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

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Abstract

The purpose of this study was to examine the relationship between the percentages of students' passing the Standards of Learning (SOL) examinations and current building condition of the high schools in the Commonwealth of Virginia. The first research question examined the relationship between the percentages of students passing the SOL examinations in school buildings that are assessed as substandard and standard. The second research question examined the difference between the percentages of students passing the SOL examinations in school buildings that are assessed structurally as substandard or standard. The third research question examined the difference in the percentages of students passing the SOL examinations in school buildings that are assessed as cosmetically substandard and standard.

This study consisted of three major data components. The first component was the percentages of students passing the SOL examinations in the high schools in the Commonwealth of Virginia. The second component was the responses of principals to the Commonwealth Assessment of Physical Environment (CAPE) assessment. This instrument required an assessment of the condition of the school building. The final data was the percentage of students participating in the free and reduced lunch program which served as a measure of control for the socioeconomic status of each student body.

The CAPE responses were used to compile descriptive statistics, pair-wise comparisons, and correlations. Schools were given a rating and placed into either standard or substandard condition based on the principals' responses on the CAPE. Once the two categories were identified, the percentages of students passing specific subtests of the SOL examinations were compared in standard and substandard condition to determine the relationship.

The findings in this study indicate there is a significant relationship between building conditions and the percentages of students passing the English writing and reading SOL examinations. This study supports previous research studies that found that building condition does have a relationship with student achievement. As the need for high quality educational experiences increases, school boards should examine the available research relating to the condition of the educational facility and its impact on student achievement.

Dedication

This paper is dedicated to my loving wife Cindy whose patience and support helped motivate and inspire me to complete this task. Without her constant encouragement, I would not have been able to complete this dissertation. My two boys, Tyler and Jacob, who constantly referred to me as “Dr. Dad” helped remind me of the importance of family and perseverance. The many prayers that were said to help me along the way were always helpful. My parents, Betty and Orville, who always kept pushing me to complete the task and my sister Angie and brother-in-law Tom who were both a source of inspiration. My mother-in-law, June, who provided me with the extra support needed to finish a task once you start it. I want all of my family to know that this was a true team effort and I am forever in debt to them for their constant support.

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Chapter 1

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

Introduction

The physical condition of the nation's public schools has been a major topic of discussion among policy makers, educators and parents. Research studies describe some of the poor school conditions that currently exist in schools, which include: poor ventilation, broken plumbing, and overcrowding. All of these conditions have raised concerns about the effects of the physical condition of the school on student achievement (Nakamura, 2000; Seymour, 2000).

In older schools that do not have the necessary building components for successful learning the facility contributes to decreased student achievement (National Center for Educational Statistics, 2000). Many of the older buildings have outdated electrical systems, thereby creating a weak infrastructure and limiting access to Internet and technological opportunities. The United States Department of Education produced a comprehensive study of the condition of America's public school facilities and found the average age of educational facilities is 40 years old (National Center for Educational Statistics, 2000).

Studies in the business world have been conducted and found employee production is influenced by the condition of the facility (Eilers, 1991, Glassman, Burkhart, Grant, & Vallery, 1978). Climate control, illumination, acoustics, and the inner space of a facility are characteristics that have been found to negatively affect worker

production. In the business world, facilities often are renovated or replaced in order to improve production and profits (Lexington, 1989).

Research studies by Cash (1993), Hines (1996), and Lanham (1999) have found a positive relationship between the condition of the educational facility and student achievement. Cash found a variance from 2 to 5 percentile rank points between the scores of students in substandard and standard buildings on the Test of Academic Proficiency (TAP). Rural high schools in the Commonwealth of Virginia were used as the population for this study.

Hines (1996) assessed urban schools in the Commonwealth of Virginia and used the TAP results to determine the relationship between student achievement and building condition. The percentile rankings revealed a minimum variance of .42 which was found in the written expression subtest in cosmetic standard condition buildings and a maximum variance of 11.36 which was found on the sources of information subtest in the overall building condition buildings based on the TAP results. This percentile variance existed between substandard and above standard buildings.

Lanham (1999) concluded that certain building and cosmetic characteristics, when combined with socioeconomic status can explain some of the variance in the Standards of Learning (SOLs) scores. His study found that the free and reduced lunch percentages accounted for the most significant variance among test scores in third and fifth grade students. In reviewing third grade English scores, the variance was 48 percent and 52 percent respectively. For each additional percentage of free and reduced lunch participation, the English assessment score declined by .82 percentage points.

Improving certain building characteristics such as air conditioning can improve student scores on standardized tests. Air conditioning was found to be a significant factor in three of the five multiple regression analyses conducted by Lanham (1999) and were conducted as well in the Cash (1993), Hines (1996), and Earthman, Cash, and VanBerkum (1995) studies. Building cleanliness also was considered a factor in three of the five multiple regression analyses that were conducted. This was also found to be true in the Hines (1996) study.

The findings of the Cash (1993) and Hines (1996) studies were basically the same, yet the studies differed dramatically in the range of differences. The differences between percentile points in the studies ranged from plus two to seven percentile points in the Cash (1993) study and from seven to 19 percentile points in the Hines study (1996). This difference in range of scores presented an interesting phenomenon that provides a unique opportunity to investigate why these differences occurred. A study that used the combined populations of the previous studies might have provided some new findings regarding this phenomenon. Comparison of the results of such a study with the previous research studies would help to determine consistency in research findings. Replication of these research studies would be an important way to extend knowledge on the importance of the relationship between building condition and student achievement by using the entire population of grades 9-12 high schools in the Commonwealth of Virginia.

Statement of the Problem

This study investigated the possible relationship between the physical condition of the school facilities and the percentage of students' scores on the Standards of

Learning Examinations using all of the high schools in the Commonwealth of Virginia as a population while controlling for socioeconomic status of the student body.

Research Question

What is the relationship between the percentage of students passing the SOL Examinations and the condition of the educational facilities?

Research Sub-Questions

1. Is there a difference between the percent of students passing the SOL Examinations in school buildings that are assessed as substandard and standard?
2. Is there a difference between the percent of students passing the SOL Examinations in school buildings that are assessed structurally as substandard or standard?
3. Is there a difference in the percentage of students passing the SOL Examinations in school buildings that are assessed as cosmetically substandard and standard?

Significance of the Study

Recent educational reform has placed a high emphasis on standardized test scores and instructional change without mentioning the relationship between the educational facility and student achievement. As Cash (1993) reports, “facilities account for a substantial amount of local investment in education and should provide the most effective support of student performance” (p. 9). As the need for high quality educational experiences increases, school boards should carefully examine the available research relating to the condition of the educational facility and its impact on student achievement.

Studies in Virginia have examined rural and urban high schools and elementary schools. This research study was important to identify any differences found when

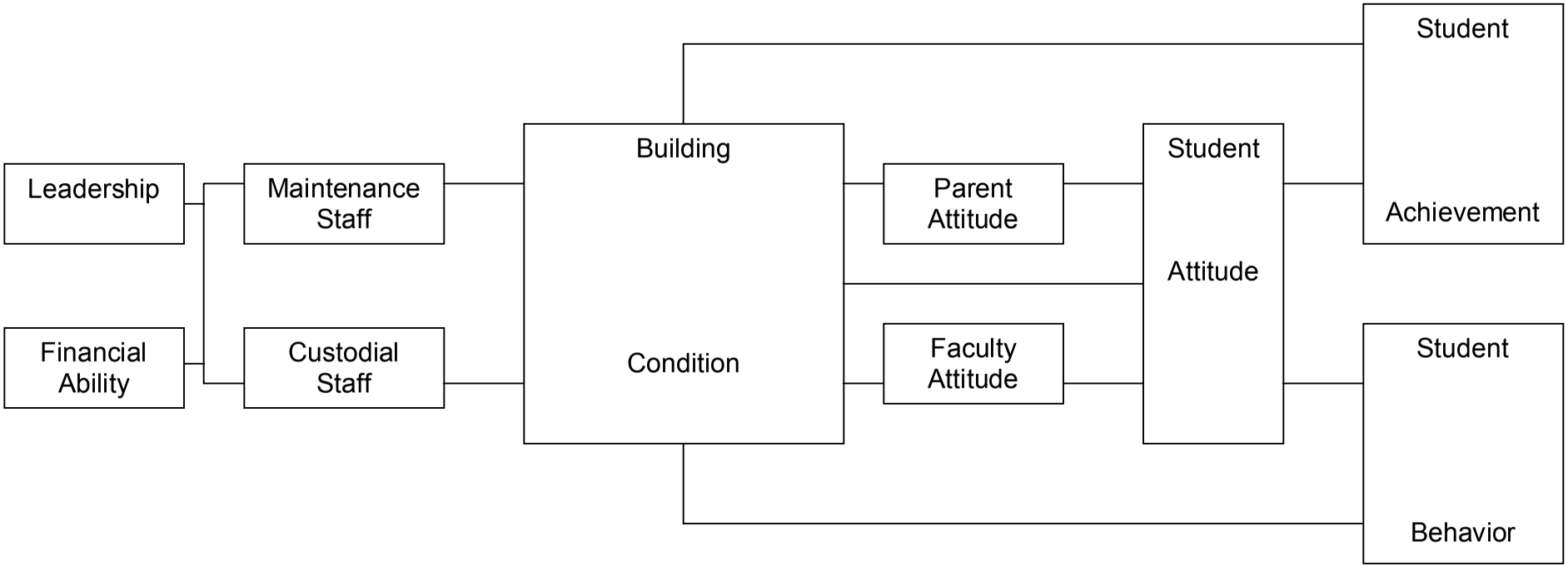
comparing the findings with previous research conducted by Cash (1993) and Hines (1996). The research findings are available to superintendents to discuss with their local school boards. Discussions may result in improved educational facilities, which may improve students' scores on Standards of Learning Examinations.

Theoretical Description

This study was guided by the premise that conditions of educational facilities have a direct relationship with the percentage of students' passing percentages on the Standards of Learning examinations when controlling the socioeconomic condition of the student body. Cash (1993) developed a theoretical model that was used to explain the relationship between school building condition and student achievement and behavior. The theoretical model also explains precursory relationships that influence the condition of the school building. Other research studies Hines (1996) Lanham (1999) have used the Cash (1993) theoretical model.

For this research the Cash (1993) model (Figure 1) was used to provide consistency among the studies. The theoretical model used for this study was found useful in explaining the relationship between the components of the model that deals with school building condition and student achievement and behavior. The theoretical model (Cash, 1993) illustrates how the building condition may directly or indirectly influence student achievement.

The theoretical model suggests that the condition of the school building may be influenced by several factors. These factors are the leadership and financial ability of the school division. The leadership of the schools includes members of the school board, the superintendent, and school principals (Cash, 1993).



Model Design (Cash, 1993, p.4)

Figure 1

The level of expectation that school leaders have about the condition of the building will determine the effort they make in providing sufficient maintenance and operations staff. High expectations may lead to increased training for maintenance staff to provide best practices for maintaining a high quality building. The financial ability of the school division also determines the amount of resources available for maintenance work. These two factors then influence the condition of the school building.

The theoretical model establishes that the building condition affects student achievement and behavior. The sum total of the building condition has a direct influence on student achievement and behavior. Components of the total building condition include the thermal system, lighting, acoustics, color, overall cleanliness of the building, presence of graffiti, condition of the furniture and equipment, the condition of the roof, and the paint on the walls. These major components, plus others, directly impact student achievement and behavior, according to the model.

The condition of the building may have a direct impact on parent and faculty attitudes, which then directly impact student attitudes. When parents and faculty members emphasize the importance of the condition of the building the students will then reflect the attitude they observe. A level of importance may be placed on maintaining a quality school environment, which may lead to a high quality educational facility.

Positive student attitudes may reduce vandalism or poor maintenance of the facility. Parent and faculty attitudes are indirectly related to student

achievement and behavior. Parents may have an impact on student attitudes because the student may reflect the attitude demonstrated by the parent. Teacher attitudes impact student attitudes because the teachers may emphasize maintaining the building. Positive attitudes throughout the educational facility will lead to improved student achievement and behavior.

Limitations

There were various limitations of this study. The first limitation examined the number of students and schools that offered Algebra I for students in the middle schools. Students may be taking Algebra I courses at the middle school which would have an impact on the passing percentages of students in the high schools. Generally speaking, the students taking Algebra I in the 9th grade may be weaker in mathematics courses which could have caused the lower passing percentage on the Algebra I SOLs. The stronger math students at the middle school level would be taking Geometry or Algebra II once they get to high school. This may have created higher Geometry and Algebra II passing percentages in the high school.

Another limitation is the number of respondents for each individual building category on the CAPE assessment. Certain building categories may have had a large number of principals respond to the item. This caused the responses to be not a representative sample concerning the item. For this study, individual factors that had 10 responses or lower were considered not to be a representative sample for the building characteristic.

The percentage of students passing the SOLs may have been different if actual SOL scores were used to measure student achievement. Actual SOL test scores would have been more accurate and would have provided a more represented category of student achievement.

The percentages of students passing the SOLs may have been different if students were categorized in the different categories identified by the Commonwealth of Virginia. The SOL passing percentages are divided into advanced proficiency, pass proficiency, or failed. The cutoff point for this study was the 70 percent pass proficiency.

The manner for which the standard and substandard buildings were identified may have been a limitation. Categorizing the three possible responses into two responses may have caused the responses to cluster around the mean of each individual CAPE item.

The Socioeconomic Status (SES) of students was the second limitation. Some students may qualify for free and reduced lunch, but due to peer pressure may not formally apply and receive this benefit, which may cause inaccurate SES information. Students qualify for free and reduced lunch by mean family income.

Self-administration of the Commonwealth Assessment of Physical Environment was a limitation because the principals were completing the assessment on their individual schools, which may have caused a bias in the findings. Principals may have inaccurately completed the assessment instrument, under-reported, or over-reported the true condition of the building.

The final limitation was the response rate of the assessment instruments. Individuals may not have completed the assessment in a timely fashion. Some principals may have refused to complete the assessment, which could have created less reliable data because a small number of responses will distort the findings. In total, 57 of the 199 principals or 25 percent did not complete the CAPE assessment instrument.

Assumptions

There were a number of assumptions that existed in this study. In trying to control all of the variables the assumption was made that all teachers are certified and licensed by the Commonwealth upon completion of a state approved university program. Therefore, there should be little difference in effectiveness throughout the Commonwealth.

Second, the Commonwealth mandates the basic curriculum all schools must offer. Students are tested on this basic curriculum through the SOL examinations. Therefore, there should be no difference in the curricular offerings throughout the Commonwealth. The curriculum is aligned to the Standards of Learning examinations and consistent throughout the Commonwealth of Virginia.

The final assumption of the study was that the principals were competent enough to adequately assess their building using the Commonwealth Assessment of Physical Environment assessment. Previous research has indicated that principals are very aware of the condition of their buildings and can adequately complete the assessment instrument.

Definition of Terms

For the purpose of this study, the following definitions are provided:

Actual Age – Date the original building was constructed.

Commonwealth Assessment of Physical Environment (CAPE) – Building evaluation instrument developed by Carol Cash (1993) that has been used by local school personnel to determine the condition of educational facilities.

Student Achievement – for this research study, student achievement was based on the students' passing percentages on the Virginia Standards of Learning Examinations in English reading and writing, Algebra I and II, Geometry, Earth Science, Biology, and Chemistry.

Organization of the Study

This study focused on the relationship between the condition of the educational facilities and the students' passing percentages on the Standards of Learning examinations for high schools grades 9-12 in the Commonwealth of Virginia. Chapter 1 includes an introduction, a statement of the problem, purpose of the study, significance of the study, research questions and sub questions, theoretical framework, limitations, definitions and organization of the study,

Chapter 2 includes a review of literature related to the conditions of the educational facility and the relationship with Standards of Learning Examinations. Included is the relationship between the physical and cosmetic features, parental involvement, socioeconomic status, and teacher effectiveness related to the educational facility.

Chapter 3 includes the methodology for the study, background of the SOLs, population, data gathering and data analysis.

Chapter 4 describes the findings of the data collection and methodology of the findings of the research study.

Chapter 5 includes the summary of the findings, discussion, conclusion, and implications for further study.

Chapter 2

Review of Literature

Introduction

The purpose of this literature review was to investigate research studies that focused on the relationship between building condition and student achievement. This topic is crucial in providing data to lawmakers, school boards, superintendents and parents to generate discussion concerning the relationship between educational facilities and student achievement.

The research studies that were examined in this study focused on the relationship between the condition of the educational facility and student achievement. The studies focused primarily on assessing and categorizing the current condition of the educational facility.

In the research studies included in this area of investigation, the researchers first of all determined the condition of the school building in order to be able to compare the scores of students' in either good or poor physical environments. The relationship of student scores and building condition was predicated upon the fact that some buildings were in better condition than others. By comparing these two groups, i.e., good and poor buildings, the researcher could determine how much of an influence the condition of the building plays upon student performance.

There are several methods of determining the condition of the school building for research purposes. Most researchers in this area of study try to make an assessment of the physical condition based upon an evaluation of the building

components using some type of assessment instrument. The instrument usually contains items related to various components of a school that have been found to have some relationship to student performance by previous research to arrive at a total score of the building based upon its condition. These studies base the building condition on an evaluation completed by principals, teachers, parents, directors of maintenance, or any combination of these groups. Some researchers have used engineers or architects to make the assessment of the school buildings using instruments designed to report the physical condition.

Other researchers have used building age as a surrogate for the building condition. In these studies researchers have used a combination of ways to assess the impact of age of building on student achievement. Some studies have compared students housed in old buildings with students housed in new buildings, while other researchers have used the scores of the same students when they have moved to new buildings after being in old buildings. The findings of all of these studies have been consistent in relating age of building to student performance.

Some research studies have explored the relationship between certain design features and student performance. In spite of the fact there are a sizable number of such studies that do not address the relationship between student performance and physical condition of a building, such studies were excluded from review in this chapter.

The present study confined the review of research to those studies that investigate the relationship between student achievement and school building

condition, as measured by an appraisal instrument or by the age of the building. This focused review of research presented a composite of the findings of such research studies to give the reader a complete view of this area of investigation.

Analysis of Research Studies

In this category of study, the results of student standardized test scores in standard and substandard buildings were compared with the condition of the educational facility using the percent of students in the free and reduced lunch program as a control for socioeconomic status.

In one group of studies, the age of the school building was considered a factor that had a direct impact on pupil achievement at elementary, middle and secondary school levels (McGuffey, 1982). School buildings normally deteriorate with age due primarily to use. In addition, weather and lack of regularly scheduled maintenance also contribute to a decline in the building condition (McGuffey and Brown, 1978). The educational facility becomes educationally obsolete primarily due to changes in the educational program for which design characteristics cannot accommodate and because school districts fail to make upgrades and adaptations as technology and education change. McGuffey (1982) states, “Therefore, one can readily associate building condition and obsolescence with school building age” (p. 239).

McGuffey and Brown (1978) studied the interrelationships of the age of classroom units (ACU), socioeconomic status (SES) variables, and student achievement variables using the Iowa Test of Basic Skills (ITBS) for fourth and eighth grades and the Test of Academic Progress for eleventh graders. The

researchers found ACU variables were, either positive or negative, in nine of the eleven tests which included, vocabulary, reading comprehension, language, using sources of information, mathematics, science and social studies for the eleventh graders. Each subject included various sub tests, which addressed specific areas for each content area. The range in variance was between 1.4 to 3.3 percent for achievement scores when compared to the ACU (McGuffey and Brown, 1978). The total variance accounted for by the SES and ACU variables was less than 60 percent for fourth grade, approximately 20 percent for eighth grade and 16 percent for eleventh grade. The results showed a differential effect, both for content and grade level, when the variances of both SES and ACU variables were combined. This study was effective because the findings were found to be significant at >.05 level.

Plumley (1978) investigated the relationship of school building age and the achievement of fourth grade pupils in a random sample of elementary schools using the individual school as the unit of analysis. Seven dependent variables representing scores of six subtests and the composite scores on the Iowa Test of Basic Skills (ITBS) were used in the analyses. There were seven independent variables which included measure of socioeconomic status; race; modernized, partially modernized, or non-modernized buildings; date of building construction; and the date of modernization.

