testing for grades K-12 and funding shortfalls being commonplace in the United States, school leaders and policy makers are continuously looking for ways to improve student achievement. With school budgets shrinking, school leaders and policy makers search for ways to deal with funding shortfalls. Some of the solutions that attempt to remedy funding shortfalls are to consolidate schools, redefine school attendance lines, and designing new schools to allow for a higher student population. Research indicates that school leaders and policy makers recognize the advantages of smaller school populations. However, when taken into context with all the variables involved, which include, but are not limited to, economic disadvantage, race, gender, school location, school funding, school culture, and teacher qualifications, the question remains what is the ideal student population size for a school.

This review of literature examined variables that affect student achievement as it relates to student population. The studies examined used a variety of methodologies to investigate various research questions related to student achievement and student population. Several studies in this literature review have found no evidence that smaller school populations aid student achievement (Conant 1959; Program Review & Investigations Committee, 2006; and Lindahl & Cain, Sr., 2012). However, in contrast, several studies in this literature review have found that relationships exist with student achievement and various variables when smaller student populations are observed (Fowler & Walberg, 1991; Lee & Smith, 1997; Leithwood & Jantzi, 2009; and Roby, 2004). Additional studies reviewed in this literature review have found mixed findings when student population size, various variables, and student achievement were observed (Werblow & Duesbery, 2009; Clotfelter, Ladd & Vigdor, 2010; Greeney & Slate, 2012). The results of the studies in this literature review present a foundation for future research into what constitutes an optimal school population size and what variables play important roles in student achievement. Additionally, the results of the studies examined in this literature review reveal a need for future research utilizing analysis and synthesis of available data to determine what is an optimal size for a school population.

CHAPTER 3
METHODOLOGY

Introduction

This study's main purpose is to determine if there is a relationship between high school student population size and selected variables on student achievement. Various aspects of the study's methodology are identified and discussed in this chapter that addresses the main purpose. The chapter is broken down into the following sections: setting and school criteria, population, data collection, definition, sources, method of calculation, and data analysis. The following sections will explain how data were gathered, what assessment instrument will be used to measure student achievement, and how the data will be analyzed using statistical analysis.

Setting and School Criteria

The setting for this study includes all public high schools within Virginia. This includes public high schools that have grade configurations that include the following: 8-12, 9-12, 10-12, and combined schools that include grade configurations that include schools within the PK-12-grade range.

The geographic areas for high schools used for this study include metropolitan, urban, suburban, and rural areas. The population density for Virginia is greatest in the northeastern part of the state with heavy concentrations in the central and eastern parts of the state (*see Figure 3.1*). The largest growth in population for Virginia has occurred in the northeastern area of the state. This population growth has spurred continued building of new schools.

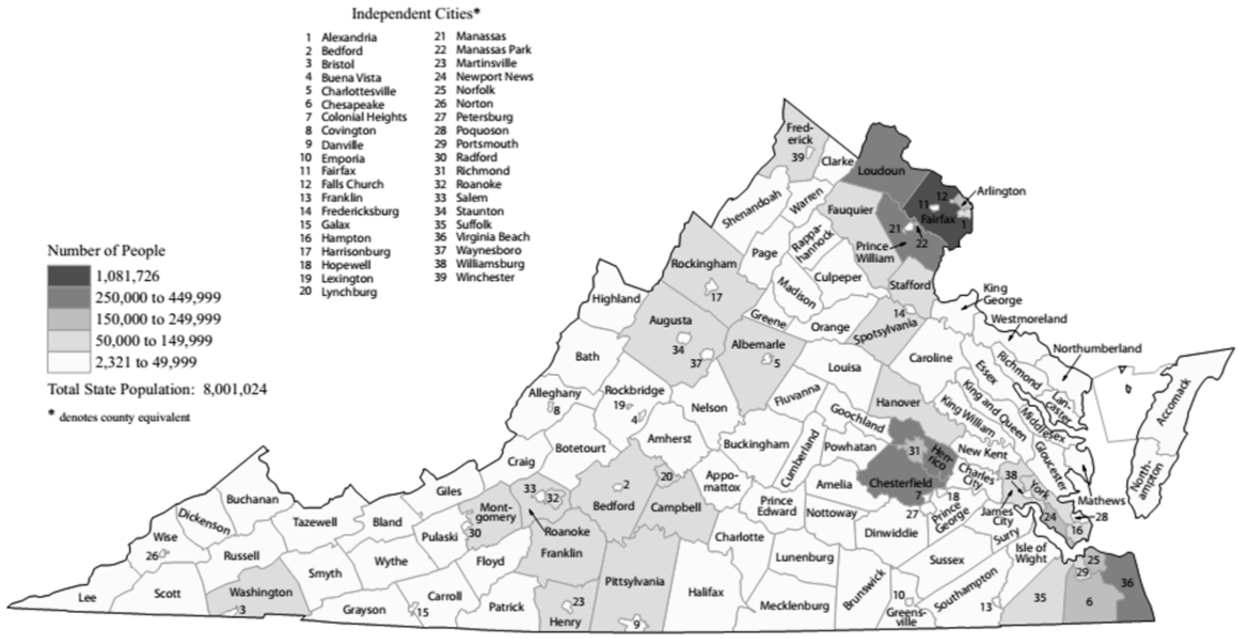

Figure 3.1. Virginia map showing population density for 2010 (U.S. Census Bureau, 2010).

Population

The population for this study consists of formal organizations designated as public secondary high schools that are governed by rules and regulations specified by the Virginia Department of Education. The secondary high schools in Virginia are tasked with educating the students that attend local school divisions. Public secondary high schools have a set curriculum that is prescribed by the Virginia Department of Education and is reflected in the Virginia Standards of Learning (SOL). In addition, public high schools must be in session for 180 days or 990 teaching hours during the academic year. The set curriculum that is embedded in the Virginia SOL assessments includes English, mathematics, science, history, and social science. Secondary high schools are measured by an annual state report card and must meet defined state and federal accountability standards. The state report card is issued for each public school division and the schools that make up that division. For the 2012-2013 school year, there were 309 public secondary schools in Virginia. Of the 309 public secondary schools in Virginia, only 102 met the defined school criteria of grade configuration, school population size, and identified demographic variables for this study. The public secondary schools in this study are further broken down into large and small schools. Of the 102 schools identified for this study, 51 met the criteria for large high schools and 51 met the criteria for small high schools.

The reason why formal organizations designated as public secondary high schools (large and small) are being used is that this is where the data for the identified variables (socioeconomic status, student attendance, minority population, and teacher quality) will originate. The reason why private, parochial, charter, or other forms of public schools are not being considered is that they are not governed by the uniformed rules and regulations that public school organizations in Virginia have to follow. Additionally, the ways in which data are obtained from schools other than formal organized secondary schools have the potential not to be uniform, and as thus, the data could be skewed if any other school besides public secondary schools were used. The population for this study is further broken down into eleventh grade male and female students that meet the defined school criteria of this study and attend public secondary high schools in Virginia.

Defining Large Versus Small High School Populations. The population for this study is further broken down into high schools that consist of large and small student populations. To achieve the distinction between large and small student populations, the current Virginia High School League (VHSL) six-classification system was used. Applying the school criteria for the study, 102 schools were identified. After examining the classification system, it was determined the student population would be Conference 6 (Large) and Conference 1 (Small). Conferences 6A South and 6A North consist of 51 high schools that were identified and met the school criteria of this study (see Appendix C). The largest high school in Conference 6 is T.C. Williams with 2,906 students (see Appendix C). The smallest high school in Conference 6 is Kecoughtan with 1,868 students (see Appendix C). There was one large school that was excluded from this study in Conferences 6A South and 6A North that did not meet the school criteria of this study. The reason for the exclusion of that one large school was that there was incomplete data on student population for the 2012-2013 school year. Conferences 1A East and 1A West consist of 56 high schools that were identified and met the school criteria of this study (see Appendix C). The largest high school in Conference 1 is Washington & Lee with 473 students (see Appendix C). The smallest high school in Conference 1 is Highland with 67 students (see Appendix C). There were five small high schools that were excluded from this study in Conferences 1A East and 1A West that did not meet the school criteria of this study. The reason for the exclusion is that there was incomplete data on student population for the 2012-2013 school year or the type of school did not meet the criteria for this study. Additionally, there were conferences that were excluded from this study as a whole because they were outside of the defined school population size as established for this study; the excluded Conferences are 5A South, 5A North,4A South, 4A North, 3A East, 3A West, 2A East, and 2A West.

Data Collection

All data for this study were obtained and collected from the Virginia Department of Education, either through the utilization of current online data or by e-mail requests through appropriate personnel employed by the Virginia Department of Education. Student information came from the Virginia Department of Education statistics and reports, data for researchers, Fall Membership Report. The Fall Membership Report is submitted by local school divisions to the Department of Education on September 30 of each school year. The fall membership count is limited to one unduplicated active record per student that attends public schools that enroll students.

The data for this study were broken down into segments (End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II SOL assessments, student attendance, socioeconomic status, minority population, and highly qualified teachers) that included the 2012-2013 student cohort who were enrolled in the eleventh grade at the time data were collected. All charts and graphs produced via the computer program IBM SPSS Statistics are located in chapter four and the appendix, located at the end of the study.

End-of-Course Standards of Learning Assessment Definition, Data Source, and Method of Calculation

Standards of Learning (SOL) assessment was defined as the minimum grade level and subject matter educational objectives, described as knowledge and skills necessary for success in school and for the preparation for life that students were expected to meet in Virginia public schools and specified by the Standards of Quality (Department of Education). For this study, five SOL assessments were used to measure the student achievement of eleventh grade male and female students in large and small high schools in Virginia. The SOL assessments in this study covered four subject areas that included English, social science, science, and math.

The data source for the SOL assessments used in this study came from the Virginia Department of Education. An initial phone call was made to the Office of Educational

Information Management to discuss the data needed for this study. A formal request was then made via e-mail to the Virginia Department of Education for the mean scaled scores for eleventh grade male and female students (see Appendix B). The requested mean scaled scores included End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II, for the schools as set forth in the setting and criteria section of this study. The information for the requested SOL assessments was provided as a Microsoft Excel computer file. The information from the Microsoft Excel computer file was examined, coded, and separated into high schools that met the conditions as set forth in the setting and criteria section of this study

The method in which the SOL assessments were calculated for the measure of student achievement was through the mean scaled scores of the identified SOL assessments for this study. The mean scaled score is the arithmetical average of the 2012-2013 SOL test scores for each identified SOL subject area assessment per high school included in this study. The mean scaled scores were calculated by adding the scores and dividing the sum by the number of scores. Once the data were coded and separated into a Microsoft excel worksheet, the information was then transferred into the computer program IBM SPSS Statistics, which was used to analyze the data.

Student Attendance Definition, Data Source, and Method of Calculation

Student attendance was defined by the percentage of attendance that equaled the average daily attendance divided by the average daily membership for each of the identified large and small high schools in this study. Student attendance was determined for large and small high schools that met the criteria for this study. There were 51 large high schools and 51 small high schools. An initial phone call was made to the Virginia Department of Education Office of Educational Information Management to discuss the data needed for this study. A formal request was then made via e-mail to the Virginia Department of Education for the 2012-2013 student attendance rate percentages broken down for each high school (see Appendix B). The information for student attendance was provided as a Microsoft Excel computer file. The information from the Microsoft Excel computer file was examined, coded, and separated into high schools that met the conditions as set forth in the setting and criteria section of this study.

