A STUDY EXAMINING THE RELATIONSHIP BETWEEN SCHOOL BUILDING CONDITIONS AND THE ACHIEVEMENT OF STUDENTS IDENTIFIED IN THE SUBGROUPS OF ECONOMICALLY DISADVANTAGED AND MINORITY IN HIGH SCHOOLS IN THE COMMONWEALTH OF VIRGINIA

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Dissertation Submitted to the Faculty at the Virginia Polytechnic Institute and State University in fulfillment of the requirements for the degree of

DOCTOR OF EDUCATION

in

EDUCATION LEADERSHIP AND POLICY STUDIES

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November 1, 2006
Blacksburg, Virginia

Key Words: Facilities, Standard and Substandard Buildings, Building Condition, Student Achievement, Economically Disadvantaged Students, Minority Students

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(ABSTRACT)

The purpose of this study is to examine the relationship between building conditions and student achievement of students identified in the subgroups of poverty and minority in high schools in the Commonwealth of Virginia. The targeted population was identified by using the study conducted by Crook (2006) which included information obtained from seventy-two high schools across the Commonwealth of Virginia. Building conditions used in the study were based upon the responses received from principals on the Commonwealth Assessment of Physical Environment (CAPE) form.

The scaled scores of economically disadvantaged students and minority students on the Standards of Learning tests administered in grades nine through eleven during the 2004-2005 school year were used to measure student achievement. The status of economically disadvantaged students was controlled by the classification of a student receiving free and reduced-priced lunch during the 2004-2005 school year. The status of minority students was controlled by ethnicity as reported by the individual schools to the Virginia Department of Education for the 2004-2005 school year.

Two basic research questions guided this study and the researcher used t-tests to compare dependent variable means across independent variables. The research questions include: Is there a significant difference between the scores of economically disadvantaged students housed in building conditions rated substandard and those housed in buildings rated standard in the high schools in the Commonwealth of Virginia? Is there a significant difference between the scores of minority students housed in buildings rated substandard and those housed in buildings rated standard in the high schools in the Commonwealth of Virginia?

This study found an inconsistent relationship between building conditions and the achievement of economically disadvantaged students. Therefore, the conclusion is that the condition of the school building does not apparently influence the achievement of economically disadvantaged students when they are housed in inferior buildings. In addition, this study found a positive relationship between building conditions and the achievement of minority students in the majority of the achievement measures. Therefore, the conclusion is that the condition of the school building does in fact influence the achievement of minority students when the building is in poor condition.

Acknowledgements

There have been many individuals who deserve acknowledgement. First, I will always be grateful to Dr. C.P. Penn who encouraged me to continue my education and apply to graduate school. I want to thank my committee, Dr. Glenn Earthman (Co-chairperson), Dr. Travis Twiford (Co-chairperson), Dr. John Schreck, and Dr. Carol Cash. I am forever grateful for your assistance while on my dissertation journey.

I want to especially thank Dr. Glenn Earthman who encouraged and supported me from the beginning of this study to the end. I cannot thank Dr. Earthman enough for his patience, prodding, and wisdom during this process.

I want to thank my best friend, Dan Grounard. He continually supported and pushed me throughout this process. I would like to also thank the entire Cohort for the support in class and in summer session.

Much gratitude to Michelle Bell, who is like my sister, and the entire Cumberland family, that has taken care of me and my family many times throughout this process.

Dedication

This study is dedicated to my wife, Mary, who has inspired me to always do more and has always provided encouragement and support: to my son, Sean, who I will always love and support; to my daughter, Kelsey, who is my miracle child; and my in-laws, Jimmie Joe and Kathy, who helped support our entire family through this process and through out our marriage.

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CHAPTER 1

Introduction

The condition of a school facility can, and often does, send a clear message to students. The willingness of a school community to invest in the school systems' facilities often directly reflects upon their willingness to contribute to the expectation levels of the students who attend school in those facilities. Conversely, if the administration and staff do not maintain the building in a way that demonstrates concern for the facility, students and faculty may feel that little is expected of them as well. Community support or lack there of can reinforce the impressions that students have about their school environments. In addition, the condition of school buildings is a very visible sign or value statement made to the student of the importance that society or the community places on education (Lemasters, 1997).

Beside the contradictory community statements about the buildings in which they are located, the poor condition of some school buildings often creates feelings of inadequacy on the part of students. This is especially true when the students represent economically disadvantaged or minority populations.

Quite often older buildings that are not in good condition are located in rural and urban areas or areas of poverty. These older facilities generally present environments which are inadequate to support current teaching methods and inhibit good teaching and learning. Yet the school systems in these areas usually do not have the financial resources to improve the conditions of these buildings.

The fact is that a preponderance of economically disadvantaged students and minority students live in areas where the school facilities are typically deficient. Obviously, this provides for an equity difference. The longer students attend school buildings in poor condition, the greater the deficit in student achievement.

Recently issues related to building conditions, the ability to provide good instruction, and student achievement has become particularly important in light of the requirements of the federally mandated No Child Left Behind (NCLB) legislation. NCLB requires schools to close the achievement gap of students who come from socioeconomic challenged families as well as those who are in certain designated minority subgroups. This becomes a significant challenge for both rural and urban schools where building conditions often do not meet acceptable standards.

Inadequate building conditions may prove to be a significant barrier which interferes with the efforts of school personnel as they attempt to close these achievement gaps. Although a number of researchers (Cash, 1993; Earthman, Cash, and Van Berkum, 1995; Edwards, 1991; Hines, 1996; Lanham 1999) have found significant relationships between student achievement and building conditions, they have not specifically focused on the achievement gaps of economically disadvantaged students and minority students.

Statement of the Problem

This study examined the differences in the achievement of economically disadvantaged students and minority students who attended standard and substandard building facilities in order to determine if the achievement differences of economically disadvantaged students and minority students are greater than those that are found in the studies that included the total student population. This investigation also explored whether or not certain student groups are more significantly impacted by substandard and standard building conditions and if the size of any of the resultant achievement gaps are statistically significant. The results of this study are particularly timely because they are related to an important educational issue and provided data on the various subgroups that have not been made available in previous studies.

Purpose of the Study

The purpose of this study was to examine the possible relationship between building conditions and academic achievement of students identified in the subgroups of economically disadvantaged and racial minority in a sample of high schools in the Commonwealth of Virginia.

Research Questions

The basic research question of this study was: Does the achievement of economically disadvantaged students and minority students improve as the physical condition of the building improves? In addition, the study responded to the following sub-problems:

1. Is there a significant difference between the scores of economically disadvantaged students in buildings rated substandard and standard in high schools in the Commonwealth of Virginia?
2. Is there a significant difference between the scores of minority students in buildings rated substandard and standard in high schools in the Commonwealth of Virginia?

Significance of the Study

Increased academic standards and expectations for student achievement, particularly among students classified as economically disadvantaged and minority, are important national issues. Instructional matters such as curriculum alignment, staff development, and teacher quality have been in the forefront of reform with little mention of school facility changes. Although numerous studies have identified a relationship between building conditions and overall student achievement, specific achievement gaps between subgroups of students have not been examined.

With the increased national attention on closing the achievement gap for students in poverty and minority students, this study investigated the relationship between the building conditions and student achievement with these subgroups in order to provide data to state and local governments as well as to local school boards. State governments in particular may find the results interesting and helpful as legislators formulate policies and regulations regarding the funding of school renovation, construction, and capital expenditures.

Virginia school systems rely heavily upon local governments to provide adequate facilities. School systems often face difficult financial decisions when it comes to the construction of new facilities and the maintenance of existing facilities due to scarce local resources. The results of this study may provide the data needed to assist local governments in making decisions on how to improve student performance. Economically disadvantaged students and minority students typically score lower on standardized tests. Data from this study may provide a way to increase the performance of these groups of students by improving the condition of buildings.

Design Model

Cash (1993) developed a theoretical model to explain the relationship between building conditions and student achievement and behavior in small rural high schools in the Commonwealth of Virginia. Hines (1996) utilized the same design model to study urban high schools in the Commonwealth of Virginia. Brannon (2000) used the Cash model to identify the antecedents to building condition to be deferred maintenance, funding priorities, and administrative decisions all of which emanated from the leadership and financial ability of the school division. Brannon stated that deferred maintenance emerged as a significant factor in local decision making as funds that had been earmarked for facility maintenance and for general upkeep were being diverted to other school reform measures. These reform measures were driven in large part by the Standards of Learning Tests (SOLs) utilized by the Commonwealth of Virginia as the measure of student achievement and subsequently used for the accreditation rating of schools.

These models are very similar in the way they illustrate how building conditions directly and indirectly affect student achievement and behaviors. The indirect influences are demonstrated by the building condition’s affect on attitudes of parents, faculty, and community that ultimately affected student attitudes. More importantly, the model postulates that building conditions do have a direct affect on student attitudes. The model further postulates that the attitudes of students eventually will influence their performance on achievement tests. The model used in this study contends that building conditions do have a direct and indirect affect on student achievement and in particular will significantly impact on the subgroups of students that are economically disadvantaged and minorities.

Administrators are constantly examining achievement data to improve instruction and ultimately increase student test scores. With the passage of the national reform legislation of No Child Left Behind, administrators are now examining the data by subgroups implementing strategies to close any achievement gaps found in these subgroups. One subgroup is defined as low socioeconomic students, specifically those students participating in the free and reduced-price lunch program. For purposes of this study, they were identified as economically disadvantaged students.

The model guiding this study suggests that substandard building conditions and physical school environments may have a greater impact on economically disadvantaged students and on minority students than upon the general student population. The model further suggests that the achievement of students classified as economically disadvantaged and minority may be less in schools with substandard building conditions compared to schools with standard building conditions.

As shown in the proposed model, deferred maintenance, funding priorities, and administrative decisions all have a significant impact on the current condition of a school facility. The resulting conditions have both a direct and indirect effect on student achievement in general and may have an effect on minority students in particular. The direct impact may come from climate control, illumination, density, acoustics, color, or availability of resources. The indirect impact may come from student attitudes, affected by parent and faculty attitudes, and coupled with a greater affect on economically disadvantaged students and the students' own attitude about the condition of the

Proposed Theoretical Model

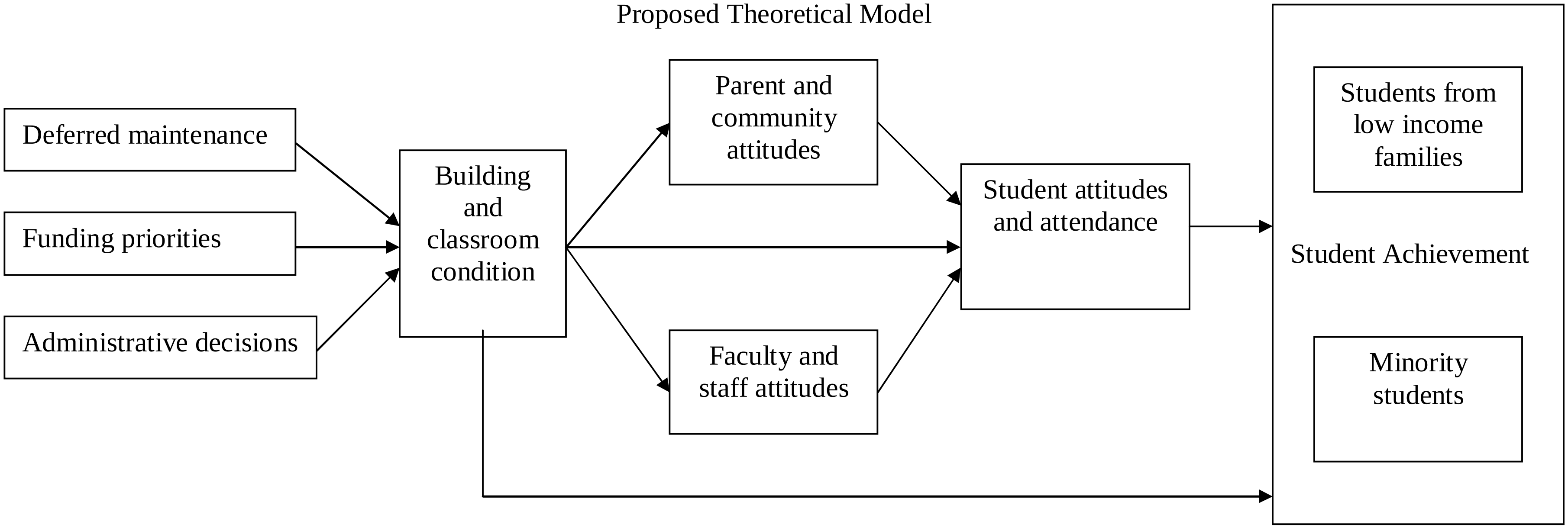

Figure One. Model for the study of the relationship between building conditions and student achievement of student subgroups identified as economically disadvantaged students and minority students.

buildings. The building conditions may be viewed as the value that administrators and community leaders place on a child's education. Parents, faculty, and staff may see poor building conditions as a sign of low expectations and lack of concern for education within the community. The poor building conditions may be viewed by the economically disadvantaged student as reinforcement of their existing conditions. Conversely, attention to the building and classroom conditions could have the reinforcing affect that an education is of value and can assist all students to achieve their goal of a better life and increased opportunities.

Definitions of Terms

In this study, the following definitions are used:

1. *Student achievement* is defined by the End-of-Course Standards of Learning tests (SOLs) given to ninth grade through eleven grade students in the Commonwealth of Virginia. These include Earth Science, Biology, Chemistry, World History I, World History II, U.S. History, Algebra I, Algebra II, Geometry, and English 11 Reading. The students scaled scores were used as a measure of achievement.
2. Students classified as *economically disadvantaged* are defined as those students receiving free and reduced-price lunch or those students identified as homeless as reported to the Virginia Department of Education.
3. *Minority student* is defined by the classifications reported by the Virginia Department of Education and include the following: American Indian or Alaskan Native, Asian or Pacific Islander, Black, White, Hispanic, and Native Hawaiian.
4. *Building condition* is defined as the rating of substandard or standard which is obtained from the Commonwealth Assessment of Physical Environment (CAPE)

developed by Cash (1993). CAPE includes factors related to climate control, acoustics, illumination, student density, science equipment adequacy, building age, and cosmetic condition. The specific building assessments obtained by Crook (2006) were used to define standard and substandard building conditions. This rating is used as an independent variable.

Delimitations

This study is a replication of the study by Cash (1993) using the attainment of student achievement for subgroups of students identified as economically disadvantaged students and minority students instead of the entire population. Unlike Cash, this study is not restricted to small rural high schools in the Commonwealth of Virginia.