The researcher used a stepwise multiple regression analysis to analyze the data. The findings indicated that the non-modernized buildings accounted for 3.3 percent to 6.4 percent of the variance on three of the five subtests and 5.3

percent on the composite score of the ITBS (Plumley, 1978). The findings of the study indicated that the older the buildings were without modernization components, the lower the composite score on the vocabulary, reading, language, work study and mathematics scores on the ITBS. This study was effective because the findings were found to be significant at >.05 level.

Chan (1979) also investigated the relationship between the age of the educational facility and student achievement of eighth grade students in a random sample of schools in Georgia. The unit of study was the individual building. The dependent variables were the composite score and the subtest scores on the vocabulary, reading, language, work-study, and mathematics sections of the ITBS. The independent variables for the study were SES; modernized, partially modernized, and non-modernized buildings; and the age of the school building.

The researcher used multiple regression to analyze the relationship between the dependent and independent variables and to determine the amount of variance in achievement scores due to the age of the school building (Chan, 1979). An analysis of covariance was used to compare achievement scores among students housed in modernized, partially modernized, and non-modernized school buildings when SES was used as a covariant.

The findings of the research study (Chan, 1979) indicated a statistical significance at the >.05 level between school building age and academic achievement as measured by the composite scores of the ITBS. The results of the study found the analysis of covariance with SES as the covariant indicated

that the achievement scores of pupils assigned to modern schools were consistently higher than students in non-modernized schools. This study was effective because the findings were found to be significant at >.05 level.

The research study conducted by Bowers and Burkett (1987) investigated the possible relationship between students and the age of the building. The study was conducted in rural Tennessee. Two elementary schools in the same school district but with different student populations were compared to determine if the educational facility had an impact on student achievement. One school was modern, and the other was built in 1939. Bowers and Burkett (1987) stated, “The newest school was located on ten acres and contained 33 classrooms with a student capacity of 825 students” (p. 4). The researchers reported, “The structure was constructed of block and brick, included, fluorescent lighting, electric heat and air conditioning, acoustics, color schemes and furniture blended into the building” (p. 6). The other school was described as having a capacity of 584 students and was completed in 1939. An addition was added in 1950.

Both of the elementary schools in this research study served grades kindergarten through eighth. Each of the schools offered an instructional program designed by the local school district and the state curriculum guide as described in the 1986, ‘Rules, Regulations and Minimum Standards of Public Schools in the State of Tennessee.’ Two hundred eighty fourth and sixth grade students were tested to determine their degree of academic achievement. All students were assumed to be from similar socio-economic levels (Bowers & Burkett, 1987).

The analysis of the data was performed using ANOVA, Chi-Square and T-tests to analyze the data and test the researcher's hypothesis. The differences between achievement and attendance were tested using ANOVA. The differences between the groups concerning instances of health and discipline were tested using Chi-square. Differences among attendance were tested using T-tests (Bowers & Burkett, 1987).

The researchers found that students in modern buildings scored significantly higher in reading, listening, language and arithmetic than the students in the older building. The significance was determined to be beyond the established >.01 significance level. The researcher determined that the students in the building with a more desirable physical environment were disciplined less frequently than students in the building with a less desirable physical environment. The difference exceeded the >.01 significance level (Bowers & Burkett, 1987).

Students, in the school building with a more desirable physical environment had significantly fewer major health problems than did students in the buildings with a less desirable physical environment. A T-test was used for the analyses, and the >.01 level of significance was established (Bowers & Burkett, 1987).

The researchers reported that students in the school building with a more desirable physical environment had significantly higher attendance records than did students from the school where the school had a less desirable environment (Bowers & Burkett, 1987).

In summary, the analysis of data revealed that, in every specific case, a significant difference existed between the students at the two schools. Achievement scores in reading, listening, language and arithmetic showed a significant difference with the students in the modern building compared with the students in the older building (Bowers & Burkett, 1987).

The researchers (Bowers & Burkett, 1987) identified the following limitations in their study: “(1) Two schools in one school system in Upper East Tennessee were used for the study. Students in grades four through six of the two schools were the subjects of the study. (2) The two schools were not selected at random. They were selected because of their age and physical environments. (3) No attempt was made to match students from one school with students with similar achievement in the other school where comparisons were made between schools” (p. 8).

The study conducted by Cash (1993) investigated the relationship between specific school conditions, student achievement, and student behavior. She used an analysis of covariance, regression, and correlation analysis to determine the relationship between building condition and student achievement.

Cash (1993) developed a facility assessment instrument and distributed the instrument to school administrators to determine the current condition of the facility. The instrument characterized schools in three different categories: “substandard”, “standard,” and “above standard”. Student achievement was measured by the Test of Academic Proficiency (TAP), which was administered to

all 11th grade students in Virginia (Cash, 1993). Socioeconomic status was measured by the percentage of students on free and reduced lunch.

The populations of the Cash (1993) study included small, rural high schools in the Commonwealth of Virginia. Small schools were defined as schools with senior class membership of 100 or less, and rural schools were identified as those not found in Virginia's eight Metropolitan Statistical Areas (MSAs). Schools that had fewer than 100 seniors but served in an area with more than 2500 students were excluded from this study because they did not fit the criteria established. There were 47 schools in 36 school divisions which had a population of fewer that 100 seniors and were located outside of urban areas (Cash, 1993). Thirty-nine schools were elected to participate in the research study. Each division superintendent was asked to appoint a central administration contact person who could provide achievement data. The socioeconomic data was based on the percentage of students participating in the free and reduced lunch program (Cash, 1993).

A positive relationship was determined to exist between the condition of the school and certain sub-tests in the student achievement tests. The writing scores were higher for students in buildings categorized as having standard building condition than students in buildings categorized as substandard. The highest test scores, however, were found in buildings rated as above standard when compared to student test scores in sub-standard buildings. Student scores in science were in the 50th percentile in substandard buildings and in the 55th percentile in above standard and standard buildings.

As shown in Table 1, the difference between student achievement in substandard and above standard schools shows a minimum +2 percentile points and a maximum of +5 percent. This is determined by the variance in percentile ranks of the various TAP sub-tests.

Table 1: The difference between student achievement in substandard and above standard schools (Cash, 1993).

	Substandard		Above Standard		
Achievement Subtest	Means	PR**	Means	PR**	Difference
Reading	185	47	188	51	+4
Mathematics	179	43	181	47	+4
Written Expression	191	57	193	59	+2
Sources of Information	189	48	193	52	+4
Basic Composite	186	49	189	53	+4
Social Studies	190	48	192	51	+3
Science	190	50	193	55	+5
Complete Composite	187	47	190	52	+5

*Test of Academic Proficiently

**Percentile Rank

Note: Scale Score means have been adjusted for socioeconomic status. The ratio of student receiving free and reduced lunches was used to control for socio-economic status of the school attendance area.

Percentile ranks have been derived from scale score means that have been adjusted for socioeconomic status.

Permission has been obtained from Cash (1993) to reproduce this table.

There was a significant increase in all sub-test score categories from standard to above standard except for science (Cash, 1993). There were several limitations to Cash's study. The survey instrument required local district personnel to assess the building condition. The self- reporting may have created a bias in reporting the accurate condition of the school facility. The second limitation was the variables that possibly could affect student achievement and behavior that were not addressed in the Commonwealth Assessment of Physical Environment instrument. Other factors may not have been addressed in the data

collection. The final limitation was the small number of schools used for the research study.

The study conducted by Earthman, Cash, and VanBerkum (1995) was a statewide study of student achievement and behavior and school building condition including all the high schools in the state of North Dakota. The main purpose of the study was to determine if there was any relationship between the condition of the school building and selected student variables. The selected student variables in this case were the academic achievement of students and their behavior, as in the Cash (1993) study.

The state of North Dakota was selected because the students as a whole score amongst the highest in the nation on the Scholastic Aptitude Test. Second, North Dakota has a population that is mostly rural with only four major metropolitan areas, and the largest metropolitan area has a population of approximately 70,000 residents. The researchers identified this population because it was the logical extension of the Cash study.

The population of the study included 199 high schools ranging in size from 65 to 1200 students. Principals in approximately 60 percent of the population responded to the request for data; this equaled 120 schools. The researchers did a follow-up study of the non-respondents and found there was no difference between the respondent and non-respondent schools.

To determine student achievement, the CTBS for 11^{th} graders was used. The sub groups of this achievement data included scores in the following categories: reading vocabulary, reading comprehension, reading as a total score,

spelling, language mechanics, language expression, language as a total score. The tests also included math sub tests. These math sub tests included: math computation, math concepts and analysis, and math as a total score. Science and social sub tests were also included in these data.

Principals were asked to evaluate their buildings by completing the CAPE instrument. The instrument was used to record the presence or absence of certain building features or components. There were 29 items in which the principals were asked to respond. The results of the evaluation were used to identify a school building in one of three rankings. The top 25 percent of school buildings were identified as being in the above standard category. The middle 50 percent of buildings were identified as in the standard category. The buildings in the bottom 25 percent were classified as below standard.

The items in the CAPE were subdivided into two categories, structural and cosmetic, as in the Cash (1993) study. The cosmetic categories related to how the building looked, such as recent painting, presence of graffiti, and cleanliness. The structural conditions were related to the parts of the building such as air conditioning, presence of windows, lighting and condition of lockers.

The achievement scale score means and percentile ranks on the sub tests of CTBS for 11th grade students and cosmetic building condition included a seven percent difference in reading vocabulary, one percent in reading comprehension, and four percent in total reading. There was an 11 percent difference in spelling and differences between language scores. However, in the language expression subtest there was a four percent difference, and a four

percent difference was found in language as a total score. Math computation included a difference of eight percent. Math concepts and analysis each had a six percent difference. There was a seven percent difference in math as a total score. Science subtest scores included an eight percent difference and in social studies there was a four percent difference. These differences were identified for schools classified as either substandard or above standard building condition.

A comparison of achievement score means and percentile ranks on the subtests of the CTBS for 11th grade students based on the 16 items relating to the structural elements which included varying amounts of differences. In reading vocabulary, the difference was five percent. In reading comprehension there was no difference between scores, and reading as a total score there was a three percent difference. Comparison of the spelling subtest scores revealed a two percent difference. The language subtest scores for language mechanics identified an eight percent difference, language expression five percent, and language as a total score had a five percent difference. The math computation scores were reportedly higher in the substandard schools than the above standard. This difference was ten percent. The math concepts and application and math total differences were three and 12 percent respectively. The total battery was one percent higher in above standard schools, and in the science and social categories the percentages were seven percent higher in the above standard and five percent higher in the substandard schools.

Hines' (1996) study involved selected Virginia urban high schools and examined the relationship between building condition, student achievement and

behavior. The researcher used the same methodology as found in the Cash (1993) study. Test scores from the Test of Academic Proficiency (TAP) measured student achievement for 11th grade students during the 1991-1992 school year. Student behavior was determined by the number of discipline infractions, suspensions and expulsions reported by the schools included in this study. An analysis of covariance, linear regression, and correlation analysis to determine the relationship between building condition and student achievement was conducted to investigate the relationship between building condition and student achievement.

The findings of the Hines (1996) study determined that scaled scores were higher in every category of the TAP achievement tests when substandard building conditions were compared to above standard buildings as determined by the Commonwealth Assessment of Physical Environment (CAPE) assessment instrument. The increase in test scores ranged from 7.16 percentile points on the social studies subtest to 11.63 percentile points on the sources of information subtest which is a test that analyzes student research skills (Hines, 1996).

When comparing the relationship of the condition of the educational facility to student behavior, suspensions were higher in the above standard buildings than in substandard buildings. Expulsions, reports of substance abuse and violence also were higher in the above standard buildings than in substandard buildings (Hines, 1996). Hines reported that the higher reporting of discipline infractions could be attributed to the diligence of the staff to report more discipline infractions. Hines did find that the relationship is not as significant among

standard to substandard buildings when examining suspensions and expulsions (1996). Incidents of behavior were reported at a high rate that may have resulted from a more positive environment.

Based on the ratings from the Commonwealth Assessment of Physical Environment in the Hines (1996) study, when the cosmetic conditions were found to be better, an increase in scores in every subtest of the Test of Academic Proficiency (TAP) achievement test scores were observed. The percentile ranks on the various subtests when related to cosmetic condition of the school had a variance of .20 to 12.92 depending upon the subtest.

The structural building conditions influenced every subtest mean score except the sources of information subtest (Hines, 1996). This was attributed to the schools being in better condition and students provided with a greater opportunity of educational experiences. Those schools categorized as above standard had the benefit of additional science laboratories, which may have improved student scores in the science subtest. Hines (1996) found that when schools are newer, had more windows, and were carpeted, students had higher Test of Academic Proficiency achievement scores (1996). The percentile scores related to structural condition of the school had a variance of 7.16 to 11.63.

Lemasters (1997) completed a review of research studies concerning the relationship between school buildings, student achievement, and student behavior. Her study addressed the question of whether or not the building condition had an impact on student achievement. Lemasters (1997) examined the ways in which the building environment affected two student variables,

student achievement and student behavior. Her literature review consisted of 53 studies that investigated the relationship between building age, room color, lighting condition, overall building maintenance, density, climate, and classroom structure. She found all factors influenced student achievement, with building age, lighting, and noise having the most significant effect.

In Lemasters' (1997) study some type of standardized or norm reference tests measured student achievement. Some type of test was administered to the students involved in the school participating in the study to measure student achievement. Student behavior was measured by the reported incidents of discipline. The data included specific types of behaviors exhibited by the students in the school that was being studied.

The research summary addressed open-education programs and open-space schools, school building age thermal factors, visual factors, color and interior painting, hearing factors, open space, windowless facilities, underground facilities, site size, building maintenance, and numerous other factors (Lemasters, 1997).

All of the studies that were reviewed found a significant relationship between student performance on selected subtests and the condition of the physical environment. Some studies revealed very weak significance. Some of the important factors that were found to have an influence on student achievement were thermal environment, proper illumination, adequate space, and availability of certain equipment and furnishings, especially in the science areas. She added that further research needs to be conducted to continue to

determine if there is a significant relationship between educational facilities and student achievement (Lemasters, 1997).

Lanham (1999) studied the relationship between building condition and student achievement among elementary students in Virginia. A systematic, random sample of 300 Virginia elementary schools that included grades three through five were included in the population. Data were compiled on the current building condition, classroom condition and demographics. Information was gathered from the responses on a building assessment completed by the principal of the building. The instrument included all items in the CAPE assessment instrument with added items to address the technology status of the elementary schools participating in the study (Lanham, 1999). The assessment was distributed to the principals of the schools participating in the study. The building principals were asked to complete 32 questions rating specific features of their school building and classrooms. Lanham (1999) stated, “Part 1 of the survey included general questions (1-11) regarding the school building. Part 2 of the survey included questions (12-28) relating the school’s classrooms. Finally, part 3 included questions (29-32) aimed at obtaining general information regarding the schools” (p. 78). Principals were asked to use their own judgment and experience when completing the assessment instrument. The principals then mailed their completed assessment instruments to the researcher for data computation.

Results of the Standards of Learning Examination were used from the 1998 administration of the examination for the third and fifth grade mathematics

and English tests. These results were used as the measure for student achievement. The percentage of students who passed the SOLs was used as the measure of student achievement because scaled scores were unavailable (Lanham, 1999).

Lanham reported that 70 percent of the respondents categorized the buildings as well maintained and considered them to be in outstanding condition. Other responses indicated that the overall structural condition of their facility was outstanding or very good (Lanham, 1999).

Various concerns were observed in this study. These concerns were found after Lanham (1999) further investigated the findings. One area of concern that was discovered by Lanham (1999) was the age of the facilities. The researcher stated the age of facilities was a concern because of the number of outdated and older school buildings. Older and outdated facilities are assumed to not provide students with the optimal learning environment. Lanham (1999) reported only 13 percent of the schools were less than ten years old. More than half, 58 percent, of the elementary schools were more than 50 years old, and 35 percent were over 40 years old. On average, the elementary buildings were found to be older than the national average of 40 years old. With the growing number of aging school facilities, the future implications for repairs and maintenance become an issue.

Lanham (1999) reported his findings were consistent with other studies. One category that was often reported in poor condition was the building roof integrity. This was found to be a structural defect in many of the schools. An

analysis of the responses of the CAPE found 47 percent of the respondents reported their respective buildings had roof leaks, and 14 percent reported the roof condition was deteriorating.

The electrical systems in the schools were also identified as a problem by the principals. According to Lanham (1999), many principals reported that their school buildings lacked the ability for expansion of the existing electrical system. Lanham (1999) reported, “Over 57 percent of the principals reported their school building did not meet the generally accepted standard providing for one outlet per wall. Principals reported that an additional problem with inadequate electrical capacity insufficient number electrical outlets to provide for computers and other instructional materials that will support technology” (p. 78).

Lanham (1999) reported that many principals expressed concerns with the heating, venting and air conditioning systems in their building. They described the systems as being outdated or in inadequate condition. Lanham (1999) reported that 68 percent of the principals had problems with regulating the temperature of their buildings.

Lanham (1999) concluded that certain building and cosmetic characteristics, when combined with socioeconomic status can explain some of the variance in the SOL scores (p. 122). Lanham (1999) reported “air conditioning and heating as a significant factor that influenced student scores on the SOLs” (p. 120). In third grade English, air conditioning accounted for 1.6 percent of the variance in SOL scores. Improving the rating of the air conditioning by one point increased scores by 4.6 percent. In fifth grade math, the variance

was 2.8 percentile points and increasing the air condition rating by one point increased test scores by 8.6 points. In fifth grade technology, air conditioning accounted for a 4.6 percent of the variance. Increasing the air conditioning rating did increase the technology SOL scores by 3.1 percentile points.

Earthman authored many research articles and has concluded that there is a relationship between the condition of the educational facility and student achievement. Earthman (1998) reported, “educational facility researchers have investigated the influence of wall color, building configuration, the presence or absence of windows in a classroom, air-conditioning, space allocation per pupil, use of carpeting on the floor, noise levels, thermal conditions, and furniture types upon student performance in an effort to discover a relationship” (p. 3).

Earthman (1998) reported that a large number of the students today attend school in older buildings. Many of the buildings are approaching forty years of age. Many of the older school facilities do not have the necessary components to enhance student achievement.

Earthman (1998) identified, “the biggest problem with the current research concerning the relationship between educational facility condition and student achievement is the lack of replication of sound research studies” (p. 2).

Earthman’s (1998), research provided findings on the relationship of educational facilities and student achievement revealing the extent that thermal environment, proper illumination, space, and equipment and furnishings have on students. Earthman (1998) reported, “In almost all cases, the better the environment is, the more positive the impact on student’s scores: test scores

among students' in substandard buildings compared to students in better school environments differed by five to 17 percentile points" (p. 1).

Edwards (1992) studied the relationship between the condition of the educational facilities and student achievement in the Washington, D.C. public school district. This research study investigated the condition of public school buildings in the Washington, D.C. Public School System, the effects of parental involvement, and how these factors affected student achievement. The Washington, D.C. school district was chosen because the system is comprised of elementary and secondary schools, and there is a wide range of building ages, student populations, and building conditions. The school system included a wide range of socio-economic groups with wealthy and poor areas and a range of diverse cultures.

The condition of the school buildings was obtained from the Parents United parent advocacy group. The D.C. Committee of Public Education (COPE) organized several groups of volunteer maintenance workers, engineers, architects, etc., to visit each school and report on the building conditions and adequacy. The teams were asked to estimate the cost of repairing building deficiencies and gauge whether the buildings were in poor, fair, or excellent condition. The teams were also asked to evaluate the adequacy of the facilities, identify school needs, and recommend if the building should be retained, consolidated, or closed.

Based on the research study, the findings supported the hypothesis that building condition is related to student achievement. In the all schools data set,

four variables were seen as significant predictors of student achievement scores. The first data set was the percentage of White students in the census tract. The second variable was the mean income in the census tract. The third significant variable was school enrollment. The main variable was the building condition of the school.

Edwards (1992) found, for every one percent increase in the White population of the school's neighbor, one could predict an increase of .16 percentage points on the average achievement scores of the schools. The second variable, mean income had an increase for every $1000 increase in mean income indicating an increase of 4.59 percentage points on achievement scores. The third variable, school enrollment, had a negative relationship with student achievement. As enrollment increased, the average percentage of achievement scores decreased. The final variable, building condition, found as one school moved from a building category, poor to fair, average achievement scores were found to increase by 5.45 percentage points. In schools that moved from poor to excellent the scores were expected to increase by 10.9 percentage points. The greatest percentage achievement score was found at the elementary level. Based on the findings of the research study, the building condition when adjusted for mean household income, ethnicity category, school enrollment, and PTA membership, achievement scores were significantly higher in the school buildings in better condition.