Student attendance was calculated by using 2012-2013 average daily attendance (ADA) for the identified large and small high schools for this study, which was the aggregate number of days of attendance of all students during a school year divided by the number of days school is in session during the year (Department of Education, 2012). Once the average daily attendance was determined, it was divided by average daily membership (ADM) for each large and small high school identified in this study. Average daily membership was the aggregate number of days of membership of all students during a school year divided by the number of days school was in session during the year (Department of Education, 2012). (ADA / ADM = Student Attendance). Once the data were coded and separated into a Microsoft excel worksheet, the information was then transferred into the computer program IBM SPSS Statistics, which was used to analyze the data.

Socioeconomic Status Definition, Data Source, and Method of Calculation

Socioeconomic status was defined as the percent of students who were eligible for any of the following services: free or reduced price meals, Temporary Assistance for Needy Families, Medicaid, or identified as either migrant or experiencing homelessness. For this study, socioeconomic status was used as a measure of economic advantage or disadvantage within a family structure. A student that received the above-mentioned services fell below the federal poverty guidelines and was considered economically disadvantaged (Department of Education, 2012). The data source for socioeconomic status came from the Virginia Department of Education, 2012-2013 Fall Membership Report, where it was reported under the disadvantaged flag.

The method in which socioeconomic status was calculated was through the information contained under the disadvantaged flag of the Fall Membership Report available for download as a Microsoft excel computer file. The disadvantaged flag identified students as economically disadvantaged. The information in the report was examined, coded, and separated into large and small high schools that met the conditions as set forth in the setting and criteria section of this study. The valid values for the disadvantaged flag are Y = Yes, N = No (Department of Education, 2012).

To calculate the percentage of eleventh grade male and female students for the identified large and small high schools for the socioeconomic status portion of this study, the following steps were used:

1. The total number of eleventh grade students for each large and small high school classified as economically disadvantaged was identified.
2. The total number of eleventh grade students for each large and small high school was determined.
3. For each large and small high school, the total number of eleventh grade students identified as economically disadvantaged was divided by the total number of eleventh grade students.

Once the data were coded and separated into a Microsoft excel computer file, the information was then transferred into the computer program IBM SPSS Statistics, which was used to analyze the data.

Minority Population Definition, Data Source, and Method of Calculation

Minority population was defined via the Federal Race Code, and designated into the racial categories that most clearly reflected the student's recognition of his or her community or with which the student most closely identified (Department of Education, 2012). The data source for minority population came from the Virginia Department of Education, 2012-2013 Fall Membership Report.

The method in which minority population was calculated was through the information contained under the Federal Race Code flag of the Fall Membership Report available for download as a Microsoft excel spreadsheet. The Federal Race Code flag identified student racial category. The information in the report was examined, coded, and separated into large and small high schools that met the conditions as set forth in the setting and criteria section of this study. The valid values for the Federal Race Code flag were 0=unspecified (used through the 2009-2010 school year), 1=American Indian/Alaska Native, 2=Asian, 3=Black or African/American, 4=Hispanic of any race, 5=White, 6=Native Hawaiian/Other Pacific Islander, 99=Two or more races, non-Hispanic (added in 2010-2011) (Department of Education, 2012).

To calculate the percentage of eleventh grade male and female students for the identified large and small high schools for the minority population portion of this study, the following steps were used:

1. The total number of eleventh grade students for each large and small high school Federal Race Code was identified.

2. The total number of eleventh grade students for each large and small high school was determined.
3. For each large and small high school, the total number of eleventh grade students identified for each Federal Race Code was divided by the total number of eleventh grade students.

Once the data were coded and separated into a Microsoft excel computer file, the information was then transferred into the computer program IBM SPSS Statistics, which was used to analyze the data.

Teacher Quality Definition, Data Source, and Method of Calculation

Teacher quality was defined by using the criteria for a highly qualified teacher as set forth by the federal government. The federal government considered a teacher highly qualified who had obtained full state certification as a teacher or passed the state teacher-licensing exam, held a license to teach in the state; and did not have certification or licensure requirements waived on an emergency, temporary, or provisional basis. A highly qualified teacher held a minimum of a bachelor's degree and demonstrated subject matter competency in each of the academic subjects in which he or she taught in a manner determined by the state and in compliance with Section 9101(23) of No Child Left Behind (U.S. Department of Education, 2004).

The data source for teacher quality came from the high schools that met the criteria for this study and as described on the Virginia Department of Education (VDOE) high school report card. Teacher quality data included the following: Percentage of core academic classes taught by teachers not meeting the federal definition of a highly qualified teacher, percentage of provisionally licensed teachers, and percentage of teacher education attainment requirement.

An initial phone call was made to the VDOE Office of Educational Information Management to discuss the data needed for this study. A formal request was then made via e-mail to the Virginia Department of Education for the 2012-2013 percentage of highly qualified teachers broken down for each high school (see Appendix B). The information for highly qualified teachers was provided as a Microsoft Excel computer file. The information from the Microsoft Excel computer file was examined, coded, and separated into high schools that met the conditions as set forth in the setting and criteria section of this study. Once the data were coded and separated into a Microsoft excel computer file, the information was then transferred into the computer program IBM SPSS Statistics, which was used to analyze the data.

Data Analysis

All the data for this study were collected for each formal organization designated as public secondary high school that met the specified school criteria and was managed using a Microsoft Excel spreadsheet. All the data for this study were examined thoroughly after entering it into the Microsoft Excel spreadsheet to make sure that it was correct. Once the data were entered into the Microsoft Excel spreadsheet, they were separated into large and small schools. The data then were imported into the latest version of IBM SPSS, a statistical analysis software program. Once the data were entered into IBM SPSS, they were again examined to identify any outliers or other abnormalities that potentially could have affected the proper statistical analysis of the data set.

After verifying the data were complete and correct in IBM SPSS, a regression analysis was performed. The reason why a regression analysis was performed on the data set is that it was the statistical analysis that has been identified to find relationships among a set of variables. The specific type of regression analysis to be performed on the data set was hierarchical multiple regression with an alpha level set at 0.05. While regression analysis allowed examination of relationships, hierarchical multiple regression allowed a closer examination of the dependent variable and a predictor variable while statistically controlling for the effects of various other independent variables on the dependent variable (see *Figure 3.2*).

Data Analysis and Statistical Method Used in Study

1. Collection of Data From Virginia Department of Education

1a.Once IRB approval had been obtained from Virginia Tech, a request was made to the Virginia Department of Education for the needed data identified for this study.	***1b***.After data were obtained from the Virginia Department of Education, the first step was to prepare the data for analysis. Microsoft Excel was used for this step.	***1c***.Data were examined to make sure that they were correct and then separated into Large and Small Schools. Data were then inserted in IBM SPSS.

2. IBM Statistical Package for the Social Sciences (SPSS)

2a. IBM SPSS is a software package used for statistical analysis in the Social Science field.	***2b.*** Data were examined again for outliers or other abnormalities that could have affected proper statistical analysis. After verifying that the data were correct, a regression analysis was performed.

3. Multiple Linear Regression Analysis

3a. Regression techniques were primarily used in order to create an equation, which was used to predict values of dependent variables for all members of the population.	***3b.***A secondary function of using regression was that it could be used as a means of explaining relationships between variables.

4. Types of Multiple Linear Regression

Standard Multiple Regression- "All independent variables were entered into the analysis simultaneously" (Kean University, 2013, p. 2).	Hierarchical Multiple Regression "Independent variables were entered into the equation in a particular order as decided by the researcher" (Kean University, 2013, p. 2).	Stepwise Multiple Regression- "Typically used as an exploratory analysis and used with large sets of predictors" (Kean University, 2013, p. 2).

5. For this study Hierarchical Multiple Linear Regression will be used

5a. Hierarchical multiple regression allowed "…the researcher, not the computer, to determine the order of entry of the variables. F-tests were used to compute the significance of each added variable (or set of variables) to the explanation reflected in R square" (Kean University, 2013, p.18).

> The hierarchical multiple regression procedure was an alternative to comparing betas for purposes of assessing the importance of the independents. In more complex forms of hierarchical multiple regression, the model involved a series of intermediate variables, which were dependents with respect to some other independents, but were themselves independents with respect to the ultimate dependent. Hierarchical multiple regression then involved a series of regressions for each intermediate as well as for the ultimate dependent. (Kean University, 2013, p. 18).

5b. Research Questions 1-5 were analyzed using Hierarchical Multiple Regression.	***5c.*** After results were determined for research questions 1-5, then further analysis was performed to examine for Collinearity / Multicollinearity.

5d. Multicollinearity referred to excessive correlation of the predictor variables. When correlation was excessive, standard errors of the b and beta coefficients became large, making it difficult or impossible to assess the relative importance of the predictor variables (Kean University, 2013, p. 21). If Multicollinearity was detected, additional measures were taken using IBM SPSS.

Figure 3.2. Collection of data, methods, and reasoning of data analysis and methodology for this study.

The first research question was addressed by performing a hierarchical multiple regression analysis. The hierarchical multiple regression analysis used the mean scaled scores for the End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II assessments for eleventh grade students as the dependent variable and school population size as the primary predictor variable while statistically controlling for socioeconomic status, student attendance, minority population, and teacher quality.

The second research question was addressed by performing a hierarchical multiple regression analysis using the mean scaled scores for the End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II assessments for eleventh grade students as the dependent variable and school population size as the primary predictor variable while only statistically controlling for socioeconomic status.

The third research question was addressed by performing a hierarchical multiple regression analysis using the mean scores for the End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II assessments for eleventh grade students as the dependent variable and school population size as the primary predictor variable while only statistically controlling for student attendance.

The fourth research question was addressed by performing a hierarchical multiple regression analysis using the mean scores for the End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II assessments for eleventh grade students as the dependent variable and school population size as the primary predictor variable while only statistically controlling for minority population.

The fifth research question was addressed by performing a hierarchical multiple regression analysis using the mean scores for the End-of-Course Reading and Writing, U.S. History, Chemistry, and Algebra II assessments for eleventh grade students as the dependent variable and school population size as the primary predictor variable while only statistically controlling for teacher quality.

When the results were determined on the five research questions, further statistical analysis was performed, specifically collinearity analysis and diagnostics using IBM SPSS. The collinearity analysis and diagnostics using IBM SPSS was performed to test for multicollinearity. Multicollinearity had the possibility of existing when two or more predictor variables in a regression model were closely related. Additionally, it occurred when one variable was predicted from one or more of the other predictor variables. The purpose of a regression model was to test each predictor variable and analyze what effect it had on the dependent variable, and establish a ranking order to see which one had the most effect on the dependent variable. Collinearity statistics help sort out the variables predicting power and help reduce the issues found if redundant variables were present.

CHAPTER 4
FINDINGS

Introduction

In this chapter, data that have been collected and analyzed will be presented which addresses the main research question. The main research question for this study examined if there was a relationship between high school student population size and selected variables on student achievement. In order to answer the main research question, descriptive statistics for both large and small high schools were examined for student achievement and then the variables of socioeconomic status, student attendance, minority population, and teacher quality, concluding with the eleventh grade population size. Following the descriptive statistics portion of this chapter, each of the five research questions statistical analyses and results were presented. This chapter concluded with a summary of the findings from the five research questions.