Limitations

1. The CAPE requires local personnel to assess their own building conditions and therefore affects the objectivity of the survey.
2. There are numerous variables that could be identified that affect student achievement such as teacher quality. This could cause an error in variance and a less significant correlation.
3. The generality of the results of this study will be restricted due to the limited population of high schools in the Commonwealth of Virginia.
4. The generality of the results of this study will be restricted due to the fact that this is a limited population of students classified as economically disadvantaged and minority.

Organization of the Study

Chapter 1 includes the introduction, the research questions, purpose of the study, significance of the study, the theoretical design model, the definitions of terms, the delimitations and the limitations, and the organization of the study.

Chapter 2 includes a review of the literature which describes the conditions of public school buildings in the United States and the Commonwealth of Virginia. Literature will be reviewed that suggests a connection between building conditions and student achievement. In addition, individual research studies will be reviewed as well as meta-analytical and summary studies.

Chapter 3 describes the methodology used in this study. This chapter defines the population, the data needs, the data gathering, and the data analysis.

Chapter 4 presents and explains the findings of this study.

Chapter 5 includes conclusions and implications, and discussions which can be drawn from the analysis and recommendations for further study.

CHAPTER 2

Review of the Literature

The theoretical design model for this study is based on research that supports the possibility of a relationship between building conditions and student achievement. Earthman (2002) stated that researchers have repeatedly found a difference of between 5 and 17 percentile points between achievement of students in poor buildings and those students in standard buildings, when socio-economic status of students is controlled. The design model in this study specifically investigates the subgroups of economically disadvantaged students and minority students. In this section a brief overview of recent studies will be presented, followed by an in depth look at a selection of important research papers on the topic.

Condition of Schools

Historically, Gabler (1987) noted that schools were initially built as simple learning factories with uninviting settings. In the past, concern for the actual physical environment of the school was limited to enforcement of minimum standards for classroom size, acoustics, lighting, and heating. Educators and the general public generally accepted that as long as these basic standards were met a child would learn; that is, it was assumed that learning was dependent more on pedagogical, psychological, and social variables than physical ones (Weinstein, 1979).

In many American schools today, students and teachers find themselves in environments that do not meet even the minimum standards. Students are often taught in storage rooms or some other converted classroom with attendant acoustic and lighting problems. Inadequate heating systems in many older facilities often cause many students to wear their winter jackets throughout the school day.

School administrators often reluctantly postpone repairs and delay new construction to save money during times of financial uncertainty. With many competing funding priorities, cuts in these areas are considered less devastating than cutting academic programs. This is particularly true in light of the scrutiny now placed on student achievement outcomes nationwide as a result of the No Child Left behind Act. The fallout of such decisions, however, is that school building conditions in the U.S. are rapidly failing. In particular, school buildings in under-funded rural and urban environments, those areas with mainly poor or minority populations, are failing at an ever increasing rate compared to suburban schools.

The late 1980s and early 1990s saw a flurry of research in the area of the condition of school facilities and how those conditions affect learning outcomes. One of the first to gain national attention was a 1989 publication by the Education Writers Association, *Wolves at the Schoolhouse Door*. America was given a wake-up call that a crisis existed and its children were being educated in buildings that were not conducive to learning and were even potentially dangerous. In 1991, the American Association of School Administrators released *Schoolhouse in the Red,* which found that one in eight public school buildings provides a poor physical environment for learning.

In the same year, 1991, one of the most referenced studies on the impact of facilities and student achievement was released. In her study of the Washington D.C. schools, Edwards (1991) concluded that student achievement, as measured by standardized tests, was 5 to 11 % higher if physical conditions of the school were improved.

Despite mounting information and research connecting the condition of schools with student achievement, federal and state legislators with the power to address the issue failed to act. It was not until the U.S. General Accounting Office (GAO) reported in 1995 that $112 billion was urgently needed to repair or upgrade the nation's public school facilities, and that some 14 million children were attending schools that needed extensive repairs or replacement, that any federal action was taken. On July 11, 1996, President Clinton unveiled plans for a four-year $5 billion school construction initiative. Clinton's plan was a milestone, but only represented a small fraction of what was needed. Research linking building conditions to student outcomes assisted in counteracting the historical reluctance to have a state or federal fund help pay for school construction.

The critical facility needs identified by the GAO in 1995 have not been eliminated everywhere. Unfortunately, in many buildings today, the conditions grow worse and the costs of correcting them grow even faster. In the ensuing years, some of the buildings considered adequate in the initial study have aged and deteriorated. In 2000, the National Education Association, in its own study, stated that the needs were more than double what the GAO estimated in 1995.

Equity Concerns

An important factor that needs further consideration when discussing the relationship between student achievement and building conditions is the inequality of school facilities. The majority of older buildings, and those buildings in poorer condition, are located in areas of greatest poverty in each school district, either in the urban or rural areas. On average, urban and rural school buildings were much older (76% and 75%, respectively, were more than 21 years old) than their suburban counterparts (59% were more than 21 years old) (Kennedy & Agron, 2004).

Constitutionally, education is the state's responsibility whereas school facilities are generally the local district's responsibility. State and federal mandates for educational programs and environmental safety are almost never accompanied by funds needed to implement them. These mandates place a financial burden on local districts. In most cases, districts must rely on taxpayers' ability to meet these capital expenses. This results in glaring inequities in school environments among districts in the same state (Lewis et al., 1989).

Students from poor areas, as a general rule, score less well than students from more affluent areas. When economically disadvantaged students attend school in a building that does not have those elements that have been proven to relate directly to student performance, they are doubly disadvantaged. In addition to the effect that poor and old facilities have on student achievement, failure to improve an old and failing facility may send a message to such students that the system values them less than it does their counterparts in more affluent areas (Earthman, 2002). As educators continue to look for strategies to raise educational outcomes for economically disadvantaged and minority students across the Commonwealth and the nation, it is important to continue to study the relationship between building conditions and student achievement.

Poverty, Race, and Educational Inequality

In 1991, Jonathan Kozol's book, *Savage Inequalities: Children in America's Schools*, provided a face, a poor minority face, to those victimized by the deplorable condition of inner-city schools. The author visited schools in over 30 neighborhoods across the nation noting how children in underprivileged black and Hispanic communities rationed not only school supplies such as pencils and crayons, but also toilet paper as well. Reporting from East St. Louis, the Bronx, Jersey City, and San Antonio, Kozol concluded that in the last 25 years racial segregation had intensified creating a two tier system of education that “diminished poor children’s horizons and aspirations” (Kozol, 1991). A high proportion of poor, non-white students in schools from New York to California were educated in rooms without heat or playground facilities, without books, or computers; schools that were under funded and overcrowded. These children lacked not only adequate school facilities and supplies, but they lacked entitlement to a world view that included, if not college, at least finishing high school with a reading level that matched their degree (Kozol, 1991).

Moreover, as stated by Kozol in 1991,

> “It has become fashionable in recent years for school systems to hire a well-known black athlete or political leader to come into the school and give a motivational lecture to the kids . . . he tells the kids, ‘You are somebody,’ and the kids repeat it, ‘I am somebody.’ But when the roof is caving in, when the light fixtures are exposed, when the sewage leaks, when the rain comes through the roof; these situations convey a much deeper message. This tells the children in the eyes of this society, ‘You are nobody at all’” (Kozol, 1991).

As if to support this idea, it is not surprising to learn that the New York State Education Department reported in 2002-2003 that New York City schools were funded, on average, with 50 per cent fewer dollars than schools in Westchester or on Long Island

(Kozol, 2005). Add to this amount of money raised by suburban parent groups and these funds can increase by the tens of thousands of dollars, in some cases one hundred thousand dollars, providing increased advantages to already privileged children (Kozol, 2005).

Drop out rates in poor, urban schools often exceeded 50% with severe consequences. For example, in one Bronx, New York, high school with a population that was 38% black, 62% Hispanic, and with no white children, perhaps 40 to 45% were expected to graduate (Kozol, 1991).

In light of this, it is interesting to note that at the time of Kozol's research, 90% of the male inmates of New York City's prisons were the former dropouts of the city's public schools (Kozol, 1991). Indeed, in a 2002 report, the GAO noted that Blacks, Hispanics and Native Americans students were more likely to drop out of school than White students. However, in this report, a variety of characteristics, including family involvement, socioeconomic status and parental education were more statistically significant than race in predicting whether or not a youth would stay in school. Moreover, dropouts earned less money and were unemployed more frequently than graduates and they were three times more likely than graduates to be on welfare. Finally it was noted that 40% of state prison inmates across the nation were high school drop outs (GAO, 2002).

In 2005, Kozol published *The Shame of the Nation: The Restoration of Apartheid Schooling in America*. For this book, Kozol visited 60 schools in 11 states over five years and reported on the unsanitary, academically ill-equipped buildings serving mainly poor Black and Hispanic children. While research studies by Cheng in China (1994) and

Lackney (1994) stressed the interactive quality of environment and learning, Kozol's work cited under-privileged minority children who were expected to achieve in educational systems lacking not only books, labs, cleanliness and safety, but also motivational instruction. Kozol described overcrowded schools with up to 45 children per class, in contrast to suburban schools that averaged less than 20. He told of schools with dirty classrooms, hallways and restrooms; schools that, furthermore, embraced "a pedagogy of direct command and absolute control" while squashing college aspirations.

Reminicent of the 1977 study of education and British working class youth, *Learning to Labor*, where Paul Willis found schools preparing lower-class children for jobs as manual laborers, Kozol's book found today's students in poor urban schools in America receiving educations that prepared them for jobs in the beauty, culinary (read "kitchen") and managerial (read "retail") spheres. The "stimulus-response" method of teaching observed by Kozol was "a program of surprisingly explicit training of young children for the modern marketplace" (Kozol, 2005, p. 89). Describing kindergarten classes in Columbus, Ohio, decorated with posters displaying the names of Sears, Kmart, Wal-Mart, and J.C. Penney, Kozol states that "Work-related themes and managerial ideas were carried over into almost every classroom of the school" (Kozol, 2005, p. 90). This linkage between education and employment, one that lacked "cultural and critical reflectiveness," left no room for students to dream of jobs as teachers, doctors or artists; instead, "the general idea that schools in ghettoized communities must settle for a different set of goals than schools that serve children of the middle and upper class has been accepted widely" (Kozol, 2005, p. 98).

As reported in the April 2004 issue of the *American School Board Journal*, students in high-poverty, high-minority schools often receive poor quality instruction. In these areas, “teachers have less experience, attend less selective colleges, and fail certification tests more frequently than teachers in wealthier schools with fewer minority students” (Black, 2004). Moreover, while achievement scores for minority students rose in the 1970s and 1980s, gaps between White students and minorities again widened in the 1990s. According to a 1999 report by the National Assessment of Education Progress (NAEP), reading test scores of Black students were about the same as 13-year-old White students, while on the NAEP science test, 9-year-old Hispanic students scored three grade levels below White students of the same age (Black, 2004).

The National Center for Education Statistics produced a report in 2005 called “A Profile of the American High School Sophomore in 2002.” This longitudinal study used a representative probability sample of 15,362 tenth-graders in 752 public, Catholic, and other private schools, from the spring term of the 2001-2002 school year. This report is the base year of a longitudinal project. Future surveys will follow this cohort of students as they finish school, drop out of school, enter the labor force or go on to postsecondary education. Selected results from this base year listed below support racial and economic disparities in student achievement.

- While 30% of the sophomores studied attended urban schools, 40% of those were Black.
- In mathematics, 32% of Asians compared to 5% of Blacks were proficient in understanding intermediate-level mathematical concepts.

- In reading, 56% of Whites and 47% of Asians were proficient at the level of simple inference as opposed to 25% of Blacks and 28% of Hispanics.
- Taking into account socioeconomic status, across all three SES groupings, Whites were more likely than Blacks or Hispanics to be proficient at various reading and mathematic levels.
- Black and Hispanic sophomores were more likely than White sophomores to feel unsafe at school.
- Black sophomores were less likely than Whites to report positive impressions about their school and teachers.

Adding to the complexity of issues surrounding low achievement outcomes and minorities is the following list of results from that same report:

- Blacks and Hispanics were more likely than Whites to agree that getting good grades is important to them.
- Blacks and Hispanics were more likely than Whites to say they went to school because subjects were interesting and challenging.
- More than Whites, Blacks and Hispanics also indicated that they liked school a great deal.
- More than Whites, Blacks and Hispanics reported that their teachers expected them to succeed in school.

These outcomes illustrate the importance of more research in this area. For instance, are the minority students surveyed on academic (prepped for college) or management (prepped for Wal-Mart) tracks? Are teacher expectations equal? Is an "A" in a predominately White school valued the same as one achieved in a school whose population is mainly Black and Hispanic, especially in light of the fact that reading scores for Whites are 50% higher on average than for Blacks (NCES, 2005)

In 1996 the National Center for Education Statistics showed that even when schools with high minority populations report adequate spending in actual dollars, because of their location in central cities, their high numbers of special-needs children and the deterioration of their facilities, the buying power of these funds means that less is spent per child, per school. This report stated that schools with over 50% minorities often existed in poor districts, making isolating race as the sole contributing factor for spending inequities difficult (NCES, 1996).

A GAO report in 1996 verified that schools with a minority population of 50.5% or more and schools serving 70% or more of students on free or reduced lunch programs required above average expenditures and these schools were most often located in urban centers (GAO, 1995).

As if in response to the need for further studies on this topic, a 2001 series of articles in the *Washington Post* examined the association of poverty and race on student achievement outcomes. Looking at data from Montgomery County, Maryland, a suburban setting, the authors found economic status a more accurate predictor of a student's academic success than race. Citing information from the National Assessment for Education Progress, "for every $10,000 increase in household income, researchers have found a 30-point gain in test scores" (Schulte & Keating, 2001). They also found low income children attending schools with high concentrations of poor children fare worse than low income children in schools where the poverty level is below 5%.

Interestingly, regardless of the poverty level in their school, middle-class children had above average achievements (Schulte & Keating, 2001).

When addressing the disparity of achievement outcomes between the rich and poor, several reports stated that reducing school size narrowed the gap in both rural and urban settings (Strange, 2005). Research from California (Friedkin & Necochea, 1988), Alaska (Huang & Howley, 1993), and West Virginia (Howley, 1996) showed that increased school size compromised achievement outcomes for less advantaged students.

In an effort to generalize these results to other settings, Howley and Bickel replicated these studies in four other states (2000). Moreover, in their examination of achievement outcomes in 13,600 schools in 2,290 districts in Georgia, Ohio, Montana, and Texas for the Rural School and Community Trust (a national non-profit organization dedicated to improving rural schools and strengthening the relationship between schools and communities), the authors found that as schools became larger, the negative impact of poverty on student achievement was exacerbated. Specifically, all four states showed a correlation between poverty and low achievement that was 10 times stronger in larger schools than in smaller ones. In addition, the benefits of a small school were most evident in the middle school years when children are at the greatest risk of dropping out.