Also of significance, the mean income and the racial composition of the area of the school were also found to be significant in all the school models

(Edwards, 1992). Edwards found that the building condition did have a direct relationship with student achievement.

Edwards (1992) stated, “There is little argument that a student’s environment affects his/her achievement. In fact, most organizations advocating educational reform mention the need for improved facilities” (p. 46). One factor cited was that routine maintenance and capital expenditures for building improvement are the first to be cut when funding is an issue (Edwards, 1992).

Edwards stated, “It is unreasonable to expect positive results from programs, educational or otherwise, that operate in negative physical environments. When schools are allowed to deteriorate to the point of having classrooms with falling ceiling plaster, chained fire doors, and non-functioning bathrooms, students question whether society really places a value on them or on education” (p. 8).

Lewis (2000) studied the facility conditions and student test performance in the Milwaukee Public Schools. The study consisted of 139 K-12 Milwaukee Public Schools and examined the effect of the building condition on student test scores compared to other influences such as family background, socioeconomic status, race/ethnicity, attendance, and student discipline. The study used the Wisconsin Student Assessment System (WSAS) mathematics, science, language, and social studies tests of fourth, eighth, and tenth grades of each school in 1996-1998 (Lewis, 2000).

This study examined the relationship between the physical condition and educational adequacy of school buildings, student achievement and behavior.

The study included direct or proxy measures of several of the factors that influenced learning (Lewis, 2000). All of the data were provided by the Milwaukee Public School system. The Construction Control Corporation produced the facility scores from a study conducted in 1991. The test scores were from students in the school district in fourth, eighth and tenth grades (Lewis, 2000).

The data consisted of three separate components: first, the measure of the facility condition and educational adequacy; second, student test scores; and finally, indicators of the characteristics of students in the 139 schools used in the analysis. The facility scores were given the most consideration (Lewis, 2000). The WSAS was a battery of five standardized tests, which included mathematics, science, language and social studies, that are administered to students in the fourth, eighth, and tenth grades.

One significant problem with this research study was that the data were from different school years. There was a five-year gap between the facility evaluation and the first year in which tests were electronically available for all three grade levels. The student characteristic indicators were available for the 1994-95 and 1995-96 school years, one or two years before the tests were available. The student indicators included: attendance, the total number of days of attendance divided by total possible days of attendance; truancy, the number of students absent for either ten or more consecutive days or ten or more days during a semester; suspension, the number of students suspended from the school; mobility, the total number of students who entered or exited a school after the third Friday; free and reduced lunch, the total students receiving free or

reduced price lunches. All of the indicators were converted to standardized scores with a mean of 100 and a standard deviation of ten. The test scores for the 1996-97 school year were used because it was closest to the year in which the facility scores were available (Lewis, 2000).

The facility assessment was measured in four separate measures: Existing Condition Total, Existing Condition Adjusted, Educational Adequacy Total, and Educational Adequacy Adjusted (Lewis, 2000). The Existing Condition scores were based on direct examination of the schools by teams from the Department of Maintenance Staff from the Milwaukee Public Schools Architects. Members of the teaching and curriculum specialist staff produced the educational Adequacy Scores. The adjusted scores were developed from adjusted ratings of the teacher/student ratios to adjust for the Functional Performance scores.

The Wisconsin Student Assessment Scores examined student knowledge of reading, mathematics, language arts (including writing), science and social studies. The 1997-98 scores reflected the percent in each school that performed at or below the proficient level. Each test was divided into four different levels of performance: minimal, basic, proficient, and advanced (Lewis, 2000). Student characteristics were identified into the following categories: attendance, truancy, suspension, mobility, and eligibility for free and reduced lunch.

The research method used for this study was multiple regression analysis. The analysis examined the possibility of a relationship between test performance and the educational adequacy of the schools. Multiple regression was used

because it provided estimates of the affect of the independent variables upon the dependent variables (Lewis, 2000).

Lewis (2000) found many significant relationships between facility condition and student achievement. He found that some of his findings were not always consistent over the number of years or areas of testing, but the numbers of significant variables were greater than expected by chance (Lewis, 2000).

Lewis (2000) identified limitations in his data, which included the gap of time between facility assessments and student test scores. Lewis stated that this gap in time could cause the inconsistency in data because different years may create skewed data from one year to the next.

According to Lewis (2000) his most interesting finding was when in individual ability differences were controlled. He found facility condition may have an impact on student performance more so than many social and economic variables. Lewis stated that historical educational research has found that family background has a much stronger impact on academic achievement, but in his study, differences in individual abilities were controlled, and the measures of school facility condition explained as much of the differences in test performance as did student family backgrounds and socioeconomic status.

Independent relationships of measure of school facilities with performance on the WSAS tests found that 11 of such relationships were significant. The significant relationships for facility measures found ten to 15 percent of the differences in test scores when the other variables were statistically controlled (Lewis, 2000). Lewis (2000) reported, “When simple one-to-one correlations

were calculated between the facility measures and test scores, there were not significant relationships" (p. 11).

In comparison, when Lewis (2000) examined 48 similar estimates of the relationship between measures of family background, which included mobility rates and eligibility for free and reduced lunch, and school attendance and suspension rates, nine of the measures were found to be significant. The variance in test scores was between eight and 28 percent of the differences in test scores.

Lewis (2000) explained that relationships were found to be insignificant when there was a gap in years in the test data. He added that very few relationships existed except with Reading test scores in 1998.

In summation, Lewis (2000) found that with the combination of his research study and the previous research studies conducted, the relationships between the building condition and student achievement are too significant to ignore. He added that the data are significant, and a relationship does exist between the building condition and student achievement.

Schneider's (2002) research study focused on the public school facilities and teaching in Washington, D.C. and Chicago and for the purpose of this literature review the "Problems with the Condition of School Facilities" section will be examined and reviewed. The study was designed to assess the effect of school facilities and teaching, but one component of the study investigated the relationship between the conditions of educational facilities and student achievement.

Schneider (2002) conducted his study in cooperation with the Center for Survey Research at SUNY Stony Brook. The methodology for this study included both telephone and paper version surveys. The Survey Research Center at SUNY, Stony Brook, drew a random sample of teachers from a list of all members of the Chicago Teachers Union, which was comprised of 23,930 teachers, a total of 1796 teachers were randomly selected to participate in the study. Of the 1796 teachers that were included in the sample, 476 were coded as non-household once the interviewing process was completed. The 476 numbers fell into one of four categories; technical phone problems, fax/data line, non-working disconnected, or wrong numbers. Another 68 numbers were non-valid, as those individuals were not currently teaching in the Chicago Public Schools. The total number of valid numbers in the sample was 1252. A total number of 688 interviews were completed, resulting in a response rate of 55 percent.

All of the teachers in Washington, D.C. were sent a paper version of the survey. The surveys were sent to all the teachers in the Washington, D.C. school district, which was comprised of 4821 total eligible teachers. There were 1273 surveys returned which comprised a 26.41 percent return rate. The survey included questions related to the teacher's view of the condition of their respective educational facility.

The effects of the facilities on test outcomes in Washington, D.C. were examined in this study. Schneider (2002) presented his data by comparing the percent of students scoring above 'basic' in schools with the best facilities and

compared them to the schools with the worst conditions. The percentage of student achievement in the two highest categories of the SAT-9 increased by 3 percent for both math and reading. One significant finding was the effect of the change among the best-conditioned schools to the worst conditioned schools was virtually identical for the smaller schools compared to the larger schools. From the results of the surveys, in the schools with the best facility score, reading and math scores were 28 and 24 percent above basic scores. Schools with the worst facility scores, in reading and math scored 25 and 21 percent respectively above basic scores. The smallest schools scored 28 and 25 percent above basic and the largest schools scored 26 and 21 percent above basic math scores.

In Chicago, Schneider (2002) studied the effects of facilities on test outcomes in Chicago. Simple regression models were used to analyze the data. The regression method explained over 76 percent of the variance in the distribution of reading test scores and 65 percent of the variance in math scores. Although Schneider (2002) controlled for demographic factors, the facility score did have an independent effect on test performance. Schneider did find that the size of the school did not have the anticipated effect on test scores. Schneider did find that in Chicago and Washington, D.C. good facilities can add 3-4 points to the percent of students who are working at or above grade level.

The purpose of this literature review was to identify research that addressed the relationship between the conditions of the educational facility with standardized test scores and to identify possible factors that may contribute to

the performance of students. This summation of the literature reviewed the key components of each research study reviewed in this chapter.

Throughout the research studies, the focus was on assessing and categorizing the current condition of the educational facility by using an assessment instrument to obtain data that determined the current physical condition of the educational facility. In order to measure student achievement, standardized tests scores were used to determine the relationship between the building condition and student achievement. The standardized tests that were used were national, state or local sponsored test systems.

The researchers first had to obtain a current building condition and then rate the educational facility in either good or poor condition. Several methods were used to determine the facility condition. Most researchers used an evaluation instrument to measure the condition of the facility while others used the age of the building as a surrogate for the building condition. Some researchers even used test scores of students in older buildings and then compared them with the scores of students in newer buildings to determine if there was a significant relationship. Some research studies involved the use of certain building features and student achievement.

In McGuffey and Brown's (1978) study they found a 1.4 to 3.3 percent variance when the data sets were compared to the age of the classroom unit. In nine of the eleven subtests, 60 percent for fourth grade students, 20 percent for eighth grade students and 16 percent for 11th grade students scored higher on standardized test scores in the newer buildings.

Plumley (1978) also studied the relationship of school buildings and the achievement of students and used a random sample of fourth grade students. Plumley (1978) used the Iowa Test of Basic Skills to measure student achievement and included SES, race, modernized, date of building construction, and the date of modernization. Plumley (1978) found that the non-modernized buildings accounted for 3.3 and 6.4 percent variance on test scores. On the composite score, a variance of 5.3 percent was found. As in the McGuffey and Brown (1978) study, Plumley (1978) found significance in the newer and more modern facilities, which accounted for increased test scores in the modernized buildings. Both studies were found to be significant at the >.05 level.

Chan (1979) also studied the relationship between the age of the building and student achievement. Chan (1979) used the Composite scores of the ITBS as did McGuffey and Brown (1978) and Plumley (1979) to measure student achievement. Chan (1979) found that the schools in the more modern facilities scored higher on standardized tests than the students in the less modernized facilities. These findings were consistent with the findings of the McGuffey and Brown, (1978) and Plumley, (1979) studies.

Bowers and Burkett (1987) investigated the possible relationship between student achievement scores and the age of the building. As in the McGuffey and Brown (1978), Plumley (1979), and Chan (1979) studies, Bowers and Burkett also found that the students in the modern buildings scored significantly higher in reading, listening, language, and arithmetic. Bowers and Burkett (1987) found similar results as in previous studies that in the more modernized facilities,

students scored higher on standardized tests and the relationship was found to be significant at the >.01 level. The McGuffey and Brown (1978) and Plumley (1979) studies were found to be significant at the >.05 level while the Chan (1979) and Bowers and Burkett (1987) studies were found to be significant at the >.01 level.

The studies conducted by Cash (1993), Earthman, et al. (1995), Hines (1996), and Lanham (1999) were all similar studies, which included a building assessment instrument and standardized test scores to measure student achievement. All of these studies used the Commonwealth Assessment of Physical Environment to measure building condition. Cash (1993), Earthman et al. (1995), and Hines (1996) all used the CAPE assessment and Lanham (1999) used the CAPE assessment with a few variations that addressed the technology capabilities of each educational facility in the study. All four studies used different populations. Cash (1993) used small rural high schools, Earthman et al. (1995), used the high schools in the state of North Dakota, Hines (1996) used urban high schools, and Lanham (1999) used elementary schools in the Commonwealth of Virginia.

Cash (1993) found a positive relationship existed between the condition of the school and certain sub-tests in the student achievement tests. Writing scores were higher for students in buildings categorized as in standard condition than for students in buildings categorized as substandard. The highest test scores were found in buildings rated as above standard when compared to students in sub-standard buildings.

A minimum of +2 percentile points and a maximum of +5 percentile points were found between student achievement in substandard and above standard buildings. The percentile ranks showed an increase in students' scores in mathematics, sources of information, science categories and total scores. There was no change in scores with students in substandard and standard buildings in the reading comprehension, basic composite and social sciences. There was a significant increase in all sub-test score categories from standard to above standard buildings except for science.

In the Earthman et al. (1995) study, the main purpose was to investigate the relationship between building condition and student achievement as in the Cash (1993) study, which addressed the relationship between building condition and student achievement. Similar results were found in the Cash (1993) study. The Earthman et al (1995) study found a five percentile point difference in reading comprehension student test scores. Reading as a total score experienced a three percent difference in students test scores. The spelling sub-test revealed a two percent difference while the Cash (1993) study didn't identify spelling in the data analysis. Language as a total score revealed a five percent difference. Overall the results of the Earthman et al. (1995) were similar in percentile points to the Cash (1993) study.

The Hines (1996) study was similar in methodology as the Cash (1993) and Earthman et al. (1995) studies which investigated the relationship of the building condition with student achievement. The significant difference was the population that was used. Hines (1996) included urban high schools in the

Commonwealth of Virginia. Unlike Cash (1993) and Earthman, Cash, and VanBerkum (1995), Hines (1996) found a higher percentile difference in the urban schools used in his study. The student test score percentile points were significantly higher which, included a 7.16 to 11.63-percentile point's difference. The higher percentile points were found in the social studies and sources of information subtests of the TAP student test scores.

Hines (1996) separated the assessment instrument conditions into cosmetic and structural conditions. This method was also used in the Cash (1993) and Earthman et al. (1995) studies. When the cosmetic condition was used a .20 to 12.92 percentile variance was found on students test scores. The structural building conditions affected every subtest of student test scores except for the sources of information student test scores. The percentile scores related to structural condition of the school had a variance of 7.16 to 11.63 percentile points.

Lanham (1999) also examined the relationship between building condition and student achievement but unlike the Cash (1993), Earthman et al. (1995) and Hines (1996) studies, Lanham (1999) used elementary schools as his population. Lanham (1999) identified the significance between student achievement when combined with SES which he found explained some of the variance in the SOL scores. Lanham (1999) found that the percentile scores paralleled previous studies and the range of significance was between 1.6 to 8.6 percentile points. Fifth grade math was consistent in the Cash (1993), Earthman et al. (1995) and Hines (1996) studies. However, one significant finding in the Lanham (1999)

study was, if the air conditioning rating was improved by one point, the average percentile increase on test scores was 8.6 points. Unlike previous studies, the rating of the air conditioning was a factor in increasing student test scores.

Lemasters (1997) completed an analysis of research studies that investigated the relationship between building condition and student achievement. All of the studies that were reviewed found significant relationships between building condition and student achievement. As in the Lemasters' (1997) study, Earthman (1998) authored numerous articles that found relationships did exist between the condition of educational facilities and student achievement.

Edwards' (1992) study was similar in methodology to the Cash (1993), Earthman et al. (1995), Hines (1996), and Lanham (1999) studies, but she found a variance in student tests scores when comparing SES. She also found that for every increase in $1000 in medium income, test scores increased by 4.49 percent. Compared to previous studies, Edwards (1992) used SES, student enrollment, and PTA membership as covariates. However, Edwards (1992) did investigate the relationship of the building condition and student achievement, and she found average achievement scores were higher in the better conditioned facilities.

Lewis (2000) also investigated the relationship between building condition and educational adequacy of school buildings, student achievement and behavior. Similar to previous studies, Lewis (2000) found significant relationships between facility condition and student achievement. As in previous studies, Lewis

(2002) found that some of his findings were not always consistent over the number of years or areas of testing. The studies conducted by Cash (1993), Earthman et al. (1995), Hines (1996), and Lanham (1999) all used consistent data. A possible discrepancy may have existed in Lewis' (2000) study because multiple years of data were used to measure student achievement. However, Lewis (2000) did find significant relationships for facility measures when compared to student test scores in ten to 15 percent of the differences in students test scores.

The final study in this literature review was conducted by Schneider (2002) which addressed the effects of the facilities on test scores in schools in Chicago and Washington, D.C. One difference in this study from previous studies is the use of phone surveys and the reliability of these surveys. However, similarly to previous studies, a variance in percentage of reading test scores included a 76 percent variance, and math scores had a 65 percent variance. One key finding of the Schneider (2002) study was the insignificance of the size of the school, which was found not to have an impact on student test scores. Schneider (2002) did find that facilities found to be in good condition could add 3-4 points to student scores on standardized tests. Based on the findings of the studies, all studies included in this literature review found a significant relationship between facility condition and student achievement.

Chapter 3

Methodology

The purpose of this study was to examine the relationship between the percent of students passing the SOL examinations in buildings that were assessed as being standard or substandard when controlling for socioeconomic status of the student body. All high schools in the Commonwealth of Virginia were included in this research study. The findings of the study were compared with the findings of similar studies that have been completed in the high schools of Virginia. The variables were investigated using analysis of covariance, pair-wise comparisons, and correlations.

Background Information describing the Standards of Learning Examinations

The Commonwealth of Virginia mandates that all secondary students enrolled in the public schools must successfully pass certain courses as part of the basic education program for which the Commonwealth is responsible in order to obtain a diploma. There are four core areas upon which students are tested. These consist of English, mathematics, social studies and science. Currently, all students must pass English reading and writing SOL examinations in order to graduate. Students may select the other SOL courses to use as verified credits for graduation.

Beginning with the graduating class of 2004, students have been required to pass SOL examinations in order to graduate. Students are required to pass two examinations in English, one in mathematics, one science, one in social studies, and one from an area of the student's choice to earn a standard diploma.

High School students enrolled in SOL tested subjects must complete an end-of-course SOL test. A student must score a minimum of 400 out of a perfect score of 600 on each subject test in order to receive a verified credit.

Students earn verified graduation credits by passing both the subject matter course and the SOL examinations. Students who are earning an advanced diploma must earn nine verified credits. Students who are receiving a standard or technical diploma must earn six verified credits.

Population

There are 299 high schools that include grades 9-12 in the Commonwealth of Virginia. Those schools with an 11th grade class were included in the study. Alternative and vocational schools were not included in this study. The total population for this study consisted of 293 high schools that have an 11th grade in the student population.

Data Needs

The data needed for this study included three components. The first was the percent of students passing the Standards of Learning examinations as a measure of student achievement. The second was the assessment of building condition through the Commonwealth Assessment of Physical Environment (CAPE) instrument. The final data needed was the measures of the socioeconomic status of students. This was determined by the percentage of students participating in the free and reduced lunch program.

The percentage of students passing the SOL examinations is reported for each school and is kept in a database maintained by the Virginia Department of

Education. This information is given to the VDOE by Harcourt Testing Services, which provides the results of the SOL examinations for all students who took an SOL test. The scores in Algebra I, Algebra II, Geometry, English Writing, English Reading, Earth Science, Biology and Chemistry were used for this study. The percentages in United States History, World History I and II, and World Geography were not used because they were not reported in all schools. The percentage of students passing each subject area in buildings assessed as in standard condition was compared with the percentage of students passing each subject area in buildings assessed as being substandard. The research investigated the possible relationship between the percentage of students passing the Standards of Learning examinations and the condition of the facility in high schools across the Commonwealth of Virginia.

The Commonwealth Assessment of Physical Environment (CAPE) was used to determine the current condition of each of the high schools with an 11th grade in the Commonwealth of Virginia. This assessment instrument has been utilized in previous studies regarding the relationship between student achievement and building condition rating. School buildings were rated based upon an assessment of the building by the principal.

The percentage of students participating in the free and reduced lunch program served as a measure of control for the socioeconomic status of each student body. The Virginia Department of Education (VDOE) provided the percentages of students participating in the free and reduced lunch program. The VDOE maintains a database that included the percentage of students receiving

free and reduced lunch identified in each high school. The percentage of free and reduced lunch participants was used as a covariant when comparing the impact on student achievement and building condition.

Instrument Design

Cash (1993) developed the Commonwealth Assessment of Physical Environment (CAPE) instrument. She developed this assessment instrument by reviewing current facility assessment instruments and research findings regarding facility factors, which may have an influence on student achievement. Cash (1993) used, “lighting, acoustics, climate control, color, density, science lab quality, and aesthetics to develop objective questions” (p. 34). She provided written descriptions when needed to assist in making accurate assessments of building condition. The CAPE instrument is composed of 27 items concerning the condition of the educational facility. The final question included the acreage of the facility. Each item on the CAPE assessment instrument is assigned a value of 1, 2, or 3.