Description Large Schools

Descriptive statistics were presented in this section for large high schools in Virginia for each of the variables used in this study. The total number of high schools in this data set that met the criteria for large high schools in Virginia was 51. Upon examination of the data, it was determined that one large high school was missing data for socioeconomic status. Since missing data could skew results when a data analysis was performed, that large high school was excluded from the study. The removal of one large high school from the large high school data set brought the total of large high schools to 50.

The purpose of the study was to investigate the relationship between a high school student population size and student achievement. In order to examine student achievement properly, it was determined that all the Standards of Learning scores identified for the study (English reading and writing, U.S. History, Chemistry, and Algebra II) would be combined into a composite score. The composite score (coded as Total Score) for large high schools ranged from a minimum of 2054.78 to 2334.52 with a standard deviation of 59.74 (see Table 4.1). Also presented in Table 4.1 were the scores for each of the Standards of Learning assessments identified for use in the study (coded as Reading, Writing, U.S. History, Chemistry, and Alg II). Although a composite score was used to gauge student achievement, the consideration of each

Standard of Learning assessment identified for the study aided in the understanding of the composite score (see Table 4.1).

Table 4.1

Descriptive Statistics for Large High Schools in Virginia for Male and Female Students in the Eleventh Grade Along With all Variables Used in Study

Descriptive Statistics

Coded As	N	Minimum	Maximum	Mean	Std. Deviation
Total Score	50	2054.78	2334.52	2201.1050	59.74209
Reading	50	423.16	467.43	446.8704	9.99259
Writing	50	407.96	507.58	469.4276	22.17709
U.S. History	50	416.45	491.87	452.6428	15.97711
Chemistry	50	392.33	471.19	424.5052	18.57789
Alg II	50	359.37	437.48	407.6590	15.77058
SES	50	4.74	60.60	23.4802	13.86239
Attendance	50	88.43	97.03	94.5558	1.55760
Minority	50	18.20	82.98	51.4716	16.66726
HQ Teacher	50	94.99	100.00	98.2288	1.69807
Total Students Eleventh Grade	50	378.0	798.0	549.460	92.9306

a. Lg_1 _Sm_2 = 1.0

The other variables that were examined as a part of the study included socioeconomic status, student attendance, student minority population, and teacher quality. Socioeconomic status (coded as SES) is the percentage of disadvantaged students, which ranged from 4.74% to 60.60% with a mean of 23.48% and a standard deviation of 13.86% (see Table 4.1). Student attendance (coded as Attendance) is the percentage of attendance, which ranged from 88.43% to 97.03% with a mean of 94.44% with a standard deviation of 1.55% (see Table 4.1). For the variable of minority population, it was determined to sum all of the minority population subgroups identified for this study into a single category (coded as Minority) with the result being the percent of minority students that would be used for the data analysis portion of the study. Minority population (coded as Minority) ranged from 18.20% to 82.98% with a mean of 51.47% and a standard deviation of 16.66% (see Table 4.1). Teacher quality (coded as HQ Teacher) for this study ranged from 94.99% to 100% with a mean of 98.22% and a standard deviation of 1.69% (see Table 4.1). The range of students that were in the eleventh grade during the 2012-2013 school year ranged from 378 to 798 with a mean of 549.46 with a standard deviation of 92.93 (see Table 4.1).

Description Small Schools

Descriptive statistics were presented in this section for small high schools in Virginia for each of the variables used in this study. The total number of high schools in the data set that met the criteria for small high schools in Virginia was 51. Upon examination of the data, it was determined that one small high school was missing data for socioeconomic status and two small high schools were missing data for Algebra II scores. Since missing data could skew results when a data analysis was performed, those three small high schools were excluded from the study. The removal of three small high schools from the small high school data set brought the total of small high schools to 48.

The purpose of the study was to investigate the relationship between high school student population size and student achievement. In order to examine student achievement properly, it was determined that all the Standards of Learning scores identified for the study (English reading and writing, U.S. History, Chemistry, and Algebra II) would be combined into a composite score. The composite score (coded as Total Score) for small high schools ranged from a minimum of 2054.88 to 2326.55 with a mean score of 2158.62 and a standard deviation of 49.21 (see Table 4.2). Also presented in Table 4.2 are the scores for each of the Standards of Learning assessments identified for use in the study (coded as Reading, Writing, U.S. History, Chemistry, and Alg II). Although a composite score was used to gauge student achievement, the consideration of each Standard of Learning assessment identified for the study aided in the understanding of the composite score (see Table 4.2).

The other variables that were examined as a part of the study included socioeconomic status, student attendance, student minority population, and teacher quality. Socioeconomic status (coded as SES) is the percentage of disadvantaged students, which ranged from 14.29% to 68.33% with a mean of 46.89% and a standard deviation of 12.25% (see Table 4.2). Student attendance (coded as Attendance) is the percentage of attendance, which ranged from 87.13% to 97.81% with a mean of 93.68% with a standard deviation of 1.95% (see Table 4.2). For the

Table 4.2

Descriptive Statistics for Small High Schools in Virginia for Male and Female Students in the Eleventh Grade Along With all Variables Used in Study

Descriptive Statistics

Coded As	N	Minimum	Maximum	Mean	Std. Deviation
Total Score	48	2054.88	2326.55	2158.6254	49.21666
Reading	48	412.09	469.42	433.7350	10.45427
Writing	48	388.75	491.00	446.0190	18.48310
U.S. History	48	399.56	486.94	438.9438	16.46570
Chemistry	48	405.29	469.96	436.3098	18.04803
Alg II	48	345.35	447.67	403.6179	24.08975
SES	48	14.29	68.33	46.8917	12.25975
Attendance	48	87.13	97.81	93.6889	1.95221
Minority	48	.00	77.65	23.1233	23.82642
HQ Teacher	48	84.00	100.00	96.8452	4.11286
Total Students Eleventh Grade	48	23.0	120.0	77.979	25.1823

a. Lg_1 _Sm_2 = 2.0

variable of minority population, it was determined to sum all of the minority population subgroups identified for this study into a single category (coded as Minority) with the result being the percent of minority students that would be used for the data analysis portion of the study. Minority population (coded as Minority) ranged from 0% to 77.65% with a mean of 23.12% and a standard deviation of 23.82% (see Table 4.2). Teacher quality (coded as HQ Teacher) for this study ranged from 84% to 100% with a mean of 96.84% and a standard deviation of 4.11% (see Table 4.2). The range of students that were in the eleventh grade during the 2012-2013 school year ranged from 23 to 120 with a mean of 77.97 with a standard deviation of 25.18 (see Table 4.2).

Data Analyses

For the data analysis section of this study, hierarchical multiple regression was used to investigate the five research questions. Hierarchical multiple regression allowed for the examination of the data in separate models. In this study, two models were employed for each research question. In the first model, the predictor variable(s) were entered to determine if they had a significant effect on the dependent variable, which in this case was student achievement. In the second model for each research question, the predictor variable(s) were entered to gauge what, if any, effect each had on the dependent variable along with student population size. For this study, a level of 0.05 was used to test for significance.

Preliminary analyses were conducted via the correlation table (see Table 4.3) to explore for potential relationships between the predictor variables and the dependent variable of student achievement. Two predictor variables were found to be significant. The results of the correlation analysis indicated that the predictor variables of socioeconomic status and student attendance were statistically correlated with the dependent variable of student achievement in this preliminary examination. The correlations between the predictor variables of socioeconomic status and student attendance and the dependent variable of student achievement was respectively moderately positive to strongly negative $r = .325$, $p < .05$ to $r = -.588$, $p < .05$. Of the two-predictor variables that were found to be significant, socioeconomic status was found to be the best predictor of student achievement. Socioeconomic status will be examined more closely in research question number two through hierarchical multiple regression.

Preliminary analyses were conducted for each research question to ensure that no violations of the assumptions of normality, linearity, or homoscedasticity existed through the examination of Normal P-Plots and Scatterplots. A preliminary analysis was conducted to check for multicollinearity. The preliminary analysis for multicollinearity was accomplished through the examination of the correlation table (see Table 4.3). Two predictor variables were found to be significantly correlated with each other. They were socioeconomic status and student attendance, which were moderately negative $r = -.442$, $p < .05$. Further analysis was conducted to determine if multicollinearity was a problem in each of the five research questions through the examination of the VIF and Tolerance results for each of the predictor variables.

Table 4.3

Correlations Between all Variables

Correlations

		Total_ Score	SES	Attendance	Minority	HQ Teacher
Total Score	Pearson Correlation	1	-.588**	.325**	-.125	.196
	Sig. (2-tailed)		.000	.001	.222	.053
	N	98	98	98	98	98
SES	Pearson Correlation	-.588**	1	-.442**	-.123	-.187
	Sig. (2-tailed)	.000		.000	.226	.065
	N	98	98	98	98	98
Attendance	Pearson Correlation	.325**	-.442**	1	-.004	-.130
	Sig. (2-tailed)	.001	.000		.968	.203
	N	98	98	98	98	98
Minority	Pearson Correlation	-.125	-.123	-.004	1	.039
	Sig. (2-tailed)	.222	.226	.968		.700
	N	98	98	98	98	98
HQ Teacher	Pearson Correlation	.196	-.187	-.130	.039	1
	Sig. (2-tailed)	.053	.065	.203	.700	
	N	98	98	98	98	98

**. Correlation is significant at the 0.01 level (2-tailed).
Total Score = Student Achievement, SES = Socioeconomic Status, Attendance = Student Attendance,
Minority = Minority Population, HQ Teacher= Teacher Quality

Data Analyses for Research Question 1

What was the relationship between high school student population size and student achievement as measured by student performance on the Virginia Standards of Learning (SOL) in English reading and writing, U.S. History, Chemistry, and Algebra II assessments when socioeconomic status, student attendance, minority population, and teacher quality were statistically controlled?

Hierarchical multiple regression was performed to investigate the relationship between high school student population size and student achievement, after statistically controlling for socioeconomic status, student attendance, minority population, and teacher quality. Preliminary analyses were conducted to ensure that no violations of the assumptions of normality, linearity, or homoscedasticity existed. The preliminary analyses were conducted by the creation of a Normal P-Plot and a Scatterplot. After examination of the Normal P-Plot and Scatterplot, no abnormalities were found (see Appendix D). An analysis was also conducted to determine if multicollinearity was present. The analysis was accomplished by examining the collinearity statistics located in the coefficients table (see Table 4.4). Specifically, the VIF and Tolerance results were examined. The VIF results ranged from 1.02 to 3.33. VIF results greater than 10 start to indicate relatively high levels of multicollinearity. The results for Tolerance ranged from .981 to .300. A Tolerance result of .10 or lower indicates multicollinearity may be a problem. The results of collinearity statistics examination revealed that collinearity was not a problem for the regression models that were obtained.

