

REVIEW OF RESEARCH AT VIRGINIA TECH ON THE
RELATIONSHIP BETWEEN SCHOOL BUILDING CONDITION AND
STUDENT AND TEACHER PERFORMANCE AND ATTITUDES

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Abstract

The research study is a review of research at Virginia Tech on the relationship between school building condition and student and teacher performance and attitudes. There have been several reviews or synthesis studies of the research in the field of school facilities over the last 65 years. One institution, Virginia Tech has produced several research studies in this area of scholarly work over the past two decades. With this large corpus of research directly related to Cash's theoretical model, first used in 1993, it becomes necessary to find out what the research has shown and also to find out what these researchers have advocated for further research.

The study extracted 84 findings from the 20 studies reviewed with 67% being statistically significant. Only eight of the 20 relationships in the theoretical model had related findings. Building Condition and Faculty Attitude and Building Condition and Student Achievement had the highest number of related findings. The study states that a better Building Condition has a positive relationship on higher student achievement and attitudes. The synthesis of the findings also drew seven conclusions that should be factored into future research decisions.

The study also extracted 74 recommendations for further research. The three relationships that had the greatest number of related recommendations for further research were Building Condition and Student Achievement, Building Condition and Student Attitudes, and Building Condition and Faculty Attitude. The relationships that were either not investigated or were investigated by one or two research studies are the areas that need more research.

The theoretical model produced several propositions for further research. The propositions follow the logical progression of the model from the decisions of the school authorities and financial ability of the school system in determining the condition of the school building to the eventual effect the school building conditions have upon student and teacher performance and attitudes. The presented taxonomy of research needs, through the propositions, serves as a guide in determining the needs for filling the gaps in the research related to Building Condition and Student and Teacher Performance and Attitude at Virginia Tech and other institutions.

Dedication

This study is dedicated to my family for their enduring love and support while on this journey. To my wife Becky, you have been a continuous beacon of sunshine and happiness. You always believed in me and sacrificed your own time and energy while I wrote. To my daughters, Mackenzie, Adeline, and Campbell, I began this journey before you were all born and nearly nine years later you can finally stop asking if Daddy is done. To my sister, Dr. Ericka Ann Peterson, for your support and encouragement over the years, especially the hard years when we both were writing. You have always just been a phone call away and assisted me at the drop of a hat. Lastly to my mother, who by herself raised two Ph.Ds. from a small steel town on the banks of the Ohio River. You always instilled in Ericka and me the importance of education and exposed us to what the world had to offer. You never gave up on either of us and sacrificed yourself so we could become the people we are today, and for this I am truly thankful.

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Table of Contents

	Page
Abstract.....	ii
Table of Contents.....	vi
Chapter 1	1
Introduction.....	1
Statement of the Problem.....	2
Research Problem.....	3
Significance.....	3
Definitions.....	4
Delimitations.....	4
Limitations.....	5
Organization of Study	5
Chapter 2.....	6
Introduction.....	6
Search Procedures.....	6
Context of the Study.....	6
Review of Cash's (1993) Theoretical Model.....	14
Research Design.....	16
Methodology.....	16
Treatment of Research Findings.....	17
Treatment of Recommendations.....	18
Chapter 3	21
Introduction.....	21
Listing of the Findings from Each Study Reviewed.....	21
Categorization of Findings According to Theoretical Model.....	37
Synthesis of Findings.....	51
Major Research Findings and Conclusions.....	53
Chapter 4.....	56
Introduction.....	56
Listing of Recommendations for Further Research According to Author.....	56

Categorization of Recommendations According to the Theoretical Model.....	78
Synthesis of Recommend Studies.....	101
Major Recommended Studies.....	103
Recommended Research That Has Been Completed.....	104
Taxonomy of Research Needs.....	105
Personal Reflections.....	113
References.....	115
Appendix A – Cash’s Theoretical Model	116
Appendix B – Possible Relationships from the Theoretical Model.....	117
Appendix C – List of the Studies Reviewed.....	118
Appendix D – List of Authors and Coding System.....	121
Appendix E – IRB Approval Letter	122

List of Figures

<i>Figure I</i> - Number of Findings by Relationships in Theoretical Model.....	50
<i>Figure 2</i> -Number of Recommendations According to the Theoretical Model....	100

Chapter 1

Introduction

Education has and will always continue to be a highly debated topic throughout the world. Many great dynasties, countries, and universities have valued the need for education. This need for an educated society required a home or place for knowledge to be shared. Buildings of various kinds housing the educational efforts have been used from the beginning of recorded history. The evolution of the educational facility continues to this day. Researchers, such as Gray (1951), Weinstein (1979), McGuffey, (1982), Lemasters (1993), and Bailey (2009) have observed, gathered, and analyzed thousands of pieces of data to describe the relationship between education and the facility. With that being said, the knowledge base that exists in the field of school facilities is still evolving. It is still possible, however, to draw some conclusions and propositions to expand the knowledge about educational facilities from extant research studies dealing with a specific subject.

There are many ways to produce knowledge experience, observation, and even research studies. In general, research studies can provide valuable information on how humans live in the world. Existent research studies have been used to generate and produce new knowledge regarding relationships between educational facilities and their inhabitants. Through systematic analyses, comparison, and meta-analyses, researchers have been able to compile and concentrate findings from previous research studies to provide guidance to consumers of research as well as producers of research.

There have been several reviews or synthesis studies of the research in the field of school facilities over the last 65 years such as Weinstein (1979), McGuffey (1982), Lemasters (1997), and Bailey (2009). During this period of time, considerable emphasis and thought has been put on school facilities because of the necessity of building up the inventory of schools in the nation resulting from the post World War II baby boom and the rapid changing and expanding of the educational program that impacted the type of school building constructed even down to the present time. There is a great deal of interest in the design of schools because of the emphasis upon a healthy and functional physical environment.

The first review of research in this area of study was completed by Gray (1951) and published in the Review of Educational Research. The Gray review included studies from the entire field of school facilities at that time. The review was succeeded 28 years later by the work of Weinstein (1979) that also included the entire scope of research on school facilities. McGuffey followed Weinstein and completed a similar review of research on school facilities in 1982. The next review was done by Lemasters (1997) and covered the years 1987 to 1997. This review was more focused than any of the previous reviews. The focus was on research dealing with the relationship between the school building condition and student achievement and behavior. The last review of research at Virginia Tech was completed by Bailey, in 2009 and was a replication of the Lemasters study in that the focus was on the relationship between school building condition and student achievement and student and teacher behavior and attitudes.

A review of the research topics in the National Clearinghouse on Educational Facilities (NCEF) indicated that the majority of research in this field of interest was completed by doctoral students and a small number of university faculty and architects. One institution of higher education, however, has a history of almost two decades of producing research especially related to the relationship of the school building and student and teacher productivity. The students and faculty at Virginia Tech have produced several research studies in this area of scholarly work. With this large corpus of research directly related to the theoretical model first used in 1993, it becomes incumbent to find out what the research has shown and also to find out what these researchers have advocated for further research.

Statement of the Problem

Over the past two decades, 20 studies have been conducted by the students and faculty of Virginia Tech on a singular area of knowledge devoted to exploring the relationship between the physical environment and student and teacher productivity. A theoretical model was developed by Carol Cash in 1993 to guide the research in a systematic fashion. The model explores relationships and theorizes how the school building came into the current condition and then postulates how the condition of the building influences the users of the space. As a consequence, a reputable corpus of

research dealing with this general topic has been conducted. Because of the number of studies completed based upon the theoretical model, it seems prudent to ascertain what the research has resulted in and how the findings of the research studies have advanced the knowledge base. In addition, the recommendations for further research contained in these studies need to be cataloged and summarized for future use. There is also the need to ascertain if there are areas of research expounded in the theoretical model that need more emphasis in the future. Placing these recommendations in a taxonomy for further research will help future researchers to establish effective research efforts.

Research Problem

Based on the numerous research studies conducted at Virginia Tech in the area of school facilities, two questions can be formulated. The research questions that will direct this study are as follows:

1. What commonalities exist among the findings of the research studies completed by students and faculty at Virginia Tech?
2. What commonalities can be found in the research recommended for further study by the researchers of the above studies that can be used to form a taxonomy for further research?

Significance

At least 20 research studies have been conducted in educational facilities at Virginia Tech. Because of the variety of results that have come from these studies it is important to analyze and synthesize the research findings and to develop a taxonomy of the recommendations for further studies to guide the field of study.

One of the outcomes of this study is a synthesis of the research findings previous researchers have produced from Virginia Tech, based on Cash's theoretical model. The synthesis serves as a focused area of a body of research emanating from the theoretical model explaining the possible relationship between school facilities and student and teacher achievement and attitudes. The synthesis serves as a concise map of what research has been completed and identifies areas of needed research.

The taxonomy allows the recommendations for further research to be summarized and cataloged for further research and helped to identify those areas that each researcher found to be the most significant and necessary. The taxonomy provides a listing of the suggested studies that may have the greatest impact or add to the already existing wealth of knowledge in the field of education facilities. The analysis and synthesis of the findings and the development of a taxonomy of recommended research can guide the future efforts allowing for more concise and focused future research.

Definitions

Synthesis - is defined as combining all available research, which includes the independent variables of building condition such as age, maintenance, color, classroom structure, density, climate conditions, lighting, noise and the dependent variables of student achievement, student behavior, and student attitude to determine if these variables generate a new summary or analysis. The synthesis also includes a list of the commonalities that exist among the findings reviewed and taxonomy of the recommendations for further research from the same studies.

Taxonomy – the study and organized classification of research studies based on the recommendations for further research.

Major Research Finding – This concept is defined as a compilation of several similar research findings derived from the dissertations and research reports used in this study that report the same general significance.

Delimitations

The review of research findings and recommendations for further research was restricted to the 20 studies completed by students and faculty associated with Virginia Tech and based on Cash's theoretical model. The restriction enabled the researcher to focus on a sizeable number of research studies in one area of knowledge that have been conducted at one university.