While this research found that the relationship between poverty, school size and achievement did not depend on race, it was true that the poorer communities in the states measured had a sizable population of minority students attending schools too large to produce high academic outcomes. The authors recommended that states “concerned about reinvesting in deteriorating school facilities . . . not be eager to increase school size in most instances, if higher student achievement, especially in poorer communities, is the goal" (Howley & Bickel, 2000).

As school districts discuss ways to improve student performance, particularly for those in low-income, minority communities, due consideration needs to be applied to the facility in which children learn; while student achievement is of utmost concern, inadequate facilities can also unfavorably impact teachers and parents. As will be shown, a school presents a total environment affecting both the physical and intellectual capability of its occupants.

Conditions in Virginia

In the Commonwealth of Virginia, school construction and renovation is a serious problem. The problems of increasing enrollments and aging facilities have forced localities to build new schools, additions to existing buildings, or relocate students to mobile units. The Virginia Department of Education has established the need for new and updated facilities through periodic surveys.

In many counties throughout the Commonwealth, facilities need to be renovated or replaced due in large part to age. These older buildings have poor thermal control, air quality, lighting, furniture, and acoustics (Earthman, 2004). Older buildings frequently contain instructional spaces that are inadequate for current teaching methods and changes in student population. Many older schools are located in areas of poverty and school construction costs have rapidly grown throughout the country. With this expensive price tag, some citizens and school board members are questioning whether the condition of the buildings has anything to do with student achievement.

In 1998, the Virginia Association of School Superintendents (VASS), commissioned the Thomas Jefferson Center for Educational Design to conduct a survey of the Commonwealth's 133 school divisions.

With the need for facilities clearly identified by the Virginia Department of Education, the survey focused on the impact of overcrowding and deteriorating facilities on learning and teaching. Duke et al. (1998) reported on the following survey questions that concentrated on five areas of concern:

1. Instructional time lost due to problems related to facilities
2. Reduced effectiveness of teaching and learning due to facilities
3. Reduced curricular options
4. Pressure on facilities resulting from state and federal mandates
5. Student health and safety issues related to facilities.

The survey revealed that lost instructional time ranged from early dismissals due to lack of air conditioning to 10 days without school due to a heating system failure. Survey responses indicated that 96 days of instruction have been lost in Virginia public schools over the 2-year period of the survey from 1997. Schools dismissed early on at least 44 other times due to facility issues. Air conditioning caused the majority of lost days and early dismissals (Duke et al., 1998). There are many additional hot days that schools remain open without air conditioning thus disregarding the adverse effects on teachers and students. These "lost instructional days" are not counted in the survey instrument.

According to the survey, 53% of school divisions were forced to increase numbers of students in a class because of increased enrollments (Duke et al., 1998). This is in sharp contrast to the research and effort put forth by the State to improve student achievement by reducing class size. Indeed, 63% of the school divisions scheduled classes in areas not designed for instruction. These make-shift classrooms included storage areas, bookrooms, hallways, offices, media centers, cafeterias, teacher workrooms, and locker rooms. In several cases the survey found science rooms without gas or water (Duke, et al., 1998). All of these conditions can compromise the delivery of instruction and reduce the effectiveness of the instructional program.

Duke, et al., (1998) reported that 20% of school divisions were being forced to eliminate course offerings due to space limitations. The reductions are often made in vocational education courses. Enrollment restrictions were reported by 16% of the school divisions in the areas of vocational education, alternative education, advanced placement courses, computer courses, and programs for 4-year-olds.

State and federal mandates have a profound effect on schools in the Commonwealth. Many of the space limitations can be traced to federal legislation regarding special education students. Over a quarter century has passed since Public Law 94-142 was passed, which provides access for students with disabilities, and some divisions still do not meet the building standards (Duke, et al., 1998).

On the state level, Virginia school divisions are required to meet Standards of Accreditation. The K-3 class size reduction grant reduces class averages to 20 students. Duke et al., (1998) reported that one urban division in the study will need to add 60 additional classrooms in order to meet this reduction. Another example of a state mandate is the need to address the Standards of Learning related to laboratory sciences. Almost 64% of the school divisions confirmed a need to increase their number of science labs.

As far as health and safety is concerned, Duke, et al., (1998) reported the survey revealed 7% of the divisions reported problems in facilities that resulted in injuries to students and student absenteeism. Student absences were mainly associated with building-based allergies and poor ventilation.

Facilities Research

A school is a social system where the students interact with their physical (facilities, spaces, lighting, thermal atmosphere, ventilation, ambience, air pollution) and psychological environments (other students and teachers) in the learning process (Cheng, 1994). The exchange between the student's personal characteristics and the classroom environment may affect learning attitude and behavior. Moreover, building condition has an influence on the attitudes not only of the students in attendance, but on the parents and faculty as well. This influence is compounded if facilities are not maintained and remain in poor condition (Lemasters, 1997).

Numerous individual and survey of research studies have been conducted since 1970. Researchers have found that various combinations of building age, building condition, and building characteristics have some influence on student achievement. According to Earthman (2004), research conducted on the relationship of school facility condition and student achievement indicates that the following criteria, in the order listed, have a demonstrable impact on learning:

1. Human Comfort-i.e., temperatures within the human comfort range as regulated by appropriate HVAC systems
2. Indoor Air Quality-i.e., appropriate ventilation and filtering systems, also as regulated by appropriate HVAC systems

3. Lighting
4. Acoustical Control
5. Secondary Science Laboratories
6. Student Capacity-Elementary
7. Student Capacity-Secondary

Individual Studies

Some more recent studies have focused on the relationship between overall building conditions that have a direct influence on student achievement. Six well-designed correlation studies have used measurable data for statistical analysis. These studies are similar to studies that have used building age as the variable affecting student achievement, but in these studies a more extensive assessment of the condition of the building is provided by the instrument used in evaluating the buildings. The results of these studies provide evidence in more accurate terms of the amount of differences in student achievement of students in substandard buildings and students in standard buildings.

The earliest of these six studies, Edwards (1991) used a composite building condition to measure the relationship with standardized student achievement scores in the District of Columbia public school system. She used data from the survey of school buildings conducted by the District of Columbia Committee on Public Education (COPE). COPE approached the question of building conditions with the outcome in mind that some schools may be recommended for closing depending on the findings. COPE organized groups of volunteer maintenance workers, engineers, and architects to visit each school and report the building condition as poor, fair, or excellent condition.

Edwards controlled for socioeconomic status of the school by using the percentage of students participating in the free and reduced-price lunch program, mean income in the census, and percentage of White students in the census. Edwards found that in the all schools data set, four variables were seen as significant predictors of student achievement scores. These included the percentage of Whites in the census of the school, the mean income in the census, the school enrollment, and the main hypothesis of the building condition of the school.

In addition, Edwards' results showed that as a school moves from one category to the next, such as poor to fair, average achievement scores of students increased by 5 percentage points. In addition, if schools were to improve conditions from poor to excellent, then one could predict an increase of 10 percentage points in the average achievement scores of students. She found this to be significant at the .05 level. Edwards (1991) stated "that as the condition of the building improves, so does the average student achievement score" (p. 41).

Student achievement scores can be the result of a wide variety of variables. Although Edwards accounted for socioeconomic status with several measures, the model may be flawed if all of the relevant factors that affect the student achievement scores are not controlled. Her model is very comprehensive but one cannot assume that her model includes all relevant independent variables.

Cash (1993) developed an instrument to measure building conditions and selected for her study small rural high schools in the Commonwealth of Virginia. These small rural high schools were often found in areas with limited fiscal resources. Cash examined the relationship between the condition of school facilities with student achievement and behavior. Her study targeted all of the small, rural high schools in Virginia with a population of fewer than 100 seniors in the school year 1991-92. These 47 schools were located primarily along the western border of the state and 41 (87.23%) participated in the study. Student achievement was determined by the scaled scores of the Test of Academic Proficiency (TAP) for grade eleven. The TAP scores include mathematics, reading comprehension, written expression, information, basic composite, social studies, science, and complete composite scores. Socioeconomic status was used as a covariant in the analysis to adjust for poverty in the student population. The final component of the study was a researcher developed assessment instrument, the Commonwealth Assessment of Physical Environment (CAPE) used to assess the building condition. The instrument yielded an overall building condition score and this was used to categorize buildings as substandard, standard, or above standard.

In addition to researching general or overall building condition, Cash divided school building conditions into two other categories: structural conditions and cosmetic conditions. There were 16 structural conditions related to physical features of the school buildings, such as air conditioning, presence of windows, lighting, and conditions of lockers, while the ten cosmetic conditions related to aesthetic aspects, such as recent painting, presence of graffiti, and cleanliness.

Students' mean scores were compared across the three categories of building conditions, i.e., overall, structural and cosmetic conditions. The data were analyzed using analysis of covariance, with the percentage of students who did not qualify for free or reduced lunch serving as the covariate.

When examining overall building conditions, it was found that achievement scores of students in the subset categories of mathematics and sciences, and in the subset category of complete composite were lower for students in substandard building conditions compared to students in above standard building conditions. The difference was greatest in science, with the average scores of students taught in above standard building conditions at the 55th percentile compared to the 50th percentile of students taught in sub-standard building conditions.

The results for cosmetic conditions indicated that all the scores of students in buildings with above standard cosmetic conditions ranged from one to four percentile points higher than those of students taught in buildings in substandard cosmetic conditions. However, no differences in student achievement in any of the subtests between the two groups were found for the structural building conditions. Structural building conditions seemed to have little effect on student achievement outcomes, but cosmetic conditions did.

Cash further analyzed specific items on the CAPE to determine if selected cosmetic and structural factors were related to student achievement. Although the overall structural condition of a school was found not related to student achievement, Cash did identify four significant factors. These structural factors included air conditioning, locker conditions, exterior noise, and science lab equipment. Higher levels of achievement were found in schools with at least some air conditioning in instructional spaces, better locker conditions, less exterior noise, and better science laboratory equipment.

The overall cosmetic condition of a school was related to student achievement, but further analysis of the CAPE items identified four significant factors. These factors were: graffiti removal, classroom furniture, and interior and exterior wall paint color. Higher achievement levels were found in schools with less graffiti, classroom furniture in better condition, and instructional areas with pastel painted walls instead of white walls.

Cash found that when composite scores on the achievement test were compared across the three building conditions substandard, standard, and above standard, it differed by as many as seven points. This number accounts for up to 11 percentile ranks. When a student mean score in the 50th percentile increases its mean scale by 11 percentile ranks, it has increased over twenty percent. Cash points out the educational significance of such a gain in her study.

Cash indicated the importance of looking beyond the numerical comparisons of scale scores and examining the limitations of the study. Limiting factors might include the sample size, parental involvement, teachers' experiences, teachers' attitudes toward the school building, and students' attitudes toward the professionalism of their teachers. Cash also mentioned the weakness in some of the questions on the CAPE assessment. Studies that examine overall building conditions rely heavily on a comprehensive assessment of the school building conditions in order to determine if the student achievement varies in different building conditions.

As presented earlier in this paper, Cheng (1994) stated that the relationship between students and teachers and their facility is an interactive one, with participants affected both physically and psychologically by their environment. Cash's study reinforces the position that presenting a clean, functional, comfortable building, even if it is not technologically state-of-the-art, will yield higher student achievement results.

In Cash's study, there were no explanations for students in above standard structural and cosmetic building conditions who scored lower on the achievement test than those in substandard structural building conditions. Confounding factors might include parental involvement, teachers' experiences, and teachers' attitudes toward the school building. A more comprehensive assessment of the school building conditions may better delineate the differences between building conditions.

Two years later, in an attempt to generalize Cash's original research of Virginian rural schools to other populations, Earthman, Cash, and Van Berkum (1995) conducted a study using all of the high schools in North Dakota. They selected North Dakota because the population scored very high on international achievement tests. This population is relatively homogeneous, the students' test scores on the SAT are among the highest in the nation, and the math scores of North Dakota eighth grade students were the third highest in the international comparisons of eighth grade math scores in 1992. School size was also more varied, with enrollments ranging between 65 and 1200 students.

The building conditions were measured by principals' survey responses to the State Assessment of Facilities in Education (SAFE). The measure of student achievement was eleventh grade students' scores on the Comprehensive Test of Basic Skills (CTBS). The instrument had three categorical conditions: overall building condition, structural building condition, and cosmetic building condition. In all, they examined 199 high school buildings in North Dakota.

They compared overall building conditions to student academic achievement on 13 subtests of the CTBS. They found that the test scores of students in above-standard building conditions were one to nine percentage points higher than those in sub-standard building conditions on 11 subtests. Test scores of students in substandard building conditions were one percentage point higher than those in the above-standard building conditions on the math total. Social studies scores indicated that there were no differences in the scores of students in above-standard building conditions and sub-standard building conditions.

The researchers also compared cosmetic conditions of the building with student achievement and found that test scores for students in above-standard building conditions were 1 to 11 percentage points higher than students attending substandard buildings on 12 subtests. The exception to the rule this time was English Mechanics, in which no difference in student achievement was found for above standard building condition and substandard building conditions.

Finally, the structural building condition was compared with student achievement. These results were much different than those found in the overall building and cosmetic. The scores of students in above standard building conditions were 1 to 8 percentage points higher than those of students in substandard building conditions on only eight subtests instead of 13 subtests. The five remaining subtests revealed an inverse relationship. The scores of students in substandard building conditions were 3 to 12 percentage points higher than those of students in above standard building conditions on four subtests: Math Comp, Math Concept and Application, Math Total, and Social Studies.

When specific items were analyzed for relationships to student achievement, the following structural items were found to be highly related: windows, floors, heat, roofs, adjacent facilities, locker conditions, ceilings, laboratory age and lighting. Regarding cosmetic items, interior paint and paint cycle, mopped floors, graffiti, and grounds were significant in terms of student achievement.

The North Dakota study did confirm the findings of Cash. The study indicated a difference of 5 percentile rank points on the composite or total achievement scores for students in substandard buildings as opposed to students in above standard buildings and there appeared to be a stronger relationship between cosmetic conditions and student achievement compared to structural conditions. However, both studies found that specific cosmetic and structural conditions are related to achievement and common elements between the two research projects were science laboratory equipment, interior paint, locker conditions and graffiti.

Although the North Dakota study did confirm many of the findings in Cash's study, there is still the concern of teachers' attitudes and the respondents 'school pride' when describing their facility. Another concern is the discrepancy in the size of the schools in the survey and the confounding effect of small school size versus large school size on achievement.