The data that were obtained from the building assessment were compiled into a composite score for each school. The composite score for each school building was placed on a continuum from the lowest to the highest score.

The composite scores in the top quartile and the bottom quartile of the continuum scores were used in the analysis of data. The schools with a composite score that falls in the top quartile were classified as standard. The schools with a composite score in the bottom quartile were classified in the substandard group. The two groups of school buildings were used to make

comparisons between the percentages of students passing the SOL examinations.

In previous research studies Cash, (1993) and Hines, (1996) placed schools in three categories. They found little variance between the achievement test scores of students in buildings that were in the middle group and those in either the upper or lower classifications. They recommended using only two categories represented by the top and bottom quartile of scores on the building assessment.

Cash (1993) and Hines (1996) also used the terminology of substandard, standard, and above standard buildings. The latter description of buildings is a misnomer, because there is no such thing as a building that is above standard. Therefore, the terminology that was used to describe the condition of the school buildings in this study was standard and substandard and will describe the upper and lower quartile of buildings respectively.

The items on the CAPE assessment were sub divided into structural and cosmetic categories. There were 16 items that specifically examined characteristics, which provided a structural building condition rating. These items dealt with the structural aspect of the building and included factors such as integrity of the roof, control of the thermal environment, and condition of the floors. The remaining eleven items examined the cosmetic condition of the school. The cosmetic items related to the aesthetic properties of the building and consisted of items such as color of paint, cleanliness of the building, and condition of the furniture.

Based on the results of the Commonwealth Assessment of Physical Environment, each response that was identified as an A on the instrument was coded as a one. Each response identified as a B was coded as a two. The responses identified as a C on the instrument were coded as a three.

The CAPE instrument contained six items that had possible multiple responses. The following items had multiple responses and are explained based on the Cash (1993) study:

Item 1: Cash addressed the age of the facility. Buildings that were categorized as forty years or older were identified as (a) response on the CAPE assessment and coded as a one. The buildings that were reported between 11 and 39 years old were identified as (b) response and coded as a two on the CAPE assessment instrument. Buildings that were categorized as ten years old or less were identified as (c) and coded as a three.

Item 11: Cash addressed the facilities adjacent to the main building. There were seven possible facilities that were listed and a comment sheet for responses not listed on the CAPE. When coding for data analysis, a one was used to categorize responses that included two or fewer adjacent facilities. A two was used to code for responses that included more than two adjacent buildings and a three was used if the response indicated four or more adjacent facilities.

Item 14: Cash addressed graffiti commonly found on the premises. Seven possible categories were provided for responses on the CAPE. Responses were coded as a one if more than three areas were identified as having graffiti visible,

a two was used if at least one area was listed and a three if no graffiti was visible to the responder.

Item 18: Cash addressed the usable condition of the science laboratory within the building. Four possible responses were available to the responder. If fewer than all four of the responses were listed by the responder a code of one was used. If the responder marked all four possible responses a two would be used to code the response. A three was used to code if all four possible choices were marked and the responder identified additional utilities and equipment.

Item 26: Cash addressed the square footage of the building. If the responder indicated the facility was less than 110 square foot per student the school was assigned a number one. A two was used if the responder indicated at least 110 square feet per student, and a three was used to identify responses that indicated at least 145 square feet per student.

Item 27: Cash addressed the approximate acreage of the school. A one was used to code for responses that indicated 15 or fewer acres, a two was used to code for responses that indicated more than 15 acres but less than 45 acres, and finally, a three was used for the responses that indicated 30 or more acres.

In this study the same rating/scoring system as explained above was used. Figure 2 identifies the various numbers of each question and the specific characteristics that are addressed in each question.

Instrument Validation and Reliability

The CAPE assessment instrument has been validated in previous

Figure 2: The listed categories will be used for this study.

Structural Building Items	Cosmetic Building Items	Acreage
1. Building Age	6. Interior Wall Paint	27. Site Acreage
2. Windows	7. Interior Paint Cycle	
3. Flooring	8. Exterior Wall Paint	
4. Heating	9. Exterior Paint Cycle	
5. Air Conditioning	12. Floors Swept	
10. Roof Leaks	13. Floors Mopped	
11. Adjacent Facilities	14. Graffiti	
16. Locker Conditions	15. Graffiti Removal	
17. Ceiling Covering	21. Classroom Furniture	
18. Science Lab Equipment	22. Grounds	
19. Science Lab Age	23. Wall Color	
20. Lighting		
24. Exterior Noise		
26. Student Density		

Note: Structural and Cosmetic Items on the Commonwealth Assessment of Physical Environment. Permission granted from Cash (1993).

research studies. Cash (1993) used three people experienced in facility assessment to review the instrument. They were asked to provide feedback concerning the relevance and accuracy of the assessment instrument. They found the instrument was reliable and asked the necessary questions to accurately assess building condition. The instrument was then revised and field-tested by eight Virginia Beach high school administrators who at that time were serving as principals in facilities with varying conditions. Cash (1993) found, “the resulting scores placed the eight Virginia Beach schools in the expected relative position from poor to better quality facilities” (p. 35).

To determine the validity of the assessment of buildings done by principals, Cash personally assessed five schools in the study population using the CAPE instrument. She assessed schools that fit the criteria for the study but were not included in the population. She then asked the division contact person to complete the assessment on the same schools that she assessed. The

responses from Cash's assessment were compared with the division contact person and the ratings were found to be similar. This insured the assessment was conducted in a consistent manner and individuals viewed the condition of the facility the same way.

Brannon (2000) investigated the knowledge level of the school board members, superintendent and school principals in Washington County Public Schools regarding the physical condition of the school buildings. He asked the members of each group to independently evaluate each of the buildings in the school division. He then evaluated the buildings to obtain an independent measure of assessment. The assessment of each group was compared with the independent assessment. After the comparison, he concluded that the principals were better able to objectively assess the condition of the buildings than the two other groups. Based upon this conclusion, it seemed reasonable to ask the principals to assess the building in which they worked.

Lanham (1999) used the CAPE instrument that had been previously developed by Cash (1993) and distributed by Hines (1996) with some minor modifications. Lanham added questions related to the technology capabilities of elementary schools. These questions focused on the number of computers in the school and number of computers that are LAN or Internet capable. The assessment instrument was distributed to 12 members of Lanham's Virginia Polytechnic Institute and State University doctoral cohort. Distribution of the assessment was designed to expose any flaws in the instrument. The questions were examined to determine if they were clear and concise and to define what

the assessment instrument was measuring. A second review was necessary in order to validate the revised instrument. In the second review, Lanham (1999) then randomly selected 20 elementary principals who were not included in the study. Twelve responses were secured and all of the respondents felt the principal could answer all of the assessment questions. Lanham found the CAPE assessment could be completed by the principals and based on the structure of the questions; they adequately addressed what was needed for the study.

Data Gathering

For this research study, two hundred and ninety-three high schools with grades 9-12 in the Commonwealth of Virginia were included in this survey. Previous research studies focused on specified categories of schools, such as rural and urban. This study included all high schools in the Commonwealth of Virginia.

The names and email addresses of the respective school divisions superintendents were obtained from the Virginia Department of Education (VDOE) website. The superintendents were sent an email explaining the purpose of the study and seeking permission to survey the principals in their school division. If a response was not secured via email, the superintendent was sent a letter asking for permission to conduct the study. If responses were not secured, personal phone contact was made. Once permission was granted, a database was kept that included all the responses provided by the school division superintendents. The CAPE was sent to school principals via email in school

divisions where the superintendent had granted permission to conduct the research study.

Once the school division superintendent granted permission to conduct the survey, the names, email addresses, and addresses of the high school principals were obtained from the VDOE website. An email was sent to the principals of the high schools participating in the study explaining the purpose. The CAPE instrument was sent as a web-link and principals were asked to complete the assessment. If the principal did not respond to the email, a letter was sent requesting participation in the study. This letter included a copy of the CAPE assessment instrument and directions for completing the assessment instrument.

The Virginia SOL examination scores in this study were categorized by the percent of students passing. SOL scores are maintained in a database by the Virginia Department of Education. For all schools, the percent of students who have passed the SOL examinations is reported for each subject area. Percentages of students passing the SOL examinations were obtained from the VDOE website and placed in a database that identified each school and passing percentage for each specific SOL examination. In the event any score was not reported for a specific subject area by the VDOE, the school was eliminated from the study because the scores obtained may be unreliable.

The VDOE also maintains a database for the percentage of students enrolled in the free and reduced lunch program at each high school. These percentages were obtained and placed in a database that identified the specific

school with the percentage of students participating in the free and reduced lunch program. In the event that the percentage of free and reduced lunch rate was not provided for each school by the VDOE, the school was eliminated from the study in order to provide consistency.

Data Analysis

For analysis of the data, results of the CAPE were entered into a database. Data were analyzed using correlations, analysis of covariance, and pair-wise comparisons. The final results of the data were reported using numerical and graphic techniques to report descriptive statistics, which included means, frequencies, percentages and statistical significance (O'Neill, 2000). Tables were developed using the Cash (1993) formats to illustrate findings.

A response category was established for each of the 27 CAPE assessment items. Each school building was identified and placed in an SPSS database. After determining the total assessment score for each school building the results were entered into a continuum from low to high score. The top and bottom quartile (25%) of schools were identified as the two groups of buildings that constituted the population from which the percentage of students passing the SOL examinations were compared.

The percentage of students passing the SOL examinations in each school was used to calculate a mean percentage for both the standard and substandard quartile of school buildings. The mean percentage of the top quartile was compared to the mean of percentages for the bottom quartile through a

correlation. An analysis of covariant was used to ascertain the difference between the two mean percentages.

The scores of the 16 items of the CAPE identified as relating to the structural qualities of buildings were used to calculate a different group of school buildings consisting of the top and bottom quartiles. The percentage of students passing the SOL examinations for each school was used to calculate a mean percentage. A mean percentage was calculated for both the top and bottom quartiles. These means were compared through a correlation. An analysis of covariance was used to demonstrate the differences between the percentage means.

Likewise, the scores of the ten items identified as relating to the cosmetic features of the building could be used to develop a new set of schools. The scores of the ten items were placed into a continuum so that the bottom and top quartile of schools were identified. The percentages of students passing the SOL examinations for each school building were used to calculate a means of percentages. The means for the bottom and the top quartiles were used to compare differences. An analysis of covariance was used to ascertain the difference between the two means.

The socioeconomic status as measured by the percentage of students participating in the free and reduced lunch rate program was used as a covariant to adjust for the achievement means of the responses. The factor of socioeconomic status was used because the percentage of students participating

in the free and reduced lunch program had relationship to the financial status of the students.

First, in order to analyze data, the percentage of students passing the SOL examinations in standard and substandard school buildings were compared to determine if there was a significant difference in the means when controlling for socioeconomic condition of the student body. The schools were then reordered and the means of students passing SOL examinations in the standard and substandard buildings were compared based upon the 16 items in the structural category of the CAPE instrument. The schools were again reordered and the means of the percentage of students passing the Standards of Learning examinations in the standard and substandard buildings were compared based on the ten items in the cosmetic category of the CAPE assessment instrument. Although the schools were reordered three separate times, there was only one school that changed from standard to substandard and this occurred in the structural building condition.

After these data had been analyzed a comparison of the results of the Cash (1993) and Hines (1996) findings was made to determine if there were consistencies among the findings. This comparison was made through an identification of those subject areas in which significant differences were found between the substandard and standard buildings. These subject areas were compared with the findings of the present study. In as much as both the Cash and Hines studies converted the mean student scaled scores into percentiles and the data utilized in the present study cannot be converted to percentiles, a

comparison was done only through visual examination of the differences or similarities. These similarities were discussed as to the relevance of the findings. This was important because the population of this study encompassed the entire high school population in the Commonwealth of Virginia; whereas the other two studies focused on urban and rural high school populations.

Analysis of Research Questions

Research Question, "What is the relationship between the percentage of students passing the SOL Examinations and the condition of the educational facility?" The purpose of this research question was to examine the relationship between the percent of students passing the SOL examinations in buildings that were assessed as being standard or substandard when controlling for socioeconomic status of the student body. All high schools in the Commonwealth of Virginia were included in this research study. The findings of the study were compared with the findings of similar studies that have been completed in the high schools of Virginia.

Analysis of Research Sub - Questions

Research Sub - Question #1

The first question, "Is there a difference between the percent of students passing the SOL examinations in school buildings that are assessed as substandard and standard?" After determining the total assessment score for each school building from the CAPE, the results were entered into a continuum from low to high score. The top and bottom quartile (25%) of schools were identified as the two groups of buildings (standard and substandard) that constituted the population from which

the percentage of students passing the SOL examinations were compared. The percentage of students passing the SOL examinations in each school was used to calculate a mean percentage for both the bottom and top quartile of school buildings. The mean percentages of the top quartile were compared to the mean of percentages for the bottom quartile through a correlation. An analysis of covariance was used to ascertain the difference between the two mean percentages. The percentages of students passing the Standards of Learning examinations in standard and substandard school buildings were compared to determine if there was a significant difference in the means when controlling for socioeconomic condition of the student body.

Research Sub - Question #2

The research question, “Is there a difference between the percent of students passing the SOL examinations in school buildings that are categorized structurally as substandard and standard?” The scores of the 16 items of the CAPE identified as relating to the structural qualities of buildings were used to calculate a means of a different group of school buildings consisting of the top and bottom quartiles. The percentage of students passing the SOL examinations for each school was used to calculate a mean percentage. A mean percentage was calculated for both the top and bottom quartiles. These means were compared through a correlation. An analysis of covariance was used to demonstrate the differences between the percentage means. The means of students passing SOL examinations in the standard and substandard buildings was compared based upon the 16 items in the structural category of the CAPE

assessment instrument. The percentage of students passing the SOL examinations in standard and substandard school buildings were compared to determine if there was a significant difference in the means when controlling for socioeconomic condition of the student body.

Research Sub - Question 3:

"Is there a difference in the percentage of students passing the SOL examinations in school buildings that are assessed cosmetically as substandard and standard?" The scores of the 11 items identified as relating to the cosmetic features of the building were used to develop a new mean score for building assessment. The scores of buildings of the 11 items were placed into a continuum so that the bottom and top quartile of schools could be observed. The percentages of students passing the SOL examinations for each school building were used to calculate a means of percentages. The means for the bottom and the top quartiles were used to compare differences. An analysis of covariance was used to ascertain the difference between the two means. The means of the percentage of students passing the SOL examinations in the standard and substandard buildings were compared based on the 11 items in the cosmetic category of the CAPE assessment instrument. The percentage of students passing the SOL examinations in standard and substandard school buildings were compared to determine if there was a significant difference in the means when controlling for socioeconomic condition of the student body.

Chapter 4

Findings

Introduction

Upon receipt of the data from the principals who completed the CAPE assessment instrument, analysis began. First, the data were consolidated. Next, building condition ratings were calculated and buildings were given a scaled score based on the Principal responses on the CAPE assessment instrument. Next schools were placed into two categories, standard or substandard. Finally, SOL percentages of students in substandard and standard school buildings were compared.

Survey Procedures

In the Commonwealth of Virginia, there are 132 school divisions and 299 high schools. For this research study, an email was sent to the Superintendents in each of the 132 school divisions in the Commonwealth of Virginia seeking permission to contact the high school principals in their school divisions to complete the CAPE assessment instrument. The initial emails were sent to the Superintendents in January 2005. By April 2005, 88 representatives from school divisions granted permission to send the assessment instrument to the principals in their respective school divisions. There were 44 school divisions that either declined participation or did not respond to the contacts. Initially, only school organizations that had grade configurations of 9-12 were included in the study. On later consideration, all high schools that had an 11th grade were included in

the population. The final results were taken from all grade configurations for high schools in the Commonwealth of Virginia.

There were 198 high school buildings that comprised the possible population that could participate in the study after permission was granted. The initial emails were sent to the high school principals contingent upon receipt of permission by the superintendent or representative of the school division. The data collection process began in January 2005 and concluded in May of 2005. The total number of respondents to the CAPE assessment was 142 which equated to a 75 percent return rate based on the number of schools that were permitted to participate in the study.

The CAPE was placed on an email web link provided through Virginia Polytechnic Institute and State University's survey system and was sent via email to all of the principals participating in the research study. The principals received an introductory message via email, which included a web-link for them to access the CAPE assessment. Principals completed the assessment and a response email was returned to the researcher that indicated their completion of the CAPE Assessment. Principal responses were placed in a database on the website and the respondents were tracked based on their completion of the identification portion of the assessment which asked principals to provide their name, school, and school division. This eliminated repeated requests to the principals to encourage them to complete the assessment that did not respond to the initial email. The principals' results were automatically tallied on the web site and percentages were provided electronically.

CAPE Assessment

The CAPE has been used successfully in several studies to generate data on the condition of school buildings. Notably, the Cash (1993), Hines (1996), Lanham (1999), and Earthman et al. (1995) studies have used the instrument in identifying the influence the building has upon student achievement. Because of the unique nature of the instrument an accurate measurement of the condition can be made by principals and others who are familiar with the school building. Cash found in her study that the responses of the principals to the CAPE were very similar to the evaluations she completed to determine the inter-rater reliability.

The CAPE was originally designed to assess the condition of a school building for research purposes only. There are many evaluative instruments on the market designed to evaluate the school building and identify maintenance needs for subsequent repair or remedy. The CAPE is different in that a majority of items on the instrument stem from previous research studies that investigated the relationship between building condition and student achievement.

The items in the CAPE provide the researcher with a score of the condition in which the building is currently found. This score is the overall representation of the condition based upon the 27 items. In responding to the items on the CAPE, principals evaluate whether or not the building has the particular element or component and also its condition. The rating that is given to each item is summed to provide a statistic representing the total condition of the building. This statistic for all buildings in the population is then displayed in rank

order from the lowest to the highest score. In this manner the researcher can identify the schools in the highest and lowest quartile.

In order to permit researchers an opportunity to explore further relationships, the items in the CAPE were divided into two groups. The first group of items were those that dealt with the structural elements of the building such as windows, ceilings, air-conditioning, and noise. The cosmetic items in the second group were those that dealt with the aesthetic qualities of the building, such as paint, colors, and condition of the furniture. Analysis of the cosmetic items subgroup of the CAPE permitted the researcher to assess the strength of the aesthetic features of the building upon student achievement. In order to obtain cosmetic condition, the 72 schools in the population were reordered and then they were used to identify a range of scores for the cosmetic building condition examining only the factors related to cosmetic condition based on the responses provided by the principals on the CAPE assessment instrument. Likewise, the 72 schools were reordered to obtain a separate analysis of the structural elements of the building which allowed the researcher to determine the influences the building itself had on the students. The results of this categorization were a summation of those items related to structural elements based on the responses provided by the principals on the CAPE assessment instrument. Based upon this categorization, student achievement scores were compared between standard and substandard schools.

The items addressed either the structural or cosmetic condition of the school building. Items 1 – 5, 10, 11, and 16 – 20 addressed the structural

condition. Items 6 – 9, 12 – 15 and 21 – 23 addressed the cosmetic condition of the school. Item 25 asked principals to rate their educational facility as either standard or below standard. Item 26 asked principals to provide the gross square footage of the school and item 27 asked principals the approximate acreage of the school site.

Building Condition Ratings

Each item on the CAPE had three possible responses. The first response was weighted as a one. The second item was weighted as a two and the third responses was weighted a three. Items one through 24, 26, and 27 were coded as a one, two, or three. The one indicated the less desirable element present in the building, the two was the mid-point and the three indicated the most desirable element. Item 25 asked principals to identify what they considered to be the current condition of their building. Principals responded by categorizing their schools in either substandard condition, coded as a two, or standard condition, coded as a three.

The sums of the responses on the CAPE were calculated to derive an overall score for each building. Responses that were coded as a one or a two were combined to comprise the substandard condition schools and the items that were coded as a three identified the schools categorized as standard condition buildings. The scores ranged between 47 and 74. The structural building condition score ranged from 25 to 42, and the cosmetic building condition score ranged from 20 to 36. Responses 26 and 27 were not included in the sum of the scaled scores because 41 of the respondents (28 percent) did not complete

these two items. Once these scores were ascertained then a comparison of the percentage of students passing the SOLs were completed. Table 2 indicates the overall, structural and cosmetic scores of the buildings.