Limitations

The compilation of the research findings may be limited by the ability of the researcher to adequately synthesize and conclude the major research findings and compile recommended studies. The study also may be limited by the quality of both the research findings and the recommended studies. Some research findings may be either weak in significance or not as robust in methodology as might be expected. Further, the importance of some of the recommended studies may be questionable, implementation may be impractical, or of little consequence in advancing the knowledge level in this area of research.

Organization of the Study

The study is organized into four chapters. Chapter 1 contains an introduction, statement of the problem, research problem, significance, definitions, delimitations, limitations, and organization of the study.

Chapter 2 contains the sources and criteria for selection of the research studies selected and the methodology used in determining the commonalities of the findings. Chapter 2 also contains a review of the theoretical model used for researching educational facilities.

Chapter 3 contains the critical review of each of the studies. The review includes a synopsis of the findings from each study as they are linked to the possible relationships found with Cash's theoretical model by author. The chapter also contains a categorization of studies by the relationship in the theoretical model, a synthesis of the findings, and major research findings and conclusions.

Chapter 4 contains recommendations for future research based by author and relationship in the theoretical model. The recommendations are placed within a taxonomy. The taxonomy is organized using propositions derived from Cash's theoretical model additionally; Chapter 4 contains concise maps of what research has been completed and identifies areas of needed research and personal reflections.

Chapter 2

Introduction

Chapter 2 contains a brief introduction, search procedures, the context of the study, a review of Cash's theoretical model, the research design, methodology, treatment of the research findings, and treatment of the recommendations. It was the intent of the researcher to review the 20 studies completed at Virginia Tech based upon Cash's theoretical model. With the number of studies conducted at one university it seemed only prudent to find out what the research has resulted in and how the findings and recommendations for future research have and can continue to advance the knowledge base of relationships, from Cash's theoretical model, and educational facilities.

Search Procedures

The studies on school facilities included here were reviewed and synthesized. The NCEF provided a list of research reviews that had been completed in the last 65 years. The significance of this time period is that the first published review of research was conducted by Gray in 1951. Since that time there have been four major reviews conducted by Weinstein (1979), McGuffey (1982), Lemasters (1997), and Bailey (2009). These studies were accessed and obtained through the NCEF web site. The nature of this study was to report the findings and recommendations for further research at one institution because of the number of dissertations and research studies completed there. Therefore, the ETD collection at Virginia Tech was the source of identification of the studies considered for synthesis completed by students at Virginia Tech. Research studies completed by the Virginia Tech faculty were identified through reputation and personal contact. In all cases, the criteria for selection of a study were that it was completed by either students or faculty at Virginia tech. The studies examined in this synthesis were all completed at one institution.

Context of the Study

In 1951, Archie L, Gray wrote about a need for further research in the areas dealing with the school-plant field. Gray (1951) identified a need for fundamental

research to be conducted in the following areas: planning, finance, architectural services, codes, sites, construction, equipment and furniture, service systems, and maintenance and operation. Gray stated that these studies must not be isolated, but rather conducted in a coordinated manner to insure the best results. The results must be available and understandable to those who are actively engaged in the planning and construction of schools (Gray, 1951). Gray listed numerous recommendations for further research based on his analysis of the research available at the time in each of the above mentioned areas. He also recommended that the voluminous information in the completed research studies be collected, evaluated, condensed, summarized, interpreted, and distributed to those who need it (Gray, 1951). While Gray addressed several of the factors included in Cash's theoretical model there were still several that are not addressed in his review. Specifically the areas of student, faculty, and parent attitude were not mentioned. There was also a noticeable omission of the influence that school leadership may have had on the building conditions.

Following the work of Gray in 1951, Carol S. Weinstein conducted a synthesis that examined the research conducted up to 1979 on the impact of the educational environment on student behavior, attitudes, and achievement (1979). Weinstein stated that the need for another review of research was clear because investigators come from a variety of disciplines and their reports are often scattered and difficult to locate (1979). The study was reported out in three sections. The first section reviewed studies that were linked to six fairly specific environmental variables. The variables included were: seating position, classroom design, density, privacy, noise, and windows. The second section considered ecological studies. Weinstein stated that the studies in section two do not limit themselves to one variable, but rather included the overall educational habits of the students (1979). The third and final section examined the studies conducted regarding open space designs on students and teachers.

Weinstein concluded in Section 1 that the physical environment had little to no impact on student achievement based upon the findings of the studies she reviewed. The only factor that appeared to have minimal significance on student achievement was seating location. However, her review of the literature concluded that the classroom environment does have a significant impact on the achievement, behaviors, and attitudes

of students. High classroom density was related to deterioration of positive attitudes and increased aggression. In addition, classrooms that were more visually appealing and “soft” were associated with better attendance, greater participation, and more positive an attitude towards the class, instructor, and classmates (Weinstein, 1979).

The study also contained four other findings. The first is that it is possible that more positive attitudes and behaviors may eventually result in increased student achievement (Weinstein, 1979). The second conclusion was that the relationship between physical design and educational programs had been neglected. Weinstein stated there was a need to review the relationship and possible congruence of architecture and educational program (1979). The third finding from the review of research concluded that researchers not only acknowledge this relationship between physical environment and student achievement, but also design and interpret studies to reflect this complexity (Weinstein, 1979). The last finding from the Weinstein study showed there is a pressing need for more carefully designed studies in the field. Many studies had to be omitted from the review due to their lack of integrity and methodology flaws. Weinstein stated that the quality of the studies will improve as greater and more in-depth research is conducted in the area of student relationships with the physical environment. However, the study did not leave any specific recommendations for further research.

Following the work of Weinstein in 1979, another review of the research on educational facilities was done by McGuffey in 1982. He reported the research findings on the impact of the physical environment, building configuration, and programmatic variables on educational outcomes (McGuffey, 1982). The research reviewed included studies that used a variety of methods and instruments such as surveys, descriptive analysis, experimental, and quasi-experimental methods. Studies reviewed were classified as basic or applied and included both lab and field based research. McGuffey selected the following physical variables for consideration: school building age, thermal factors, visibility factors, hearing factors, and color and interior paint (1982). Building configuration variables selected were limited to open space, amount of space, windowless facilities, and underground facilities. Variables selected as programmatic included: site size, building utilization, building maintenance, special instructional facilities, support

facilities, and school plant size (McGuffey, 1982). The conclusions and findings from the research review were reported out for each variable.

McGuffey concluded, from the review of research, that building age, thermal factors, seeing factors, color and interior paint, and hearing factors had a significant impact on student achievement and performance. Building configuration factors such as amount of space had mixed conclusions. McGuffey recommended that more research be conducted, particularly in the area of student overcrowding (1982). McGuffey also concluded that open space had no statistical significant influence on student achievement, but did improve personal development of students. She stated that the research indicated there was no significant evidence to support the supposition that windowless and underground facilities impacted student achievement either way.

Site size was found to be a significant factor in two studies, but not in the third study reviewed. There was no significant impact on student achievement, supported from the two studies regarding building utilization. McGuffey concluded that older, dilapidated facilities significantly impacted behavior and attitude of students (1982). Multiple studies were reviewed for the variable of support facility and the results were mixed. Special instructional facilities, such as science labs, were found to have a positive impact on student achievement. McGuffey also concluded that school size had a significant impact on student achievement.

Overall, McGuffey stated that school facilities have both a positive and negative affect on pupil achievement. Two overarching conclusions were warranted from the 1982 McGuffey study:

- Obsolete and inadequate school facilities detract from the learning process; modern, controlled physical environments enhance it.
- Facilities may have differential impact on the performance of pupils in different grades and for different subjects.

McGuffey reported that even though the variance in student learning was small, when other variables are combined, school facilities take on considerable importance (1982).

McGuffey did recommend further studies be conducted on certain variables where the research was limited. The variables recommended for additional research included

amount of space or crowding and open space buildings. However, no specific recommendations for further research are stated.

Linda Lemasters conducted a synthesis of the research studies pertaining to the relationships between student achievement, student behavior, and building facilities (1997). As part of this study, a matrix was created that identified, at that time, areas of research that had been conducted and the areas where there was little to no research. She reviewed 53 studies conducted from 1980 through 1997. Lemasters concluded from the review of the research that three variables played a statistical significant role in affecting student achievement and behavior. The three variables were: building condition, lighting, and site noise. Lemasters also noted that while not deemed significant, other variables impacted student behavior and achievement. These variables were: facility age, color, maintenance, density, climate conditions, and classroom structure. The study concluded that building condition does positively or negatively influence student achievement and behavior (Lemasters, 1997). This conclusion further confirmed the work of McGuffey (1982) and Weinstein (1979).

Based on her synthesis, Lemasters (1997) supported the premise that school facilities that were well maintained had a positive influence on student achievement. McGuffey came to a similar conclusion to this statement in 1982, concluding that obsolete learning environments detract from the learning process. Weinstein did not find conclusive statistical data to support the effect of building conditions on student achievement, but did concede that the physical environment affected attitude and further that positive attitudes influence student achievement (1979).

The second conclusion from Lemasters (1997), supported by the research was that well maintained school facilities influenced student behavior. This statement was supported by both the McGuffey and Weinstein studies.

The third conclusion from the Lemasters study spoke to privacy. Privacy was not a variable considered by McGuffey, but Weinstein recommended further studies be conducted regarding privacy. Lemasters and other studies agreed and concluded that students would seek privacy in the classroom, even if it must be created by them, as privacy in the classroom tends to reduce student anxiety and stress (1997).

Lemasters also concluded that full spectrum lighting with trace amounts of ultraviolet content had a positive effect on student health. This variable was not included in either the Weinstein or McGuffey reviews, as Lemasters addressed it in her synthesis. McGuffey concluded that lighting had a significant influence on visual performance and that natural light had little impact on classroom performance (1982).

The final conclusion drawn from the review of research by Lemasters was that non-instruction noise had an adverse effect on the student learner. McGuffey found that noise could interfere with student learning, while Weinstein did not see a significant effect of noise on learning (McGuffey, 1982, Weinstein, 1979). Weinstein (1979) stated that classroom noise levels should be maintained with the generally approved range suggested by research.