Hines' (1996) study of large urban high schools in Virginia also found a positive relationship between building conditions and student achievement. This study focused on selected urban high schools in the state of Virginia. The high schools were identified as schools in metropolitan areas with populations of over 100,000 and student enrollments of over 25,000. Eighty-eight secondary schools where identified as schools in urban areas. The Test of Academic Proficiency (TAP) scores as described earlier in the Cash (1993) study were used in each school to assess student achievement during the school year 1992-1993. All achievement scores were adjusted for socioeconomic status by using the percentage of students in the free and reduced lunch program for each school. The Commonwealth Assessment of Physical Environment (CAPE), which consists of mainly objective questions concerning the building conditions, was completed by school division personnel. Hines revised some of the questions in the CAPE as a result of the Cash study in an attempt to make it more applicable to an urban setting. The CAPE was also modified to address other minor concerns that arose in Cash's study, such as clarity when answering survey questions regarding heating, air conditioning, lack of participant's knowledge regarding differences in fluorescent lighting and the insignificance of questions regarding the paint cycle. Overall, these concerns did not interfere with the division of surveyed schools into substandard, standard, and above standard condition.

As in the Cash study, the data were analyzed using an analysis of covariance to compare the adjusted means of student achievement scores with the three building assessment ratings. The eight defined achievement means were compared across the building conditions and the composite total means were compared between the two cosmetic conditions and the two structural conditions.

In this study, Hines found that student achievement scores were higher in schools with better building conditions. Scale scores were higher on every subtest of the Test of Academic Proficiency for standard buildings. Hines found that student achievement was as much as 17 percentile points higher in mathematics in buildings with above standard conditions than buildings with substandard conditions. Students, in above standard building conditions, achieved as much as 15 percentile points higher than students in substandard building conditions in reading comprehension.

The results comparing the lower building condition scores with the upper building condition scores in the cosmetic building condition analysis showed an increase of over 4 percentile points in all subsets except for sources of information. The complete composite score was 6 percentile points more in the upper building conditions. The results from the structural building conditions analysis showed an increase in scores between lower condition scores and upper condition scores in every area except for sources of information. The differences between each group were rather large which suggests a relationship with improved structural conditions and student achievement.

Hines' study demonstrates a strong relationship between overall building conditions, (including both cosmetic and structural conditions) and student achievement for urban high schools. When Hines contrasted his findings to those of Cash, he found that when comparing cosmetic and structural differences, scale scores and percentile ranks in urban schools were consistently higher than rural schools regardless of the school building condition. More importantly, as the building condition category increased, so did the difference in composite scores. For schools in substandard condition, the mean scale score difference between rural and urban schools was 3.65 points, for standard condition schools it was 9.31, and for above standard schools the difference was 10.13 points.

Certain concerns in Hines' study must be addressed. First, there is the reliability of those reporting on the building's condition. While in Cash's study, Virginia educators and on-site evaluators reported the same results, Hines' study had no such comparison of reliability. In addition, three school districts did not respond, though taking into consideration the size, ethnicity, and composite of the non-responding schools, the author extrapolates that the results of the study would be the same. There is also the issue of ‘school pride’ when considering how a respondent describes their facility: feelings toward the community or the history of the building may interfere with objectivity about a facility’s condition. Finally, there is the concern of equal funding between districts. Hines points out that an ill maintained building in an affluent district could be considered palatial in a poorer district. Lastly, as Hines indicates, the results cannot be applied to the general population of high schools due to the selection of urban high schools in his study.

Despite these concerns, a comparison of the Hines study to the Cash study demonstrates the importance of continuing to research myriad school populations, adding to the body of research that can direct planners, educators, policy makers, and architects as they build, remodel, or selectively improve the nation’s schools.

Lanham (1999) replicated the study conducted by Cash in 1993. Lanham chose to examine the relationship between the conditions of the school buildings and classrooms and student achievement in Virginia elementary schools. He modified the Cash model by adding other variables such as deferred maintenance and technology. He predicted that deferred maintenance would negatively affect the building and classroom conditions and therefore negatively impact student achievement. He also added four items about technology that were used in a separate analysis to investigate a relationship between the presence and absence of technology and student achievement. The technology items related to the availability of technology as defined by Ethernet services, not the presence of computer equipment.

The population included all elementary schools in Virginia containing grades 3 and 5. A systematic random sample of 300 schools, which represented one-third of the schools, was selected from this population. Responses were received from 191 principals for a 64% response rate. The conditions of buildings, as well as demographic information, were assessed using an Assessment of Building and Classroom Conditions in Elementary Schools in Virginia. This instrument was similar to the one used in the studies of Cash (1993), Earthman, et al. (1995), and Hines (1996).

Lanham used the Standards of Learning Assessments (SOLs) of Spring 1998, for the measure of student achievement. This test is the required state assessment for all schools and is published by the Virginia Department of Education. Scaled scores were used for the third grade English assessment, fifth grade English assessment, third grade mathematics assessment, and fifth grade mathematics assessment. The percentage passing score was used for the fifth grade technology assessment, as scaled scores were not available.

The building assessment information indicated that a large portion of Virginia elementary schools were more than 30 years old and had a number of structural and classroom defects. While principals gave high composite ratings to their schools, their responses to individual questions showed problems with roof leaks and climate control. Similar to other studies in this field, information on the percentage of students on free and reduced lunches was used to control for the socioeconomic status of the student body.

Lanham used two statistical analyses, a Pearson's product moment correlation and a step-wise multiple regression analyses. The Pearson r was used to find out the interrelationships among various independent variables that were listed in the building assessment instrument. The five-step multiple regression analysis was used to determine the relationship between the identified dependent and two or more independent variables.

The statistical analysis revealed that the percentage of students participating in the free and reduced lunch program was the most significant variable in student achievement.

The items analyzed were building age, building purpose, years since last renovation, room structure, roof integrity, years since last interior painting, years since last exterior painting, electrical services, floor type, overall building maintenance, overall structural condition, classrooms in trailers, classrooms without windows, heating quality, air conditioning quality, ceiling type, lighting type, wall color, sweeping frequency, mopping frequency, electrical outlets, local-area network access, Internet access, cable TV access, furniture condition, classroom structural condition, classroom cosmetic condition, overall condition, enrollment, percentage of students in the free or reduced–price lunch program, and total site size.

Air conditioning was a significant factor in three of the five analyses, third grade English, fifth grade English, and fifth grade Technology. Air conditioning accounted for a total variance of 1.6% in third grade English, 2.8% in fifth grade English, and 4.8% in fifth grade Technology. Lanham concluded that air conditioning was the single most important building factor that had a significant impact on achievement scores. The results in the study identifying the significance of air conditioning to student achievement are consistent with the previous results found in the Cash (1993), Earthman et al (1996), and the Hines (1996) studies. Other variables found significant in one or more of the analyses were ceiling type, site size, frequency of floor sweeping and mopping, connection to a wide-area network, room structure, overall building maintenance, and flooring type; however, these seven factors were found to be significant at a lesser level of confidence.

The year 1999 was the first of Standards of Learning testing in Virginia and the confounding variable of aligned curriculum was still a factor in many schools at that time. School divisions adjusted their instructional program to align with the assessment as the date for using these tests for school accreditation rating came closer. Curriculum alignment was a larger concern in schools with inadequate funding which are the same schools where poorer building conditions seem to exist.

Here again, as with Cash (1993) and Hines (1996), is evidence that the physical comfort of the student in the school and aspects of school cosmetics affect student achievement. A student's ability to be attentive, healthy, and maintain a positive attitude towards learning can be linked to aspects of the overall environment, i.e., a good school facility, suggesting the interactive nature of the student and the school.

O'Neill (2000) investigated the possible impact of school facilities on student achievement, behavior, attendance, and teacher turnover rate in selected Texas middle schools in Region XIII Educational Service Center. The population included 48 districts in the region and contained a total of 76 middle school facilities.

Building ratings were determined by the middle school principals using a research instrument developed by the researcher. O'Neill decided to use a large portion of the *Guide for School Facility Appraisal* (Hawkins & Lilley, 1998) dealing with middle schools. In addition, a portion of the CAPE developed by Cash (1993) was incorporated.

Student achievement was compared to the independent variable of school facilities. The independent categories were the seventeen school facilities with the highest total score (top 25%) compared to the seventeen school facilities (bottom 25%) rated the lowest by the score on the TLEA.

O'Neill found that both the t-tests and Pearson product-moment correlations indicated that school facilities had a significant impact on student achievement. The t-test for dependent variable means across independent variable categories used in analyzing student achievement measures demonstrated that there were several significant differences between the top 25% and the bottom 25% of school facilities as determined by the total score on the research questionnaire. These included the following measures: percent passing reading, percent passing math, percent passing all sections, and percent passing reading, writing, and math. These findings were consistent with the other studies utilizing a self-evaluation ranking of substandard and standard building conditions.

Reviews of Research Studies

A number of reviews of research studies have also provided relevant information for future studies. Weinstein (1979) analyzed studies prior to 1980 and found that there was no relationship between building conditions and student achievement. She investigated specific environmental variables such as seating position, classroom design, furniture arrangement, crowding, and noise. She did comment that there was an insufficient amount of studies relating the affects of facility conditions on student achievement outcomes.

McGuffey (1982) reviewed studies dealing with how school facilities impacted student learning, performance, and self-concept. He identified seven studies on the specific topic of the relationship between the condition of facilities and learning. These studies utilized stepwise multiple regression to examine the relationship between scores of students on standardized tests and the age of a school or a judgment on a school's condition. In most cases, the newer the school, the higher students scores were likely to be. Other factors identified as having an affect on student achievement were thermal conditions, lighting, color and interior painting, acoustics, and building maintenance. McGuffy concluded that even though the amount of variance in student achievement may seem small, it exceeds many other educational variables and should not be ignored.

McGuffy's results must be examined with caution due to the shortage of data with some of the variables identified in the studies and each study reviewed used different methodologies to analyze the data. The larger concern is the fact that he used his own judgment to identify significant findings and therefore reviewer bias was difficult to control.

Lemasters' (1997) study was a synthesis of research pertaining to the relationship between building conditions, student achievement, and student behavior. Lemasters stated that "there have been many studies completed since Weinstein and McGuffey's reviews in 1979 and 1982, but there has been no critical review of this research during the past fourteen years" (Lemasters, 1997, p. 2). This means that educators, architects, and planners have no readily accessible information to guide them when designing and remodeling schools. The author also focused on the need for research data to offer insight into best practices in the field of design and construction of school buildings.

Lemasters conducted an extensive search for every paper or study related to the topic using several generally accepted sources. After the studies had been selected, she critically reviewed each one. She used the following independent variables to classify her studies: color, maintenance, age, classroom structure, climate controls, density, noise, and lighting. She then counted the number of studies containing the specified independent variable and student achievement.

Student achievement in most studies was based on standardized scores. The synthesis was focused on findings, summarizing, and drawing conclusions. Lemasters reviewed the Cash study in relation to the significance for color since pastel painted walls were an indication of a physical element that positively influenced student achievement. However in Hines (1996), Lemasters found color did not appear to have a great impact on achievement. She similarly reviewed each study that included each independent variable in her study.

Lemasters found that Cash (1993), Earthman, Cash, and Van Berkum (1995), and Hines (1996) conducted studies that supported the relationship between building conditions and student achievement. Higher quality ratings were associated with higher levels of student achievement, as measured by mean scale scores. This was particularly true in the areas that were cosmetic. Lemasters concluded the following:

1. School facilities that are well-maintained have a positive impact on student achievement.
2. School facilities that are maintained well positively influence student behavior.
3. Students did seek areas of privacy in the classroom, even if they must create the structures themselves, as classrooms with areas of privacy reduce student anxiety and stress.
4. Full-spectrum fluorescent lighting with trace amounts of ultraviolet content has a positive effect on student health.
5. Non-instruction noise has an adverse effect on the student learner.

As with the Hines and Cash studies, Lemasters also questioned the interplay of a building's condition and the students' resultant attitude and how this affects student's achievement. Do students feel greater pride and perform better in schools that are well maintained and absent of graffiti, or do student's with good attitudes and pride in their surroundings promote concern for the facility as shown by a cleaner, better kept environment?

Concerns regarding this review of current studies include the following: the need for a diversity of populations- geographically, economically and ethnically- to be included in the studies, and the use of similar statistical procedures for an accurate comparison of outcomes regarding achievement. When relying on hundreds of published studies, it is challenging to devise a matrix that includes all dependent and independent variables for analysis. While results consistently show that students do better academically in well-maintained facilities, the exact level of achievement and the reason for this rise is difficult to ascertain across the board due to the many variables involved in calculating this affect. Another consideration includes consistency in the research: Are all studies valid in the same way given the various types of methodology, statistical measures, survey tools, and achievement measurements in use? What remains clear, and as Lemasters affirms in her conclusion, is that good school buildings communicate to students their communities care, and as a result, students respond with optimal achievement.

CHAPTER 3

Methodology

Introduction

In this chapter, the population and setting of this study are identified. Data needs are explained, including the methodology used in data gathering. The assessment instrument used for measuring student achievement is discussed. The analysis of the data is discussed including the identification of the variables and the types of statistical analyses to be used.

Population and Setting

This study included a sample of high schools located in the Commonwealth of Virginia. To determine which schools might become a part of the targeted sample population, the study by Crook (2006) was used, which included information on seventy-two high schools across the Commonwealth of Virginia. Crook's appraisal of the building conditions was completed during the 2004-2005 school year. This coincides with the Standards of Learning tests that were utilized in this study.

Crook (2006) completed a replication of the Cash (1993) study investigating the relationship between school building condition and student achievement. In that study he selected 72 high schools from the 142 appraised as to their condition. He was able to classify all buildings into the categories of either substandard building or standard building conditions. Each building was assigned a score based upon the responses of their principals to the Commonwealth Assessment of Physical Environment (CAPE) developed by Cash (1993). Each item was scored from 1 to 3 and the building score was dependent upon the responses that the principal selected. The scores of all buildings were then placed on an ordinal scale from the low to high score with one representing the low score and three representing high score. Crook determined the bottom quartile of scores represented schools in substandard condition. Conversely, he determined that schools with scores in the top quartile to be in standard condition. The results of his assessment of the buildings were utilized in this study. Crook has provided and given permission to the researcher to utilize the data on building conditions he collected from all the high schools identified in his study.

This study utilized the thirty-six schools that Crook classified as substandard and the thirty-six schools that were classified as standard. The population were thus determined based upon the work of Crook and were used to investigate the relationship between building conditions and student achievement of economically disadvantaged (students receiving free and reduced-price lunch) and minority students.