Table 2: The overall, structural, and cosmetic scaled scores based on the CAPE assessment responses.

	Range	N	%
Building Condition			
Standard	66-74	36	25
Substandard	47-58	36	25
Cosmetic Condition			
Standard	30-36	36	25
Substandard	20-28	36	25
Structural Condition			
Standard	33-42	36	25
Substandard	25-33	36	25

Note: The scores indicated were derived from responses to items in the Commonwealth Assessment of Physical Environment.

There were 142 principals who completed the CAPE Assessment instrument. Each school was given a scaled score based on the principal's responses on the CAPE. All schools were ranked on a continuum from lowest score to highest score, depending on the score they received from the principal. To determine the two groups of schools that would be identified as substandard and standard, the list was divided into quartiles. These two groups were used to compare the percent of students passing the SOL examinations. The top 25 percent and the lower 25 percent of the scaled score for each building was used in the final analysis of the data. Once a scaled score for each building was

determined, schools were divided into either standard or substandard building condition schools. The top quartile included 36 schools and the bottom quartile included 36 schools. This was based on the 25 percent breakdown for the top and bottom quartiles.

School Demographics

School demographics were not a factor in determining the scaled score for each building. Once a score was established school demographics were identified to determine if there were any factors that influenced the scaled scores. The school demographics included: school assigned identification number, scaled building condition score, enrollment, free and reduced lunch participation percentage, dropout rate, minority percentages and pupil to teacher ratio. Table 3 illustrates the demographics for the substandard condition buildings. Table 4 illustrates the standard condition buildings and the school demographics.

Based on the mean percentages for the school enrollment of the standard and substandard condition buildings the enrollment was significantly higher in the standard condition buildings when compared to the substandard condition buildings. The standard schools had a mean enrollment of 1106 students compared to the mean enrollment of 729 for the substandard schools. Many of the substandard schools were located in the more rural areas of the state when compared to the standard schools which were much larger in enrollment.

The substandard building condition schools had a higher free and reduced lunch percentage, 34.2 percent, when compared to the standard building condition schools which had a 22.3 percent free and reduced lunch rate. The

dropout rate was lower in the substandard condition buildings. A 1.67 percent difference in the substandard condition buildings was found when compared to the standard condition buildings which had an overall 1.8 percent dropout rate. The minority percentage in the substandard condition buildings was lower with a 19.2 percent when compared to the 29.4 percent in the standard condition buildings. The final school demographic factor that was examined was the student to teacher ratio. The standard building condition schools had higher students to teacher ratio, 12 to 1, albeit because the enrollment in the standard schools was significantly higher compared to the substandard where students to teacher ratio was 11.1 to 1.

After careful examination of the school demographics, the buildings used in this study were similar. However, the school enrollment was higher in the standard condition buildings when compared to the substandard condition buildings.

Adjusted Achievement Scale Score Means

Once the substandard and standard schools were determined, the percent of students passing the SOLs in each school was averaged deriving a single percentage for the group of buildings. These two scores were compared statistically using an ANCOVA. The percent of students passing the SOLs in each school on English reading and writing, Algebra I, Algebra II and Geometry were averaged in the substandard and standard condition so a comparison could be completed. The adjusted mean was the difference between the group mean,

Table 3: The school demographics for the substandard building condition schools. (Bottom Quartile)

School	Scaled Score	Enrollment	Free and reduced	Dropout Rate	Minority Percentage	Pupil to teacher Ratio
107	53	1133	33.99	.78	9	11.0
108	58	1276	40.32	.71	38	10.8
109	54	304	51.10	.81	1	11.0
110	52	463	45.93	.96	56	11.4
111	57	1297	7.63	.15	26	14.7
112	56	1339	10.28	1.26	8	9.3
113	56	484	18.78	1.10	12	10.6
114	55	627	16.32	.55	15	13.8
115	52	524	32.17	1.49	8	11.3
116	55	777	17.58	1.86	7	11.9
117	57	1149	24.61	2.77	35	13.6
118	54	577	36.97	1.49	4	11.3
119	54	1469	29.37	2.29	44	9.3
120	57	605	37.17	1.20	59	11.0
121	58	795	37.06	1.49	1	11.3
122	52	332	26.18	.27	3	8.4
123	47	178	11.96	.69	0	10.6
124	50	1036	21.62	.91	13	7.9
125	57	587	42.02	1.86	4	11.9
126	57	926	20.29	1.86	5	11.9
127	57	505	71.27	4.13	0	11.1
128	52	885	40.19	2.08	3	10.9
129	55	673	31.04	1.70	36	13.0
130	54	433	31.93	1.15	1	11.8
131	58	449	39.86	2.50	22	11.3
132	56	731	26.54	1.86	6	11.9
133	54	667	37.07	1.70	40	13.0
134	55	199	63.86	1.49	1	11.3
135	56	451	37.67	1.94	48	10.1
136	55	1125	14.83	2.32	25	10.9
137	53	206	64.62	.81	3	11.0
138	58	641	71.27	3.24	44	10.6
139	56	588	28.54	2.33	35	9.2
140	52	183	55.38	4.13	0	11.1
141	55	832	25.81	2.80	25	11.0
142	53	1811	30.25	1.56	56	11.9

Table 4: The school demographics for the standard building condition schools. (Top Quartile)

School	Scaled Score	Enrollment	Free and reduced	Dropout Rate	Minority	Pupil to teacher Ratio
1	71	1253	0	.44	10	11.1
2	71	1101	14.12	1.26	13	9.3
3	68	942	14.53	.30	31	13.0
4	68	1351	0	.98	43	12.9
5	68	1111	7.32	.28	9	9.0
6	66	1149	36.83	9.31	47	11.9
7	70	1838	45.59	1.00	66	11.2
8	66	1267	35.15	1.53	26	10.3
9	67	922	3.15	.31	3	12.8
10	69	976	37.70	1.27	10	11.2
11	69	237	26.07	1.60	40	10.9
12	74	1657	12.78	1.54	23	11.8
13	73	1453	8.01	.92	30	11.7
14	67	709	27.08	1.87	27	10.2
15	70	592	22.87	0	30	11.3
16	66	347	23.08	1.61	20	11.5
17	66	536	18.27	1.86	3	11.9
18	69	103	29.17	3.07	5	11.6
19	66	1249	15.51	1.00	27	11.9
20	68	808	39.33	2.93	49	11.2
21	73	514	25.64	2.77	26	13.6
22	67	2115	26.67	1.56	47	11.9
23	67	1212	24.96	1.00	14	11.9
24	70	610	34.44	3.65	52	10.9
25	72	1593	35.21	9.31	45	11.9
26	66	2088	22.76	2.77	51	13.7
27	69	441	25.60	2.21	31	12.0
28	67	470	34.32	.29	3	14.3
29	70	2059	29.81	.44	63	12.8
30	67	751	13.95	1.50	6	15.4
31	74	720	12.65	.10	9	12.9
32	69	1237	21.95	3.36	55	12.6
33	69	1445	11.22	.92	35	11.7
34	69	1829	36.96	.44	64	14.3
35	67	977	11.62	.15	22	13.6
36	67	2159	20.53	1.56	26	11.9

percentages of students passing the SOL examinations and the overall mean of the covariant, free and reduced lunch percentage. The adjusted means were closely related compared to the unadjusted means. The covariant used was the percentage of students who qualified for free and reduced lunch. This factor was used to adjust for socioeconomic status because of its relationship to the financial status of the students. Table 5 illustrates these differences.

Table 5: A comparison of students passing percentages on the Standards of Learning examinations with overall building condition.

Overall Building Condition SOL student passing percentages				
Achievement	Standard	Substandard	Difference	Significance
English Reading	87.7%	81.1%	6.6%	.001*
English Writing	88.9%	83.4%	5.5%	.019*
Algebra I	72.5%	74.0%	-1.5%	.660
Algebra II	87.9%	85.4%	2.5%	.565
Geometry	81.1%	82.2%	-1.1%	.557

Note: SOL passing percentages have been adjusted for socioeconomic status. *Denotes significance at the >.05 level.

The comparison of the percent of students passing the SOLs between the two building categories indicated a higher percent of students that passed the English writing and reading SOLs in standard buildings compared to the substandard buildings. The percent of students passing the English reading SOLs were 6.6 percent higher in standard condition buildings when compared to substandard condition buildings. This percentage was found to be significant at the >.05 level. The percent of students passing the SOLs in English writing were 5.5 percent higher in standard buildings which were found to be significant at the >.05 level when compared to substandard buildings. The percent of students

passing the Algebra I SOLs were 1.5 percent higher in substandard buildings when compared to standard buildings. The percent of students passing the Algebra II SOLs were 2.5 percent higher in standard buildings when compared to substandard. The percent of students passing the Geometry SOLs were 1.1 higher in substandard buildings when compared to standard. None of the latter three comparisons were significant.

Achievement and Cosmetic Building Condition

Eleven questions on the CAPE addressed cosmetic conditions. The areas of focus included interior and exterior paint, grounds, graffiti, and floor maintenance. These focus areas were represented in the model design as building conditions that may influence student achievement. The schools were divided into substandard and standard schools based on the responses to the cosmetic items.

The percent of students passing the SOLs were adjusted for socioeconomic status, and then the two groups were compared. Based on the cosmetic building condition responses from the principals on the CAPE instrument the percent of students passing the English reading SOLs were 6.6 percent higher in the standard schools which was found to be significant at the >.05 level when compared to the substandard schools.

The percent of students passing the English writing SOLs were 5.5 percent higher in the standard schools which was found to be significant at the >.05 level when compared to the substandard schools. The percent of students passing the Algebra I SOLs were 1.5 percent higher in the standard schools

when compared to the substandard schools. The percent of students passing the Algebra II SOLs were 2.5 percent higher in the standard schools when compared to the substandard schools. Finally, the percent of students passing the Geometry SOLs were 1.1 percent higher in the substandard schools when compared to the standard schools. These three comparisons were not significant. Table 6 illustrates this comparison.

Table 6: A comparison of student passing percentages on the Standards of Learning examinations based on the cosmetic condition building ratings provided by the principals.

Cosmetic Building Condition				
Achievement	Standard Schools N=36	Substandard Schools N=36	Combined	Significance
	Mean SOL passing percentages	Mean SOL passing percentages	Difference	
English Reading	87.7%	81.1%	6.6%	.001*
English Writing	88.9%	83.4%	5.5%	.019*
Algebra I	72.5%	74.0%	-1.5%	.660
Algebra II	87.9%	85.4%	2.5%	.565
Geometry	81.1%	82.2%	-1.1%	.557

Note: All student Standards of Learning passing percentages have been adjusted for socioeconomic status. *Denotes significance at the >.05 level.

Achievement and Structural Building Condition

Sixteen items on the CAPE addressed structural condition, which included windows, heat, air conditioning, roof leaks, and ceiling condition and each area was chosen because it had been explored for its possible impact on production in business or learning in education. Table 6 contains the results of the analysis of the adjusted percent of students passing the SOLs between the schools in

standard condition and those in substandard condition. The schools in the lowest quartile scored 33 or lower in the cosmetic category. There were 36 schools in this quartile. Schools classified as standard condition scored 34 or higher. There were 36 schools in this category.

Based on the results provided by the principals, the percent of students passing the English reading SOLs were 6.7 percent higher, which was found to be significant at the >.05 level in the standard schools when compared to the substandard schools. The percent of students passing the English writing SOLs were 7.0 percent higher which was found to be significant at the >.05 level in the standard schools when compared to the substandard schools. The percent of students passing the Algebra I SOLs were 2.8 percent higher in substandard condition buildings when compared to standard condition buildings. The percent of students passing the Algebra II SOLs were 1.3 percent higher in the standard schools when compared to the substandard schools. The percent of students passing the Geometry SOLs were 1.2 percent higher in the standard schools when compared to the substandard schools. Table 7 illustrates these differences.

Table 7: A comparison of student passing percentages on the Standards of Learning examinations based on the structural condition building ratings provided by the principals.

Structural Building Condition				
	Standard Schools N=36	Substandard Schools N=36	Combined	Significance
Achievement	Mean SOL passing percentages	Mean SOL passing percentages	Difference	
English Writing	87.9%	80.9%	7.0%	.001*
English Reading	89.5%	82.8%	6.7%	.008*
Algebra I	71.9%	74.7%	-2.8%	.346
Algebra II	87.3%	86%	1.3%	.598
Geometry	82.3%	81.1%	1.2%	.672

Note: All student Standards of Learning passing percentages have been adjusted for socioeconomic status. *Denotes significance at the >.05 level.

Science Equipment and Science Achievement

Two items on the CAPE were directed towards science lab function ability and the update of facilities. The first question, item 18 assessed the number of capabilities currently available in the schools science classrooms. Responses were coded as a three if the science classroom had three or more functions available. Also, responses were coded as a two if there was one function available and a one if there were no functions available in the science classrooms.

The choices on the CAPE assessment instrument were water, gas, sinks, and electricity. Based on the responses provided by the principals, 68 of the schools had three or more functions in the science classrooms and had been

updated less than five years ago. Only four schools were in the lowest quartile on this comparison.

The percent of students passing the Earth Science SOLs were 2.2 percent higher in schools that had three or more functions in the science classroom than those that did not have these functions operating. The percent of students passing the Biology SOLs was 3.6 percent higher in schools that had three or more functions. The percent of students passing the Chemistry SOLs were .1 percent higher in the schools with less than three functions in the science laboratory. There were four schools that comprised the schools that had less than three functions in the science classroom. The difference in students' passing percentages is illustrated in Table 8.

Table 8: A comparison of Science Lab Equipment Availability with students passing percentages on Science Standards of Learning examinations.

	Lacking at Least One N=4	Three or More N=68	Difference	Significance
Science Achievement				
Earth Science	71.2%	73.4%	2.2%	.746
Biology	77.2%	80.8%	3.6%	.471
Chemistry	86.5%	86.4%	-.1%	.950

Note: All student Standards of Learning passing percentages have been adjusted for socioeconomic status. *Denotes significance at the >.05 level.

The second science related item on the CAPE, item 19, addressed the duration of time since the science equipment was updated to current standards. Responses were coded as a three if updated less than five years ago, if an update occurred five to nine years ago were coded as a two, and if an update occurred over ten years ago, responses were coded as a one. The choices

were: over ten years ago (N=16), between five and ten years ago (N=26), and fewer than five years (N=30). The percent of students passing the Earth Science, Biology, and Chemistry SOLs were calculated. Table 9 illustrates these differences.

Table 9: A comparison of Science Lab Equipment Age with student passing percentages on Science Standards of Learning examinations.

	Updated over 10 years ago	Updated between 5 and 9	Less than 5 years	Significance
Science Achievement	N=16	N=26	N=30	
Earth Science	87.2%	70.5%	69.5%	.221
Biology	81.2%	76.9%	81.6%	.113
Chemistry	87.2%	87.1%	85.3%	.792

Note: All student Standards of Learning passing percentages have been adjusted for socioeconomic status. *Denotes significance at the >.05 level.

Individual Building Condition Factors and Achievement

In order to investigate the importance of each building condition factor, the individual CAPE item responses were compared across each students passing percentage on the Standards of Learning examinations. The items on the CAPE assessment instrument, the number in each group, and the associated adjusted students passing percentages on the Standards of Learning examinations were examined. Based on the responses on the CAPE by the principals, there were varying responses. In the Cash (1993) and Hines (1996) studies, buildings were categorized as above standard, standard or below standard; however, this study categorized the buildings as standard or substandard. In the Cash and Hines studies, a response coded as a three was the most desirable condition. In this study the three also indicated the most desirable condition. However, in this

study there were three responses for each CAPE item. The lower two responses were combined and identified as substandard buildings, and the responses coded as a three identified buildings as in standard condition. This allowed the researcher to identify the various responses provided by the principals on the CAPE instrument and identify the buildings that were placed in standard or substandard condition. This variance in responses created a skewed view of the various buildings but gave an accurate depiction of the condition of the school.

Building Age

Building age was represented in each condition group. When the standard and substandard percentages of students passing the English writing SOLs were compared across the two building conditions the percent of students passing the SOLs was 3.7 percent higher in standard buildings when compared to substandard condition buildings. The percent of students passing the English reading SOLs was 4.1 percent higher in the standard buildings when compared to the substandard buildings. The percent of students passing the Algebra I SOLs was .2 percent higher in the standard buildings when compared to the substandard buildings. However, the percent of students passing the Algebra II SOLs was 1.4 percent higher in the substandard buildings when compared to the standard buildings. The percent of students passing the Geometry SOLs was .2 percent higher in the standard buildings when compared to the substandard buildings. These findings were consistent with the findings of Hines (1996), Cash (1993), Chan (1979) and McGuffey and Brown (1978). Table 10 illustrates these differences.

Table 10: The percentages of students passing the SOLs and the Age of Building CAPE assessment responses provided by school principals.

Cape Item	Achievement	Building Condition Factors	Building Condition Factors	Difference
Age of Building		11 years or older N=38	10 years old or less N=34	
	English Writing	82.7%	86.4%	3.7%
	English Reading	84.2%	88.3%	4.1%
	Algebra I	73.2%	73.4%	.2%
	Algebra II	87.3%	85.9%	-1.4%
	Geometry	81.6%	81.8%	.2%

Windows:

All schools had instructional areas with some windowed rooms. Most (N=60) of the buildings had instructional areas with windows in all areas. When the percentages of students passing the SOLs were compared between the two groups, the English writing passing percentages was 1.3 percent higher than substandard buildings when compared to standard buildings. The percent of students passing the English reading SOLs, percentages was 2.5 percent higher in substandard buildings when compared to standard buildings. The percent of students passing the Algebra I SOLs was 5.3 percent higher in the substandard buildings when compared to the standard buildings. The percent of students passing the Algebra II SOLs was 1.9 percent higher in the standard buildings when compared to substandard buildings. Finally, the percent of students passing the Geometry SOLs was 1.2 percent higher in standard buildings when compared to substandard buildings. Table 11 illustrates these differences.

Table 11: The percentages of students passing the SOLs and the window condition based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factors	Building Condition Factors	Difference
Windows		Windows are in fewer than¼ or in at least¼ but fewer than ¾of the instructional spaces N=12	Windows are in at least¾of the instructional spaces N=60	
	English Writing	85.5%	84.2%	-1.3%
	English Reading	88.0%	85.5%	-2.5%
	Algebra I	77.7%	72.4%	-5.3%
	Algebra II	85.1%	87.0%	1.9%
	Geometry	80.7%	81.9%	1.2%

Floors

The item which addressed floors asked if the floors were: wood, condition one; tile or terrazzo; condition two; or carpet, condition three. One school reported the floors in the building were wood, but a majority of the schools reported the floors were tile or terrazzo, (N=67). Four schools reported that the floors were carpeted. The percent of students passing the English writing SOLs was 3.4 percent higher in the buildings that were in standard condition compared to the substandard buildings. The percent of students passing the English reading SOLs was.2 percent higher in substandard condition when compared to standard condition buildings. The percent of students passing the Algebra I SOLs was 3.7 percent higher in substandard condition buildings when compared to standard condition buildings. The percent of students passing the Algebra II SOLs was 3.5 percent higher in the substandard condition buildings when compared to the standard condition buildings. Finally, the percent of students

passing the Geometry SOLs was.2 percent higher in substandard condition when compared to standard condition buildings. Based on the small number of responses (less than 10) for each category this information may not be a representative sample of the CAPE responses. Table 12 illustrates these differences.

Table 12: The percentages of students passing the SOLs and the floor type based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Flooring		Wood, tile or terrazzo N=67	Carpet N=5	
	English Writing	84.2%	87.6%	3.4%
	English Reading	86.1%	85.9%	-.2%
	Algebra I	73.5%	69.8%	-3.7%
	Algebra II	86.9%	83.4%	-3.5%
	Geometry	81.8%	79.8%	-.2%

Heat

Heat conditions were well represented in each category. The number of respondents that reported the school building had even heat, unable to control was 37, standard condition, when compared to buildings that had even heat, able to control which had 35 respondents. The percent of students passing the English writing SOLs was 4.1 percent higher in buildings in standard condition when compared to substandard condition buildings. The percent of students passing SOLs was 3.8 percent higher in the standard condition buildings when compared to the substandard condition buildings. The percent of students passing the Algebra I SOLs was 1.1 percent higher in the standard condition buildings when compared to the substandard buildings. The percent of students passing the Algebra II SOLs was 2.4 percent in the standard condition buildings

when compared to the substandard condition buildings. However, the percent of students passing the Geometry SOLs was 1.8 percent higher in the substandard condition buildings when compared to the standard condition buildings. The percent of students passing the SOLs indicated there may be some relationship to heating condition between achievement and the ability to regulate the heat in the building. Table 13 illustrates these differences.