In addition to the synthesis of the findings from Lemasters, she also listed several recommendations for further research. The recommendations included:

- Researchers could follow student achievement and behavior for a longer period of time. Many of the studies in the synthesis were of short duration (Lemasters, 1997, p. 199).
- Some of the research reviewed had methodology issues. Lemasters stated that trying to control all the variables in a study was nearly impossible. This inability to account for all the variables in a study should be considered when stating the findings and the methodology and studies should only incorporate designated variables (1997, p.199).
- Several of the studies reviewed should be replicated with improved and concise methodology. These studies could be conducted in various climates, geographical regions, and different grade levels (Lemasters, 1997, p. 200).
- More inquiries should be made into the impact leadership and community financial support has on school facilities. Does the influence of leadership and community send value statements to students that may affect their attitudes (Lemasters, 1997, p.200)?

Lemasters (1997) reviewed the research in school facilities from 1980 to 1997. This study supported and disputed several of the previous research studies and syntheses.

Lemasters made several recommendations for further research, which led to another synthesis of research conducted by John Bailey in 2009.

Bailey's (2009) study was also a synthesis of studies pertaining to building conditions, student achievement, student behavior, and student attitude. The researcher synthesized 54 selected studies from 1998 through 2008. Bailey hypothesized that each of the selected studies involving building conditions as independent variables, had a direct influence on student achievement, student behavior, and student attitude (2009). Bailey's synthesis of the literature, along with the studies of Weinstein (1979), McGuffey (1982), and Lemasters (1997) supported the contention that building condition was directly related to student achievement, student behavior, and student attitude (2009). There are four conclusions stated by Bailey in his 2009 synthesis:

- Studies that used a building assessment instrument, based on research findings, found that there was statistically significant influence upon the health and productivity of students and teachers (Bailey, 2009, p. 189).
- Studies that used a school building assessment instrument, based on maintenance needs, could not find a significant difference in measures of student health and productivity (Bailey, 2009, p.189).
- Studies that used student mean scores of standardized achievement tests rather than the percent of students passing and assessment measure, showed significant differences in scores indicating the building had an influence upon student achievement (Bailey, 2009, p.189).
- Studies that used student attitude as the dependant variable showed there was no significant influence between school building conditions and student attitudes (Bailey, 2009, p.189).

In addition to the synthesis of the findings from Bailey, he also listed several recommendations for further research. The recommendations included:

- Further research using student attendance rates as a dependent variable as a surrogate or proxy for student achievement should be conducted (Bailey, 2009, p.195).

- Bailey recommended a review of research studies be conducted with the next generation of studies devoted to the relationship between school buildings and student achievement (Bailey, 2009, p.195).
- Based on his review of the research, Bailey recommended a replication of the 2008 Earthman study on student attitude and its effect on student moral, perceptions, achievement, and behavior (Bailey, 2009, p.195). The replication would help to gain a better understanding regarding the relationships with student attitude.
- As Lemasters did in 1997, Bailey recommended a national study on the relationship between school building conditions and student performance (2009, p.196).
- Bailey recommended additional studies be conducted using the instruments which measure building conditions, student performance, and student and teacher attitude. These instruments would be subject to validation to norm their effectiveness, validity, and reliability (Bailey, 2009, p. 196).
- A study that addressed the advancement of technology and its influence on building conditions and the relationship on student behavior, attitude, and achievement was recommended (Bailey, 2009, p. 197).
- Bailey's (2009) final recommendation dealt with the corpus of research studies conducted involving the relationships between building conditions and student achievement, behavior, and attitude. Bailey stated that many of the studies in his synthesis were based on the theoretical model by Cash in 1993 (2009). It seems appropriate to find out what researchers at these institutions have reported out. A study that analyzes the findings of these studies completed from 1993 to 2009 should be mounted to report the results (Bailey, 2009, p.197).

It is this last recommendation by Bailey in 2009 that the researcher is proposing to conduct. Because of the number of studies completed based upon the same theoretical model, it seems prudent to find out what the research has resulted in and how the findings of the research studies have advanced the knowledge base. In addition the recommendations for further research contained in these studies need to be cataloged and summarized for future use. There is also the need to ascertain if there are areas of

research expounded in the theoretical model that need more emphasis in the future. Placing these recommendations in a taxonomy for further research will help future researchers to ascertain effective research efforts.

Review of Cash's (1993) Theoretical Model

The purpose of this study was to synthesize the findings of the corpus of research conducted by students and faculty at Virginia Tech, based on Cash's 1993 theoretical model. The second purpose was to organize the recommendations for further research contained in the studies into a systematic taxonomy. The taxonomy will serve as beginning point for other researchers to mount studies to investigate these possible relationships. The theoretical model used was originally developed by Cash in 1993 (see Appendix A). She investigated the relationship between school building condition and student behavior and student achievement. The model design, used in research, was developed to show-relationships between multiple variables dealing with the relationship between building conditions and student achievement (Cash, 1993). This model was used to express the relationship between student achievement, behavior, and the quality of the facility. A theoretical model is used to explain human phenomena that are related to how the physical environment can influence humans (Earthman and Lemasters, 2011).

The theoretical model is used to generate a series of propositions or relationships to be tested to determine validity of a theory. The relationships between the variables are displayed as the lines between the panels. Each line in the model represents a statement of a possible relationship between the two panels. In other words, the line indicates that one panel can be a possible influence upon the following panel. This possible relationship can then be tested through research. All of the relationships are part of the theoretical construct that endeavors to explain human behavior in an organization and the possible influence buildings have on individuals (Earthman and Lemasters, 2011).

Within the theoretical model, the relationships could not be determined if the precipitating factors of leadership, financial ability, maintenance, and custodial staff were not considered possible factors. In addition to the presiding factors, the model also considers the regular maintenance of the building. This continuous task can intensify or diminish over a period of time and have an effect on the condition within a building.

Cash (1993) contended that building condition potentially affects student behavior and achievement directly and indirectly. The relationship between student achievement and behaviors related to building conditions may also impact faculty, student, and parent attitudes.

The direct influence of building facilities may come from physical factors within the building: lighting, heating and ventilation systems, acoustics, and color. Indirectly the student achievement and behavior may be influenced by parent and faculty attitude (Cash, 1993). It is this theoretical model, which considers numerous factors that have been used extensively at Virginia Tech to explain the relationships between school buildings and student behavior and achievement. These relationships are the basis upon which all of the research studies have been completed.

The theoretical constructs of the Cash (1993) model that have driven research in the past can also provide guidance to future research. Several propositions have been derived from the model to systematize research approaches. Earthman and Lemasters (2011) developed propositions that cover several relationships of the theoretical model. These propositions are statements under which research can be expanded. In the model there is a progression of relationships. There are relationships that can be explored to look at the antecedents of how the building came to be in the condition in which it is in at the present time. There are also propositions that address the relationships regarding how the condition of the building influences student, teacher, principal, and community attitudes and student achievement. The propositions are listed below.

Proposition I - The leadership and financial ability of the school system determine the efficiency and extant of maintenance and operational services provided in the school system.

Proposition - II The condition of the school building results from not only the efforts of the maintenance and operations staff, but also from the efforts of the leadership to require school buildings to be in excellent shape.

Proposition III - The condition of the school building directly influences the attitudes of faculty, parents, and students.

Proposition IV - The attitudes students have about their surroundings permeates their feeling about the worth of the building in which they are housed, the community in which they live, and in turn influence their feelings about their own worth.

Proposition V - The resultant attitudes students have about the school building influences to a certain extent their achievement.

Proposition VI - As a result of the school building condition, students perform better because of building features and condition that assist in the learning process.

These propositions can guide further research and can serve as major divisions of a taxonomy.

Research Design

This study analyzed and synthesized the research studies conducted at one university. The study analyzed and synthesized research studies conducted at Virginia Tech from 1993 to present. The research studies included are based on the theoretical model, originally used by Cash (1993). This study synthesized the findings from each of these studies. The synthesis serves as a focused meta-analysis of a body of research emanating from the theoretical model explaining the possible relationship between school facilities and student and teacher productivity. The synthesis serves as a concise map of what research had been completed and identifies areas of needed research.

The recommendations for further research from each study have been analyzed and categorized into a taxonomy. The taxonomy provides an organized listing of the suggested studies that may have the greatest impact. In addition, the proposed studies are grouped according to relationships expressed in the theoretical model.

Methodology

There are two kinds of data that have been extracted from the selected dissertations and studies: (a) the findings of the research study and (b) recommendations for further research. Each of these data sets, based on studies using Cash's theoretical model from Virginia Tech, were reviewed and presented in the judgment of good research. The research findings are presented in two sections, results of the research findings and the taxonomy for future research.

Treatment of the Research Findings

The findings from each of these 20 studies were synthesized in order to draw overarching conclusions or reoccurring themes based on Cash's theoretical model. The findings are synthesized and presented in Chapter 3. The syntheses of the studies are linked to the different relationships expressed in the theoretical model.

The treatment of data for this study included a process of grouping and re-grouping the research findings until a list of findings that are congruent were established. The findings from each study were extracted in totality. These findings were then placed under the appropriate heading for the relationship for which the study was designed. If there was any doubt as to which relationship the finding should be listed, the researcher referred back to the purpose of the individual study to make the determination. All findings were placed in one of the 20 categories of relationships identified in the List of Relationships (see Appendix B) or under other.

Each extracted finding was coded in order to track the finding throughout the study. The first code was the first initial of the author's last name. If there were multiple authors with the same initial a number was also added. Such as Baily was coded as B1 and Brannon was coded as B2.

The second code was by level of education such as elementary, middle school, high school. If in the examination of a particular finding, it was difficult to determine what level of education it would fit into; a category of other was established into which it was placed.

The third code added to each finding was in the area of significance. All findings that are statistically significant are coded as SF. The findings that are not statistically significant are coded NSF, but treated in the analysis in the same manner as the findings that are statistically significant. These findings are reported out in like manner.