Tables 1 and 2 show the percent of students receiving free or reduced lunches at each school. These data were obtained from the Virginia Department of Education. The schools were identified only alphabetically and not by particular name. In Crook's study the standard schools range from 3.19% to 45.49% of students receiving free and reduced-price lunch (Table One). The substandard schools range from 7.63% to 71.27% of students receiving free and reduced-price lunch (Table Two). In this study, the twelve schools with the highest percentage of students receiving free and reduced-price lunch in buildings with standard conditions were compared to a like number of schools with a similar percentage of students receiving free and reduced-priced lunch in buildings with substandard conditions (Table Three). This provided a better comparison of the high schools by reducing the gap in the percentage of students on free and reduced-priced

Table 1

High Schools Rated With Standard Building Conditions by Crook (2006) and their Percentage of Students on Free and Reduced-Priced Lunch and Minority Students

School	Free/Reduced-price %	Minority %
High School A	27.08	27
High School B	35.15	26
High School C	35.21	55
High School D	11.22	35
High School E	12.78	31
High School F	13.95	8
High School G	12.65	9
High School H	15.51	28
High School I	23.08	20
High School J	22.76	55
High School K	36.96	65
High School L	34.44	47
High School M	20.53	26
High School N	26.07	42
High School O	14.53	33
High School P	N/A	9
High School Q	36.83	50
High School R	7.32	10
High School S	39.33	49
High School T	22.87	30
High School U	24.96	52
High School V	14.12	13

Table 1 (continued)

School	Free/Reduced-price %	Minority %
High School W	21.95	55
High School X	45.49	34
High School Y	34.32	3
High School Z	37.7	11
High School AA	3.19	5
High School BB	8.01	30
High School CC	N/A	44
High School DD	25.6	32
High School EE	18.27	3
High School FF	26.67	16
High School GG	29.17	5
High School HH	25.64	28
High School II	29.81	64
High School JJ	11.62	23

Table 2

High Schools Rated With Substandard Building Conditions by Crook (2006) and Their Percentage of Students on Free and Reduced-Priced Lunch and Minority Students

School	Free/Reduced %	Minority %
High School KK	30.25	36
High School LL	26.18	3
High School MM	21.62	1
High School NN	11.96	13
High School OO	27.17	5
High School PP	40.19	4
High School QQ	63.37	0
High School RR	45.93	56
High School SS	31.04	36
High School TT	29.37	45
High School UU	64.62	3
High School VV	20.29	6
High School WW	39.86	22
High School XX	31.93	1
High School YY	32.17	8
High School ZZ	37.07	41
High School AAA	71.27	0
High School BBB	40.32	39
High School CCC	48.18	1
High School DDD	14.83	28
High School EEE	16.32	16
High School FFF	55.38	61

Table 2 (continued)

School	Free/Reduced %	Minority %
High School GGG	37.67	48
High School HHH	63.86	1
High School III	18.78	12
High School JJJ	28.54	27
High School KKK	37.06	1
High School LLL	10.28	9
High School MMM	24.61	37
High School NNN	33.99	10
High School OOO	17.78	8
High School PPP	7.63	26
High School QQQ	36.97	5
High School RRR	37.17	59
High School SSS	26.54	6

Table 3

The High Schools with the Highest Percentage of Students on Free and Reduce-Priced Lunch in Standard Condition Compared to High Schools with a Similar Percentage of Students on Free and Reduced-Priced Lunch in Substandard Condition

Standard Condition Schools		Substandard Condition Schools	
School	F/R Lunch %	School	F/R Lunch %
High School X	45.49	High School RR	45.93
High School S	39.33	High School BBB	40.32
High School Z	37.7	High School PP	40.19
High School K	36.96	High School WW	39.86
High School Q	36.83	High School GGG	37.67
High School C	35.21	High School RRR	37.17
High School B	35.15	High School ZZ	37.07
High School L	34.44	High School KKK	37.06
High School Y	34.32	High School QQQ	36.97
High School II	29.81	High School NNN	33.99
High School GG	29.17	High School YY	32.17
High School A	27.08	High School XX	31.93

lunch in each high school in the initial study. In turn, this allowed controls for wealthy schools versus poorer schools. Schools with a higher percentage of students on free and reduced-price lunch are often the schools that encounter limited socioeconomic conditions. These conditions have been statistically related to achievement outcomes. The twelve schools with the highest percentage of minority students in buildings with standard conditions were compared to a like number of schools with a similar percentage of minority students in buildings with substandard conditions (Table Four). This provided a better comparison of the high schools by reducing the gap in the percentage of minority students in each high school in the initial study. This allowed controls for schools with comparable minority populations.

Data Collection

Three different sets of data were needed for this study. They were:

1. The mean scale score of the ten Standards of Learning tests administered in 2004-2005 for students in grades nine through twelve classified as economically disadvantaged from each school included in the study.
2. The mean scale score of the Standards of Learning tests administered in 2004-2005 for students in grades nine through twelve classified as minority from each school included in the study.
3. The survey data collected on each school used in the study to determine whether the building condition is either substandard or standard.

This study allowed for a comparison of scores of students classified as economically disadvantaged and scores of minority students who are in schools with

Table 4

The High Schools with the Highest Percentage of Minority Students in Standard Condition Compared to High Schools with a Similar Percentage of Minority Students in Substandard Condition

Standard Condition Schools		Substandard Condition Schools	
School	Minority %	School	Minority %
High School K	65	High School FFF	61
High School II	64	High School RRR	59
High School C	55	High School RR	56
High School J	55	High School GGG	48
High School W	55	High School TT	45
High School U	52	High School ZZ	41
High School Q	50	High School BBB	39
High School S	49	High School MMM	37
High School L	47	High School SS	36
High School CC	44	High School KK	36
High School N	42	High School DDD	28
High School D	35	High School JJJ	27

building conditions rated either substandard or standard. Achievement scores were obtained from the Virginia Department of Education.

The Virginia Department of Education was asked to provide mean scaled scores of economically disadvantaged students and minority students for the Standard of Learning tests administered in grades nine through eleven during the 2004-2005 school year. The mean scale scores were individually broken down by each Standard of Learning test. The Standard of Learning tests administered in high school are as follows; English Reading, Algebra I, Geometry, Algebra II, Earth Science, Biology, Chemistry, World History I, World History II, and United States History.

The status of economically disadvantaged students were determined by the classification of a student receiving free and reduced-priced lunch and homeless students as determined by the school and reported to the Virginia Department of Education for the 2004-2005 school year. These students are then coded as economically disadvantaged students when they are administered the Standards of Learning tests. When assessing the results only students classified as economically disadvantaged were utilized.

The status of minority students was determined by ethnicity as reported by the individual schools to the Virginia Department of Education for the 2004-2005 school year. The minority population for this study has the following make up: 86.5% African-American, 9.5% Hispanic, and 3.9% Asian and Pacific Islander.

Data Gathering

In the summer of 2006, an e-mail was sent to the Virginia Department of Education requesting the mean scaled scores for economically disadvantaged students for ten of the Standard of Learning tests administered in grades nine through eleven during the 2004-2005 school year in all identified schools. In addition, a request was made for the mean scaled scores for minority students for ten of the Standard of Learning tests administered in grades nine through eleven during the 2004-2005 school year in all identified schools. The request included the name and position of the person making the request, a brief explanation of the dissertation, and what was hypothesized.

Data Analysis

This was a descriptive-survey study and used descriptive statistics to analyze the data. The quantitative data obtained from the Virginia Department of Education and from the Crook (2006) survey were manually entered into a Microsoft Excel Spreadsheet. Data were then analyzed using the Statistical Package for Social Studies (SPSS). The results of the study were reported using numerical and graphic techniques to report descriptive statistics including means, frequencies, percentages, and standard deviations as mentioned in *Understanding Research Methods and Statistics: An Integrated Introduction for Psychology* (Heiman, 2001).

Descriptive statistical comparisons were done for the purpose of showing the relationship between the variables. The dependent variables of student achievement were compared to the independent variable of building conditions as measured by the CAPE in the study by Crook (2006). These variables were examined using t-tests to compare dependent variable means across independent variable categories. A confidence level of $p>.05$ was required to show a relationship.

Research Question 1

The question of “Is there a significant difference between the scores of economically disadvantaged students in building conditions rated substandard and standard in high schools in the Commonwealth of Virginia?" was investigated using t-tests to compare dependent variable means across independent variable. The independent variable was the school buildings rated as substandard by the CAPE compared to the school buildings rated as standard by the CAPE (Figure Two). This question was investigated by statistically comparing the scores of economically disadvantaged students in substandard schools with the scores of economically disadvantaged students in standard schools.

Figure Two suggested that the building conditions that the economically disadvantaged students are housed in have an affect on them and ultimately their achievement.

Research Question 2

The question of "Is there a significant difference between the scores of minority students in buildings rated substandard and standard in high schools in the Commonwealth of Virginia?" was investigated using t-tests to compare dependent variable means across independent variable. The independent variable was the school buildings rated as substandard by the CAPE compared to the school buildings rated as standard by the CAPE (Figure Two). This question was investigated by statistically comparing the scores of minority students in substandard schools with the scores of minority students in standard schools.

Figure Two suggested that the building conditions that the minority students are housed in have an affect on them and ultimately their achievement.

Finally, the results of the analyses of student achievement in research question one and two were compared with the findings of previous researchers who have

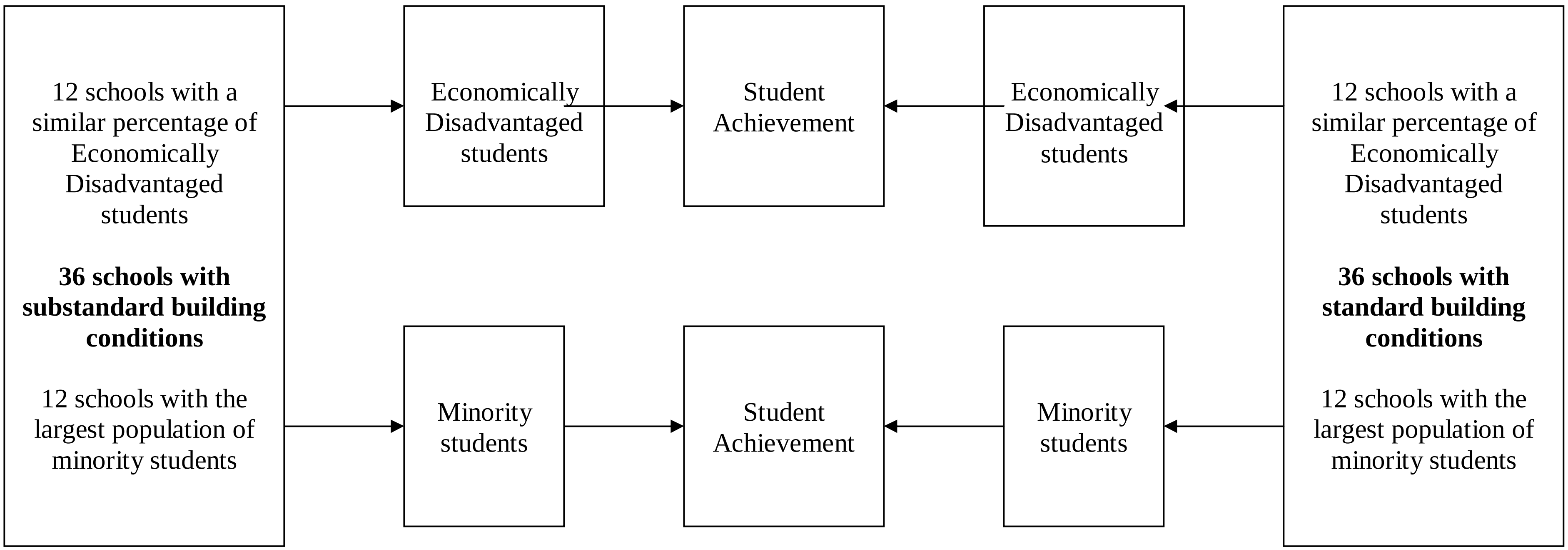

Figure two. Model for the data analysis for the study of the relationship between building conditions and student achievement of student subgroups identified as economically disadvantaged students and minority students.

investigated the relationship between school building condition and student achievement using the general student population.

CHAPTER 4

Findings

The purpose of this study was to examine the possible relationship between building conditions and academic achievement of students identified in the subgroups of economically disadvantaged and racial minority in a sample of high schools in the Commonwealth of Virginia. This chapter contains the findings of the two research questions in this paper. The first question examined the relationship between the scores of economically disadvantaged students in buildings rated substandard and in buildings rated standard. The second question examined the relationship between the scores of minority students in buildings rated substandard and in buildings rated standard. It was the belief that this study would show a relationship between building conditions and student achievement of economically disadvantaged students and show a relationship between building conditions and student achievement of minority students. One of the intended outcomes of conducting such a study was to understand the relation school facilities might have with the achievement gap of identified subgroups.

Statistical Analysis

Economically Disadvantaged Students

Information gathered from the Virginia Department of Education provided the data on student achievement for addressing question one. A t-test was performed to compare dependent variable means across independent variables categories. The independent categories were the twelve schools with the highest percentage of students receiving free and reduced-price lunch in buildings with standard conditions and the twelve schools with a similar percentage of students receiving free and reduced-priced lunch in buildings with substandard conditions. The dependent variable was student achievement as measured by Virginia Standards of Learning tests administered in high schools as follows; English Reading, Algebra I, Geometry, Algebra II, Earth Science, Biology, Chemistry, World History I, World History II, and United States History.

The t-test gives correct probabilities when the assumptions it is based on are true for the population being analyzed. Statisticians make three assumptions when they derive a t distribution for analysis on an independent sample design. For the two populations, the scores on the dependent variable are normally distributed and have variances that are equal (Heiman, 2001). In addition, the two samples are randomly selected from their population (Heiman, 2001). The t-test is relatively unaffected by rather severe violations of the assumptions of homogeneity of variance and normality of the distributions in the population. For this reason, the t-test is said to be robust; that is, it is a test relatively unaffected by violations of its underlying assumptions (Heiman, 2001).

As shown in Table Five, the results of the test indicated a mean of 430.15 for the students classified as economically disadvantaged in buildings rated standard on the Algebra I test and a mean value of 426.85 for the students classified as economically disadvantaged in buildings rated substandard on the Algebra I test. Thus the difference in the group mean values was 3.30. This difference between mean values was significant at the 0.01 level of significance, $t = 4.074$, $df = 1085$, $p = 0.000$.

As shown in Table Six, the results of the test indicated a mean of 445.28 for the students classified as economically disadvantaged in buildings rated standard on the Algebra II test and a mean value of 446.84 for the students classified as economically disadvantaged in buildings rated substandard on the Algebra II test. Thus the difference

Table 5

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Algebra I Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Algebra I Test

Group Statistics

	ALG1	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	734	430.1495	13.69538	.50551
Substandard	2.00	523	426.8474	14.48814	.63352

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	32.65	.000	4.113	1255	.000	3.3020	.80287	1.72693	4.87715
Equal variances not assumed			4.074	1085.06	.000	3.3020	.81049	1.71174	4.89233

Table 6

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Algebra II Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Algebra II Test

Group Statistics

	ALG II	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	446	445.2787	26.47043	1.25341
Substandard	2.00	135	446.8422	18.24674	1.57043

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	91.53	.000	-.642	579	.521	-1.5635	2.43722	-6.35.39	3.22335
Equal variances not assumed			-.778	319.399	.437	-1.5635	2.00930	-5.51663	2.38958

in the group mean values was -1.5635. This difference between mean values was not significant at the 0.05 level of significance, t = -.778, df = 319, p = 0.437.