Table 13: The percentages of students passing the SOLs and the heating condition based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Heating		Uneven heat unable to control or even heat , unable to control N=35	Even heat, able to control N=37	
	English Writing	82.3%	86.4%	4.1%
	English Reading	84.2%	88.0%	3.8%
	Algebra I	72.8%	73.7%	1.1%
	Algebra II	85.4%	87.8%	2.4%
	Geometry	82.6%	80.8%	-1.8%

Air Conditioning

The CAPE assessment instrument surveyed schools to determine the level of air conditioning in instructional spaces. The percentages of students passing the English writing and reading, Algebra I, Algebra II, and Geometry SOLs was higher in the substandard condition schools when compared to the standard condition buildings. Although based on the responses, 65 of the respondents reported that air conditioning was available in all instructional areas and well regulated, which was condition three when compared to seven responses indicating that air conditioning was available in some or most

instructional spaces. Based on the small number of responses (less than 10) for each category this information may not be a representative sample of the CAPE responses. Table 14 illustrates these differences.

Table 14: The percentages of students passing the SOLs and the air conditioning condition based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Air Conditioning		No air conditioning or air conditioning in some or in all but unable to control N=7	Air conditioning in all instructional spaces N=65	
	English Writing	86.5%	84.2%	-2.3%
	English Reading	87.2%	86%	-1.2%
	Algebra I	75.3%	73.1%	-2.1%
	Algebra II	88.2%	86.5%	-2.3%
	Geometry	83.2%	81.5%	-1.7%

Interior Paint

There were two items that investigated the quality of the interior paint. Item six, asked when the interior walls in classrooms spaces were last painted. Only two schools of the population responded that their school was last painted over 15 years ago. There were 14 respondents that reported the interior had been painted between eight and 15 years ago, and the remaining 56 respondents reported the interior had been painted less than eight years ago. The percent of students passing the English writing SOLs was 3.2 percent higher in the standard condition buildings compared to the substandard condition buildings. The percentage of students passing the English reading, Algebra I, Algebra II SOLs was higher in substandard condition when compared to the

standard condition. The percentages of students passing the Geometry SOLs was identical in the standard and substandard building condition. Table 15 illustrates this difference.

Table 15: The percentages of students passing the SOLs and when the last time the interior was painted based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Interior Walls Painted		Over 25 years ago or between 8 and 15 years N=16	Less than 8 years N=56	
	English Writing	81.9%	85.1%	3.2%
	English Reading	87%	85.9%	-1.1%
	Algebra I	78.5%	71.8%	-6.7%
	Algebra II	87.9%	86.3%	-1.6%
	Geometry	81.7%	81.7%	0

Interior Paint Cycle

The second item, number seven, asked if there was a regularly scheduled painting cycle for the interior walls. There were 29 respondents that reported that there was a regular paint cycle, and it was over eight years. There were 43 respondents that reported that there was a regular paint cycle, and it occurred in less than 8 years. The percent of students passing the English writing and reading SOLs was 2.5 and .9 percent higher in the standard condition buildings when compared to the substandard condition buildings. The percentages of students passing the Algebra I, Algebra II and Geometry SOLs was higher in the substandard building condition when compared to the standard condition buildings. Table 16 illustrates these differences.

Table 16: The percentages of students passing the SOLs and the interior paint cycle based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Interior Paint Cycle		No or over 8 year cycle N=29	Yes, 8 years or fewer year cycle N=43	
	English Writing	83%	85.5%	2.5%
	English Reading	85.6%	86.5%	.9%
	Algebra I	77.2%	70.7%	-6.5%
	Algebra II	86.9%	86.5%	-.4%
	Geometry	84.2%	80%	-4.2%

Exterior Paint

There were two items on the CAPE which addressed the exterior paint appearance and when the paint cycle is accomplished. Item number eight asked when the exterior areas were painted. The percentages of students passing the English writing and reading, Algebra I, Algebra II, and Geometry SOLs was higher in standard building condition when compared to substandard building condition. The percentages of students passing the English writing and reading SOLs was 5.5 and 6.5 percent higher in the standard condition buildings when compared to the substandard condition buildings. The percentages of students passing the Algebra I, Algebra II, and Geometry SOLs was 1.9 and 2.0 percent higher in the standard condition buildings when compared to the substandard condition buildings. Table 17 illustrates these differences.

Table 17: The percentages of students passing the SOLs and the last time the exterior surfaces were painted based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Exterior Paint		Over 7 years or between 4 and 7 years N=31	Within the last four years or no exterior surface needs painted N=41	
	English Writing	81.3%	86.8%	5.5%
	English Reading	82.6%	88.8%	6.2%
	Algebra I	72.1%	74.1%	2.0%
	Algebra II	85.5%	87.5%	2.0%
	Geometry	80.6%	82.5%	1.9%

Paint Cycle

Item nine on the CAPE assessment looked at the paint cycle for exterior surfaces. The percentages of students passing the English writing and reading SOLs was 2.9 and 4.2 percent higher in the standard condition buildings when compared to the substandard condition buildings. However, the percentage of students passing the Algebra I SOLs was 1.7 percent in the substandard condition buildings when compared to the standard condition buildings. The percentage of students passing the Algebra II and Geometry SOLs was higher in the standard condition buildings when compared to the substandard condition buildings. The buildings that had paint cycles more than seven years (N= 40) comprised the substandard condition buildings, and buildings that had paint cycles less than seven years (N=32) comprised the standard condition. Table 18 illustrates these differences.

Table 18: The percentages of students passing the SOLs and the exterior paint cycle based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Exterior Paint Cycle		No or Yes, over 7 year cycle N=40	Yes, 7 year or fewer year cycle N=32	
	English Writing	83.8%	86.7%	2.9%
	English Reading	84.2%	88.6%	4.2%
	Algebra I	74%	72.3%	-1.7%
	Algebra II	85.9%	87.6%	1.7%
	Geometry	81.2%	82.3%	1.1%

Roofs

Item ten on the CAPE assessment instrument looked at ceiling condition as an indicator of water damage to the roof. There were 32 respondents that indicated that there were no visible signs of water damage to the roof, which comprised the standard condition buildings. There were 42 respondents that indicated that the ceiling was deteriorating or water stains are visible, which comprised the substandard condition buildings. The percentage of students passing the English writing and reading, Algebra I, Algebra II, and Geometry SOLs was all higher in the standard condition buildings when compared to the substandard buildings. The difference in student passing percentages ranged from.6 percent to 3.2 percent with English reading having the highest difference. Differences in student passing percentages were consistent among all subject areas. Table 19 illustrates these differences.

Table 19: The percentages of students passing the SOLs and the roof condition based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Roof Condition		Ceiling is deteriorating due to water damage-water falls or ceiling is currently developing a few stains due to minor leaks N=42	No visible signs, only a few water spots N=30	
	English Writing	83.6%	85.6%	2.0%
	English Reading	84.8%	88%	3.2%
	Algebra I	73%	73.6%	.6%
	Algebra II	86.4%	87.1%	.7%
	Geometry	80.9%	82.8%	2.1%

Adjacent Facilities

On Item 11, the responder was asked to list exterior facilities associated with schools and indicative of surrounding terrain and space. The facilities included football, baseball, soccer and softball fields; tennis courts; and a swimming pool. Substandard condition buildings, which were identified as having no adjacent facilities or 1-5 adjacent facilities present (N=25) on school grounds had a 3.7 percent higher students passing percentages on the Algebra I SOLs when compared to students in standard buildings. The standard condition buildings which had six or more adjacent facilities (N=47) on school grounds had higher student passing percentages on the English writing and reading, Algebra II, and Geometry SOLs. The English writing and reading students passing percentages were 4.2 and 5.3 percent higher in standard buildings when compared to substandard condition buildings.

The percent of students passing the Algebra I, Algebra II, and Geometry SOLs was 3.7, 3.8 and 6.1 percent higher in standard condition buildings compared to substandard buildings. These percentages indicated that the facilities that had more adjacent facilities available for extracurricular activities had higher students passing percentages on the SOLs. Table 20 illustrates these differences.

Table 20: The percentages of students passing the SOLs and the number of exterior structures adjacent to the school based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Adjacent Facilities		None present or 1-5 adjacent buildings N=25	6 or more adjacent facilities N=47	
	English Writing	81.7%	85.9%	4.2%
	English Reading	82.7%	88%	5.3%
	Algebra I	71.8%	74.1%	3.7%
	Algebra II	84.2%	88%	3.8%
	Geometry	77.7%	83.8%	6.1%

Floor Maintenance

Two items were related to floor maintenance; one asked how often floors were swept and the other asked how often floors were mopped. There were seventy schools that indicated that the floors were swept daily or more frequently. The percentages of students passing the English writing and reading, and Algebra I SOL s was higher in the standard condition buildings when compared to the substandard. The percentage of students passing the Algebra II and Geometry SOLs was higher in the substandard condition buildings when compared to the standard condition buildings. Based on the small number of

responses (less than 10) for each category this information may not be a representative sample of the CAPE responses. Table 21 illustrates these differences.

Table 21: The percentages of students passing the SOLs and the number of times the floors are swept based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Sweeping		Monthly or Weekly N=2	Daily or more frequently N=70	
	English Writing	77%	84.6%	7.6%
	English Reading	84.1%	86.2%	2.1%
	Algebra I	67.6%	73.4%	5.8%
	Algebra II	97%	86.4%	-10.6%
	Geometry	95.3%	81.3%	-14%

Mopping

However, the mopping cycle of the schools was not as uniform. There were 24 schools that indicated floors were mopped monthly, which comprised the substandard condition buildings, and 48 schools indicated that the floors in the buildings were mopped daily. The percentages of students passing the English writing and reading, Algebra II, and Geometry SOLs was higher in standard condition buildings when compared to substandard condition buildings. The percentage of students passing the English writing and reading SOLs was 3.8 and 1.6 percent higher in standard buildings. The percentage of students passing the Algebra II and Geometry was 5.2 and 2.5 percent higher in the standard condition buildings. However, the percentage of students passing the Algebra I SOLs was .9 percent higher in substandard condition buildings when compared

to standard buildings. Table 22 illustrates the differences in the percentages of students passing the SOLs and the number of times floors are mopped.

Table 22: The percentages of students passing the SOLs and the number of times the floors are mopped based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Mopping		Annually or Monthly N=24	Weekly N=48	
	English Writing	81.9%	85.7%	3.8%
	English Reading	85.1%	86.7%	1.6%
	Algebra I	73.9%	73%	-.9%
	Algebra II	83.2%	88.4%	5.2%
	Geometry	80%	82.5%	2.5%

Graffiti

Item 14 asked respondents to determine if there was graffiti in some areas, all areas, or there was no graffiti present. There were 34 respondents that reported that there was no graffiti present in the building, which comprised the standard condition buildings, and there were 38 schools which responded that there was graffiti present in some or all areas, which comprised the substandard condition buildings. The percentages of students passing the English writing and reading, Algebra II, and Geometry SOLs in standard condition buildings was higher when compared to the substandard condition buildings. The percentages of students passing the English writing and reading SOLs was 4.5 and 3.4 percent higher in standard condition buildings when compared to substandard condition buildings. The percentage of students passing the Algebra II and Geometry SOLs was 3.3 and 3.4 higher in standard condition buildings when compared to substandard condition buildings. However, the percentage of

students passing the Algebra I SOLs was 2.6 percent higher in substandard condition when compared to standard condition buildings. Table 23 illustrates these differences.

Table 23: The percentages of students passing the SOLs and the presence of graffiti in the school building based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Graffiti Present		Present in all or some areas N=38	None present N=34	
	English Writing	82.3%	86.8%	4.5%
	English Reading	84.5%	87.9%	3.4%
	Algebra I	74.5%	71.9%	-2.6%
	Algebra II	85.1%	88.4%	3.3%
	Geometry	80.1%	83.5%	3.4%

Graffiti

Item 15 addressed how long it took for graffiti to be removed. There were six respondents that indicated that the graffiti was removed during summer maintenance or longer than a week for removal. These responses comprised the substandard condition buildings. There were 66 respondents that indicated that graffiti was removed in less than a week or no graffiti present. This comprised the standard condition buildings. Based on the large number of respondents that reported that graffiti was removed in less than a week or no graffiti was present, based on the small number of responses (less than 10) for each category this information may not be a representative sample of the CAPE responses. Table 24 illustrates the differences in the percentages of students passing the SOLs and the amount of time that is needed for graffiti to be removed.

Table 24: The percentages of students passing the SOLs and the amount of time that is needed for graffiti to be removed based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Graffiti Removed		Until summer maintenance or more than a week or less than a month N=6	Less than a week or no graffiti present N=66	
	English Writing	73.4%	85.4%	12%
	English Reading	70.4%	87.6%	17.2%
	Algebra I	74.6%	73.2%	-1.4%
	Algebra II	91.7%	86.2%	-5.5%
	Geometry	77.2%	82.1%	4.9%

Locker Condition

Item 16 assessed the condition of lockers. There were nineteen respondents that indicated that most of the lockers were not functional or less than three-fourths of the lockers were not functional, which comprised the substandard buildings. There were 53 respondents that indicated that over three-fourths of the lockers were functional or in good condition, which comprised the standard condition buildings. Based on the responses, there was a significant difference between the percentages of students passing the SOLs in the two conditions of buildings. The percentages of students passing the English writing and reading, Algebra II, and Geometry SOLs were surprisingly higher in the standard buildings. The percentages of students passing the English writing and reading SOLs was 7.2 and 7.4 percent higher in the standard condition buildings compared to the substandard condition buildings. The percentage of students passing the Algebra II and Geometry SOLs was 5.5 and 7.2 percent higher in the

standard condition buildings compared to the substandard condition buildings. However, the percent of students passing the Algebra I SOLs was .4 percent higher in the substandard condition buildings when compared to the standard buildings. Table 25 illustrates these differences.

Table 25: The percentages of students passing the SOLs and the current condition of the lockers in the school building based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Locker Condition		Most are not functional or not in use or at least¾of the lockers are functional N=19	Over¾of the lockers are functional and in good repair N=53	
	English Writing	79%	86.4%	7.4%
	English Reading	80.8%	88%	7.2%
	Algebra I	73.6%	73.2%	-.4%
	Algebra II	82.6%	88.1%	5.5%
	Geometry	76.4%	83.6%	7.2%

Acoustics

Item 17 addressed acoustics and what type of material was used for the interior ceilings in the buildings. There were 17 respondents that indicated that the interior ceilings were made of wood or open beams, or plaster, or acoustical tiles in at least three fourths of instructional spaces, which comprised the substandard condition buildings. There were 55 respondents that indicated that acoustical tiles were found throughout instructional spaces which comprised the standard condition buildings. The percentages of students passing the English writing and reading SOLs was 1.7 and 1.5 percent higher in standard condition buildings when compared to substandard condition buildings. The percentage of

students passing the Algebra II and Geometry SOLs was 1.3 and 4.8 percent higher in standard condition buildings when compared to substandard condition buildings. However, the percent of students passing the Algebra I SOLs was 1.5 percent higher in substandard condition buildings when compared to standard condition buildings. Table 26 illustrates these differences.

Table 26: The percentages of students passing the SOLs and the current ceiling property in the school building based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Ceiling Property		Wood or Open Beams or plaster or acoustical tiles in at least ¾ of instructional spaces N=17	Acoustical tiles throughout the instructional spaces N=55	
	English Writing	83.1%	84.8%	1.7%
	English Reading	85%	86.5%	1.5%
	Algebra I	74.4%	72.9%	-1.5%
	Algebra II	85.7%	87%	1.3%
	Geometry	78%	82.8%	4.8%

Science Laboratories

Items 18 and 19 addressed information about the quality and age of science laboratories. This topic was discussed earlier, beginning on page 15, as a major area.

Lighting

Item 20 identified buildings by the type of lighting. The highest student passing percentages on the Standards of Learning examinations was found in the standard buildings on the English writing and reading SOLs. The percent of

students passing the English writing SOLs was 5.2 percent higher in buildings that had fluorescent lighting when compared to the students passing percentages in buildings that did not have SUCV lighting. The percent of students passing the English reading SOLs was 4.5 percent higher in standard condition buildings when compared to substandard condition buildings. The lowest students passing percentages on the Standards of Learning examinations were found on the Algebra I and Algebra II SOLs with a .8 percent difference between standard and substandard condition buildings. Table 27 illustrates these differences.

27: The percentages of students passing the SOLs and the lighting type in the school buildings based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Lighting		Incandescent lighting or fluorescent lighting-hot N=30	Fluorescent lighting-cold N=42	
	English Writing	81.4%	86.6%	5.2%
	English Reading	83.5%	88%	4.5%
	Algebra I	72.8%	73.6%	.8%
	Algebra II	86.2%	87%	.8%
	Geometry	82.8%	80.9%	-1.9%

Furniture

The condition of classroom furniture was assessed by item 21. There were 32 respondents that indicated most of the instructional spaces had furniture that was facially scarred or half of the spaces had facially scarred furniture. There were 40 respondents that indicated that all of the furniture was functionally sound and facially attractive, which comprised the standard condition buildings. The percentages of students passing English writing and reading SOLs was 1.8 and

.4 percent higher in the standard condition buildings when compared to the substandard condition buildings. The percentage of students passing the Algebra I SOLs was 2.2 percent higher in standard condition buildings when compared to substandard condition buildings. The percent of students passing the Algebra II and Geometry SOLs was eight and four percent higher in standard schools when compared to the substandard condition buildings. Based on the findings, the condition of the classroom furniture did have an impact on student passing percentages on the Standards of Learning examinations. Table 28 illustrates these differences.

Table 28: The percentages of students passing the SOLs and the current condition of the furniture in the school building based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Furniture		Most rooms have furniture that is facially scarred or damage or half the rooms have minor facial scars N=32	All furniture is functionally sound and facially attractive N=40	
	English Writing	83.4%	85.2%	1.8%
	English Reading	85.9%	86.3%	.4%
	Algebra I	72%	74.2%	2.2%
	Algebra II	82.1%	90.1%	8%
	Geometry	79.4%	83.4%	4%

Grounds

Item 22 considered the condition of school grounds. There were 65 respondents that indicated that the school landscaping was in good condition and attractive to the community, which comprised the standard building condition.

There were seven schools that indicated that there was no landscaping and sidewalks were cracking or landscaping was present and sidewalks were in good condition, which comprised the substandard condition buildings. Based on the small number of responses (less than 10) for each category this information may not be a representative sample of the CAPE responses. Table 29 illustrates these differences.

Table 29: The percentages of students passing the SOLs and the current condition of the school grounds based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Condition of Grounds		There is no landscaping and sidewalks not present or damage or there is landscaping and sidewalks are presents and in good condition N=7	The landscaping is in good condition and attractive N-65	
	English Writing	86.8%	84.2%	-2.6%
	English Reading	86.6%	86.1%	-.5%
	Algebra I	73.2%	73.3%	.1%
	Algebra II	91.2%	86.2%	-5%
	Geometry	82.3%	81.6%	-0.7%

Wall Color

Item 23 revealed that the percent of students passing the English writing SOLs in standard condition schools with pastel colors scored 5.0 percent higher when compared to substandard schools with dark colors or white or off-white colors. The percent of students passing the Algebra I SOLs was 3.7 percent

higher in standard condition buildings when compared to substandard condition buildings. The percentages of students passing the English reading, Algebra II and Geometry SOLs were 3.7, 3.2, and 3 percent higher in the standard condition buildings when compared to the substandard condition buildings. Table 30 illustrates these differences.

Table 30: The percentages of students passing the SOLs and the current color of the walls in the school buildings based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Color of Walls		Dark or White or Off-White colors N=37	Pastel Colors N=35	
	English Writing	82%	87%	5%
	English Reading	84.3%	88%	3.7%
	Algebra I	73.2%	73.4%	.2%%
	Algebra II	85.1%	88.3%	3.2%
	Geometry	80.2%	83.2%	3%

Noise

Item 24 examined whether or not the school was located in a noisy area. There were seven respondents that indicated that the school was located near a busy highway but measures have been taken to reduce the noise level or no measures have been taken to reduce noise level. There were 65 respondents that indicated that the school was not located near a busy highway. Based on the responses, a difference could not be ascertained for this item. Table 31 illustrates this difference.