The coded findings were then merged with other similar subject findings into a major finding. This was done by reviewing the content of the finding to find similarities. For example, findings that show statistically significant relationship between building condition and student achievement in mathematics on more than one level of education were combined into a single statement reflecting the findings. This will represent a major

finding. A similar treatment was done on all groups of findings. Research findings that were singular in nature and not amenable to being combined into a larger finding are reported as such.

The process of treating the findings in the grouping and coding process is condensed in this listing:

1. Extraction of Findings from research studies
2. Grouping of Findings under relationships
3. Coding of Findings by author and into levels of education, where possible – ES, MS, HS
4. Coding statistically significant Findings and non-significant Findings
5. Combining similar Findings into Major Findings
6. Reporting of all Findings including Major Findings

To provide a validation on the accuracy of the researcher's extraction of findings and recommendations, a review was made by a panel of authors from the selected studies. The researcher submitted a sample of the findings with supporting data to the authors for review. The authors validated the accuracy of the researcher's extractions. Based upon their report, the findings were assumed to be accurate or not. The following individuals were contacted to serve on the validation panel: Dr. John Bailey, Dr. Linda Lemasters, and Dr. Thomas Whitley.

Treatment of the Recommendations

The recommendations for further research are presented in a taxonomy. Each of the recommendations for future research were reviewed in a critical manner, grouped, and coded into similar categories as the findings from each of the 20 studies at Virginia Tech. The feasibility of conducting the recommendations for future research was also determined by the researcher by employing the question, "Is the research study able to be done?" This question was answered based upon the practicability of the study. Some researchers in the effort to complete the study recommend studies that might be beyond the capability of the average researcher in terms of financial demands and accessibility to subjects. The researcher took the recommended future studies and placed them in a taxonomy. This taxonomy provides an organized listing of the suggested studies that may

have the greatest impact or add to the already existing wealth of knowledge in the field of education facilities. The findings from the taxonomy are also linked to the different contributing factors in the theoretical model. In other words, in the theoretical model there are lines indicating a relationship between two panels. This line indicates that one panel has an influence upon another succeeding panel. Studies were placed in such relational lines to indicate how the researcher dealt with that particular relationship. This taxonomy then serves as a guide for future research, as to what areas of research are the most pressing, highly recommended, or will add the greatest gains to the existing body of knowledge. If a recommendation for further research had already been conducted by Virginia Tech, it was listed and flagged in the taxonomy. The taxonomy can also assist future researchers attempting to conduct a study in educational facilities.

The process of treating the recommendations for future research in the grouping/re-grouping process is condensed in this listing:

1. Extraction of Recommendations for future research from research studies
2. Grouping of Recommendations under relationships
3. Coding of the Recommendations by author and by levels of education, where possible – ES, MS, HS
4. Combining similar Recommendations into Major Recommendations
5. Reporting of the Major Recommendations for Future Research

Public school authorities have recently placed extremely rigid restrictions on access to students, teachers, and administrators for research purposes. These limitations have restricted researchers from having access to students and teachers because of pressure from the school board to study for the state examinations. These limitations will restrict the feasibility of conducting certain primary research studies in the future. Because of these presumed limitations, some suggested studies may seem impossible to complete. The taxonomy allows future researchers to determine what proposed studies are most pressing in educational facilities.

In determining the feasibility of conducting the recommended research to be included in the taxonomy, several criteria were employed:

- Recommended studies that directly address the relationships embodied in the theoretical model were included in the taxonomy.

- Recommended studies that tend to be duplicates of other recommended studies, but with different populations were merged into one recommended study for further research.
- If a study did not have any significant findings, there is little reason to believe replication on either a different or larger population or using different methodology would produce significant findings and were not included in the taxonomy.

Each recommended study was evaluated based upon all of the above criteria and successfully met them. The taxonomy of recommended research studies will be reflected upon Cash's theoretical model to determine area of study that might need emphasis in the future.

Chapter 3

Introduction

Chapter 3 contains the critical review of each of the studies. This review includes an introduction, a coded listing of the findings from each study reviewed, and a categorization of the findings from each study as they are linked to the possible relationships found with Cash's theoretical model. Chapter 3 also includes a synthesis of the findings from the studies reviewed and major research findings.

Listing of the Findings from Each Study Reviewed

The listings of the findings section of the paper are by the author, in alphabetical order, followed by verbatim listings of the finding from each study. Studies that reported findings in a paragraph form have been split into individual findings for analysis purposes.

Each of the findings reported have also been coded, allowing the reader to track each finding throughout the study. Findings have been labeled by the first letter of the author's last name and a number. For instance, the first researcher is Bailey and his code is B1. Brannon is the second researcher and his code is B2. A complete listing of the researchers and their codes is contained in Appendix E. Studies with multiple authors have the first letter from each author's last name. Findings that are reported to be in a particular school level or population have been coded with ES for elementary school, MS for middle school, HS for high school, and OS for other school or no particular level is reported. The final code applied to the findings is whether or not they are significant or not significant. Findings reported to be significant have been coded with an SF. Studies that reported findings that are not significant are coded as NSF.

Bailey 2009 p.189 – B1

1. In those studies that used a building assessment instrument based upon research findings, the building does have a significant influence upon the health and productivity of students and teachers. B1-OS-SF

2. In those studies that used a school building assessment instrument based upon the maintenance needs, the researchers could not always find significant differences in student measures of health and productivity. B1-OS-NSF
3. In those studies that used student mean scores of standardized achievement tests rather than the percent of students passing an assessment measure, significant differences in student scores were found indicating the building did have an influence upon students. B1-OS-SF
4. In those studies where student attitudes was the dependent variable, the researchers could not find a significant line of influence between school building condition and student attitudes. The analysis did, however, show a trend towards influence, but that influence was weak. B1-OS-NSF

Brannon 2000 p.124 and 125- B2

1. The findings in this study indicate there is a positive relationship between building conditions and leadership and financial support. Through the expressed beliefs or perceptions of the corporate leadership of the school division that maintaining school facilities in good condition is a high priority and their subsequent request and allocation of funds to support these perceptions, a relationship can be demonstrated. B2-OS-SF
2. The appraisal of the actual facilities indicated the buildings were in good condition. The physical evaluation supports the perceptions and actions of the leadership of the schools. Upon reviewing the data, a pattern of relationship can be acknowledged. While some below-standard conditions exist, 14 of 17 school buildings were reported to be in standard or above-standard condition as determined by the scaled results of an independent contractor. B2-OS-SF
3. Although not fully funded, the school board and board of supervisors provided increases in budgetary dollars for the entire five-year period. These conditions and budget figures indicate a positive relationship exists between the actual condition of the school buildings and the financial support that is required to maintain them. B2-OS-SF
4. Perceptions of educational leadership support this relationship as a majority of all groups reported they viewed maintaining school facilities as one of their

top priorities. Their perceptions indicated that the overall maintenance and condition of school buildings were standard or above standard. B2-OS-SF

Bullock 2007 p.82 and 83 – B3

1. The data from this study show that there is a positive relationship between school building condition and student achievement at the middle school level in the Commonwealth of Virginia. The differences in percentage of students passing the Standards of Learning Examinations in standard and substandard school buildings are higher in some areas of the SOL Examination than others, but there is a definite overall positive relationship between school building condition and student achievement. B3-MS-SF
2. The data also showed a positive relationship between the structural and cosmetic conditions of the building and student achievement. B3-MS-SF
3. The data from this study showed that the differences in passing percentages varied between females and males. Generally the differences in passing percent appeared to be higher among females than male in most areas. B3-MS-SF
4. An examination of some individual aspect of buildings showed that some areas in the building influenced student achievement more than others. The age of the buildings had an influence on reading. B3-MS-SF

Cash 1993 p.77, 78, and 79 – C1

1. Student achievement was found to be higher in those buildings with higher quality ratings. C1-HS-SF
2. When building condition was subdivided into structural and cosmetic conditions and student achievement was compared across the levels of the conditions, higher student achievement mean scale scores were found in schools with higher quality cosmetic building condition ratings. Student achievement mean scale scores were almost identical for both lower and upper scoring schools on structural ratings. Student achievement appeared to be more directly related to cosmetic factors. C1-HS-SF
3. Science achievement of students was higher in buildings with better quality science facilities than in those with lower quality science facilities. C1-HS-SF

4. A review of individual factors on the Commonwealth Assessment of Physical Environment revealed a relationship between student achievement and several factors. Because the factors may have been related to local available money, a Pearson's correlation coefficient was calculated between building condition and Local Composite Index. The resulting coefficient was .136, indicating a very low correlation between the two factors. A Pearson's correlation coefficient was also calculated between building condition and the socioeconomic proxy variable regarding free lunch, which has been used throughout the study. That correlation coefficient was .14, which also indicated a very low correlation. These low correlations minimized any consideration of varying economic conditions as a factor in the following results, which were already adjusted for socioeconomic status: C1-HS-SF
 - a. Higher achievement was associated with schools with at least some air conditioning in instructional spaces.
 - b. Higher achievement was associated with schools with less graffiti.
 - c. Higher achievement was associated with schools with better locker conditions.
 - d. Higher achievement was associated with schools with better science laboratory equipment.
 - e. Higher achievement was associated with schools with classrooms furniture in better equipment.
 - f. Higher achievement was associated with schools with pastel painted walls instead of white walls in the instructional areas.
 - g. Higher achievement was associated with schools with less noisy external environments.
 5. Building condition and student behavior factors were related. The schools with higher quality buildings reported higher incidents per student ratios of violence/substance abuse, suspensions, and expulsions. C1-HS-SF
- Crook 2006 p.112 -118 – C2**
1. Student achievement was found to be generally higher in those buildings with higher quality ratings. C2-HS-SF