Table 4.4

Analysis Using the Coefficients Table to Check for Collinearity Between High School Student Population Size and Student Achievement, After Statistically Controlling for Socioeconomic Status, Student Attendance, Minority Population, and Teacher Quality

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1758.655	356.813		4.929	.000		
	SES	-1.827	.313	-.548	-5.830	.000	.731	1.368
	Attendance	3.164	2.997	.098	1.056	.294	.755	1.324
	Minority	-.462	.191	-.196	-2.419	.017	.981	1.020
	HQ Teacher	2.102	1.550	.114	1.356	.178	.909	1.100
2	(Constant)	1814.875	357.211		5.081	.000		
	SES	-1.419	.426	-.425	-3.328	.001	.391	2.558
	Attendance	3.226	2.982	.099	1.082	.282	.755	1.325
	Minority	-.702	.255	-.298	-2.748	.007	.543	1.841
	HQ Teacher	1.777	1.559	.097	1.140	.257	.889	1.125
	Lg_1 _Sm_2	-23.902	17.017	-.205	-1.405	.164	.300	3.338

a. Dependent Variable: Total Score

In model one of the hierarchical multiple regression, all the predictor variables (socioeconomic status, student attendance, minority population, and teacher quality) were entered. This model was statistically significant F (4, 93) = 15.52; $p < .05$ and explained 40% of the variance in student achievement (see Table 4.5). After entry of school size in model two, the total variance explained by the model as a whole was 41%. The overall F test for this model was significant (F (5, 92) = 12.94; $p <.05$) (see Table 4.6). The introduction of school size did not add anything significant to the explanation of the variance in student achievement after controlling for the predictor variables (R^2 Change = .013; F (1, 92) = 1.97; $p > .05$) and was not significant (see Table 4.5).

Table 4.5

Model Summary of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for all Predictor Variables

Model Summary

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.633[a]	.400	.375	46.32928	.400	15.527	4	93	.000
2	.643[b]	.413	.381	46.08882	.013	1.973	1	92	.164

a. Predictors: (Constant), HQ Teacher, Minority, Attendance, SES
b. Predictors: (Constant), HQ Teacher, Minority, Attendance, SES, Lg_1 _Sm_2
c. Dependent Variable: Total Score

Table 4.6

ANOVA of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for all Predictor Variables

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	133310.709	4	33327.677	15.527	.000[b]
	Residual	199615.385	93	2146.402		
	Total	332926.094	97			
2	Regression	137501.609	5	27500.322	12.946	.000[c]
	Residual	195424.485	92	2124.179		
	Total	332926.094	97			

a. Dependent Variable: Total Score
b. Predictors: (Constant), HQ Teacher, Minority, Attendance, SES
c. Predictors: (Constant), HQ Teacher, Minority, Attendance, SES, Lg_1 _Sm_2

Data Analyses for Research Question 2

What was the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only socioeconomic status was statistically controlled?

Hierarchical multiple regression was performed to investigate the relationship between high school student population size and student achievement, after statistically controlling for socioeconomic status. Preliminary analyses were conducted to ensure that no violations of the assumptions of normality, linearity, or homoscedasticity existed. The preliminary analyses were conducted by the creation of a Normal P-Plot and a Scatterplot. After examination of the Normal P-Plot and Scatterplot, no abnormalities were found (see Appendix E). An analysis was conducted to determine if multicollinearity was present. The analysis was accomplished by examining the collinearity statistics located in the coefficients table (see Table 4.7). Specifically, the VIF and Tolerance results were examined. The VIF result was 1.81. VIF results greater than 10 start to indicate relatively high levels of multicollinearity. The result for Tolerance was .551. A Tolerance result of .10 or lower indicates multicollinearity may be a problem. The results of collinearity statistics examination revealed that collinearity was not a problem for the regression models that were obtained.

Table 4.7

Analysis Using the Coefficients Table to Check for Collinearity Between High School Student Population Size and Student Achievement, After Statistically Controlling for Socioeconomic Status

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	2248.839	10.764		208.921	.000		
	SES	-1.961	.276	-.588	-7.119	.000	1.000	1.000
2	(Constant)	2243.728	15.190		147.714	.000		
	SES	-2.081	.373	-.624	-5.584	.000	.551	1.814
	Lg_1 _Sm_2	6.235	13.021	.053	.479	.633	.551	1.814

a. Dependent Variable: Total Score

In model one of the hierarchical multiple regression, the predictor variable of socioeconomic status was entered. This model was statistically significant F (1, 96) = 50.67; $p < .05$ and explained 34% of the variance in student achievement (see Table 4.8). After entry of school size in model two, the total variance explained by the model as a whole remained at 34%.

The overall F test for this model was significant (F (2, 95) = 25.24; p <.05) (see Table 4.9). The introduction of school size did not add anything significant to the explanation of the variance in student achievement after controlling for socioeconomic status (R^2 Change = .002; F (1, 95) = .229; p > .05) and was not significant (see Table 4.8).

Table 4.8

Model Summary of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Socioeconomic Status

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.588[a]	.345	.339	47.64256	.345	50.676	1	96	.000
2	.589[b]	.347	.333	47.83495	.002	.229	1	95	.633

a. Predictors: (Constant), SES
b. Predictors: (Constant), SES, Lg_1 _Sm_2

Table 4.9

ANOVA of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Socioeconomic Status

ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	115024.007	1	115024.007	50.676	.000[b]
	Residual	217902.087	96	2269.813		
	Total	332926.094	97			
2	Regression	115548.782	2	57774.391	25.249	.000[c]
	Residual	217377.312	95	2288.182		
	Total	332926.094	97			

a. Dependent Variable: Total Score
b. Predictors: (Constant), SES
c. Predictors: (Constant), SES, Lg_1 _Sm_2

Data Analyses for Research Question 3

What was the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only student attendance was statistically controlled?

Hierarchical multiple regression was performed to investigate the relationship between high school student population size and student achievement, after statistically controlling for student attendance. Preliminary analyses were conducted to ensure that no violations of the asumptions of normality, linearity, or homoscedasticity existed. The preliminary analyses were conducted by the creation of a Normal P-Plot and a Scatterplot. After examination of the Normal P-Plot and Scatterplot, no abnormalities were found (see Appendix F). An analysis was conducted to determine if multicollinearity was present. The analysis was accomplished by examining the collinearity statistics located in the coefficients table (see Table 4.10). Specifically, the VIF and Tolerance results were examined. The VIF result was 1.06. VIF results greater than 10 start to indicate relatively high levels of multicollinearity. The result for Tolerance was .942. A Tolerance result of .10 or lower indicates multicollinearity may be a problem. The results of collinearity statistics examination revealed that collinearity was not a problem for the regression models that were obtained.

Table 4.10

Analysis Using the Coefficients Table to Check for Collinearity Between High School Student Population Size and Student Achievement, After Statistically Controlling for Student Attendance

Coefficients

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1186.734	294.731		4.027	.000		
	Attendance	10.555	3.130	.325	3.372	.001	1.000	1.000
2	(Constant)	1462.965	294.512		4.967	.000		
	Attendance	8.181	3.081	.252	2.655	.009	.942	1.062
	Lg_1 _Sm_2	-35.388	11.076	-.304	-3.195	.002	.942	1.062

a. Dependent Variable: Total Score

In model one of the hierarchical multiple regression, the predictor variable of student attendance was entered. This model was statistically significant *F* (1, 96) = 11.36; *p* < .05 and explained 10% of the variance in student achievement (see Table 4.11). After entry of school size in model two, the total variance explained by the model increased to 19%. The overall F test for this model was significant (*F* (2, 95) = 11.33; *p* <.05) (see Table 4.12). The introduction of school size explained an additional 9% of the variance in student achievement after controlling for student attendance (R^2 Change = .087; *F* (1, 95) = 10.20; *p* < .05) and was significant (see Table 4.11).

Table 4.11

Model Summary of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Student Attendance

Model Summary[c]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.325[a]	.106	.097	55.68468	.106	11.368	1	96	.001
2	.439[b]	.193	.176	53.19188	.087	10.209	1	95	.002

a. Predictors: (Constant), Attendance
b. Predictors: (Constant), Attendance, Lg_1 _Sm_2
c. Dependent Variable: Total Score

Table 4.12

ANOVA of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Student Attendance

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	35250.918	1	35250.918	11.368	.001[b]
	Residual	297675.175	96	3100.783		
	Total	332926.094	97			
2	Regression	64135.355	2	32067.678	11.334	.000[c]
	Residual	268790.738	95	2829.376		
	Total	332926.094	97			

a. Dependent Variable: Total Score
b. Predictors: (Constant), Attendance
c. Predictors: (Constant), Attendance, Lg_1 _Sm_2

Data Analyses for Research Question 4

What was the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only minority population was statistically controlled?

Hierarchical multiple regression was performed to investigate the relationship between high school student population size and student achievement, after statistically controlling for minority population. Preliminary analyses were conducted to ensure that no violations of the assumptions of normality, linearity, or homoscedasticity existed. The preliminary analyses were conducted by the creation of a Normal P-Plot and a Scatterplot. After examination of the Normal P-Plot and Scatterplot, no abnormalities were found (see Appendix G). An analysis was conducted to determine if multicollinearity was present. The analysis was accomplished by examining the collinearity statistics located in the coefficients table (see Table 4.13). Specifically, the VIF and Tolerance results were examined. The VIF result was 1.48. VIF results greater than 10 start to indicate relatively high levels of multicollinearity. The result for Tolerance was .672. A Tolerance result of .10 or lower indicates multicollinearity may be a problem. The results of collinearity statistics examination revealed that collinearity was not a problem for the regression models that were obtained.

Table 4.13

Analysis Using the Coefficients Table to Check for Collinearity Between High School Student Population Size and Student Achievement, After Statistically Controlling for Minority Population

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	2191.330	10.736		204.109	.000		
	Minority	-.293	.239	-.125	-1.230	.222	1.000	1.000
2	(Constant)	2336.872	25.239		92.590	.000		
	Minority	-1.169	.247	-.496	-4.730	.000	.672	1.488
	Lg_1 _Sm_2	-75.611	12.227	-.648	-6.184	.000	.672	1.488

a. Dependent Variable: Total Score

In model one of the hierarchical multiple regression, the predictor variable of minority population was entered. This model was found not to be statistically significant F (1, 96) = 1.51; $p > .05$ and only explained 1% of the variance in student achievement (see Table 4.14). After entry of school size in model two, the total variance explained by the model increased to 29%. The overall F test for this model was significant (F (2, 95) = 20.16; $p <.05$) (see Table 4.15). The introduction of school size explained an additional 28% of the variance in student achievement after controlling for minority population (R^2 Change = .283; F (1, 95) = 38.23; $p < .05$) and was significant (see Table 4.14).

Table 4.14

Model Summary of Hierarchical Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Minority Population

Model Summary[c]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics: R Square Change	F Change	df1	df2	Sig. F Change
1	.125[a]	.016	.005	58.43091	.016	1.513	1	96	.222
2	.546[b]	.298	.283	49.59791	.283	38.239	1	95	.000

a. Predictors: (Constant), Minority
b. Predictors: (Constant), Minority, Lg_1 _Sm_2
c. Dependent Variable: Total Score

Table 4.15

ANOVA of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Minority Population

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	5165.697	1	5165.697	1.513	.222[b]
	Residual	327760.396	96	3414.171		
	Total	332926.094	97			
2	Regression	99230.603	2	49615.301	20.169	.000[c]
	Residual	233695.491	95	2459.953		
	Total	332926.094	97			

a. Dependent Variable: Total Score
b. Predictors: (Constant), Minority
c. Predictors: (Constant), Minority, Lg_1 _Sm_2

Data Analyses for Research Question 5

What was the relationship between high school student population size and student achievement as measured by student performance on the Virginia SOL English reading and writing, U.S. History, Chemistry, and Algebra II assessments when only teacher quality was statistically controlled?