As shown in Table Seven, the results of the test indicated a mean of 430.73 for the students classified as economically disadvantaged in buildings rated standard on the Geometry test and a mean value of 435.21 for the students classified as economically disadvantaged in buildings rated substandard on the Geometry test. Thus the difference in the group mean values was -4.4784. This difference between mean values was significant at the 0.01 level of significance, t = -4.739, df = 985, p = 0.000. However, it was significant in the fact that the economically disadvantaged students in substandard building conditions scored higher than the economically disadvantaged students in standard buildings.

As shown in Table Eight, the results of the test indicated a mean of 421.15 for the students classified as economically disadvantaged in buildings rated standard on the Earth Science test and a mean value of 419.03 for the students classified as economically disadvantaged in buildings rated substandard on the Earth Science test. Thus the difference in the group mean values was 2.1176. This difference between mean values was significant at the 0.01 level of significance, t = 3.474, df = 903, p = 0.001.

As shown in Table Nine, the results of the test indicated a mean of 421.69 for the students classified as economically disadvantaged in buildings rated standard on the Biology test and a mean value of 418.78 for the students classified as economically disadvantaged in buildings rated substandard on the Biology test. Thus the difference in the group mean values was 2.9138. This difference between mean values was significant at the 0.01 level of significance, t = 3.408, df = 579, p = 0.001.

Table 7

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Geometry Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Geometry Test

Group Statistics

	Geom	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	642	430.7266	16.52673	.65226
Substandard	2.00	416	435.2050	13.94749	.68383

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	17.57	.000	-4.572	1056	.000	-4.4784	.97961	-6.40062	-2.55620
Equal variances not assumed			-4.739	985.508	.000	-4.4784	.94502	-6.33290	-2.62393

Table 8

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Earth Science Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Earth Science Test

Group Statistics

	ESCI	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1045	421.1454	9.14715	.28296
Substandard	2.00	580	419.0278	13.00096	.53984

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	88.10	.000	3.828	1623	.000	2.1176	.55314	1.03265	3.20255
Equal variances not assumed			3.474	903.0	.001	2.1176	.60950	.92140	3.31380

Table 9

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Biology Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Biology Test

Group Statistics

	BIO	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	791	421.6936	7.78542	.27682
Substandard	2.00	469	418.7797	17.51976	.80899

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	98.51	.000	4.052	1258	.000	2.9138	.71910	1.50303	4.32458
Equal variances not assumed			3.408	579.303	.001	2.9138	.85504	1.23446	4.59316

As shown in Table Ten, the results of the test indicated a mean of 435.75 for the students classified as economically disadvantaged in buildings rated standard on the Chemistry test and a mean value of 441.15 for the students classified as economically disadvantaged in buildings rated substandard on the Chemistry test. Thus the difference in the group mean values was -5.3952. This difference between mean values was significant at the 0.01 level of significance, t = -4.055, df = 279, p = 0.000. However, it was significant in the fact that the economically disadvantaged students in substandard building conditions scored higher than the economically disadvantaged students in standard building conditions.

As shown in Table Eleven, the results of the test indicated a mean of 440.88 for the students classified as economically disadvantaged in buildings rated standard on the World History I test and a mean value of 435.40 for the students classified as economically disadvantaged in buildings rated substandard on the World History I test. Thus the difference in the group mean values was 5.4828. This difference between mean values was significant at the 0.01 level of significance, t = 2.954, df = 418, p = 0.003.

As shown in Table Twelve, the results of the test indicated a mean of 442.15 for the students classified as economically disadvantaged in buildings rated standard on the World History II test and a mean value of 428.55 for the students classified as economically disadvantaged in buildings rated substandard on the World History II test. Thus the difference in the group mean values was 13.5989. This difference between mean values was significant at the 0.01 level of significance, t = 6.073, df = 272, p = 0.000.

Table 10

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Chemistry Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Chemistry Test

Group Statistics

	CHEM	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	277	435.7509	14.38641	.86440
Substandard	2.00	115	441.1461	10.84525	1.01133

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	9.09	.003	-3.617	390	.000	-5.3952	1.49182	-8.32819	-2.46218
Equal variances not assumed			-4.055	279.7	.000	-5.3952	1.33040	-8.01405	-2.77632

Table 11

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the World History I Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the World History I Test

Group Statistics

	WHI	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	377	440.8836	18.28080	.94151
Substandard	2.00	250	435.4008	25.29296	1.59967

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	13.64	.000	3.148	625	.002	5.4828	1.74155	2.06276	8.90275
Equal variances not assumed			2.954	418.161	.003	5.4828	1.85617	1.83416	9.13134

Table 12

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the World History II Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the World History II Test

Group Statistics

	WH2	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	747	442.1456	24.18154	.88476
Substandard	2.00	197	428.5467	28.87368	2.05716

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.103	.748	6.730	942	.000	13.5989	2.02072	9.63331	17.56459
Equal variances not assumed			6.073	272.764	.000	13.5989	2.23936	9.19033	18.00757

As shown in Table Thirteen, the results of the test indicated a mean of 446.87 for the students classified as economically disadvantaged in buildings rated standard on the U.S. History test and a mean value of 462.03 for the students classified as economically disadvantaged in buildings rated substandard on the U.S. History test. Thus the difference in the group mean values was -15.1575. This difference between mean values was significant at the 0.01 level of significance, t = -18.280, df = 594, p = 0.000. However, it was significant in the fact that the economically disadvantaged students in substandard building conditions scored higher than the economically disadvantaged students in standard building conditions.

As shown in Table Fourteen, the results of the test indicated a mean of 435.08 for the students classified as economically disadvantaged in buildings rated standard on the Reading test and a mean value of 445.12 for the students classified as economically disadvantaged in buildings rated substandard on the Reading test. Thus the difference in the group mean values was -10.0488. This difference between mean values was significant at the 0.01 level of significance, t = -12.670, df = 726, p = 0.000. However, it was significant in the fact that the economically disadvantaged students in substandard building conditions scored higher than the economically disadvantaged students in standard building conditions.

Minority Students

Information gathered from the Virginia Department of Education provided the data on student achievement for addressing question two. A t-test was performed to compare dependent variable means across independent variables categories. The independent categories were the twelve schools with the highest percentage of minority

Table 13

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the United States History Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the United States History Test

Group Statistics

	U.S.H	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	614	446.8717	9.43528	.38078
Substandard	2.00	388	462.0291	14.50944	.73661

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	34.86	.000	-20.038	1000	.000	-15.1575	.75644	-16.64185	-13.67307
Equal variances not assumed			-18.280	594.6	.000	-15.1575	.82920	-16.78599	-13.52894

Table 14

T-test Between the Students Classified as Economically Disadvantaged in Buildings Rated Standard on the Reading Test and Students Classified as Economically Disadvantaged in Buildings Rated Substandard on the Reading Test

Group Statistics

	READ	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	639	435.0753	11.78673	.46628
Substandard	2.00	361	445.1241	12.19032	.64160

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	4.80	.029	-12.789	998	.000	-10.0488	.78574	-11.59071	-8.50694
Equal variances not assumed			-12.670	726.3	.000	-10.0488	.79313	-11.60593	-8.49172

students in buildings with standard conditions and the twelve schools with a similar percentage of minority students in buildings with substandard conditions. The dependent variable was student achievement as measured by Virginia Standards of Learning tests administered in high schools as follows; English Reading, Algebra I, Geometry, Algebra II, Earth Science, Biology, Chemistry, World History I, World History II, and United States History.

As shown in Table Fifteen, the results of the test indicated a mean of 440.47 for minority students in buildings rated standard on the Algebra I test and a mean value of 436.57 for minority students in buildings rated substandard on the Algebra I test. Thus the difference in the group mean values was 3.8971. This difference between mean values was significant at the 0.01 level of significance, $t = 4.897$, $df = 1808$, $p = 0.000$.

As shown in Table Sixteen, the results of the test indicated a mean of 453.57 for minority students in buildings rated standard on the Algebra II test and a mean value of 454.66 for minority students in buildings rated substandard on the Algebra II test. Thus the difference in the group mean values was -1.0937. This difference between mean values was not significant at the 0.05 level of significance, $t = -.337$, $df = 240$, $p = 0.736$.

As shown in Table Seventeen, the results of the test indicated a mean of 434.23 for minority students in buildings rated standard on the Geometry test and a mean value of 433.53 for minority students in buildings rated substandard on the Geometry test. Thus the difference in the group mean values was .6952. This difference between mean values was not significant at the 0.05 level of significance, $t = .637$, $df = 864$, $p = 0.524$.

Table 15

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Algebra I Test and Students Classified as Minority Students in Buildings Rated Substandard on the Algebra I Test

Group Statistics

	ALG I	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1417	440.4696	20.63154	.54808
Substandard	2.00	702	436.5725	15.28876	.57704

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	118.5	.000	4.437	2117	.000	3.8971	.87828	2.17469	5.61946
Equal variances not assumed			4.897	1807.92	.000	3.8971	.79584	2.33621	5.45795

Table 16

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Algebra II Test and Students Classified as Minority Students in Buildings Rated Substandard on the Algebra II Test

Group Statistics

	ALG II	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	888	453.5666	37.24041	1.24971
Substandard	2.00	176	454.6602	39.68762	2.99157

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	.059	.808	-.352	1062	.725	-1.0937	3.10689	-7.19002	5.00267
Equal variances not assumed			-.337	239.966	.736	-1.0937	3.24210	-7.48029	5.29295

Table 17

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Geometry Test and Students Classified as Minority Students in Buildings Rated Substandard on the Geometry Test

Group Statistics

	GEO	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1470	434.2251	21.85116	.56992
Substandard	2.00	479	433.5299	20.36805	.93064

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	1.76	.184	.615	1947	..539	.6952	1.13096	-1.52277	2.91327
Equal variances not assumed			.637	864.210	.524	.6952	1.09128	-1.44663	2.83713

As shown in Table Eighteen, the results of the test indicated a mean of 424.49 for minority students in buildings rated standard on the Earth Science test and a mean value of 416.43 for minority students in buildings rated substandard on the Earth Science test. Thus the difference in the group mean values was 8.0612. This difference between mean values was significant at the 0.01 level of significance, $t = 14.542$, $df = 1348$, $p = 0.000$.

As shown in Table Nineteen, the results of the test indicated a mean of 423.42 for minority students in buildings rated standard on the Biology test and a mean value of 414.08 for minority students in buildings rated substandard on the Biology test. Thus the difference in the group mean values was 9.3333. This difference between mean values was significant at the 0.01 level of significance, $t = 12.344$, $df = 567$, $p = 0.000$.

As shown in Table Twenty, the results of the test indicated a mean of 435.56 for minority students in buildings rated standard on the Chemistry test and a mean value of 429.47 for minority students in buildings rated substandard on the Chemistry test. Thus the difference in the group mean values was 6.0879. This difference between mean values was significant at the 0.01 level of significance, $t = 4.741$, $df = 206$, $p = 0.000$.

As shown in Table Twenty-One, the results of the test indicated a mean of 452.46 for minority students in buildings rated standard on the World History I test and a mean value of 427.12 for minority students in buildings rated substandard on the World History I test. Thus the difference in the group mean values was 25.3355. This difference between mean values was significant at the 0.01 level of significance, $t = 16.526$, $df = 519$, $p = 0.000$.

As shown in Table Twenty-Two, the results of the test indicated a mean of 450.33 for minority students in buildings rated standard on the World History II test and a mean

Table 18

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Earth Science Test and Students Classified as Minority Students in Buildings Rated Substandard on the Earth Science Test

Group Statistics

	ESCI	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1860	424.4955	13.26458	.30757
Substandard	2.00	695	416.4342	12.15888	.46121

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	3.61	.057	13.977	2553	.000	8.0612	.57676	6.93027	9.19221
Equal variances not assumed			14.542	1348.90	.000	8.0612	.57676	6.97374	9.14874

Table 19

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Biology Test and Students Classified as Minority Students in Buildings Rated Substandard on the Biology Test

Group Statistics

	BIO	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1757	423.4170	11.22387	.26777
Substandard	2.00	437	414.0838	14.78191	.70711

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	104.99	.000	14.531	2192	.000	9.3333	.64231	8.07366	10.59287
Equal variances not assumed			12.344	567.110	.000	9.3333	.75612	7.84814	10.81839

Table 20

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Chemistry Test and Students Classified as Minority Students in Buildings Rated Substandard on the Chemistry Test

Group Statistics

	CHEM	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	671	435.5638	9.73197	.37570
Substandard	2.00	174	429.4759	16.19892	1.22804

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Equal variances assumed	68.16	.000	6.298	843	.000	6.0879	.96671	4.19047	7.98537
Equal variances not assumed			4.741	206.433	.000	6.0879	1.28422	3.55605	8.61979

Table 21

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the World History I Test and Students Classified as Minority Students in Buildings Rated Substandard on the World History I Test

Group Statistics

	WHI	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1554	452.4613	26.48824	.67194
Substandard	2.00	344	427.1259	25.55779	1.37798

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference Lower	Upper
Equal variances assumed	2.87	.090	16.153	1896	.000	25.3355	1.56844	22.25940	28.41150
Equal variances not assumed			16.526	519.02	.000	25.3355	1.53308	22.32365	28.34726

Table 22

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the World History II Test and Students Classified as Minority Students in Buildings Rated Substandard on the World History II Test

Group Statistics

	WHII	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1090	450.3394	21.42046	.64881
Substandard	2.00	188	456.8021	22.46318	1.63830

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	27.83	.000	-3.793	1276	.000	-6.4628	1.70393	-9.80559	-3.11995
Equal variances not assumed			-3.668	249.204	.000	-6.4628	1.76209	-9.93326	-2.99228

value of 456.80 for minority students in buildings rated substandard on the World History II test. Thus the difference in the group mean values was -6.4628. This difference between mean values was significant at the 0.01 level of significance, t = -3.668, df = 249, p = 0.000. However, it was significant in the fact that the minority students in substandard building conditions scored higher than the minority students in standard building conditions.

As shown in Table Twenty-Three, the results of the test indicated a mean of 455.19 for minority students in buildings rated standard on the United States History test and a mean value of 445.82 for minority students in buildings rated substandard on the United States History test. Thus the difference in the group mean values was 9.3801. This difference between mean values was significant at the 0.01 level of significance, t = 9.692, df = 627, p = 0.000.

As shown in Table Twenty-Four, the results of the test indicated a mean of 442.61 for minority students in buildings rated standard on the Reading test and a mean value of 436.33 for minority students in buildings rated substandard on the Reading test. Thus the difference in the group mean values was 6.2815. This difference between mean values was significant at the 0.01 level of significance, t = 9.037, df = 979, p = 0.000.