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. C2-HS-SF
3. 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. C2-HS-NSF
4. 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. C2-HS-SF
5. 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. C2-HS-SF
 - b. 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. C2-HS-SF
 - c. One key finding of this study is the CAPE assessment item was related to air conditioning. 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. C2-HS-SF
 - 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. Based on the data, the condition of the roof structure had no significant impact on student achievement. C2-HS-NSF

e. The percentages of students passing the English writing and reading SOLs were significantly higher in the buildings that had fluorescent lighting when compared to buildings that had incandescent lighting. The percentages of students passing the Algebra I and Algebra II were higher in standard buildings. Passing percentages were higher in the substandard buildings in Geometry. C2-HS-SF

f. 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. C2-HS-NSF

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. C2-HS-SF

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. C2-HS-SF

i. 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. C2-HS-SF

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. C2-HS-SF

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. C2-HS-SF

Earthman 2008 p. 43-44 – E1

1. Based upon the evidence of the statistical analysis it is safe to conclude that students in unsatisfactory buildings display more negative attitude towards their school building and their reaction to it than students in satisfactory buildings. E1-HS-SF
2. Students in satisfactory school buildings demonstrated a better attitude than students in unsatisfactory school buildings. E1-HS-SF
3. Students in unsatisfactory school buildings were able to identify the apparent poor conditions of the building and to express themselves about how these conditions influence them. E1-HS-SF
4. Students in satisfactory school buildings displayed a positive attitude towards their school building. E1-HS-S
5. The comparison of the Standards of Learning Assessment scores in English between the two high school groups of students did not demonstrate a significant difference between the two sets of scores at the $p < .05$, however the significant level of $p < 0.57$ indicates that significance might be achieved if the population were larger. The study was not able to establish any link between student attitudes towards their building and SOL scores. E1-HS-NSF

Earthman, Cash, and Van Berkum 1996 p. 31- ECV1

1. The students in the above standard school buildings scored higher than those in the substandard buildings on twelve of the thirteen subtests. There was no

difference between the percentile rank between substandard and above standard schools in Language Mechanics. ECV1-HS-NSF

2. Using the structural conditions of buildings as a measure of comparison with achievement scores, the results were not the same as for the overall building and cosmetic building conditions. In eight of the subtests, student in above standard buildings scored above those in the substandard buildings. In four subtests, students in the substandard buildings scored higher. Social studies and mathematics were the areas where these differences were found. Data shows a difference in student achievement scores between those in above standard buildings and those in substandard buildings. ECV1-HS-SF
3. Quality of science laboratories in terms of age and availability were compared. Students in school buildings where there was newer science equipment and all three utilities were available scored from 4 to 6 percentile points higher than students in buildings where such equipment was older and not available. ECV1-HS-SF
4. Students in the above standard buildings recorded fewer disciplinary incidents than those in the substandard buildings when comparisons were made on the overall and cosmetic conditions of the building. When the structural building condition was used as a measure the results were different. There were more reported disciplinary incidents in above standard buildings than in substandard buildings. ECV1-HS-SF
5. Age of building, air conditioning in the classroom, and noise are building conditions that are important to student learning, and in the previous analyses, these conditions were positively related to higher scores in above standard buildings. ECV1-HS-SF

Earthman and Lemasters 2009 p.323– EL1

1. The differences between the responses of teachers in satisfactory buildings are significantly different than those of teachers in unsatisfactory buildings at the $p < 0.05$ level of confidence. Similar results are obtained on the attitudinal scale of the MCAP, again at the $p < 0.05$ level. EL1-HS-SF

Hines 1996 p.86 – 88– H1

1. Scale scores improved on every subtest of the Test of Academic Proficiency when substandard buildings were compared to above standard buildings as determined by the Commonwealth Assessment of Physical Environment Survey. These improvements ranged from a mean scale score of 7.16 points on the social studies subtest to 11.63 points on the sources of information subtest. H1-HS-SF
2. The conclusions are not as clear in the area of student behavior. Suspensions did increase as the building conditions moved from substandard to standard based on ratings on the CAPE. Still there is more reporting of suspensions, expulsions, and incidents of violence and substance abuse overall from buildings rated substandard to buildings rated above standard, thus supporting the hypothesis. H1-HS-SF
3. When building condition was analyzed separately based on structural and cosmetic conditions, improved cosmetic conditions were associated with increased mean scale scores on every subtest of the Test of Academic Proficiency. H1-HS-SF
4. Among the individual building conditions, higher achievement scores were associated with newer buildings, more windows, and carpeting. The presence of air-conditioning was associated with higher scores. More recent exterior painting also was associated with higher scores. Schools with more extracurricular facilities nearby reflected higher achievement. In the schools that were mopped more frequently, the student achievement was higher. Expedient graffiti removal was associated with higher achievement. Higher achievement was associated with better locker conditions, but 60 of the 66 schools were in the above standard category. Better classroom furniture was associated with higher scores. Grounds in better condition were associated with higher scores. H1-HS-SF

Lanham 1999 p. 129 – L1

1. Clearly, certain school building and cosmetic characteristics, when combined with socio-economic information, can provide partial explanations for the

variance in student achievement on Standards of Learning Assessments in English, mathematics, and technology. L1-ES-SF

2. Improving certain building conditions, particularly air-conditioning systems, can improve student achievement. Air-conditioning was identified as a significant factor in 3 of the 5 regression analyses in this study as well as in the studies conducted by Cash (1993), Hines (1996) and Earthman, Cash, and Berkum (1995). L1-ES-SF
3. Building cleanliness, while measured by different variables, also was a factor, on student achievement, identified by 3 of the 5 regression analyses in this study as well as Hines (1996) study. However, this factor should not mask the fact that considerable expenditures on building infrastructure are needed now to address specific structural weaknesses and will be needed in the future as these schools continue to age. L1-ES-SF

Leigh 2012 p. 73 – 74 - L2

1. The findings in this study indicate that there is a positive relationship between building conditions and teacher attitudes. Analysis of the CAPE instrument indicated that School B (newer school) had more building components present that related to positive student achievement than did School A (older school). L2-ES-SF
2. Further analysis of the MCAP instrument revealed that teachers in School B (newer school) had a statistically significant better overall attitude about the condition of their classroom and its influence on student learning than did teachers in School A (older school) where more desirable building conditions were not present. L2-ES-SF
3. A significant statistical difference in teacher response scores were found with the newer building and the older building, which indicated that teachers in the newer school building had a better attitude towards their working environment than did teachers in the older school building. L2-ES-SF
4. The data also revealed that classroom conditions in the newer building made teachers feel better about themselves than did their counterparts in the older

building who felt that their buildings classroom conditions made it harder for them to come to work every morning. L2-ES-SF

5. Teacher response scores in the older building indicated that classroom conditions caused them to have more emotional/mental problems than did teachers in the newer building. L2-ES-SF
6. Data also indicated that teachers in the newer building had a better attitude about their classroom and its influence on student learning than did teachers in the older building. L2-ES-SF

Lemasters 1997 p. 196 – 198 - L3

1. School facilities that are well maintained have a positive impact on student on student achievement. L3-OS-SF
2. School facilities that are maintained well positively influence student behavior. L3-OS-SF
3. Students will seek areas of privacy in the classroom, even if they must create the structure themselves, as classrooms with areas for privacy reduce anxiety and stress. L3-OS-SF
4. Full spectrum fluorescent lighting with trace amounts of ultraviolet content has a positive effect on student health. L3-OS-SF
5. Non-instruction noise has an adverse effect on the student learner. L3-OS-SF

Lemasters and Earthman 2003 p. 52- 53 - LE1

1. The first hypothesis stated that students in air-conditioned buildings would score higher on achievement test than would students in non-air-conditioned buildings. This was not supported by the data analysis, yet there were significant relationships found on some subtests. LE1-OS-NSF
2. The second hypothesis stated that the difference in achievement scores between students attending air-conditioned and non-air-conditioned buildings would vary according to the level of schooling and the length of time they attended school in the present buildings. This hypothesis must be rejected because no significant differences were statistically found between the student scores on the three grade levels. LE1-OS-NSF

3. The third hypothesis stated that air-conditioning will contribute uniquely to the variance in student achievement when other variables are controlled. This hypothesis was not tested because of the results of the analyses for the first hypothesis. Therefore, this hypothesis cannot be either rejected or retained.
LE1-OS-NSF

Mayo 2012 p. 70 – 76 – M1

1. The findings indicated no statistically significant relationship between the renovation process and the demographic variables, when the 1 x 3 ANOVA was conducted on the renovation stages and the demographic variables. For purposes of this study, no statistically significant relationship indicated the composition of the student population in the schools remained the same during the renovation process. M1-MS-NSF
2. To determine the statistical significance of the mean scaled scores in the areas of mathematics and reading on the renovation process, the means of the scaled scores during the pre-renovation, renovation, and post-renovation were compared. In mathematics, mean scores only increased 0.7 points from the pre-renovation stage to the renovation stage. The mean scores increased 6.23 points from the renovation stage to the post renovation stage. When looking at the pre-renovation to the post-renovation stages, an increase of 6.93 points was noted. The 1 x 3 ANOVA did not note a statistical significance with $p = 0.845$. Reading mean scores increased 11.71 points from the pre-renovation stage to the renovation stage. The renovation stage to the post-renovation stage indicated an increase of 8.61 points. When comparing the pre-renovation mean scores to the post-renovation mean scores an increase of 20.32 points was noted. The 1 x 3 ANOVA did not note a statistical significance with $p = 0.059$. M1-MS-NSF
3. When comparing individual schools to the state averages in mathematics, three schools scored higher than the state average during all stages of the renovation process, three school[s] sic scored lower than the state average during all stages of the renovation process, and four schools noted a

combination of higher and lower mean scaled scores during the stages of the renovation process when compared to the state average. M1-MS-NSF

4. When comparing individual schools to the state averages in reading, four schools scored lower than the state average during all stages of the renovation process, one schools cored higher than the state average during all stages of the renovation process, and five schools noted a combination of higher and lower mean scaled scores during the stages of the renovation process when compared to the state average. M1-MS-NSF

McLean 2011 p 68 – 70– M2

1. Based upon the findings there is no significant difference between the school building conditions of elementary school buildings rated as high and low performing by the Virginia Department of Education. M2-ES-NSF
2. The quality of teacher indices which was the number of fully licensed and the number with advanced degrees between high and low was not enough to be considered statistically significant. Therefore, based upon the summary of findings there was no significant difference between teacher quality measures in high and low performing elementary school buildings rated by the Virginia Department of Education. M2-ES-NSF
3. Based upon the findings, there was a statistically significant difference between student attendance rates of high and low performing schools. M2-ES-SF
4. There was no significant difference established between the school enrollments of high and low performing schools. M2-ES-NSF
5. The highest student participation rate in free and reduced lunch was observed in low performing schools. There was a significant difference established between the student participation rate in free and reduced price lunch in high and low performing schools. M2-ES-SF