Table 31: The percentages of students passing the SOLs and the current location of the school buildings based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Location of School		Yes, and no measures to reduce noise or yes, but measures have been taken to reduce noise N=11	No N=61	
	English Writing	84.0%	84.5%	.5%
	English Reading	84.1%	86.5%	2.4%
	Algebra I	76.2%	72.7%	-3.5
	Algebra II	83.5%	87.3%	4.2%
	Geometry	79.3%	82.2%	-2.9%

Building Condition

Item 25 asked respondents to determine if the school was in standard or below standard condition. There were 11 respondents that indicated the school building was below standard and 61 respondents that indicated that the building was in standard condition. Based on the small number of respondents describing their building in substandard condition, the results may not reflect a significant difference in Standard of Learning passing percentages. Table 32 illustrates these differences.

Table 32: The percentages of students passing the SOLs and the current condition of the school buildings based on the CAPE assessment responses from the school principals.

Cape Item	Achievement	Building Condition Factor	Building Condition Factor	Difference
Condition of the Building		Unanswered or substandard N=11	Standard N=61	
	English Writing	77.7%	85.6%	7.9%
	English Reading	80.1%	87%	6.9%
	Algebra I	66.6%	74.6%	8%
	Algebra II	79.2%	88.4%	9.2%
	Geometry	77.3%	82.8%	5.5%

Square Footage and Acreage

Based on the number of respondents that did not answer this item on the CAPE, (N=41) 28 percent, these two areas were not included in the final analysis.

Summary

Chapter 4 provided survey responses concerning building conditions from the principals in school divisions across the Commonwealth of Virginia. The CAPE Assessment instrument information completed by the school principals was based on the current perceptions principals had on their school buildings.

Each question was analyzed by the percentage and frequency of responses for each question. The percentages of students passing the SOLs were then used to determine if the principal responses on the CAPE assessment instrument had a difference between standard and substandard condition buildings. The differences were then reported using the free and reduced percentages for each school as a covariate to adjust for the difference in SOL passing percentages.

Data reported in Chapter 4 were collected through on-line web based surveys sent to the principals in the schools that were eligible to participate in the research study. The chapter provided descriptive statistics about the responses, presented findings which were related to the research questions, and summarized the results.

Chapter 5

Summary of Findings, Discussion, Conclusion, Implications, Recommendations for Further Study

The purpose of chapter five is to address the research question, "What is the relationship between the percentage of students passing the SOL examinations and the condition of the educational facilities?" This chapter will also present a summary of the findings and a discussion of these studies. A comparison of the Cash (1993) and Hines (1996) studies was conducted to determine if the same findings were found in this study as previously found in those two earlier studies. Recommendations for further study will conclude this chapter.

Summary

The entire population of high schools in the Commonwealth of Virginia was used to investigate the relationship between building condition and student achievement. The building condition rating was derived from the Commonwealth Assessment of Physical Environment which was a building assessment instrument developed by Cash (1993). The assessments achieved through this instrument permitted the comparison of the total building condition to student achievement.

The items on the CAPE are subdivided into two categories. Those items relating to aesthetics of the building are grouped into cosmetic category. Likewise those items relating to the physical structure of the building are grouped into a

structural category. These two categories permitted the researcher to analyze how those two categories of items influenced student achievement.

Student achievement was represented by the percent of students passing the Standards of Learning examinations in English writing and reading, Algebra I, Algebra II, and Geometry for the 2003-04 school year. The percentages of students passing the SOLs were available on the web-site of the Virginia Department of Education. The percentages of students passing the science Standards of Learning examinations which included Earth Science, Biology, and Chemistry were compared across the three building conditions to address the science quality questions on the Commonwealth Assessment of Physical Environment. All of the percentages of students passing the SOLs were adjusted for socioeconomic status through the use of the free and reduced lunch percentages for each respective school. These percentages were based on the 2004-05 school nutrition reports provided by the Virginia Department of Education database.

Findings

An ANCOVA was conducted to determine if there was a statistical significance between the student passing percentages on the Standards of Learning examinations in substandard and standard buildings. The significance level was measured at the >.05 level. Through a pair-wise comparison of the percentage of students passing SOL examinations in standard and substandard condition buildings with the free and reduced lunch percentage used as the covariate, some statistical significance was found. However, one key finding was

that when the free and reduced lunch percentage was not used as a covariate the students' passing percentages on the Standards of Learning were similar in significance, and again the passing percentages were higher in standard condition buildings when compared to substandard buildings. This held true for all subjects except for the percent of students passing the Algebra I SOLs.

When the percentages of students passing the SOLs were compared between standard and substandard buildings, significance was found in the English reading and writing Standards of Learning examinations. The significance was found at the >.05 level on the English writing and reading Standards of Learning examinations. However, on the Algebra I, Algebra II, and Geometry Standards of Learning examinations there was no statistical significance found. In fact, the percentages of students passing the SOLs in Algebra I and Geometry were higher in the substandard buildings than in standard buildings. The percent of students passing the Algebra II SOLs was 2.5 percent higher in the standard buildings but was not found to be statistically significant.

The cosmetic category of buildings was compared using the standard and substandard classification to determine if the cosmetic condition of the school influenced student achievement. Each school was given a cosmetic scaled score based on the responses of the principals on the CAPE assessment, and these two classifications were compared to determine if the cosmetic building condition influenced student achievement. The scaled scores were identical in the standard and substandard school buildings when examining overall building

condition and cosmetic condition, so the differences were the same when examining the overall and cosmetic building condition.

The percentages of students passing in standard and substandard buildings were compared based on the structural responses on the CAPE assessment instrument. Based on the responses, the percentages of students passing English writing and reading were greater in standard buildings than the percentages of students passing these subjects in substandard school buildings. The difference between the two percentages was significant at the >.05 level of confidence. There was no statistical significance found on the Algebra I, Algebra II, and Geometry percentages of students passing Standards of Learning examinations.

An examination of the Science lab equipment found no statistical significance between the percentages of students passing the SOL examinations in standard and substandard buildings. One factor that must be addressed is there was a very small number (N=4) that did not have all the identified functions available in the science lab. With this small number of schools, the percentages of students passing the Standard of Learning examinations may be skewed due to the small number.

The second item related to science condition was Item 19 which addressed when the science classroom was updated. When an analysis of the students' passing percentages was conducted, the percentages of students passing the science SOLs were higher in the buildings that had an update ten or more years ago.

There were a number of findings that were found to have a relationship between the condition of the school and student achievement. The following information was a result of this study.

1. Student achievement was found to be generally higher in those buildings with higher quality ratings. The percent of students passing the English writing and reading SOLs was found to be significant at the >.05 level. The Algebra II and Geometry were higher in standard buildings when compared to substandard buildings but were not statistically significant. The percent of students passing the Algebra I SOLs was higher in the substandard buildings when compared to the standard buildings. There was no significant difference between the two groups of students in Algebra I.
2. When building condition was subdivided into structural and cosmetic conditions, the percentages of students passing English writing and reading were significantly higher at the >.05 level in both categories. The percentages of students passing the Algebra II, and Geometry SOLs were all higher in the standard buildings when compared to the substandard buildings when examining the cosmetic building category but were not statistically significant. The percent of students passing the Algebra I SOLs was higher in the substandard buildings when compared to the standard buildings in the cosmetic condition category.
3. The percent of students passing the science SOLs was significantly higher when the science classrooms had three or more functions available for

use in the classroom. However, the percent of students passing science SOLs was higher in the buildings that had a science equipment update over ten years ago. Based on the data, the availability of science functions has more of an impact on student achievement when compared to an update of the science classrooms.

4. A review of the individual building factors as represented by the 27 items on the Commonwealth Assessment of Physical Environment revealed a relationship between student achievement and several of the building factors.
    a. The age of the building indicated a significant difference between the older and younger buildings; however, in the buildings that were ten years or less, the percent of students passing the Algebra II SOLs was higher in the substandard buildings when compared to the standard buildings. This is an unanticipated finding because one would assume that all of the SOL passing percentages would be higher in the standard buildings because of the updated technology capabilities and updated instructional resources available.
    b. With current research that indicates natural lighting is more conducive than the lack of windows or other source of natural light to student achievement, the assumption is present that in the facilities with more windows higher student achievement would be found in these buildings. However, in this study the percentages of

students passing the English writing and reading and Algebra I SOLs were higher in the substandard buildings when compared to the standard buildings. The older buildings may have had more window surfaces and the newer buildings probably have less glass that may help save on energy costs. This finding creates discussion on how significant natural lighting is on student achievement.

c. One key finding of this study is the CAPE assessment item related to air conditioning. In previous research studies, air conditioning was found to have a significant impact on student achievement. In this study, the percentage of students passing the SOLs was found to be higher in the substandard schools compared to the standard schools in all five subject areas tested. The reason for this difference may be attributed to the small number of schools that stated there was no air conditioning which was six compared to 65 schools that stated the air conditioning was able to be regulated at the classroom level. This may have caused a skewed difference in the students' passing percentages. Another reason for the difference may be related to the substandard buildings which were located in the more rural areas of Virginia. Many of the schools in the western part of Virginia do not have air conditioning because the outside temperature may not dictate the need for air conditioning. This finding could also be a result of SES. Poor

students tend to be found in less wealthy districts and less wealthy districts have less air conditioning.

d. In schools that had no visible water stains or spots present in the ceiling the percentages of students passing the SOLs had a small difference between buildings that had no roof leaks when compared to buildings that had roof leaks or were developing minor water spots. It would be assumed that if the school buildings had roof leaks then the instructional day may be interrupted, thus lowering student achievement. In this study there was some difference, but no large difference was found. Based on the data, the condition of the roof structure had no significant impact on student achievement.

e. The percentages of students passing the English writing and reading SOLs were significantly higher in the buildings that had fluorescent lighting –cold when compared to buildings that had fluorescent lighting-hot or incandescent lighting. Although the percentages of students passing the Algebra I and Algebra II were higher in standard buildings, the students' passing percentages were higher in the substandard buildings in Geometry. One would assume that the percentages of students passing all of the SOLs would be significantly higher in standard buildings, but in this study this was found not to hold true. The responses on the CAPE assessment may not have been accurate because there were very

few respondents who knew the difference between the different lighting types currently available in the school.

f. The ceiling property of school buildings has been found in previous research studies to have an impact on student achievement. However in this study, the acoustical properties were found not to have a significant impact on student achievement. The percentages of students passing the English writing and reading, and Algebra II, and Geometry SOLs were higher in standard buildings but lower in substandard condition buildings on the Algebra I SOLs. This could be attributed to the larger number of schools that currently have acoustical tiles in each classroom. However, smaller class sizes may be a factor that has more of an impact on student achievement instead of the type of ceiling in the classrooms.

g. One item on the CAPE asked the principal to rate the building condition. The responses indicated there was a significant difference between the percentages of students passing between the standard and substandard buildings. The percent of students passing the English writing and reading, Algebra I, Algebra II, and Geometry were higher in the schools identified as being in standard condition. The results of the CAPE indicated that 61 principals (84 percent) identified their schools as being in standard condition. The percentages of students passing the SOLs ranged from 5.5 percent to a high of 9.2 percent. These higher percentages may be skewed

due to the large number of principals that described their schools in standard condition, but the difference in passing percentages must not be ignored. This higher percentage may be an accurate description of the condition of the facility based on the opinion of the principal.

h. Another CAPE item that requires discussion is the graffiti found in the school buildings. For all of the school principals that indicated that there was no graffiti or that the graffiti was removed as soon as possible in the school buildings, the percentages of students passing the English writing and reading, Algebra II, and Geometry were all higher in the standard schools compared to the substandard. The percentages of students passing the Algebra I SOLs were higher in the substandard schools. This is an interesting phenomenon because the assumption exists that student achievement would be higher in schools that had little or no graffiti present.

i. In the Cash (1993) and Hines (1996) studies, the mathematics percentile ranks were uniformly higher in the standard condition schools. In this study, there were 12 CAPE assessment items that indicated the percentages of students passing the Algebra I SOLs were higher in the substandard condition schools. The difference in Algebra I passing percentages may be attributed to the smaller class sizes in the substandard schools which were 11.1 to 1

compared to 12 to 1 in the standard buildings. More emphasis has been placed on Algebra I because in some school divisions, Algebra I has been an indicator for students graduating in four years. The substandard condition schools were located in more rural areas that may have more resources allocated for Algebra I remediation and enhancement.

j. The percentage of students passing the English reading and writing, Algebra I, Algebra II, and Geometry SOLs were all higher in the buildings that had pastel colors throughout the school buildings.

k. In all but six of the 27 separate CAPE assessment items a greater percentage of students in substandard buildings scored higher in Algebra I than students in standard buildings. With the exception of the exterior paint, the building components of furniture condition, adjacent facilities, roof condition, color of walls, and condition of the facility are important to a good building. A majority of the differences were found in the percentages of students passing the Algebra I SOLs. This may be a direct result of the dropout rate, which was lower in the substandard condition buildings. Middle school students could be taking Algebra I SOLs which could result in lower percentages of students passing in the high schools because usually the higher level math students will take Algebra I at the middle school. The enrollment in the substandard buildings was lower when compared to the standard buildings which could

have an impact of more individualized instruction provided to students.

Conclusion

The data from this study show that there is a positive relationship between the building condition and student achievement, but in a limited number of subtests. A strong difference in the percentage of students passing the English reading and writing subtests was found which supports the conclusion, but the differences between the percentages of students passing the SOLs in Algebra II and Geometry in substandard and standard buildings were positive but not strong enough for significance. In fact, in the subtest of Algebra I there was a negative difference in many cases.

The students from each high school in the Commonwealth of Virginia are expected to pass the Standards of Learning examinations with a minimum of 70 percent. The impact of the building condition is something that lawmakers and school officials need to carefully examine to insure all students are receiving the necessary assistance to be successful on the Standards of Learning examinations.

Discussion

This study provided support that a relationship between building condition and student achievement does exist. The percentages of students passing the Standards of Learning examinations between standard and substandard building conditions differed by up to 17.2 percentage points. The differences in

percentages of students passing were found in the English reading subtest of the SOLs for students in buildings where graffiti was removed in less than a week.

The difference in the standard and substandard overall building condition differed by up to 6.6 percentage points in the English reading. When comparing standard schools with the substandard schools in the cosmetic condition schools, the percentages of students passing the SOLs in the standard schools were higher by a maximum of 6.6 percentage points, again in the English reading subtest. When comparing standard schools with substandard schools in the structural condition, the percentages of students passing the SOLs were also higher in the standard schools. A majority of the student achievement variance is attributed to socioeconomic status. However, when the socioeconomic status, free and reduced lunch percentage, as in this study, is controlled, there is a difference of five to eleven percentile points associated with building condition, then one would assume that more attention would be placed on building condition and maintenance. From this perspective, when the percentage points on individual factors increased by a high total of 17.2 percent, this increase can significantly impact the school's accreditation status.

The Virginia Standards of Learning examinations require that all schools score a minimum of 70 percent on all subject areas; one would conclude that a 17.2 percent increase may change the current accreditation status of a school. Also, with the "No Child Left Behind" federal mandate that all schools make adequate yearly progress, an increase in Standards of Learning percentages could greatly impact whether or not a school meets this mandate.

One significant item that needs to be discussed is the percent of students passing the Algebra I Standards of Learning examinations. In the Cash (1993) and Hines (1996) studies, they found mathematics to be uniformly higher in standard condition buildings compared to the substandard buildings. However, in this study Algebra I was found to be higher in the substandard condition buildings when compared to the standard buildings in many instances.

Smaller class sizes in the substandard schools as well as the smaller enrollment may impact the Algebra I passing percentages. Also, the exact number of students that take Algebra I at the middle school may have influenced the results of the investigation. Naturally, the subject area of mathematics can not be compared directly with the field of Algebra, but both subject areas deal with the abstract of numeration where similarities do exist.

As Cash (1993) stated, building maintenance is a costly part of the total school budget within every school division. She adds, if the factors which were identified showed increased student achievement across structural building categories, which are more expensive, then the increase in building expenditures may be questioned. However, if the changes were needed to cosmetic conditions, which are generally less expensive, then the funding for the repairs or upgrades would be more cost effective.

Comparison of Previous Research Studies

When comparing the Cash (1993) and Hines (1996) studies with this study, many similarities existed. Building condition was found to have a relationship with student achievement. However, in the Cash and Hines studies,

the Tests of Academic Proficiency were used to measure student achievement, and the studies used percentile ranks to record differences. The current study used the percent of students passing the Standards of Learning examinations to measure student achievement. In order to identify the common elements of Cash, Hines, and this study, an examination of an increase in student achievement was used to determine any similarities or differences in passing percentages.

One key consideration when making a comparison of the previous research studies is, the Tests of Academic Proficiency were National norm referenced standardized tests, whereas, the Standards of Learning examinations are curriculum based. All school divisions in the Commonwealth of Virginia are expected to pass the SOL examinations with a minimum of 70 percent pass rate, and each school's accreditation is based on these passing percentages. The key difference on the scoring of these examinations was that the mean scores were based on National passing means. The SOL examination percentages are true percentages for each individual school, and no two schools passing percentages are the same.

When comparing the previous research studies conducted by Cash (1993) and Hines (1996) with the overall building condition, similarities did exist. When examining the standard and substandard school and comparing student achievement, the Cash (1993) study found that all components of the TAP achievement percentile ranks were higher in the standard condition buildings. The largest difference was found on the science and total composite sections of

the TAP test. Likewise, in the Hines (1996) study, the percentile ranks in all areas of the TAP tests were higher in the standard condition buildings when compared to the substandard buildings. The percentile ranks ranges in the Cash (1993) study were from two percentile ranks to five percentile ranks. The Hines (1996) study had a larger difference in percentile ranks with a range of between nine and 17 percentile ranks.

The findings of this study found similar differences between the percent of students passing the Standards of Learning examinations between standard and substandard condition buildings. However, in this study the Algebra I and Geometry SOLs were higher in many instances in the substandard buildings when compared to the standard buildings. The English writing and reading and Algebra II percentages of students passing the SOLs were higher in the standard buildings when compared to the substandard. Table 33 illustrates these differences.

Table 33: The differences of achievement percentile rank score and percent of students passing in substandard and standard buildings with the overall building condition.

Subject Areas	Cash (TAP)[1] 1993	Hines (TAP)[1] 1996	Crook (SOL) [2] 2006 % Student Passing
Reading Comprehension	+4	+15	--
Math Application	+4	+17	--
Language/Writing	+2	+ 9	--
Sources of Info	+4	+13	--
Basic Composite	+4	+13	--
Social Science	+3	+11	--
Science	+5	+ 9	--
Total Composite	+5	+14	--
English Reading	--	--	6.6*
English Writing	--	--	5.5*
Algebra I	--	--	-1.5
Algebra II	--	--	2.5
Geometry	--	--	-1.1

1 = Test of Academic Proficiency

2 = Standards of Learning

* = Significant >.05

When comparing the previous research studies conducted by Cash (1993) and Hines (1996) with the cosmetic building condition, similarities did exist. When examining the standard and substandard schools and comparing the student achievement of the Cash (1993) study, all components of the TAP achievement percentile ranks were higher in the standard condition buildings. The range of percentile ranks was between two and four with the largest difference being found in the science and total composite areas of the TAP tests. The Hines (1996) study had similar results. The percentile ranks were higher in every TAP test category with the greatest difference being found in the total composite, science, basic composite and reading components of the TAP test. The range of percentile ranks was between four and six.

In this study the percentages of students passing the English writing and reading and Algebra II SOLs were higher in the standard condition buildings when compared to the substandard. The percentages of students passing the Algebra I and Geometry SOLs were lower in this study which was a difference from the Cash (1993) and Hines (1996) studies. Table 34 illustrates these differences.

Table 34: The differences of achievement percentile rank score and percent of students passing in substandard and standard buildings with the cosmetic building condition.