In answering question one, the results of the study can be summarized as the following:

1. The t-test between scores of students in the twelve schools with the highest percentage of economically disadvantaged students in buildings with standard conditions and a like number of scores of students in schools with a similar

Table 23

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the United States History Test and Students Classified as Minority Students in Buildings Rated Substandard on the United States History Test

Group Statistics

	USH	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1468	455.1996	14.25385	.37202
Substandard	2.00	461	445.8195	19.18368	.89347

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	92.09	.000	11.282	1927	.000	9.3801	.83143	7.74946	11.01068
Equal variances not assumed			9.692	627.414	.000	9.3801	.96783	7.47949	11.28065

Table 24

T-test Between the Students Classified as Minority Students in Buildings Rated Standard on the Reading Test and Students Classified as Minority Students in Buildings Rated Substandard on the Reading Test

Group Statistics

	READ	N	Mean	Std. Deviation	Std. Error Mean
Standard	1.00	1402	442.6083	16.05685	.42883
Substandard	2.00	419	436.3267	11.19756	.54704

Independent Samples Test

	Levene's Test Equality of Variances		t-test for Equality of Means						
	F	Sig.	t	df	Sig. (2-tailed)	Mean Difference	Std. Error Difference	95% Confidence Interval of the Difference	
								Lower	Upper
Equal variances assumed	61.48	.000	7.482	1819	.000	6.2815	.83957	4.63492	7.92817
Equal variances not assumed			9.037	979.261	.000	6.2815	.69509	4.91751	7.64557

percentage of economically disadvantaged students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Reading Test was significant with a negative relationship.

2. The t-test between scores of students in the twelve schools with the highest percentage of economically disadvantaged students in buildings with standard conditions and a like number of scores of students in schools with a similar percentage of economically disadvantaged students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Tests in mathematics were as follows:
    a. Algebra I was significant.
    b. Geometry was significant with a negative relationship.
    c. Algebra II was not significant.
3. The t-test between scores of students in the twelve schools with the highest percentage of economically disadvantaged students in buildings with standard conditions and a like number of scores of students in schools with a similar percentage of economically disadvantaged students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Tests in the sciences were as follows:
    a. Earth Science was significant.
    b. Biology was significant.
    c. Chemistry was significant with a negative relationship.
4. The t-test between scores of students in the twelve schools with the highest percentage of economically disadvantaged students in buildings with standard

conditions and a like number of scores of students in schools with a similar percentage of economically disadvantaged students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Tests in the social studies were as follows:

   a. World History I was significant.
   b. World History II was significant.
   c. United States History was significant with a negative relationship.

In answering question two, the results of the study can be summarized as the following:

1. The t-test between scores of students in the twelve schools with the highest percentage of minority students in buildings with standard conditions and a like number of scores of students in schools with a similar percentage of minority students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Reading Test was significant.
2. The t-test between scores of students in the twelve schools with the highest percentage of minority students in buildings with standard conditions and a like number of score of students in schools with a similar percentage of minority students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard Learning Tests in mathematics were as follows:

   a. Algebra I was significant.
   b. Geometry was not significant.

c. Algebra II was not significant.

3. The t-test between scores of students in the twelve schools with the highest percentage of minority students in buildings with standard conditions and a like number of schools with a similar percentage of minority students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Tests in the sciences were as follows:

   a. Earth Science was significant.

   b. Biology was significant.

   c. Chemistry was significant.

4. The t-test between scores of students in the twelve schools with the highest percentage of minority students in buildings with standard conditions and a like number of scores of students in schools with a similar percentage of minority students in buildings with substandard conditions regarding the dependent variable of mean scale scores on the Virginia Standard of Learning Tests in the social studies were as follows:

   a. World History I was significant.

   b. World History II was significant with a negative relationship.

   c. United States History was significant.

CHAPTER 5

Summary, Conclusions, and Recommendations

Summary

The purpose of the study was to examine the possible relationship between building conditions and academic achievement of students identified in the subgroups of economically disadvantaged and racial minority in a sample of high schools in the Commonwealth of Virginia. The basis for selecting these subgroups stemmed from the data across the country and states that illustrates an achievement gap for economically disadvantaged students and for minority students. In addition, there is the consideration that federally mandated No Child Left Behind (NCLB) legislation requires schools to close the achievement gap of students who come from socioeconomic challenged families as well as those who are in certain designated minority subgroups.

Instructional matters such as curriculum alignment, staff development, and teacher quality have been in the forefront of reform with little mention of school facility changes. Research has shown that there is a positive relationship between building conditions and student achievement (Edwards, 1991; Cash, 1993; Earthman, Cash, Van Berkum, 1995; Hines, 1996; Lanham, 1999; O'Neill, 2000). Therefore, the school building condition variables were selected in order to examine another possible variable to assist in closing the achievement gap.

Crook (2006) recently completed a replication of the Cash (1993) study investigating the relationship between school building condition and student achievement. In order to access the building conditions of each of the schools in his study, he utilized the Commonwealth Assessment of Physical Environment (CAPE) developed by Cash. This study utilized his assessment data for the building conditions. The necessary achievement data were obtained through a request to the Virginia Department of Education.

Statistical analysis was applied to each of the two research question. A t-test was performed to compare dependent variable means across independent variable categories. The independent categories were the twelve schools with the highest percentage of students receiving free and reduced-price lunch in buildings with standard conditions were compared to a like number of schools with a similar percentage of students receiving free and reduced-priced lunch in buildings with substandard conditions

Conclusions

Analysis of the findings revealed in this study led to several conclusions regarding the impact of building conditions on student achievement for economically disadvantaged students and minority students. These conclusions are determined not only from the findings that demonstrate statistical significance, but also from the findings that demonstrate no statistical significance. These conclusions and implications were derived from the analysis of data presented in Chapter IV. The following conclusions are presented in reference to the two research questions.

Research Question 1

Is there a significant difference between the achievement scores of economically disadvantaged students in buildings rated substandard and standard in high schools in the Commonwealth of Virginia?

The t-test for dependent variable means across independent variable categories used in analyzing research question one revealed that there were several significant differences in test scores of students in facilities with standard building conditions and students in substandard building conditions. This included the following measures of student achievement: Algebra I, Earth Science, Biology, World History I, and World History II. This is consistent with the research literature dealing with the achievement of all students in these two building conditions (Edwards, 1991; Cash, 1993; Earthman, Cash, Van Berkum, 1995; Hines, 1996; Lanham, 1999; O'Neill, 2000).

The data obtained by utilizing a t-test for Algebra II indicated that the difference in the group mean values was -1.56. This difference between mean values was not significant at the 0.05 level of significance. Therefore, differences in building conditions did not produce significantly different means for this subtest.

The data obtained by utilizing a t-test for Reading, Geometry, Chemistry, and United States History indicate a significant difference between the test scores of students in standard buildings and test scores of students in substandard buildings. However, this t-test demonstrates that the means have a negative mean value that is large enough to be significant at the 0.05 level of significance. Therefore, economically disadvantaged students in substandard building conditions outperformed economically disadvantaged students in standard buildings. This is inconsistent with the research literature dealing with the achievement of all students in these two building conditions (Edwards, 1991; Cash, 1993; Earthman, Cash, Van Berkum, 1995; Hines, 1996; Lanham, 1999; O'Neill, 2000).

In summation, the results of the analysis indicated mixed results and an inconsistent relationship between building conditions and the achievement of economically disadvantaged students. Therefore, the conclusion is that the condition of the school building influence on the achievement of economically disadvantaged students when they are housed in inferior buildings is inconclusive.

Research Question 2

Is there a significant difference between the achievement scores of minority students in buildings rated substandard and standard in high schools in the Commonwealth of Virginia?

The t-test for dependent variable means across independent variable categories used in analyzing research question two revealed that there were several significant differences between the test scores of minority students in standard buildings and test scores of minority students in substandard buildings. This included the following measures of student achievement: Reading, Algebra I, Earth Science, Biology, Chemistry, World History I, and United States History. This is consistent with the research literature dealing with the achievement of all students in these two building conditions (Edwards, 1991; Cash, 1993; Earthman, Cash, Van Berkum, 1995; Hines, 1996; Lanham, 1999; O'Neill, 2000).

The data obtained by utilizing a t-test for Geometry and Algebra II indicated that the difference in the group mean value was 0.69 and -1.09 respectively. These differences between mean values were not significant at the 0.05 level of significance. Therefore, differences in building conditions did not produce significantly different means.

The data obtained by utilizing a t-test for World History II indicate a significant difference between the test scores of minority students in standard rated buildings and test scores of minority students in substandard rated buildings. However, this t-test demonstrates that the means have a negative mean value that is large enough to be significant at the 0.05 level of significance. Therefore, minority students in substandard building conditions outperformed minority students in standard buildings. This is inconsistent with the research literature dealing with the achievement using all students in these two building conditions (Edwards, 1991; Cash, 1993; Earthman, Cash, Van Berkum, 1995; Hines, 1996; Lanham, 1999; O'Neill, 2000).

In summation, the results of the analysis indicated a positive relationship between building conditions and the achievement of minority students in the majority of the achievement measures. This can be measured in significant differences in seven subtests of the SOLs for students in standard buildings. Therefore, the conclusion is that the condition of the school building does in fact influence the achievement of minority students when the building is in poor condition.

Discussion

Data collection, analysis, and examination led the researcher to a number of conclusions. The following implications are based on research results, and they are presented with the hope that additional data will be gathered by other researchers to test the validity of each suggestion.

Since the variable of overall building conditions is a significant factor for most measures of student achievement for minority students; division administration, local elected officials, and state level legislators need to consider the impact poor building conditions have on the achievement of minority students. Division administrators should examine the ripple effect that the significant difference indicated in the Standards of Learning Reading test seems to have on the areas of science and history in which significant differences were found. Without the ability to read on grade level and decode words properly, it is difficult for minority students to pass the SOL tests in other academic areas. These results help to confirm the troubling indication that minority students in inadequate facilities are finishing high school with a reading level that does not match their degree as stated by Kozol (1991).

These results would seem to have more significance than some previous studies that utilized norm referenced tests rather than criterion referenced tests utilized in this study. A norm referenced test measures broad skill areas sampled from a variety of textbooks, syllabi, and the judgments of curriculum experts. Each individual is compared with other examinees and assigned a percentile rank or stanine. A criterion referenced test measures specific skills which make up a designated curriculum. Each individual is compared with a preset standard for acceptable achievement. The performance of other examinees is irrelevant. Therefore, a criterion referenced test levels the playing field for all students regardless of race.

When minority students in two different building conditions are taught the same objectives by certified teachers and are administered a criterion referenced test, any significant difference between student scores could be attributed to the difference in the building conditions among other variables. The significant differences found between the achievement of minority students in standard building conditions and the achievement of minority students in substandard building conditions indicate the need for school administrators to address this factor when searching for ways to close the achievement gap for minority students.

The results from this study indicate a relationship between the building conditions and minority student achievement on the reading assessment. This is similar to the results found in the Cash study which found a difference of four percentile ranks in reading comprehension scores of students in substandard versus above standard building conditions. This is also the case in Hines' study which found a difference of fifteen percentile ranks. In Lanham's study, the variable found to be significant in explaining the differences in English 3 results among schools was not the overall building conditions. The specific variables that were found to be significant included ceiling type, air conditioning, site size, and sweeping frequency. English 5 results did not indicate any factors related to overall building conditions. Again, in O'Neill's study, significance was found between the top 25% and bottom 25% of school facilities regarding the percentage of eighth graders passing reading.

The results in the Cash, Hines, Lanham, and O'Neill studies indicate a relationship between building conditions and student achievement on the math assessment. As in English, Lanham's results were not significant for overall building conditions but were significant for air conditioning and room structure. In this study, the results indicated significance only in Algebra I and not in Geometry or Algebra II with minority students scores in substandard versus standard building conditions. There is a difference in the results of the studies when examining Geometry and Algebra II. Algebra I results in this study are consistent with the past studies. This may be due to the fact that all students are required to take the Algebra I test and only those students enrolled in the advance study diploma track have to take Algebra II. Therefore, a different group of students classified as advanced may be accounting for the results instead of the entire minority population.

The results from this study indicate a relationship between the building conditions and minority student achievement on the science assessments. This is similar to the results found in the Cash study which found a difference of five percentile ranks in science. This is also the case in Hines' study which found a difference of nine percentile ranks.

The results from this study indicate a relationship between the building conditions and minority student achievement on the history assessments. This is similar to the results found in the Cash study which found a difference of three percentile ranks in social studies. This is also the case in Hines' study which found a difference of eleven percentile ranks.

There were four common subtests where significant differences were found for both economically disadvantaged students and minority students in buildings rated standard. These included Algebra I, Earth Science, Biology, and World History I. These subtests are all similar in the fact that all students are required to take these tests. Algebra II, Geometry, Chemistry, and World History II are usually taken by only those students trying to complete an advanced study diploma. Reading and U.S. History are eleventh grade tests and students do not have to pass U.S. History in order to graduate. The Reading test may be affected by students earning a modified standard diploma that do not have to take the test. These differences between the tests are explained when examining the number of students taking each subtest.

Again, the similarities between the results of previous studies and with the significant differences found between the achievement of minority students in standard building conditions and the achievement of minority students in substandard building conditions indicated in this study, there is a need for school administrators to address this factor when searching for ways to close the achievement gap for minority students.

Due to the mixed and inconsistent data found between the economically disadvantaged students in building conditions rated standard and economically disadvantaged students in building conditions rated substandard, there is concern with who uses the instrument to evaluate the building conditions. In other words, principals that rated the building conditions are usually coming from far different experiences than economically disadvantaged students. Buildings that principals rated as substandard may in fact have been considered standard or above standard in the mind of an economically disadvantaged student. Therefore the environment that the principal is rating substandard may in fact be a better environment than the student experiences at home. Thus, lessening and sometimes eliminating the effect of poor building conditions on students identified as economically disadvantaged.

As shown in Table 25, the results obtained for economically disadvantaged students vary on certain subtests and are inconsistent with the research literature in certain subtests pertaining with the achievement of all students. This result is also inconsistent with the results found in this study with the achievement of minority students in the two building conditions. Nine differences in student scores were found in this study when comparing economically disadvantaged students in substandard and standard

Table 25

Comparison of the Results of Economically Disadvantaged Students and Minority Students with Previous Studies of Cash (1993) and Hines (1995)

TESTS	EDA	Minority	Cash	Hines
Reading	-10.04	6.3	4	15
Algebra I	3.3	3.8		
Algebra II	-1.56	-1.1		
Geometry	-4.47	0.69		
Math			4	17
Earth Science	2.1	8.1		
Biology	2.91	9.3		
Chemistry	-5.39	6.1		
Science			5	9
World Histroy I	5.48	25.3		
World History II	13.59	-6.5		
U. S. History	-15.15	9.4		
History			3	11

Note: EDA is the mean differences in economically disadvantaged student scores between the two building conditions on the Virginia SOLs.
Minority is the mean differences in minority student scores between the two building conditions
on the Virginia SOLs.
Cash is the percentile rank difference in student scores between the two building conditions on
the Test for Academic Proficiency
(TAP).
Hines is the percentile rank difference in student scores between the two building conditions on
the Test for Academic Proficiency
(TAP).

buildings. Five indicated a positive relationship and four indicated a negative relationship.