O’Sullivan 2006 p. 111 – 116 – S1

1. The percentage of students participating in the free and reduced price lunch program was the most significant predictor of student academic achievement. S1-HS-SF

2. The variable, facilities adjacent to the building, had a significant influence on student academic achievement on the PSSA reading and math exams. Principals that reported building with adjacent facilities had reading 2.3% higher and math 4.7% higher than schools that did not reports an adjacent facility. S1-HS-SF
3. There is a relationship between buildings that have graffiti on the exterior walls and classrooms and student achievement. Principals that reported no graffiti on exterior walls the PSSA reading score would be 49.5 points higher, on the scaled score than those that reported graffiti on the exterior walls. S1-HS-SF
4. There is a relationship between interior painting cycle and student achievement. Analysis indicated that a survey response showing an increase in the time frame between painting cycles would equate to a decrease on the PSSA writing scores of 3.9 points. S1-HS-SF
5. An examination of the data indicate that a high school's overall cosmetic classroom condition increase one level, satisfactory to outstanding, the student PSSA reading scores were 6.5 points higher, on the scaled score. S1-HS-SF
6. The variable building renovation/addition was identified to have a significant relationship between structural building conditions and student achievement. The data indicated that a survey response which increases one level had student PSSA mathematics scores that were 4.8 points higher, on a scaled score. S1-HS-SF

Shifflett 2010 p. 89 –93 – S2

1. Overall teacher satisfaction was minimally affected by the renovation project. Areas of dissatisfaction include cleanliness of the school, teachers seeking a transfer to avoid another renovation project, teachers considering relocation during the project, and room temperature having an effect on satisfaction. S2-HS-SF
2. A difference in teacher satisfaction between the schools was found. Overall teacher satisfaction was higher at SDHS (47%) compared to WMHS (28%) while the majority of the teachers at WMHS were classified as neutral (70%).

Overall dissatisfaction was not found to be different between the schools. S2-HS-SF

3. Differences in teacher satisfaction between the two schools regarding safety and odor were found. Question 3: I felt safe during the renovation project found the mean for SDHS to be 1.94 and WMHS as 2.70, based on an independent sample t-test. S2-HS-SF
4. No significance between the two schools was found when analyzing satisfaction code, age category, gender, number of classroom moves, subject area taught by the teacher, or years of teaching experience. S2-HS-NSF
5. Differences in teacher satisfaction were found when analyzed by gender. The independent t-test for gender and each survey question revealed eight questions had significance. Overall, both males and females felt satisfied but the females were less satisfied regarding questions of safety, cleanliness, job satisfaction during and after the renovation project, school rating during and after the renovation project, difficulty with construction workers, and negative effects of room temperature. S2-HS-SF
6. Teacher satisfaction among the 21-25 age group was significantly higher than the 26-35 age group. 1.11 for the 21-25 age category compared to 2.22 for the 26-35 age category, based on the results from a one-way ANOVA test. No other age category had a significant mean difference. S2-HS-SF
7. The number of moves, subject area taught, and years of experience had no significant impact on teacher satisfaction. S2-HS-NSF

Thornton 2006 p. 90 – 93 – T1

1. The results of the analysis indicated mixed results and an inconsistent relationship between building conditions and the achievement of economically disadvantaged students. Therefore, the conclusion is that the condition of the school building influence on the achievement of economically disadvantaged students when they are housed in inferior buildings is inconclusive. T1-HS-NSF
2. The results of the analysis indicated a positive relationship between building conditions and the achievement of minority students in the majority of the

achievement measures. This can be measured in significant differences in seven subtests of the SOLs for students in standard buildings. Therefore, the conclusion is that the condition of the school building does in fact influence the achievement of minority students when the building is in poor condition.

T1-HS-SF

Walton 2011 p. 61 – 62– W1

1. Common themes from all three groups focused on wide open spaces that increase visibility and hallways wide enough to support a smooth flow of student traffic. W1-HS-SF
2. All three groups cited controlling access to the school building by use of security vestibules that allow for screening those persons who enter the school building as a common theme. All three groups mentioned cameras to record and provide surveillance as factors that help support a safe school environment. W1-HS-SF
3. All three groups spoke of the location of the school office as paramount to school safety. W1-HS-SF
4. Restrooms and locker rooms were cited by the majority of the three groups as potential places of danger because of visibility issues as well as design issues. W1-HS-SF
5. All three groups spoke of doors and windows and the ability to secure the large number of doors as problematic. W1-HS-SF

Whitley 2009 p.77– W2

1. The total expenditures for the budget line items of facilities and debt service indicated that school divisions with school buildings classified as satisfactory outspent local school divisions with buildings classified as unsatisfactory every year for five years. W2-OS-SF
2. The differences on a five year average were statistically significant for both total expenditures and for per-pupil costs. Analysis of the Local Composite Index and the VEA Financial Capacity Index indicated that there was no significant difference in the local school division's ability to fund capital projects. W2-OS-SF

Categorization of Findings According to the Theoretical Model

The categorization of the findings section of the paper will be grouped according to which relationship the finding addresses. The studies are not listed in any rank or particular order. Studies that reported findings in a paragraph form have been split into individual findings for analysis purposes. Relationships with no related findings are listed as a subtitle only.

Leadership and maintenance staff size

Leadership and building age and quality of materials

1. The appraisal of the actual facilities indicated the buildings were in good condition. The physical evaluation supports the perceptions and actions of the leadership of the schools. Upon reviewing the data, a pattern of relationship can be acknowledged. While some below-standard conditions exist, 14 of 17 school buildings were reported to be in standard or above-standard condition as determined by the scaled results of an independent contractor. B2-OS-SF

Leadership and custodial staff

Financial ability and maintenance staff

Financial ability and building age and quality of materials

1. Although not fully funded, the school board and board of supervisors provided increases in budgetary dollars for the entire five-year period. These conditions and budget figures indicate a positive relationship exists between the actual condition of the school buildings and the financial support that is required to maintain them. B2-OS-SF
2. The total expenditures for the budget line items of facilities and debt service indicated that school divisions with school buildings classified as satisfactory outspent local school divisions with buildings classified as unsatisfactory every year for five years. W2-OS-SF
3. The differences on a five year average were statistically significant for both total expenditures and for per-pupil costs. Analysis of the Local Composite Index and the VEA Financial Capacity Index indicated that there was no significant difference in the local school divisions' ability to fund capital projects. W2-OS-SF

4. The findings in this study indicate there is a positive relationship between building conditions and leadership and financial support. Through the expressed beliefs or perceptions of the corporate leadership of the school division that maintaining school facilities in good condition is a high priority and their subsequent request and allocation of funds to support these perceptions, a relationship can be demonstrated. B2-OS-SF

Financial ability and custodial staff

Maintenance staff and building condition

1. In those studies that used a school building assessment instrument based upon the maintenance needs, the researchers could not always find significant differences in student measures of health and productivity. B1-OS-NSF
2. Perceptions of educational leadership support this relationship as a majority of all groups reported they viewed maintaining school facilities as one of their top priorities. Their perceptions indicated that the overall maintenance and condition of school buildings were standard or above standard. B2-OS-SF

Building age and quality of materials and building condition

1. An examination of some individual aspect of buildings showed that some areas in the building influenced student achievement more than others. The age of the buildings had an influence on reading. B3-MS-SF
2. A review of individual factors on the Commonwealth Assessment of Physical Environment revealed a relationship between student achievement and several factors. Because the factors may have been related to local available money, a Pearson's correlation coefficient was calculated between building condition and Local Composite Index. The resulting coefficient was .136, indicating a very low correlation between the two factors. A Pearson's correlation coefficient was also calculated between building condition and the socioeconomic proxy variable regarding free lunch, which has been used throughout the study. That correlation coefficient was .14, which also indicated a very low correlation. C1-HS-SF
3. Quality of science laboratories in terms of age and availability were compared. Students in school buildings where there was newer science

equipment and all three utilities were available scored from 4 to 6 percentile points higher than students in buildings where such equipment was older and not available. ECV1-HS-SF

Custodial staff and building condition

Building condition and student achievement

1. In those studies that used a building assessment instrument based upon research findings, the building did have a significant influence upon the health and productivity of students and teachers. B1-OS-SF
2. In those studies that used student mean scores of standardized achievement tests rather than the percent of students passing an assessment measure, significant differences in student scores were found indicating the building did have an influence upon students. B1-OS-SF
3. The data from this study show that there is a positive relationship between school building condition and student achievement at the middle school level in the Commonwealth of Virginia. The differences in percentage of students passing the Standards of Learning Examinations in standard and substandard school buildings are higher in some areas of the SOL Examination than others, but there is a definite overall positive relationship between school building condition and student achievement. B3-MS-SF
4. The data also showed a positive relationship between the structural and cosmetic conditions of the building and student achievement. B3-MS-SF
5. Student achievement was found to be higher in those buildings with higher quality ratings. C1-HS-SF
6. When building condition was subdivided into structural and cosmetic conditions and student achievement was compared across the levels of the conditions, higher student achievement mean scale scores were found in schools with higher quality cosmetic building condition ratings. Student achievement mean scale scores were almost identical for both lower and upper scoring schools on structural ratings. Student achievement appeared to me more directly related to cosmetic factors. C1-HS-SF

7. Science achievement of students was higher in buildings with better quality science facilities than in those with lower quality science facilities. C1-HS-SF
8. 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. C2-HS-SF
9. 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. C2-HS-NSF
10. 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. C2-HS-SF
11. 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. C2-HS-SF
12. The comparison of the Standards of Learning Assessment scores in English between the two high school groups of students did not demonstrate a significant difference between the two sets of scores at the $p<.05$, however the significant level of $p<0.57$ indicates that significance might be achieved if the population were larger. The study was not able to establish any link between student attitudes towards their building and SOL scores. E1-HS-NSF
13. The students in the above standard school buildings scored higher than those in the substandard buildings on twelve of the thirteen subtests. There was no difference between the percentile rank between substandard and above standard schools in Language Mechanics. ECV1-HS-NSF