Hierarchical multiple regression was performed to investigate the relationship between high school student population size and student achievement after statistically controlling for teacher quality. Preliminary analyses were conducted to ensure that no violations of the assumptions of normality, linearity, or homoscedasticity existed. The preliminary analyses were conducted by the creation of a Normal P-Plot and a Scatterplot. After examination of the Normal P-Plot and Scatterplot, no abnormalities were found (see Appendix H). An analysis was conducted to determine if multicollinearity was present. The analysis was accomplished by examining the collinearity statistics located in the coefficients table (see Table 4.16). Specifically, the VIF and Tolerance results were examined. The VIF result was 1.05. VIF results greater than 10 start to indicate relatively high levels of multicollinearity. The result for Tolerance was .952. A Tolerance result of .10 or lower indicates multicollinearity may be a problem. The results of collinearity statistics examination revealed that collinearity was not a problem for the regression models that were obtained.

Table 4.16

Analysis Using the Coefficients Table to Check for Collinearity Between High School Student Population Size and Student Achievement, After Statistically Controlling for Teacher Quality

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
		B	Std. Error	Beta	t	Sig.	Tolerance	VIF
1	(Constant)	1828.135	179.744		10.171	.000		
	HQ Teacher	3.610	1.842	.196	1.960	.053	1.000	1.000
2	(Constant)	2019.108	178.829		11.291	.000		
	HQ Teacher	2.253	1.787	.122	1.261	.210	.952	1.050
	Lg_1 _Sm_2	-39.362	11.321	-.338	-3.477	.001	.952	1.050

a. Dependent Variable: Total Score

In model one of the hierarchical multiple regression, the predictor variable of teacher quality was entered. This model was found not to be statistically significant F (1, 96) = 3.84; $p > .05$ and only explained 3% of the variance in student achievement (see Table 4.17). After entry of school size in model two, the total variance explained by the model increased to 14%. The overall F test for this model was significant (*F* (2, 95) = 8.18; p <.05) (see Table 4.18). The introduction of school size explained an additional 11% of the variance in student achievement after controlling for teacher quality (R^2 Change = .109; *F* (1, 95) = 12.08; $p < .05$) and was significant (see Table 4.17).

Table 4.17

Model Summary of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Teacher Quality

Model Summary[c]

					Change Statistics				
Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	R Square Change	F Change	df1	df2	Sig. F Change
1	.196[a]	.038	.028	57.74518	.038	3.843	1	96	.053
2	.383[b]	.147	.129	54.67406	.109	12.088	1	95	.001

a. Predictors: (Constant), HQ Teacher
b. Predictors: (Constant), HQ Teacher, Lg_1 _Sm_2
c. Dependent Variable: Total Score

Table 4.18

ANOVA of Hierarchical Multiple Regression to Investigate the Relationship Between a High School Student Population Size and Student Achievement, After Statistically Controlling for Teacher Quality

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	12813.534	1	12813.534	3.843	.053[b]
	Residual	320112.560	96	3334.506		
	Total	332926.094	97			
2	Regression	48947.082	2	24473.541	8.187	.001[c]
	Residual	283979.012	95	2989.253		
	Total	332926.094	97			

a. Dependent Variable: Total Score
b. Predictors: (Constant), HQ Teacher
c. Predictors: (Constant), HQ Teacher, Lg_1 _Sm_2

Summary of Findings

The purpose of this study was to investigate, through hierarchical multiple regression, the relationship between high school student population size and student achievement when statistically controlling for the predictor variables of socioeconomic status, student attendance, minority population, and teacher quality. The manner in which the relationship between high school student population size and student achievement when controlling for the predictor variable was investigated was through a series of five research questions. In each of the five research questions, a check of assumptions was performed to check for normality, linearity, and homoscedasticity along with an analysis to determine if multicollinearity was an issue prior to performing the hierarchical multiple regressions. The results for each of the five research questions in terms of the check for assumptions and for multicollinearity revealed no abnormalities that warranted further investigation.

The first research question revealed that when all of the predictor variables were taken into account in model one of the hierarchical multiple regression, socioeconomic status, student attendance, minority population, and teacher quality were found to be statistically significant $F(4, 93) = 15.52$; $p < .05$ and explained 40% of the variance in student achievement. A look at the Beta levels in model one indicated that two of the predictor variables were significant with socioeconomic status ($ß = -.548$, $p < .05$) ranking higher than minority population ($ß = -.196$, $p <.05$) (see Table 4.3). The negative Beta levels for socioeconomic status and minority population indicated that a decrease in either would result in student achievement rising. In the second model for the first research question, when high school student population size was entered in addition with all of the predictor variables, the result was not significant (R^2 Change = .013; $F(1, 92) = 1.97$; $p > .05$). This result indicated that when all variables were accounted for, there was not a relationship between high school population size and student achievement. To further investigate if the high school student population size had a bearing on student achievement when the other predictor variables were taken into account, they were separated out and analyzed individually. The manner in which high school student population size, student achievement, and the individual predictor variables were examined was undertaken in research questions two through five.

In the second research question, socioeconomic status was entered into model one by itself. The result of model one indicated that the result was significant $F(1, 96) = 50.67$; $p < .05$

and explained 34% of the variance in student achievement (see Table 4.8). The result indicated that there was a relationship between poverty and student achievement. A look at the Beta level indicated that as poverty decreased, student achievement increased (ß = -.588, p <.05) (see Table 4.7). After entry of high school student population size in model two, the total variance explained by the model as a whole remained at 34% (F (2, 95) = 25.24; p <.05) (see Table 4.9). The introduction of school size did not add anything significant to the explanation of the variance in student achievement after controlling for socioeconomic status (R^2 Change = .002; F (1, 95) = .229; p > .05) and was not significant (see Table 4.8). The result of model two indicated that high school student population size did not have an influence on student achievement when socioeconomic status was taken into account and thus no relationship existed.

For the third research question, student attendance was entered into model one by itself to determine if it had a bearing on student achievement. The result of model one for the third research question indicated that there was a significant result F (1, 96) = 11.36; p < .05 and explained 10% of the variance in student achievement (see Table 4.11). The result indicated that there was a relationship between student attendance and student achievement. A look at the Beta level for model one indicated that the higher the student attendance rate was, the better students did in school (ß = .325, p <.05) (see Table 4.10). After entry of school size in model two, the total variance explained by the model increased to 19% (F (2, 95) = 11.33; p <.05) (see Table 4.12). The introduction of school size explained an additional 9% of the variance in student achievement after controlling for student attendance (R^2 Change = .087; F (1, 95) = 10.20; p < .05) and was significant (see Table 4.11). The variance indicated that there was a relationship between high school student population size and student achievement after controlling for student attendance. A look at the Beta level for model two indicated that the smaller high schools had a lower student achievement rate (ß = -.304, p <.05) (see Table 4.10).

For the fourth research question, minority population was entered into model one by itself to determine if it had a bearing on student achievement. The result of model one of the fourth research question indicated that minority population alone did not affect student achievement and was not significant F (1, 96) = 1.51; p > .05 and only explained 1% of the variance in student achievement (see Table 4.14). However, when high school population size was entered in conjunction with minority population in model two, the total variance explained by the model increased to 29% (F (2, 95) = 20.16; p <.05) (see Table 4.15). The introduction of school size explained an additional 28% of the variance in student achievement after controlling for minority population (R^2 Change = .283; F (1, 95) = 38.23; p < .05) and was significant (see Table 4.14). The variance indicated that there was a relationship between high school population size and the overall student achievement after controlling for the percentage of minority students. However, a closer look at the Beta level for model two revealed that as the percentage of minority students increased, student achievement on the standards of learning assessments decreased (ß = -.648, p <.05) (see Table 4.13).

In the fifth research question, teacher quality was entered into model one to see if it had an influence on student achievement. The result for model one of the fifth research question indicated that teacher quality did not have an influence on student achievement when taken into account by itself and was not a significant factor F (1, 96) = 3.84; p > .05 and only explained 3% of the variance in student achievement (see Table 4.17). After entry of school size in model two, the total variance explained by the model increased to 14% (F (2, 95) = 8.18; p <.05) (see Table 4.18). The introduction of school size explained an additional 11% of the variance in student achievement after controlling for teacher quality (R^2 Change = .109; F (1, 95) = 12.08; p < .05) and was significant (see Table 4.17). This result indicated that there was a relationship between high school population size and student achievement while controlling for teacher quality. A look at the Beta coefficients for high school student population size revealed that as the size of the high school student population size decreases when controlling for teacher quality, student achievement on the standards of learning assessments decreased (ß = -.338, p <.05) (see Table 4.16).

CHAPTER 5

CONCLUSION, DISCUSSION, IMPLICATIONS, AND RECOMMENDATIONS

Introduction

In this chapter, several sections will be presented that will serve to conclude this study. In the first section, an overview of the study will be presented, which briefly details the entire study. The next section of this chapter is the conclusions section. The purpose of the conclusion section is to answer the main research question in regards to the data that were analyzed in Chapter Four. The discussion section of this chapter is where observations, thoughts, and implications will be presented. Additionally, the discussion section will serve as a means to bring the research and data full circle in relation to the findings of previous studies included in this study. The implications presented will offer suggestions for addressing issues that have been raised in the research of this study and potential solutions on how to undertake the suggestions. In the final section, recommendations, information will be presented for further research on the topic of high school student population size and the importance of further research along with the rationale for that research. This chapter will conclude with a summary.

Overview of the Study

In reviewing the pertinent research and data on school population size and student achievement, it became apparent that several dissimilarities existed among the studies included in this study. Additionally, from the review of the existing research, it became apparent that many school divisions in Virginia share similar problems, but there are no two alike in the makeup of their student populations. The review of research indicated that additional analyses of data were needed to assist local governing bodies, school superintendents, administrators, teachers, and other stakeholders to make informed decisions when it came to providing the best education for students. Several significant studies were identified and included in the literature review of this study. From the literature review, the predictor variables of socioeconomic status, student attendance, minority status, and teacher quality were identified to aid in the development of the research questions.

From the information garnered from the literature review and research questions, a methodology was developed that would best aid in the analysis of the data set. Hierarchical multiple regression was identified as the statistical method to be used to analyze the data for the five research questions. The reason hierarchical multiple regression was utilized is that it allows the researcher, not the statistical software package, to determine the order of variable entry (Kean University, 2013). The order of variable entry for the hierarchical multiple regressions was based on the findings of the studies contained in the literature review. In addition, hierarchical multiple regression allowed for the analysis of the data in two separate models for each research question. In the first model, the predictor variable(s) were entered to determine if they had a significant effect on the dependent variable of student achievement. In the second model, the predictor variable(s) were entered to gauge what, if any, effect each had on the dependent variable along with student population size. Data analyses from the hierarchical multiple regressions were used to answer the five research questions in the summary of findings section located in chapter four of this study. A brief overview of the findings from chapter four indicated the following:

Research question 1: When socioeconomic status, student attendance, minority population, and teacher quality were taken into account, a relationship existed with student achievement. However, in model two, when all of the variables were accounted for, they were found not to have a relationship with high school population size and student achievement.