In addition to these mixed results, the mean differences in the scores with a positive relationship are all small compared to the other results found in the study. Therefore the relationship between the achievement of economically disadvantaged students and building conditions found in this study may indicate the impact of their home environment and conditions outside of the school setting as having the most impact on their achievement as a subgroup.

Usually poverty is the main factor in determining success in school, whereas, race is not a main factor in determining student achievement. Yet data from this study showed that there were differences in student scores between the two groups of students when race was a factor. Howley and Bickel (2000) did find in their study examining 13,600 schools in four states that all four states showed a correlation between poverty and low achievement that was 10 times stronger in larger schools than in smaller ones. While the research found that the relationship between poverty, school size, and achievement did not depend on race. In this study, the majority of schools rated standard where larger than the schools rated substandard. This fact may have affected the results for economically disadvantaged students in the two building conditions.

Generational poverty, parent involvement, and the lack of resources in the home may all be factors that are impacting the economically disadvantaged students outside of the school environment. These factors are important to investigate as educators continue to try to close the achievement gap of economically disadvantaged students.

Recommendations for Future Research

1. A research study could be conducted that would utilize a qualitative analysis to examine the relationship between building conditions and economically disadvantaged students' and minority students' attitudes toward school. This type of inquiry might provide insights pertaining to the influence that overall building conditions have that were not possible to explore through a quantitative inquiry. A survey instrument or interview protocol could be constructed to collect responses from students on how they feel about certain conditions in their school and how certain conditions may affect them physically or mentally.
2. A research study could be conducted examining the relationship between the same subgroups utilized in this study and building conditions categorized as structural and cosmetic. This would enable researchers to investigate specific conditions within the buildings.
3. A research study could be conducted with more complete breakdown of the minority subgroup. African-American, Hispanic, Asian-Pacific, and Native-American subgroups could be utilized instead of the overall category of minority. This study had African-Americans as the largest subgroup under the heading of minority students. The other subgroups should be broken out to examine the true effect on each minority subgroup.
4. A research study could be conducted using the subgroup of minority students in a longitudinal approach. The Virginia Standards of Learning Tests are administered each year in Virginia which lends itself to a longitudinal study. All students are

given an identification number in Virginia. This number follows them if they transfer schools or school divisions in the state of Virginia. Therefore, once the researcher has identified the schools in the study, the students in the study can be tracked from year to year.

5. The present study should be replicated and the size of high schools could be controlled to eliminate the effect of small school size and large school size that may have existed in this study.
6. The present study should be replicated and eliminate the use of the Algebra II test, the World History II test, and the Chemistry test. These classes and tests are traditionally taken by advanced study diploma students. The rest of the tests are taken by everyone. Therefore, when examining the data, the researcher is examining only the above average students identified in the subgroups of economically disadvantaged and minority. This could attribute to the inconsistencies found in the data in this study.
7. A study could be conducted on student attitudes towards the building conditions and student achievement. A study could be completed using the attitudes of students in substandard and standard school buildings and then comparing student achievement between the two groups of students. Then the researcher could conduct an independent samples t-test using the Standards of Learning tests or some other assessment tool.
8. A study could be conducted to investigate the relationship of financial ability and school building conditions. As stated earlier, Kozol (2005) reported on the academically ill equipped buildings serving mainly poor black and Hispanic

children. A survey can be completed to categorize buildings into two categories such as standard and substandard and then examine the relationship between financial resources, amount of funds spent on facilities, and maintenance and operations by the school divisions.

REFERENCES

Black, S. (2004). "Unfinished business: The persistence of racial inequality in the nation's classrooms. Retrieved on August 17, 2006 from: www.asbj.com

Brannon, W. (2000). *A study of the relationship between school leadership and the condition of school buildings.* Unpublished doctoral dissertation. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Cash, C. (1993). *A study of the relationship between school building condition and student achievement and behavior.* Unpublished doctoral dissertation. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Cheng, Y.C. (1994). Classroom environment and student affective performance: An effective profile. *Journal of Experimental Education, 62(3), 221-239.*

Crook, J. (2006). *The relationship between the percentage of students' passing the standards of learning examinations and the condition of the educational facilities in the high schools in the Commonwealth of Virginia.* Unpublished doctoral dissertation. Blacksburg, VA: Virginia Polytechnic Institute and State University.

Duke, D.L., Griesdorn, J., Gillespie, M., and Tuttle, J.B. (1998). *Where our children learn matters: A report on the Virginia school facilities impact study.* Charlottesville, VA: The Thomas Jefferson Center for Educational Design.

Earthman, G.I., Cash, C.S., and Van Berkum, D. (1995). *A statewide study of student achievement and behavior and school building condition.* Council of Educational Facility Planners, International (CEFPI) Annual Meeting, Dallas, TX.

Earthman, G.I. (2002). *School facility conditions and student academic achievement.* UCLA's Institute for Democracy, Education, & Access. Los Angeles, California.

Earthman, G.I. (2004). *Executive Summary: Prioritization of 31 criteria for school building adequacy.* American Civil Liberties Union Foundation of Maryland. Baltimore, MD.

Edwards, M.M. (1991, May). *Building conditions, parental involvement and student achievement in the D.C. public school system.* Unpublished master's thesis, Georgetown University, Washington, D.C.

Friedkin, N and Necochea, J. (1988). School Size and Performance: A Contingency Perspective. *Educational Evaluation and Policy Analysis*, 10 (3), 237-249.

Gabler, J. (1987). School buildings need to become more inviting. *The School Administrator, 44*(6), 6.

Hawkins, H.L. & Lilley, H.E. (1998). *Guide for school facility appraisal.* Phoenix, AZ: The Council of Educational facility Planners International.

Heiman, G.W. (2001). *Understanding research methods and statistics* (2nd ed.). Boston: Houghton Mifflin Company.

Hines, E.W. (1996). *Building condition and student achievement and behavior.* Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University.

Howley, C. (1996). Compounding Disadvantage: the Effects of School Size and District Size on Student Achievement in West Virginia. *Journal of Research in Rural Education*, 12 (1), 25-32.

Howley, C. & Bickel, R (2000). “When it Comes to Schooling . . . Small Works: School Size, Poverty, and Student Achievement,” *Rural School and Community Trust*, Randolf, VT.

Huang, G. and Crowley, C. (1993). Mitigating Disadvantage: Effects of Small-Scale Schooling on Student Achievement in Alaska. *Journal of Research in Rural Education* 9(3), 137-149.

Kennedy, M. & Agron, J. (2004, March 1). No buildings left behind. *American School & University,* Retrieved August 12, 2005, from http://asumag.com/mag/university_no_buildings_left/index.html.

Kozol, J. (1991). Savage inequalities: Children in America's schools. New York, NY: HarperCollins

Kozol, J. (2005). The Shame of the Nation: The Restoration of Apartheid in America, Crown Publishers: New York, NY.

Lackney, J.A. (1994). *Educational facilities: The impact and role of the physical environment of the school on teaching, learning and educational outcomes.* Milwaukee, WI: University of Wisconsin-Milwaukee, Architecture and Urban Planning Research.

Lanham III, J. W. (1999). *Relating building and classroom conditions to student achievement in Virginia’s elementary schools.* Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University.

Lemasters, L.K. (1997). *A synthesis of studies pertaining to facilities, student achievement, and student behavior.* Blacksburg, VA: Unpublished doctoral dissertation, Virginia Polytechnic Institute and State University.

Lewis, A., et al. (1989). *"Wolves at the schoolhouse door: An investigation of the condition of public school buildings.* A Report of the Education Writers Association. Washington, D.C.: Education Writers association.

McGuffey, C. (1982). "Facilities." Chapter 10, Herbert Walberg (ed.) Improving Educational Standards and Productivity. Berkeley: McCutchan Publishing Corp., PP 237-288.

National Center for Education Statistics. (2005). *A profiled of the American high school sophomore in 2002: Initial results from the base year of the education longitudinal study of 2002.* NCES 2005-338. Washington, DC:USDOE.

O'Neill, D. J. (2000). *The impact of school facilities on student achievement, behavior, attendance, and teacher turnover rate in Central Texas middle schools.* Unpublished doctoral dissertation, Texas A&M University.

Schulte, B.& Keating, D. (2001). "Pupils' Poverty Drives Achievement Gap." *Washington Post.* Retrieved August 17, 2006 from: www.washingtonpost.com

Strange, M. (2005). "Small Schools, Poverty, and the Achievement Gap," *School Business Affairs*; v71 n5, May.

U.S. General Accounting Office. (2002). *School finance: Per-pupil spending differences between selected inner city and suburban schools varied by metropolitan area.* GAO-03-234. Washington, DC:GAO.

U.S. General Accounting Office. (1995a). *School facilities: Conditions of America's schools.* GAO/HEHS-95-61d. Washington, DC:GAO.

Weinstein, C. (1979). "The Physical Environment of the School: A Review of the Research." Review of Educational Research. Vol. 49, No. 4, Fall, 1979, PP. 577-610.

APPENDIX A

E-mail from Dr. Cash Granting Permission to Utilize Theoretical Model

You have my permission to use the theoretical model as you have requested. Thanks.

Carol Cash

-----Original Message-----
From: James Thornton [mailto:JTHORNTON@cucps.k12.va.us]
Sent: Thursday, November 02, 2006 12:17 PM
To: ccash@hanover.k12.va.us
Subject: Permission to use Theoretical Model

Dr. Cash:

I am requesting permission to utilize your Theoretical Model as the model for my Dissertation on Building Conditions and Student Achievement for the subgroups Identified as Economically Disadvantaged and Racial Minority in High Schools in Virginia.

Sincerely,

James Thornton

James Thornton
Division Superintendent
Cumberland County Public Schools
P.O. Box 170

APPENDIX B

IRB Approval

VirginiaTech

Office of Research Compliance
Institutional Review Board
1880 Pratt Drive (0497)
Blacksburg, Virginia 24061
540/231-4991 Fax: 540/231-0959
E-mail: moored@vt.edu
www.irb.vt.edu
(FWA00000572 expires 7/20/07)
IRB # is IRB00000667.

DATE: September 20, 2006

MEMORANDUM

TO: Glen Earthman
James Thornton

FROM: David M. Moore

SUBJECT: **IRB Exempt Approval:** “ A Study Examining the Relationship Between School Building Constructions and The Achievement of Students Identified in the Subgroups of Economically Disadvantaged and Minority in the High Schools in the Commonwealth of Virginia” , IRB # 06-487

I have reviewed your request to the IRB for exemption for the above referenced project. I concur that the research falls within the exempt status. Approval is granted effective as of September 19, 2006.

As an investigator of human subjects, your responsibilities include the following:

1. Report promptly proposed changes in previously approved human subject research activities to the IRB, including changes to your study forms, procedures and investigators, regardless of how minor. The proposed changes must not be initiated without IRB review and approval, except where necessary to eliminate apparent immediate hazards to the subjects.

2. Report promptly to the IRB any injuries or other unanticipated or adverse events involving risks or harms to human research subjects or others.

cc: File

Invent the Future

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

Vita

JAMES D. THORNTON

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FARMVILLE, VIRGINIA 23901
(434) 392-5358 (Home)
(804) 492-4212 (Work)
(804) 492-4818 (FAX)
E-Mail: jthornton@cucps.k12.va.us

EDUCATION:

Virginia Tech
Blacksburg, Virginia
Doctorate of Education – Education Leadership and Policy Studies-2006

Virginia State University
Petersburg, Virginia
Masters of Science – Administration/Supervision - 1998

Longwood University
Farmville, Virginia
Bachelor of Science - Mathematics -1985

TEACHING EXPERIENCE:

Cumberland County Public Schools
Cumberland, Virginia
1991 - 1995: Secondary Mathematics Grades 9-12

King and Queen County Public Schools
King and Queen, Virginia
1989 - 1991: Secondary Mathematics Grades 8-12

ADMINISTRATIVE EXPERIENCE:

Superintendent of Schools, 2004-Present
Cumberland County Public Schools
Assistant Superintendent, 2001 – 2004
Cumberland County Public Schools
Principal, 1998 – 2001
Cumberland County Middle School
Assistant Principal, 1995 – 1998
Cumberland County Middle School

ENDORSEMENTS:

Division Superindent License
Administration and Supervision (Pre K-12)
Secondary Mathematics Grades 9-12
(Education technology standards have been met)

PROFESSIONAL ASSOCIATIONS:

Virginia Association of Secondary School Principals, 1995- Present
Virginia Education Association, 1989 -1995
Phi Delta Kappa, 1998-Present
Virginia Association of School Superintendents, 2001-Present
Virginia School Board Association, 2004-Present

HONORS:

Community Builder Award from the Masonic Order, 1996
Unsung Hero Award from Scales Family for community service, 1996
James River District Coach of the Year, 1997
Associated Press, Virginia Single A, Coach of the Year Football, 1997

ACCOMPLISHMENTS:

Fully Accredited School Division, 2005-2006
Successfully negotiated and implemented a laptop initiative that supplied all high school students with a Dell laptop
Prepared and presented the 2002-2003 school budget that was fully funded
Managed a curriculum re-alignment program for Cumberland High School
Instituted a Senior Project Program to raise standards for graduating seniors
Implemented a pilot Math Lab with Cortez Management Group
Developed and implemented a Character Education Program at the ninth grade level, in cooperation with the Cumberland Elementary School

COMMUNITY SERVICE:

Chairman of the steering committee for Cumberland's Promise through the America's Promise program, lead by General Colin L. Powell (Ret.)
Cumberland Ruritan Club, 2001-Present
Chairman/Board Member of Cumberland County Public Schools Foundation, 2001 - 2006
Prince Edward County Dixie Youth League Coach, 1987 – 1989, 1999-Present
Cumberland County Youth League Football Coach, 1999-Present

PRESENTATIONS:

Speaker at the Virginia Association for Supervision and Curriculum Development (VASCD) Conference. Topic: Students in Action: Redesigning the Secondary Learning Experience, November 2006.

Speaker at the Virginia School Board Association (VSBA) Conference. Topic: Business Approach to School Reform: Pay Performance and Innovative Scheduling, November 2006.

Speaker at the VSBA Governor's Conference. Topic: Pay Performance, July 2006.