14. Using the structural conditions of buildings as a measure of comparison with achievement scores, the results were not the same as for the overall building and cosmetic building conditions. In eight of the subtests, student in above standard buildings scored above those in the substandard buildings. In four subtests, students in the substandard buildings scored higher. Social studies and mathematics were the areas where these differences were found. Data shows a difference in student achievement scores between those in above standard buildings and those in substandard buildings. ECV1-HS-SF
15. Age of building, air conditioning in the classroom, and noise are building conditions that are important to student learning, and in the previous analyses, these conditions were positively related to higher scores in above standard buildings. ECV1-HS-SF
16. Scaled scores improved on every subtest of the Test of Academic Proficiency when substandard buildings were compared to above standard buildings as determined by the Commonwealth Assessment of Physical Environment Survey. These improvements ranged from a mean scale score of 7.16 points on the social studies subtest to 11.63 points on the sources of information subtest, this overall improvement denotes a very strong relationship and supports the research question. H1-HS-SF
17. When building condition was analyzed separately based on structural and cosmetic conditions, improved cosmetic conditions were associated with increased mean scale scores on every subtest of the Test of Academic Proficiency. H1-HS-SF
18. Among the individual building conditions, higher achievement scores were associated with newer buildings, more windows, and carpeting. The presence of air conditioning was associated with higher scores. More recent exterior painting also was associated with higher scores. Schools with more extracurricular facilities nearby reflected higher achievement. In the schools that were mopped more frequently, the student achievement was higher. Expedient graffiti removal was associated with higher achievement. Higher achievement was associated with better locker conditions, but 60 of the 66

schools were in the above standard category. Better classroom furniture was associated with higher scores. Grounds in better condition were associated with higher scores. H1-HS-SF

19. Clearly, certain school building and cosmetic characteristics, when combined with socio-economic information, can provide partial explanations for the variance in student achievement on Standards of Learning Assessments in English, mathematics, and technology. L1-ES-SF
20. Improving certain building conditions, particularly air-conditioning systems, can improve student achievement. Air conditioning was identified as a significant factor in 3 of the 5 regression analyses in this study as well as in the studies conducted by Cash (1993), Hines (1996) and Earthman, Cash, and Berkum (1995). L1-ES-SF
21. Building cleanliness, while measured by different variables, also was a factor, on student achievement, identified by 3 of the 5 regression analyses in this study as well as Hines (1996) study. L1-ES-SF
22. The findings in this study indicate that there is a positive relationship between building conditions and teacher attitudes. Analysis of the CAPE instrument indicated that School B (newer school) had more building components present that related to positive student achievement than did School A (older school). L2-ES-SF
23. School facilities that are well maintained have a positive impact on student on student achievement. L3-OS-SF
24. The first hypothesis stated that students in air-conditioned buildings would score higher on achievement test than would students in non-air-conditioned buildings. This was not supported by the data analysis, yet there were significant relationships found on some subtests. LE1-OS-NSF
25. The second hypothesis stated that the difference in achievement scores between students attending air-conditioned and non-air-conditioned buildings would vary according to the level of schooling and the length of time they attended school in the present buildings. This hypothesis must be rejected

because no significant differences were statistically found between the student scores on the three grade levels. LE1-OS-NSF

26. The third hypothesis stated that air-conditioning will contribute uniquely to the variance in student achievement when other variables are controlled. This hypothesis was not tested because of the results of the analyses for the first hypothesis. Therefore, this hypothesis cannot be either rejected or retained. LE1-OS-NSF
27. Based upon the findings there is no significant difference between the school building conditions of elementary school buildings rated as high and low performing by the Virginia Department of Education. M2-ES-SF
28. There is a relationship between buildings that have graffiti on the exterior walls and classrooms and student achievement. Principals that reported no graffiti on exterior walls the PSSA reading score would be 49.5 points higher, on the scaled score than those that reported graffiti on the exterior walls. S1-HS-SF
29. There is a relationship between interior painting cycle and student achievement. Analysis indicated that a survey response showing an increase in the time frame between painting cycles would equate to a decrease on the PSSA writing scores of 3.9 points. S1-HS-SF
30. An examination of the data indicate that a high school's overall cosmetic classroom condition increase one level, satisfactory to outstanding, the student PSSA reading scores were 6.5 points higher, on the scaled score. S1-HS-SF
31. The variable building renovation/addition was identified to have a significant relationship between structural building conditions and student achievement. The data indicated that a survey response which increases one level had student PSSA mathematics scores that were 4.8 points higher, on a scaled score. S1-HS-SF
32. Differences in teacher satisfaction between the two schools regarding safety and odor were found. Question 3: I felt safe during the renovation project found the mean for SDHS to be 1.94 and WMHS as 2.70, based on an independent sample t-test. S2-HS-SF

33. The results of the analysis indicated mixed results and an inconsistent relationship between building conditions and the achievement of economically disadvantaged students. Therefore, the conclusion is that the condition of the school building influence on the achievement of economically disadvantaged students when they are housed in inferior buildings is inconclusive. T1-HS-NSF
34. The results of the analysis indicated a positive relationship between building conditions and the achievement of minority students in the majority of the achievement measures. This can be measured in significant differences in seven subtests of the SOLs for students in standard buildings. Therefore, the conclusion is that the condition of the school building does in fact influence the achievement of minority students when the building is in poor condition. T1-HS-SF
35. Full spectrum fluorescent lighting with trace amounts of ultraviolet content has a positive effect on student health. L3-OS-SF
36. Non-instruction noise has an adverse effect on the student learner. L3-OS-SF
37. The variable, facilities adjacent to the building, had a significant influence on student academic achievement on the PSSA reading and math exams. Principals that reported building with adjacent facilities had reading 2.3% higher and math 4.7% higher than schools that did not reports an adjacent facility. S1-HS-SF

Building condition and parent attitude

Building condition and student attitudes about their building

1. In those studies where student attitudes were the dependent variable, the researchers could not find a significant line of influence between school building condition and student attitudes. The analysis did, however, show a trend towards influence, but that influence was weak. B1-OS-NSF
2. Based upon the evidence of the statistical analysis it is safe to conclude that students in unsatisfactory buildings display more negative attitude towards their school building and their reaction to it than students in satisfactory buildings. E1-HS-SF

3. Students in satisfactory school buildings demonstrated a better attitude than students in unsatisfactory school buildings. E1-HS-SF
4. Students in unsatisfactory school buildings were able to identify the apparent poor conditions of the building and to express themselves about how these conditions influence them. E1-HS-SF
5. Students in satisfactory school buildings displayed a positive attitude towards their school building. E1-HS-SF

Building condition and faculty attitude

1. The differences between the responses of teachers in satisfactory buildings are significantly different than those of teachers in unsatisfactory buildings at the $p < 0.05$ level of confidence. Similar results are obtained on the attitudinal scale of the MCAP, again at the $p < 0.05$ level. EL1-HS-SF
2. Further analysis of the MCAP instrument revealed that teachers in School B (newer school) had a statistically significant better overall attitude about the condition of their classroom and its influence on student learning than did teachers in School A (older school) where more desirable building conditions were not present. L2-ES-SF
3. A significant statistical difference in teacher response scores were found with the newer building and the older building, which indicated that teachers in the newer school building had a better attitude towards their working environment than did teachers in the older school building. L2-ES-SF
4. The data also revealed that classroom conditions in the newer building made teachers feel better about themselves than did their counterparts in the older building who felt that their buildings classroom conditions made it harder for them to come to work every morning. L2-ES-SF
5. Teacher response scores in the older building indicated that classroom conditions caused them to have more emotional/mental problems than did teachers in the newer building. L2-ES-SF
6. Data also indicated that teachers in the newer building had a better attitude about their classroom and its influence on student learning than did teachers in the older building. L2-ES-SF

7. Overall teacher satisfaction was minimally affected by the renovation project. Areas of dissatisfaction include cleanliness of the school, teachers seeking a transfer to avoid another renovation project, teachers considering relocation during the project, and room temperature having an effect on satisfaction. S2-HS-SF
8. A difference in teacher satisfaction between the schools was found. Overall teacher satisfaction was higher at SDHS (47%) compared to WMHS (28%) while the majority of the teachers at WMHS were classified as neutral (70%). Overall dissatisfaction was not found to be different between the schools. S2-HS-SF
9. No significance between the two schools was found when analyzing satisfaction code, age category, gender, number of classroom moves, subject area taught by the teacher, or years of teaching experience. S2-HS-NSF
10. Differences in teacher satisfaction were found when analyzed by gender. The independent t-test for gender and each survey question revealed eight questions had significance. Overall, both males and females felt satisfied but the females were less satisfied regarding questions of safety, cleanliness, job satisfaction during and after the renovation project, school rating during and after the renovation project, difficulty with construction workers, and negative effects of room temperature. S2-HS-SF
11. Common themes from all three groups focused on wide open spaces that increase visibility and hallways wide enough to support a smooth flow of student traffic. W1-HS-SF
12. All three groups cited controlling access to the school building by use of security vestibules that allow for screening those persons who enter the school building as a common theme. All three groups mentioned cameras to record and provide surveillance as factors that help support a safe school environment. W1-HS-SF
13. All three groups spoke of the location of the school office as paramount to school safety. W1-HS-SF

14. Restrooms and locker rooms were cited by the majority of the three groups as potential places of danger because of visibility issues as well as design issues. W1-HS-SF
15. All three groups spoke of doors and windows and the ability to secure the large number of doors as problematic. W1-HS-SF
16. Teacher satisfaction among the 21-25 age group was significantly higher than the 26-35 age group. 1.11 for the 21-25 age category compared to 2.22 for the 26-35 age category, based on the results from a one-way ANOVA test. No other age category had a significant mean difference. S2-HS-SF
17. The number of moves, subject area taught, and years of experience had no significant impact on teacher satisfaction. Previous studies were not found that support or contradict these findings. S2-HS-NSF