Research question 2: When socioeconomic status was analyzed in model one, a relationship existed between poverty and student achievement. However, when student population size was introduced in the second regression model, it did not have an influence on student achievement when socioeconomic status was taken into account and thus no relationship existed.

Research question 3: When student attendance was analyzed in model one, a relationship existed between student attendance and student achievement. In model two, there was a relationship between high school student population size and student achievement after controlling for student attendance.

Research question 4: When minority population was analyzed in model one, no relationship existed between minority population and student achievement. In model two, there was a relationship between high school student population size and student achievement after controlling for the percentage of minority students.

Research question 5: When teacher quality was analyzed in model one, no relationship existed between teacher quality and student achievement. In model two, there was a relationship between high school student population size and student achievement after controlling for teacher quality.

From the summary of findings, the main research question will be addressed in the conclusion section. This will be followed with discussion and implications of the findings. The study will conclude with recommendations for future research along with a summary.

Conclusion

In this section, the main research question will be addressed. The answer to the main research question of is there a relationship between a high school student population size and student achievement when statistically controlling for selected variables, the answer is yes according to the data. High school student population size influenced student achievement the most when the predictor variables of student attendance, minority population, and teacher quality were taken into account. Out of the four variables that were analyzed in the second model of the hierarchical multiple regression, only socioeconomic status was found not to have a relationship with high school population size and student achievement. However, it should be noted that even though no relationship existed between socioeconomic status, student achievement, and high school population size, it does not mean that socioeconomic status should be excluded from consideration. Socioeconomic status and the variables (student attendance, minority population, and teacher quality) that were shown to have a relationship with high school population size and student achievement will be discussed further in the next section of this study with implications for practical suggestions on the issues that have been raised in this research.

Discussion

In this section, discussion will be offered based on the results of the data analysis performed in chapter four on the five research questions for this study whether they were found to demonstrate statistical or non-statistical significance. In addition, the discussion section will serve to bring full circle the findings of the studies utilized in the literature review section together with this study's findings and offer support for the conclusion reached regarding the main research question. Where applicable, implications will be proposed that offer suggestions for civic leaders, school leaders, superintendents, school administrators, and other stakeholders, which address matters that have been raised in this study during the course of research.

In research question one, the predictor variables of socioeconomic status, student attendance, minority population, and teacher quality were included in the hierarchical multiple regression. In model one, when all of the variables were accounted for, the results indicated that there is a correlation among all the variables and student achievement and were found to be statistically significant $F(4, 93) = 15.52$; $p < .05$. In model two, when all of the predictor variables were accounted for, they were found not to have a relationship with high school population size and student achievement (see Table 4.5). This finding corresponds with two studies that examined similar multiple variables when school size and student achievement are taken into account (Lamdin 1996; Lindahl & Cain, Sr., 2012).

Although no relationship existed in model two of research question one when all of the predictor variables were accounted for between student achievement and high school population size, model one should not be discounted entirely. The reason why the results for research question one, model one should not be discounted is the fact that school leaders and administrators have to deal with socioeconomic status, student attendance, minority population, and teacher quality in some form or fashion on a daily basis, no matter the size of the school or school division. The fact that these predictor variables were correlated with student achievement is an indication that they are important and should be considered when school leaders and administrators are looking at ways to make overall improvements to their school divisions. For this reason, the predictor variables were separated out for research questions two through five to investigate the possibility that when student population size is factored in, the predictor variables individually may have a bearing on student achievement. The implications that follow for research questions two through five will give a better indication on how to implement strategies for each predictor variable that will best serve to improve student achievement for school divisions, schools, and students.

For research question two, socioeconomic status was examined to determine if a relationship existed between student achievement and school population size. The first model of the hierarchical multiple regression produced a significant result. The model indicated that there was a relationship between socioeconomic status and student achievement. However, when school population size was introduced into model two of the hierarchical multiple regression, the result was not significant. This finding was surprising, since a number of studies included in the literature review found that socioeconomic status was a predictor of student achievement when student population size was considered (Fowler & Walberg, 199; Leithwood & Jantzi, 2009; Program Review & Investigations; Stewart, 2009; Werblow & Duesberry, 2009). A closer look at the results of research question two would indicate that while no relationship existed between socioeconomic status, student achievement, and high school population size, the data told a different story. In model one of the hierarchical multiple regression, the result was significant F (1, 96) = 50.67; $p < .05$ (see Table 4.8). The result indicated that a relationship did exist between socioeconomic status and student achievement. The overall inference in regards to socioeconomic status and student achievement was that the issue was not rooted in the size of a high school population. Ready (2010) stated that "… the least disputed conclusion to emerge from educational research over the past half-century is that socioeconomically disadvantaged children are less likely to experience school success" (p. 271). The implication derived from this finding for school leaders, especially in Virginia, is that there needs to be methods and practices put in place that encourage students that are economically disadvantaged to succeed, no matter the school population size. A possible solution to this issue is for school leaders and administrators to use local data to identify students that are economically disadvantaged. Once students are identified, school administrators need to have a system in place that tracks students long-term academic progress. This long-term tracking could be accomplished through periodic benchmark testing in grades K-12. If a student is found to be struggling in school, measures need to be implemented that seek to address problems in the classroom. One strategy that could be implemented to help students that are economically disadvantaged is a tiered instructional intervention methodology such as Response to Intervention.

In research question three, model two, a relationship was shown to exist between high school population size and student achievement after controlling for student attendance (see Table 4.11). The relationship implies that no matter the size of a high school student population, the more frequently and regularly students attend school, the better they will perform academically. The finding that there is a relationship between student attendance, high school population size, and student achievement is similar with studies performed by other researchers (Lamdin, 1996; Roby, 2004; Werblow & Duesbery 2009). The part of the data analysis that caused alarm was when the Beta level in model two was examined (see Table 4.10). It revealed that smaller high schools have a lower rate of student achievement on the Virginia Standards of Learning assessments than large high schools. This finding is in contrast to the meta-analysis performed by Leithwood and Jantzi (2009), which found in terms of truancy and attendance, smaller secondary schools fare better in terms of academics than larger secondary schools.

The reason why smaller high schools have a lower rate of student achievement on the Virginia Standards of Learning assessments could be a result of the small high school population size that was examined as part of this study. The size range for small high schools was between 67 students and 473 students. In addition, the percentage of small high schools socioeconomically disadvantaged student population was double that of large high schools (Large – M = 23.48 vs Small – M = 46.89). What this indicates is that there is a possibility that a percentage of students that attend small high schools, no matter the geographic location in Virginia, may be experiencing economic difficulties, which may be affecting student achievement and attendance. School leaders and administrators need to be aware of this and seek to put measures into place that address this problem. One possible solution is that closer ties or relationships could be developed between the parents, students, and the local high school, which will better serve to get students in school on a more regular basis. In addition, administrators in small school divisions could reach out to their local community service boards and utilize their services and assistance.

In regards to research question four, model two, the data indicated that there is a relationship between high school population size and student achievement after controlling for the percentage of minority students (see Table 4. 14). In schools with a large minority population, whether a large high school (between 1,868 and 2,906 students) or a small high school (between 67 and 473 students), student achievement declined. This finding is similar to the study conducted by Lamdin (1996). Lamdin (1996) concluded that schools with a larger minority enrollment would have lower mathematics scores (p. 160). Additionally, another similar finding was presented in the study commissioned by the Kentucky Legislative Research Commission (2006). In that study, when race was factored in and analyzed, the results indicated that minority students did not do as well as Caucasian students on standardized assessments despite the student population size (Program Review and Investigations Committee, 2006).

In this study, large high schools in Virginia (M= 51.47) had a higher percentage of minority students than small high schools in Virginia (M= 23.12). In theory, it could be reasoned that small high schools in Virginia will have a higher percentage of student achievement when the percentage of minority population is taken into account. This theory is in contrast to

Werblow and Duesbery (2009) who found that schools with both large and small student populations showed some gains in terms of student achievement (p.18-21).

In regards to minority population, school leaders and administrators cannot control the level of minority populations in their schools. What they can and do control is the way in which they strive to reach students despite their minority status. Minority students in school today tend to be economically disadvantaged. An implication for school leaders and school administrators is to employ some of the suggestions found in the previous recommendations of this study. School administrators need to work to provide the assistance that minority students need to be academically successful and make sure minority students are receiving the most up-to-date intervention strategies based on current research.

The results for the fifth research question, model two, indicated that there is a relationship between high school student population size and student achievement when controlling for teacher quality (see Table 4.17). This finding indicates that high schools in Virginia with student populations between 1,868 and 2,906 tend to have a higher percentage of highly qualified teachers and thus students perform better on the Virginia Standards of Learning assessments. This finding is supported by an observation of the Beta level performed in model two of the hierarchical multiple regression for teacher quality ($\beta = -.388$, $p < .05$) (see Table 4.16). This finding is also similar to Lindahl and Cain, Sr. (2012) results. In their study, Lindahl and Cain, Sr. (2012) found that as the size of the high school population increased, so did the scores on both the reading and math assessments examined in their study when teacher quality was taken into account (p.10).

In addition, a further indication of the Beta level reveals (see Table 4.16) that as the size of the high school student population decreases when controlling for teacher quality, student achievement on the Virginia Standards of Learning assessments decreases. Essentially, what this observation indicates is that there is a probability that in smaller high schools in Virginia, teacher quality is not equivalent to larger high schools. Most small schools in Virginia are located in rural areas that for the most part struggle to recruit and retain highly qualified teachers. The reasons for this are varied, but one could speculate that in rural school divisions, the salary scales are not equal to larger schools divisions. Additionally, school divisions with smaller high school populations need to find teachers with multiple certifications who are highly qualified to teach multiple preparations in order to be more economically efficient. An example of this would be employing a highly qualified teacher in a small high school in Virginia to teach Chemistry, Biology, and Earth Science. An implication for civic leaders and superintendents in small localities in Virginia is to examine their school division salary scales and work with local boards of supervisors, city councils, and town councils to increase funding associated with recruiting and maintaining a highly qualified teacher work force. Another implication for practice would fall to the local school division leadership in small school localities. They would need to examine their policies and the procedures used in hiring teachers and the effectiveness of veteran teachers. School leaders should use results from benchmark testing over a set period to ascertain a teacher's effectiveness in the classroom. Teachers who have shown a record of not performing well over a period of time could be subject to being placed on improvement plans or face contract non-renewal.

Recommendations for Future Research

This study has answered many questions about high school student population size and student achievement when statistically controlling for selected variables. The results of the study while answering the research questions has raised issues that could be the basis of future research studies.

1. The data set used for this study encompassed only one year of data for the 2012-2013 school year. The reason why this was the case was because of several factors. One factor was the nature of the Virginia High School League (VHSL) classification system used to determine the population for large and small high schools in Virginia. High schools in Virginia are reclassified every three years by the VHSL based on size and had just gone through a reclassification cycle. This factor combined with the new guidelines set forth by the Virginia Department of Education calling for stricter Virginia Standards of Learning Assessments prevented the ability to go back any further than 2012-2013. Subsequently, no new data were available in time to use in the study that had incorporated the new, more rigorous Virginia Standards of Learning Assessments. A recommendation for future research would include a data set of large and small high schools in Virginia that includes at least a three-year span of data.