Subject Areas	Cash (TAP) [1] 1993	Hines (TAP)[1] 1996	Crook (SOL)[2] 2006 % Student Passing
Reading Comprehension	+4	+5	--
Math Application	+4	+4	--
Lang/Writing	+2	+4	--
Sources of Info	+4	0	--
Basic Composite	+4	+5	--
Social Science	+3	+4	--
Science	+5	+5	--
Total Composite	+5	+6	--
English Reading	--	--	6.6*
English Writing	--	--	5.5*
Algebra I	--	--	-1.5
Algebra II	--	--	2.5
Geometry	--	--	-1.1

1 = Test of Academic Proficiency

2 = Standards of Learning

*= Significant >.05

When comparing the previous research studies conducted by Cash (1993) and Hines (1996) with the structural building condition, similarities did exist. When examining the standard and substandard schools and comparing the student achievement of the Cash (1993) study, all components of the TAP achievement percentile ranks were higher in the standard condition buildings.

The range of percentile ranks was between two and four with the largest difference being found in the science and total composite areas of the TAP tests. The Hines (1996) study had similar results. However, Hines (1996) found that the results of the Sources of Information component of the TAP test were higher in substandard buildings when compared to the substandard buildings. The percentile ranks were higher in every other TAP test category with the greatest difference being found in the total composite, mathematics application components of the TAP test. The range of percentile ranks was between five and nine.

Similarly in this study the percentages of students passing the English writing and reading, Algebra II, and Geometry SOLs were higher in the standard condition buildings when compared to the substandard. The percentages of students passing the English writing and reading SOLs were found to be significant at the >.05 level. However, unlike in the Cash (1993) and Hines (1996) studies the percentages of students passing the Algebra I SOLs were higher in the substandard buildings when compared to the standard. Table 35 illustrates these differences.

Table 35: The differences of achievement percentile rank score and percent of students passing in substandard and standard buildings with the structural building condition.

Subject Areas	Cash (TAP) [1] 1993	Hines (TAP) [1] 1996	Crook (SOL) [2] 2006 % Student Passing
Reading Comprehension	+4	+8	--
Math Application	+4	+9	--
Lang/Writing	+2	+5	--
Sources of Info	+4	-1	--
Basic Composite	+4	+7	--
Social Science	+3	+7	--
Science	+5	+7	--
Total Composite	+5	+9	--
English Reading	--	--	6.7*
English Writing	--	--	7.0*
Algebra I	--	--	-2.8
Algebra II	--	--	1.3
Geometry	--	--	1.2

1 = Test of Academic Proficiency

2 = Standards of Learning

* = Significant >.05

In this study the most significant finding was in the percent of students passing the English writing and reading SOLs. A similar finding was found in the Cash (1993) and Hines (1995) studies with the Reading Comprehension and Writing subtests of the TAP achievement examinations. The passing percentages were higher in the standard condition buildings when compared to the substandard. The percentages of students passing the English writing and reading SOLs were found to be significant at the >.05 level. Table 36 illustrates these differences.

Table 36: The differences of achievement percentile rank score and percent of students passing in substandard and standard buildings with the overall building condition.

Subject Areas	Cash (TAP)[1] 1993	Hines (TAP)[1] 1996	Crook (SOL)[2] % Student Passing Difference
English Reading	+4	+15	6.6*
English Writing	+2	+ 9	5.5*

1 = Test of Academic Proficiency

2 = Standards of Learning

* = Significant >.05

Study Concerns

As in the Cash (1993) and Hines (1996) studies there were a few concerns that must be addressed. The biggest concern is the reliability of the data. Some principals may not have responded accurately because their perception of the facility condition may be distorted due to school pride or allegiance to the school. Some principals may be in schools that are in poor condition and may not have another facility to compare with their school.

Another study concern is the use of percentage of students passing an examination compared to actual scores on the Standards of Learning examinations. Obviously, using scaled scores is the better data to use in research studies, but only the percent of students passing is provided on the Virginia Department of Education web-site. Using student raw or scaled scores is more accurate than using percentages of student passing. A researcher is able to do more precise analysis of the scaled scores than using the percentage of students passing a subject. In addition the scaled scores represent an individual student where as percentage of students passing represents the entire class.

The percent of students passing a specific subject area test may be higher in one school division, but this may be due to a smaller number of students that

participated in the testing compared to a larger testing population in a larger school division. Raw and scaled scores are more definite scores because the scores represent the scores of actual individuals who are tested and identified between high and low scores. In addition, scaled scores provide a continuous score scale across the different forms and levels of a test series. The percentage of students passing the SOLs indicates a mean percentage which may have a higher error of measurement which creates problems with the data.

The free and reduced lunch percentage could also be a study concern. Due to peer pressure or fear of being labeled some parents or students may not apply for free or reduced lunch. This may create an inaccuracy in the actual free and reduced lunch percentages of the students in each respective school.

The percent of students passing the SOLs provided by the Virginia Department of Education provide a percentage for all students in each respective school. Some school divisions do not test all subject areas thus creating gaps in student achievement data.

There has been a considerable amount of time that has elapsed since the Cash (1993) study was completed. In that time period new buildings have been constructed, renovations have been completed, buildings additions, and emphasis has been placed on building condition. Architectural and consulting firms have advised school division personnel on the best utilization of capital funds and how to maximize space. Better utilization of spaces is considered when the building administration plans the master schedule. All of the updates may have improved the percent of students passing the SOLs.

Recommendations for Further Study

As a result of this study, the following recommendations for further research are offered.

1. Conduct a study that examines the percent of minority students in each school and determine if there is a relationship between building condition and minority performance. Further research needs to be completed in this area to determine if there is a significant difference between achievement of minority students in substandard and standard school buildings. Such a study should identify substandard and standard buildings initially and then identify those schools with the greatest number of minority students for comparison of academic achievement. This study could then indicate if building condition is a more important factor in minority achievement than in the general population.
2. Researchers could conduct a study that examines a possible relationship between student enrollment, building condition and student achievement. One significant finding of the present study was that a majority of the substandard schools were found in the rural areas of the Commonwealth of Virginia which had smaller student enrollments. This study could be completed by identifying groups of schools and placing them in standard and substandard categories and examining if there is a relationship between the total student enrollment and student achievement. This could be done on all configurations of schools.

3. A study could be completed by investigating the building condition and the relationship between the student achievement of Low Income Family (LIF) students in substandard and standard buildings. In such a study the percent of LIF students would be used to define the student population in the two categories of buildings. Comparison of student achievement between LIF students in substandard and standard buildings would determine the extent of influence building condition has on achievement of these students. The assumption exists that if the percentage of students from LIF is higher then students would perform lower on standardized tests. In this study the free and reduced lunch percentage was higher in substandard buildings. This study could be performed at all grade level configurations.
4. A study could be conducted that compares student achievement and building conditions on a multi-state level creating regional comparisons. The Commonwealth of Virginia has had numerous research studies. A multi-state examination of building condition and the relationship with student achievement may further validate these studies.
5. A study could be conducted that investigates the relationship between student achievement and faculty attitudes and building condition. The assumption exists that in newer buildings student achievement is higher. However, with the focus on Standards of Learning examinations many school divisions have placed a higher emphasis on teaching strategies that focus on teaching to the Standards of Learning examinations. This

study could be completed by creating a survey that would ask teachers questions related to their current teaching practices and what they feel is important to student achievement. Then ask teachers to complete the CAPE assessment instrument because their interpretation of the building condition may be different from the responses provided by the principals. Then compare between the CAPE assessment results and student achievement.

6. Revise the CAPE assessment instrument and apply to middle and elementary school populations and use the Standards of Learning examination passing percentages to determine if there is a relationship between building condition and student achievement. An independent review could be conducted of the school buildings to provide an objective opinion of the facilities.
7. There have been sufficient research studies during the last 15 years using the same basic methodology studying the relationship between school building condition and student achievement to warrant a meta-analysis of the extant studies on this topic.
8. Lemasters (1997) conducted a review of various research studies. Numerous research studies have been conducted that have provided data that investigates the relationship between student achievement and building condition. An updated review of the current research would be beneficial to the educational community.

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Appendices

School Divisions that granted permission to participate in this research study

School Division	*Number of eligible Schools*	*Number of schools that participated per division*
Accomack County	2	1
Amelia County	1	1
Amherst County	1	1
Appomattox County	1	1
Augusta County	5	5
Bath County	1	1
Bedford County	3	3
Bland County	3	3
Botetort County	3	3
Bristol County	1	1
Brunswick County	1	1
Buchanon County	4	3
Buckingham County	1	0
Buena Vista County	1	0
Campbell County	4	2
Caroline County	1	0
Carroll County	1	1
Charles City County	1	0

Charlotte County	1	1
Chesapeake City	6	5
Clarke County	1	1
Colonial Heights City	1	0
Colonial Beach County	1	0
Covington City	1	1
Craig County	1	0
Culpepper County	1	0
Cumberland County	1	1
Danville City	2	1
Dickenson County	3	3
Dinwiddie County	1	1
Essex County	1	1
Falls Church City	1	1
Floyd County	1	1
Fluvana County	1	1
Franklin County	1	1
Frederick County	3	2
Fredericksburg City	1	1
Galax City	1	1
Giles County	2	2
Gloucester County	1	1
Goochland County	1	1

Grayson County	1	0
Greensville County	1	0
Hanover County	4	3
Harrisonburg City	1	1
Henry County	2	2
Highland County	1	1
Hopewell City	1	0
Isle of Wight County	2	2
King and Queen County	1	1
King George County	1	1
King William County	1	1
Lancaster County	1	0
Loudoun County	8	4
Louisa County	1	1
Lynchburg City	2	2
Madison County	1	1
Manassas Park City	1	1
Martinsville City	1	1
Mathews County	1	1
Mecklenburg County	2	1
New Kent County	1	1
Newport News City	5	4
Norfolk City	5	4

Northampton County	1	1
Northumberland County	1	1
Orange County	1	1
Patrick County	1	1
Pittsylvania County	4	2
Poquoson City	1	1
Powhatan County	1	0
Prince Edward County	1	0
Prince George County	2	1
Radford City	1	1
Rappahannock County	1	1
Richmond County	1	1
Roanoke County	4	4
Rockbridge County	1	0
Rockingham County	3	3
Russell County	3	2
Scott County	3	2
Shenandoah County	3	2
Smyth County	3	2
Southampton County	1	1
Spotsylvania County	5	3
Stafford County	5	3
Staunton City	1	1

Suffolk City	3	2
Surry County	1	0
Sussex County	1	0
Tazewell County	4	4
Virginia Beach City	11	7
Warren County	1	1
Washington County	4	2
Waynesboro City	1	0
Westmoreland County	1	1
Williamsburg/James City County	2	1
Wythe County	3	1
York County	4	3
99 total school divisions	198 total eligible schools	142

Message Accompanying the CAPE Assessment Evaluation Instrument on the emails sent to Superintendents

Dear Mr. _____

I am currently doing research in cooperation with the Division of Educational Leadership and Policy Studies at Virginia Polytechnic Institute and State University. My research involves a study of the relationship between the school facility condition and the Virginia Standards of Learning Examination percentages in the High Schools in the Commonwealth of Virginia.

The purpose of this study is to determine if there a relationship among these variables. Data from this study may provide valuable information which affect Standards of Learning Examination scores. With the average age of schools currently at 40 years old, updated research must be conducted to determine if there is a relationship between the condition of the educational facility and Standards of Learning Examination percentages.

In order to complete this research, data on the Standards of Learning Examination scores, free and reduced lunch recipients, and building condition will be needed for this study. The Standards of Learning examination scores and the free and reduced lunch rate percentages will be obtained from the Virginia Department of Education databases and will be used for this study. The facility assessment results will be needed from the information provided by the High School Principals in your school division on the Commonwealth Assessment for Physical Environment which will identify the current condition of the facility.

The names of the participating schools will be listed in the appendix and will not be identified for this study. The intent of this report is not to compare schools, but rather to look at the targeted relationship.

To grant permission for this study to be conducted in your school division, simply reply: "Permission Granted" or "Yes" to this email request. Your cooperation is greatly appreciated. The survey consists of 27 questions and should take approximately 15-20 minutes to complete.

If you have any questions or require clarification, please call me at Granby High School 757 - 451-4116,
(H) 757-484-0765 or (C) 757-615-9460.

Sincerely,

Jeffrey R. Crook
Candidate for Doctoral Degree
Virginia Polytechnic Institute and State University

Message Accompanying the CAPE Assessment Evaluation Instrument on the emails sent to Principals

Dear Principal,

I am currently doing research in cooperation with the Division of Educational Leadership and Policy Studies at Virginia Polytechnic Institute and State University. My research involves a study of the relationship between the school facility condition and the Virginia Standards of Learning Examination percentages in the High Schools in the Commonwealth of Virginia.

The purpose of this study is to determine if there a relationship among these variables. Data from this study may provide valuable information which affect Standards of Learning Examination percentages. With the average age of schools currently at 40 years old, updated research must be conducted to determine if there is a relationship between the condition of the educational facility and Standards of Learning Examination percentages.

In order to complete this research, data on the Standards of Learning Examination scores, free and reduced lunch recipients, and building condition will be needed for this study. The Standards of Learning examination scores and the free and reduced lunch rate percentages will be obtained from the Virginia Department of Education databases and will be used for this study. The facility assessment results will be needed from the information provided by the High School Principals on the Commonwealth Assessment for Physical Environment which will identify the current condition of the facility.

To access the assessment instrument, click on the following web link: https://survey.vt.edu/survey/entry.jsp?id=1098303862347 Upon completion, simply click submit and the results will automatically be tallied. Your cooperation is appreciated.

If you have any questions or require clarification, please call me at Granby High School 757 - 451-4116 or my home at 757-494-0765.

Sincerely,

Jeffrey R. Crook
Candidate for Doctoral Degree
Virginia Polytechnic Institute and State University

The Commonwealth Assessment of Physical Environment (Cash, 1993)

CAPE Assessment Instrument
Directions for Completion

Thank you for agreeing to complete the CAPE assessment instrument to rate your school. Please feel free to make any comments on the spaces provided to clarify or to express concerns.

Please complete the Commonwealth Assessment of Physical Environment and provide the information requested on the final two items.

Principal Name:_____

School Division:_____

High School:_____

1. What is the age of the school building in number of years? A facilities age is your best estimate of the time period during which most of the space used by students was built.

☐ a. 40 years old or older
☐ b. 11-39 years old
☐ c. 10 years old or less

Comments:

2. Are windows visible in each instructional area?

☐ a. Windows are fewer that 1/4th of the instructional spaces
☐ b. Windows are in at least 1/4th, but fewer than 3/4ths of the instructional spaces
☐ c. Windows are in at least 3/4ths of the instructional spaces

Comments:

3. What kind of flooring is found in the majority of the instructional areas?

☐ a. Wood floor
☐ b. Tile or terrazzo
☐ c. Carpet

Comments:

4. What quality of heat is found in the majority of the instructional spaces?

☐ a. Uneven heat/unable to control in each room
☐ b. Even heat/unable to control in each room
☐ c. Even heat/able to control in each room

Comments:

5. What quality of air conditioning system is found in the majority of the instructional spaces?

☐ a. No air conditioning available
☐ b. Air conditioning in some instructional spaces, or air conditioning in all instructional spaces, but not well regulated
☐ c. Air conditioning in all instructional spaces which can be well regulated

Comments:

6. When was the last time the interior walls, including classroom spaces, were painted?

☐ a. Over 15 years ago
☐ b. Between 8 and 15 years
☐ c. Less than 8 years ago

Comments:

7. Is there a regularly scheduled painting cycle for interior walls? Is so, what is it?

☐ a. No
☐ b. Yes, over 8 year cycle
☐ c. Yes, 8 year or fewer year cycle

Comments:

8. When was the last time the exterior walls, or windows and trim, were painted?

☐ a. Over 7 years ago
☐ b. Between 4 and 7 years
☐ c. Within the last 4 years or no exterior surface requires exterior surface painting

Comments:_

9. Is there a regularly scheduled painting cycle for exterior walls, or windows & trim? If so, what is it?

☐ a. No
☐ b. Yes; Over 7 year cycle
☐ c. Yes; 7 year or fewer year cycle or not needed because no exterior surface requires periodic painting

Comments:

10. Are there indications of roof leaks in the building?

☐ a. Ceiling is deteriorating due to water damage, and / or water falls in some areas of the facility requiring buckets for water collection
☐ b. Ceiling is currently developing a few stains due to minor leaks
☐ c. No visible signs, or only a few old water spots in ceiling

Comments:

11. Which of the following facilities are adjacent to, or part of, the school complex? Please circle all that apply.

☐ a. None present
☐ b. 1-5 adjacent facilities
☐ c. 6 or more adjacent facilities

12. How often are classroom floors swept (if wood, tile or terrazzo) or vacuumed (if carpeted)?

☐ a. Monthly
☐ b. Weekly
☐ c. Daily or more frequently

Comments:

13. How often are classroom floors mopped (if wood, tile or terrazzo) or cleaned (if carpeted)?

☐ a. Daily or weekly
☐ b. Monthly
☐ c. Annually

Comments:

14. Is graffiti commonly found on premises? Circle yes or no for each listed item that applies.

☐ a. Present in all areas
☐ b. Present in some areas
☐ c. None present

15. How long does the graffiti remain before it is removed?

☐ a. Until summer maintenance
☐ b. More than a week, less than a month
☐ c. Less than a week or no to all parts of #14

Comments:

16. What is the condition of the lockers?

☐ a. Most are not functional or not in good repair
☐ b. At least three-fourths of the lockers are functional and in good repair
☐ c. Over three-fourths of the lockers are functional and in good repair

Comments:

17. What type of material is used for the majority of interior classroom ceilings?

☐ a. Wood or open beams
☐ b. Plaster or acoustical tiles in at least three/fourths of the instructional spaces
☐ c. Acoustical tiles throughout the instructional spaces

Comments:

18. Please indicate which utilities or equipment are available and in usable condition in the science labs? Please circle all that apply.

☐ a. Gas
☐ b. Water
☐ c. Sinks
☐ d. Electricity

Comments:

19. How long ago was science equipment updated to current standards?

☐ a. Over 10 years ago
☐ b. Between 5 and 9 years ago
☐ c. Less than 5 years ago or the building is less than 5 years old

Comments:

20. What type of lighting is available in the instructional areas?

☐ a. Incandescent lighting
☐ b. Fluorescent lighting– hot
☐ c. Fluorescent lighting– cold

Comments:

21. What is the condition of the classroom furniture?

☐ a. Most rooms have furniture that is either facially scarred or functionally damaged
☐ b. Though at least half the rooms may have some minor facial scars on the student desks, all the furniture is functionally sound and looks satisfactory
☐ c. All the classrooms have furniture which is functionally sound and facially attractive

Comments:

22. What is the condition of the school grounds?

☐ a. There is no landscaping, and sidewalks are either not present or damaged

☐ b. There is landscaping and the sidewalks are present and in good repair (acceptable to the community)

☐ c. The landscaping and other facilities are attractive and well maintained (it is a center of pride for the community

Comments:

23. What color are the walls in a majority of the instructional spaces?

☐ a. Pastel colors

☐ b. White or off-white colors

☐ c. Dark Colors

Comments:

24. Is the facility located near a busy, major high-way, frequently used rail line, an area where aircraft frequently pass overhead, or any other loud noise producing environment?

☐ a. Yes, and no measures have been taken to reduce the noise level within the facility

☐ b. Yes, but measures have been taken to reduce the level of noise within the facility

☐ c. No

Comments:

25. What do you consider the condition of your facility cosmetically and structurally?

☐ a. Below standard

☐ b. Standard

☐ c. Above Standard

Comments:

******Please Provide the Following Information if you can*******

26. What is the approximate gross square footage of the facility? (Use buildings' rough dimensions)

Length	X (Times)	Width	= Gross Square Ft

27. What is the approximate acreage of the school site?

Acreage

Vita

Jeffrey Ray Crook

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Chesterfield, Virginia 23832

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EDUCATIONAL BACKGROUND:

EdD

Educational Leadership and Policy Studies to be awarded in May 2006. Virginia Polytechnic Institute and State University, Blacksburg, Virginia.

Master's of Science

Educational Administration, Old Dominion University, Norfolk, Virginia, August 1999.

Bachelor's of Science

Health and Physical Education, Old Dominion University, Norfolk, Virginia, May 1994.

EMPLOYMENT:

Assistant Principal, Lee-Davis High School, Hanover County Public Schools, Mechanicsville, Virginia.

Assistant Principal, Granby High School, Norfolk Public Schools, Norfolk, Virginia.

School Improvement Coordinator, Granby High School, Norfolk Public Schools, Norfolk, Virginia.

Teacher. Granby High School, Norfolk Public Schools, Norfolk, Virginia.