2. The current study only included large and small high schools in Virginia. The size range included in this study did not include all of the high schools in Virginia. A recommendation for future research would be to include all of the high schools in Virginia. Future research that includes all of the high schools in Virginia could possibly identify a high school student population size range where student achievement was maximized.
3. The current study only incorporated high school students in the eleventh grade. A recommendation for a future study would be to utilize a sample of high school students in Virginia that includes grades nine through twelve.
4. In the course of research, a recurring theme emerged from the literature review. That theme was that socioeconomic status affected student achievement in some way. While in this study, socioeconomic status was found not to have a relationship with high school student population size and student achievement; however, it should be noted that it was found to be significant in terms of student achievement regardless of high school population size. A recommendation for future study should include in its methodology a way to gauge what impact socioeconomic status has on all students that are economically disadvantaged. For example, a future study could include in its methodology a way in which to include the parents' level of education, parents' income level, and whether the parents are employed. In addition, a future study could include the overall poverty level of the community in which the student attends school. A study of this nature could be useful in developing overall strategies and programs that benefit students that come from economically disadvantaged situations.
5. The current study only investigated high schools located in Virginia and did not include their geographical location (i.e. urban, suburban, or rural). A recommendation for a future study would be to incorporate the location of the high schools being examined and determine if geographic location had any bearing on student high school student population size and student achievement when statistically controlling for selected variables.

Summary

The purpose of this study was to examine large and small high schools in Virginia to try to understand if the size of the high school student population influenced student achievement based on identified predictor variables. Using hierarchical multiple regression, the data were analyzed, and the five research questions that were developed to guide the study were answered. From the findings of the data analysis in chapter four, a conclusion was reached which answered the main research question. The answer to the main research question of is there a relationship between a high school student population size and student achievement when statistically controlling for selected variables, the answer was yes according to the data. In the discussion section, several of this study's findings were discussed that both supported and conflicted with past research studies. The discussion section tied the results from this study together with findings from the studies utilized in the literature review section. The results of the discussion section led to implications for future practice that will aid school division superintendents, school administrators, teachers, and local governing bodies and community leaders in Virginia. This study recognized that the aforementioned stakeholders cannot control aspects like student economic levels or minority status in their communities, but they can and should develop or implement practices that will ensure the academic success of all students that attend their schools, whether they are large or small high schools. Hopefully, the information contained in this study along with the recommendations for further research will aid stakeholders to make better and more informed decisions and will result in future research studies that will benefit all secondary students in Virginia.

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APPENDIX A

IRB EXEMPTION LETTER

VirginiaTech

Office of Research Compliance
Institutional Review Board
North End Center, Suite 4120, Virginia Tech
300 Turner Street NW
Blacksburg, Virginia 24061
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website http://www.irb.vt.edu

MEMORANDUM

DATE:	July 28, 2014
TO:	Glen I Earthman, Michael James Brown
FROM:	Virginia Tech Institutional Review Board (FWA00000572, expires April 25, 2018)
PROTOCOL TITLE:	A Study Examining Secondary Student Achievement in the Eleventh Grade Based on Large and Small High School Population Size in Virginia
IRB NUMBER:	**14-742**

Effective July 25, 2014, the Virginia Tech Institution Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

This approval provides permission to begin the human subject activities outlined in the IRB-approved protocol and supporting documents.

Plans to deviate from the approved protocol and/or supporting documents must be submitted to the IRB as an amendment request and approved by the IRB prior to the implementation of any changes, regardless of how minor, except where necessary to eliminate apparent immediate hazards to the subjects. Report within 5 business days to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

All investigators (listed above) are required to comply with the researcher requirements outlined at:

http://www.irb.vt.edu/pages/responsibilities.htm

(Please review responsibilities before the commencement of your research.)

PROTOCOL INFORMATION:

Approved As:	**Exempt, under 45 CFR 46.110 category(ies) 4**
Protocol Approval Date:	**July 25, 2014**
Protocol Expiration Date:	**N/A**
Continuing Review Due Date*:	**N/A**

*Date a Continuing Review application is due to the IRB office if human subject activities covered under this protocol, including data analysis, are to continue beyond the Protocol Expiration Date.

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

Per federal regulations, 45 CFR 46.103(f), the IRB is required to compare all federally funded grant proposals/work statements to the IRB protocol(s) which cover the human research activities included in the proposal / work statement before funds are released. Note that this requirement does not apply to Exempt and Interim IRB protocols, or grants for which VT is not the primary awardee.

The table on the following page indicates whether grant proposals are related to this IRB protocol, and which of the listed proposals, if any, have been compared to this IRB protocol, if required.

Invent the Future

VIRGINIA POLYTECHNIC INSTITUTE AND STATE UNIVERSITY
An equal opportunity, affirmative action institution

APPENDIX B
DETAILS OF INFORMATION REQUEST

VirginiaTech
Invent the Future

Michael Brown <mibrown2@vt.edu>

Details of Information request

Michael Brown <mibrown2@vt.edu>
To: Bethann.Canada@doe.virginia.gov
Cc: Glen Earthman <earthman@vt.edu>
Bcc: Michael Brown <mibrown2@vt.edu>

Mon, Jul 28, 2014 at 4:05 PM

Mrs. Canada,

It was a pleasure talking with you today in regards to the information needed for my study. Again, I am a doctoral student at Virginia Tech in the Educational Leadership and Policy Studies Program. The title of my study is: A Study Examining Secondary Student Achievement in the Eleventh Grade Based on Large and Small High School Population Size in Virginia.

The information that I am requesting is as follows: (In Microsoft Excel format)

The mean scaled scores for eleventh grade students for the 2012-2013 school year in the following subjects: Broken down for each high school.

2012-2013 English reading and Writing mean scaled scores

2012-2013 Chemistry mean scaled scores

2012-2013 United States History mean scaled scores

2012-2013 Algebra II mean scaled scores

Additional information needed is as follows:

2012-2013 Percentage of highly qualified teachers broken down for each high school.

2012-2013 Student attendance rate percentages broken down for each high school. If possible for the eleventh grade only, broken down for each high school.

Again, I appreciate your time and assistance with this. As we discussed today in regards to the time frame of my request, if I could have the information back by August 15 or sooner it would be greatly appreciated. If you or any of your staff have a question in relation to my information request, my contact information is by e-mail: mibrown2@vt.edu or via phone at 540-641-1796.

Sincerely,

Mike Brown

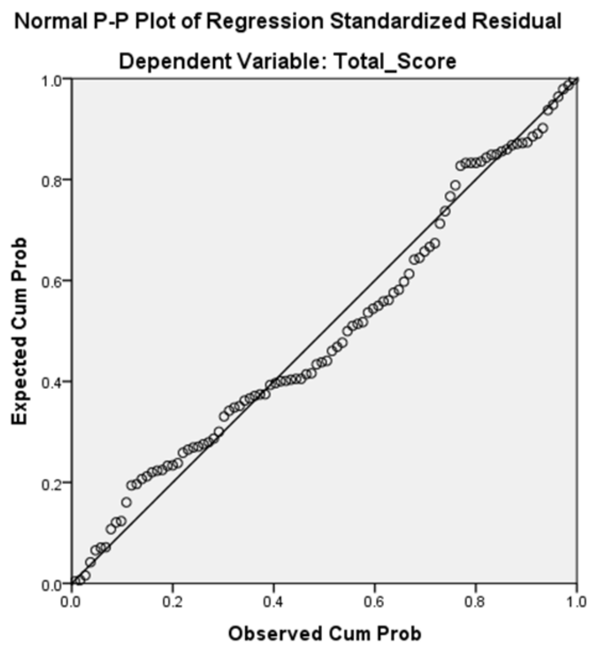
APPENDIX C

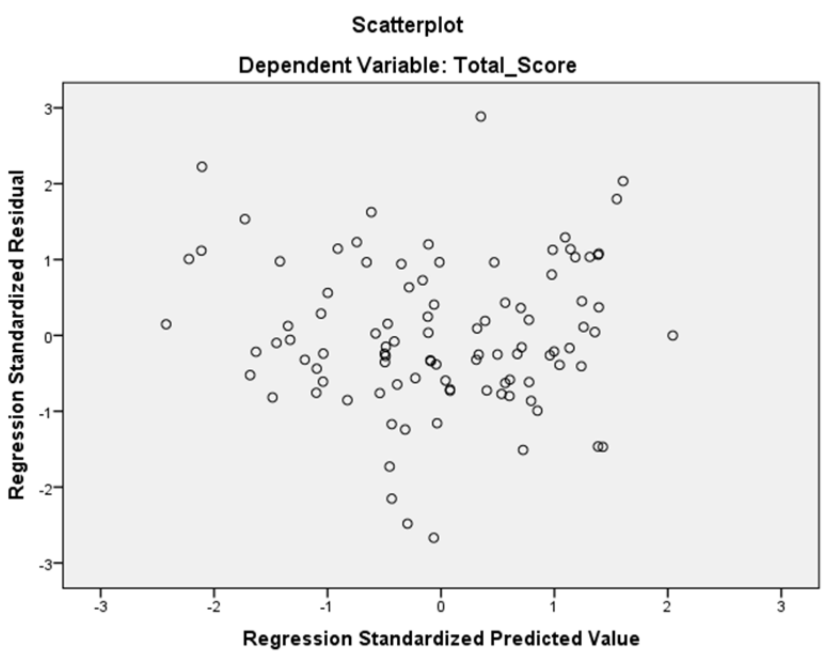
LARGE AND SMALL HIGH SCHOOLS WITH AVERAGE DAILY MEMBERSHIP (ADM) BASED ON VIRGINIA HIGH SCHOOL LEAGUE MARCH 31, 2012 FIGURES (VIRGINIA HIGH SCHOOL LEAGUE).

Large High Schools				Small High Schools			
6A-South		**6A-North**		**1A-East**		**1A-West**	
Conference 1		***Conference 5***		***Conference 41***		***Conference 45***	
High School	**ADM**	**High School**	**ADM**	**High School**	**ADM**	**High School**	**ADM**
Bayside	1,938	Centerville	2,325	Chincoteague	148	Bath County	229
Frank Cox	1,940	Chantilly	2,603	Northampton	460	Bland-Rocky Gap	303
First Colonial	1,996	Herndon	2,208	Franklin	308	Covington	232
Landstown	2,331	Oakton	2,211	Surry County	268	Craig County	212
Ocean Lakes	2,298	Robinson Secondary	2,704	Sussex Central	339	Auburn	370
Tallwood	2,021	Westfield	2,791			East Montgomery	276
Granby	1,998					Radford	442
						Narrows	227
Conference 2		***Conference 6***		***Conference 42***		***Conference 46***	
Bethel	1,873	Fairfax	2,648	Central -King & Queen Co.	222	Chilhowie	446
Kecoughtan	**1,868**	Langley	2,013	Mathews	418	Patrick Henry-Glade Spring	405
Woodside	2,069	Madison – Fairfax Co.	1,980	Middlesex	354	Rural Retreat	357
Grassfield	2,080	McLean	1,975	West Point	249	George Wythe-W	451
Oscar Smith	2,127	South Lakes	2,275	Charles City	224	Fort Chiswell	457
Western Branch	2,152	Hayfield	1,949			Galax	381
		Washington - Lee	2,044				
Conference 3		***Conference 7***		***Conference 43***		***Conference 47***	
Varina	1,894	Annandale	2,412	Rappahannock Co.	263	Council	104
Thomas Dale	2,296	Lake Braddock	2,565	Colonial Beach	175	Haysi	264
Cosby	2,044	South County	1,989	Essex	467	Honaker	379
James River-Chesterfield Co.	1,989	West Potomac	2,296	Lancaster	379	Hurley	178
Franklin County	2,167	West Springfield	2,303	Northumberland	438	Twin Valley	226
Patrick Henry-Roanoke City	1,953	**T.C. Williams**	**2,906**	Rappahannock	342	Holston	297
		W.T. Woodson	2,090	**Washington & Lee**	**473**	Northwood	261
Conference 4		***Conference 8***		***Conference 44***		***Conference 48***	
Gar-Field	2,451	Battlefield	2,566	Altavista	410	Castlewood	337
C.D. Hylton	2,193	Stonewall Jackson – Prince William County	2,392	William Campbell	323	Eastside	441
Colonial Forge	2,007	Osbourn	1,983	Central-Luneburg	445	Rye Cove	213
Riverbend	1,911	Osbourn Park	2,721	Cumberland	454	Twin Springs	235
Stafford	1,906	Patriot	2,250	**Highland**	**67**	Thomas Walker	254
Forest Park	2,368			Parry McCluer	324	J.I. Burton	279
Woodbridge	2,691					Clintwood	302

APPENDIX D

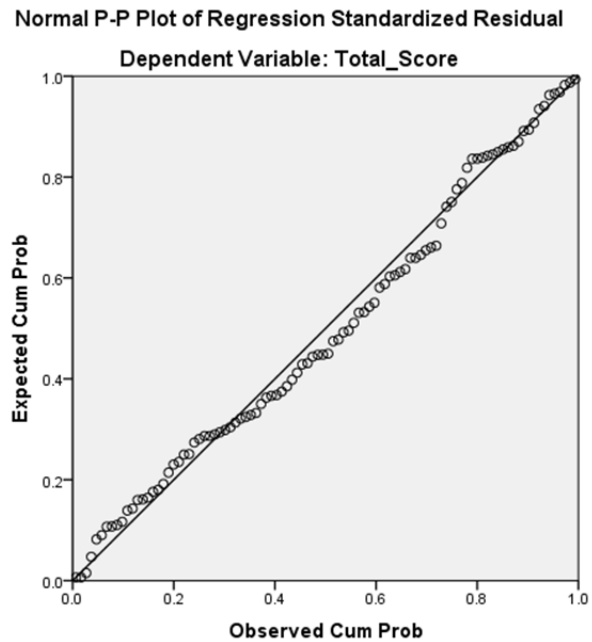
CHECK FOR ASSUMPTIONS OF NORMALITY, LINEARITY, AND HOMOSCEDASTICITY FOR SOCIOECONOMIC STATUS, STUDENT ATTENDANCE, MINORITY POPULATION, AND TEACHER QUALITY

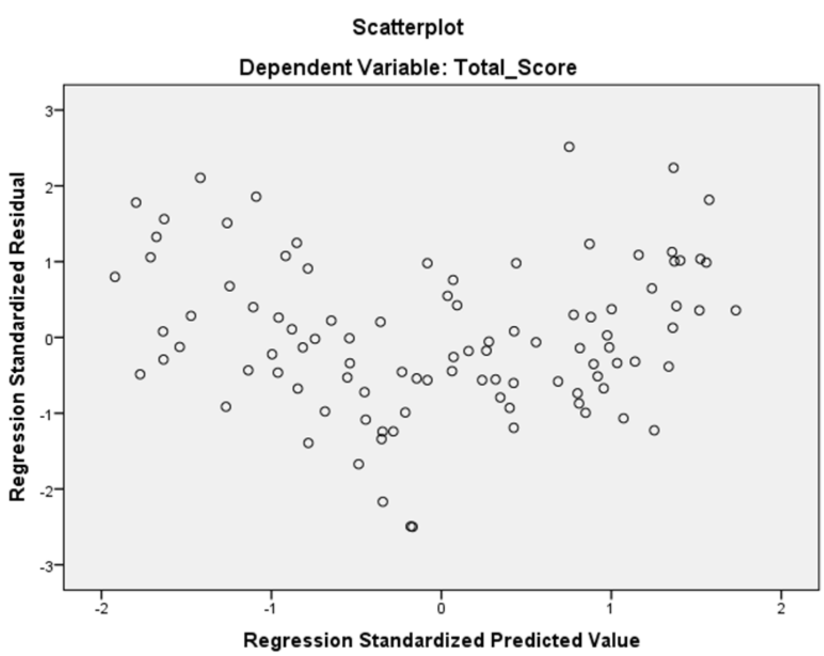




APPENDIX E

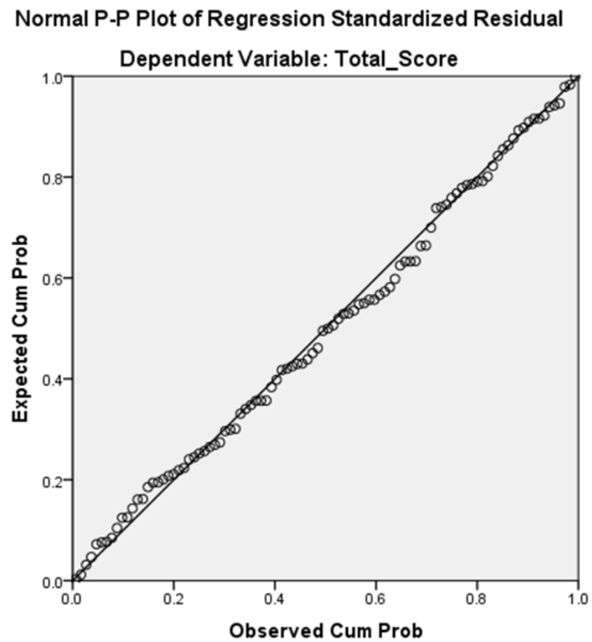
CHECK FOR ASSUMPTIONS OF NORMALITY, LINEARITY, AND HOMOSCEDASTICITY FOR SOCIOECONOMIC STATUS

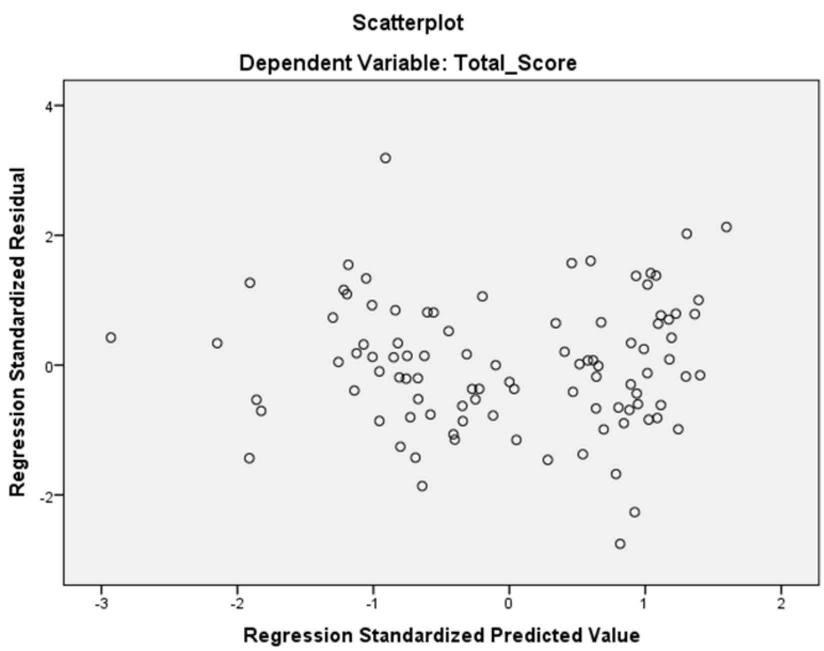




APPENDIX F

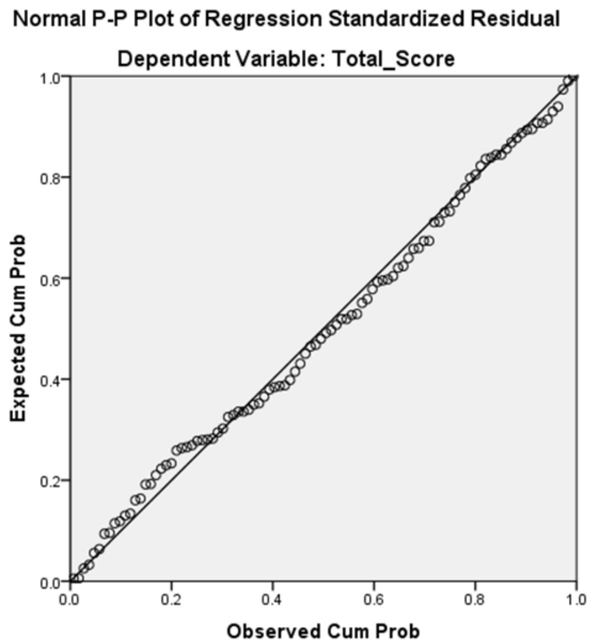
CHECK FOR ASSUMPTIONS OF NORMALITY, LINEARITY, AND HOMOSCEDASTICITY FOR STUDENT ATTENDANCE

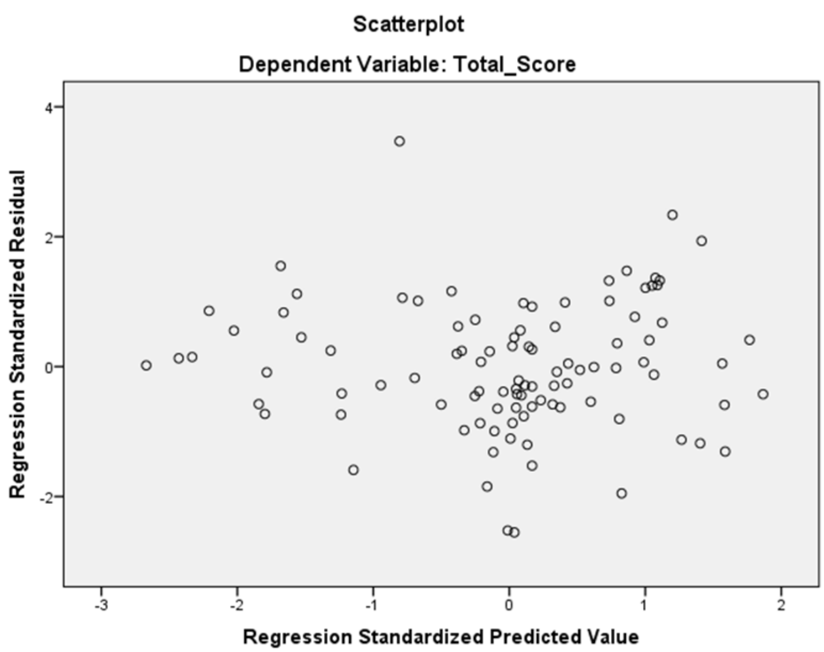




APPENDIX G

CHECK FOR ASSUMPTIONS OF NORMALITY, LINEARITY, AND HOMOSCEDASTICITY FOR MINORTITY POPULATION





APPENDIX H
CHECK FOR ASSUMPTIONS OF NORMALITY, LINEARITY, AND HOMOSCEDASTICITY FOR TEACHER QUALITY