Building condition and student behavior

1. Building condition and student behavior factors were related. The schools with higher quality buildings reported higher incidents per student ratios of violence/substance abuse, suspensions, and expulsions. C1-HS-SF
2. Students in the above standard buildings recorded fewer disciplinary incidents than those in the substandard buildings when comparisons were made on the overall and cosmetic conditions of the building. When the structural building condition was used as a measure the results were different. There were more reported disciplinary incidents in above standard buildings than in substandard buildings. ECV1-HS-SF
3. The conclusions are not as clear in the area of student behavior. Suspensions did increase as the building conditions moved from substandard to standard based on ratings on the CAPE. Still there is more reporting of suspensions, expulsions, and incidents of violence and substance abuse overall from buildings rated substandard to buildings rated above standard, thus supporting the hypothesis. H1-HS-SF
4. School facilities that are maintained well positively influence student behavior. L3-OS-SF

5. Students will seek areas of privacy in the classroom, even if they must create the structure themselves, as classrooms with areas for privacy reduce anxiety and stress. L3-OS-SF

Parent attitude and student attitudes about their building

Faculty attitude and student attitudes about their building

Student attitudes and student achievement

Student attitudes and student behavior

Other – findings that do not fit with a relationship

1. The data from this study showed that the differences in passing percentages varied between females and males. Generally the differences in passing percent appeared to be higher among females than male in most areas. B3-MS-SF
2. The findings indicated no statistically significant relationship between the renovation process and the demographic variables, when the 1 x 3 ANOVA was conducted on the renovation stages and the demographic variables. M1-MS-NSF
3. To determine the statistical significance of the mean scaled scores in the areas of mathematics and reading on the renovation process, the means of the scaled scores during the pre-renovation, renovation, and post-renovation were compared. In mathematics, mean scores only increased 0.7 points from the pre-renovation stage to the renovation stage. The mean scores increased 6.23 points from the renovation stage to the post renovation stage. When looking at the pre-renovation to the post-renovation stages, an increase of 6.93 points was noted. The 1 x 3 ANOVA did not note a statistical significance with $p = 0.845$. Reading mean scores increased 11.71 points from the pre-renovation stage to the renovation stage. The renovation stage to the post-renovation stage indicated an increase of 8.61 points. When comparing the pre-renovation mean scores to the post-renovation mean scores an increase of 20.32 points was noted. The 1 x 3 ANOVA did not note a statistical significance with $p = 0.059$. M1-MS-NSF

4. When comparing individual schools to the state averages in mathematics, three schools scored higher than the state average during all stages of the renovation process, three school scored lower than the state average during all stages of the renovation process, and four schools noted a combination of higher and lower mean scaled scores during the stages of the renovation process when compared to the state average. M1-MS-NSF
5. When comparing individual schools to the state averages in reading, four schools scored lower than the state average during all stages of the renovation process, one school scored higher than the state average during all stages of the renovation process, and five schools noted a combination of higher and lower mean scaled scores during the stages of the renovation process when compared to the state average. M1-MS-NSF
6. The quality of teacher indices which was the number of fully licensed and the number with advanced degrees between high and low was not enough to be considered statistically significant. Therefore, based upon the summary of findings there was no significant difference between teacher quality measures in high and low performing elementary school buildings rated by the Virginia Department of Education. M2-ES-NSF
7. Based upon the findings, there was a statistically significant difference between student attendance rates of high and low performing schools. M2-ES-SF
8. There was no significant difference established between the school enrollments of high and low performing schools. M2-ES-NSF
9. The highest student participation rate in free and reduced lunch was observed in low performing schools. There was a significant difference established between the student participation rate in free and reduced price lunch in high and low performing schools. M2-ES-SF
10. The percentage of students participating in the free and reduced price lunch program was the most significant predictor of student academic achievement. S1-HS-SF

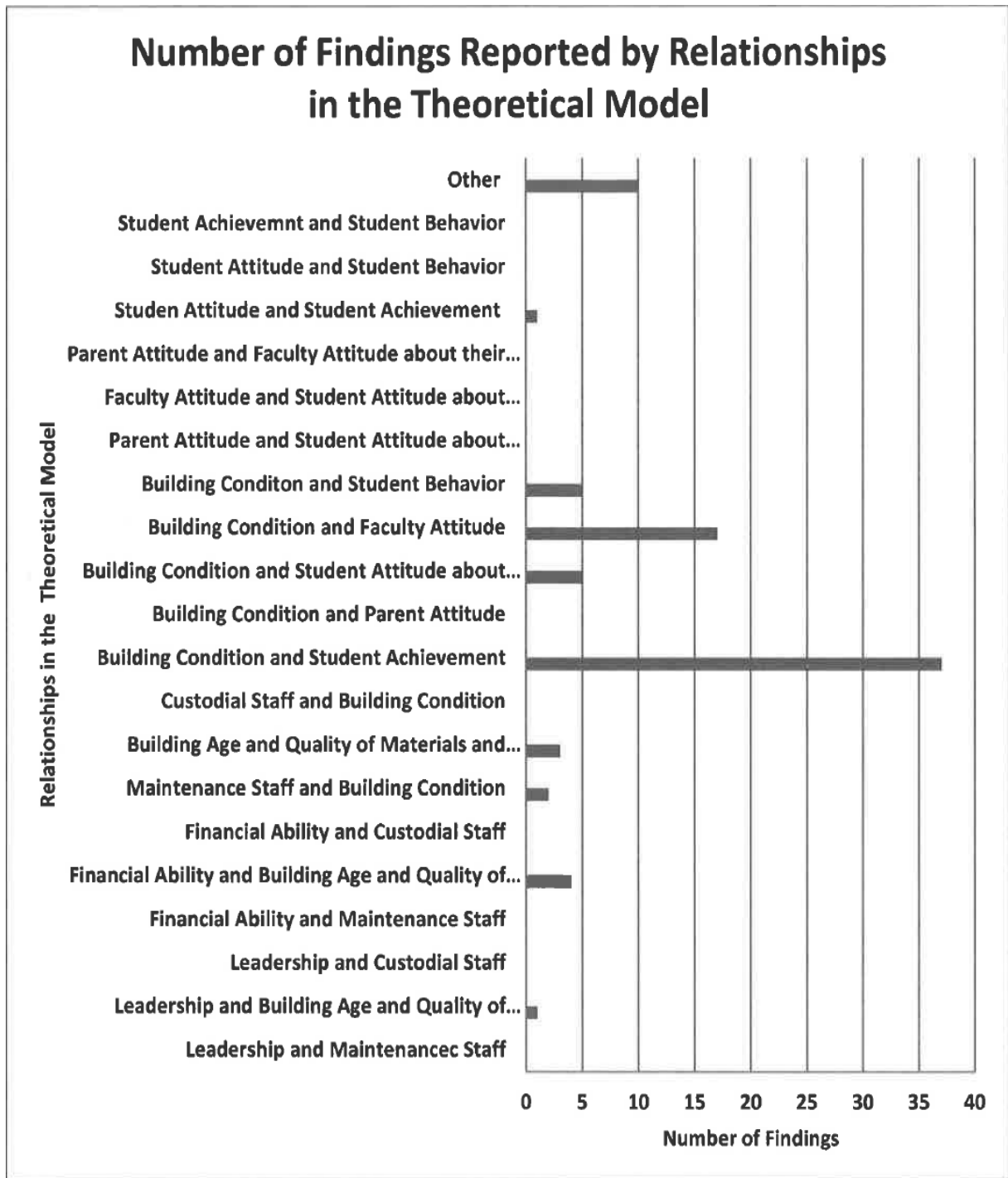


Figure 1. Number of Findings Reported by Relationships in the Theoretical Model

Synthesis of Findings

The study extracted a total of 84 findings from the 20 studies reviewed. A further synthesis of the findings showed that 67 were considered to be statistically significant, while 17 were not considered to be statistically significant based upon the author's reporting. There were 15 findings related to elementary school, 7 related to middle school, 44 findings related to high school, and 18 related to other educational facilities.

Each finding was placed under one of 20 relationships found in Cash's theoretical model. Each finding was only listed once. If a finding was not related to a particular relationship it was listed as other. There were 10 findings reported under the other relationship. Several of the relationships did not have a finding placed under them. These relationships were: Leadership and Maintenance Staff, Leadership and Custodial Staff, Financial Ability and Maintenance Staff, Financial Ability and Custodial Staff, Custodial Staff and Building Condition, Building Condition and Parent Attitude, Parent Attitude and Student Attitude about their building, Faculty Attitude and Student Attitude about their building, Student Attitude and Student Achievement, Student Attitude and Student Behavior, and Student Achievement and Student Behavior.

Eight of the relationships found in the theoretical model had findings related to and placed under them. These relationships included Leadership and Building Age and Quality of Materials with one finding. Financial Ability and Building Age and Quality of Materials had four findings. Maintenance Staff and Building Condition had two findings. Building Age and Quality of Materials had three findings. Both Building Condition and Student Attitudes and Building Condition and Student behavior had five related findings.

The two relationships that had the greatest numbers of related findings were Building Condition and Faculty Attitude and Building Condition and Student Achievement. Building Condition and Faculty Attitude had 17 related findings. Of the 17 reported finding, 15 were considered to be statistically significant as reported by the author and two were considered to be not statistically significant. Of the findings reported 12 were grouped as high school, zero as middle school, five as elementary, and zero as other.

In a review of the ten statistically significant findings related to Building Condition and Faculty Attitude at the high school level teachers and staff showed

building security in four of the ten reported statistically significant findings. Building security was not reported at the elementary level as a theme. There were no findings reported for middle schools.

The five statistically significant findings that were reported under high school and the relationship of Building Condition and Faculty Attitude involved teacher satisfaction and were split. Three findings reported that teacher satisfaction was affected by building condition and two findings reporting that teacher satisfaction was not affected by building condition.

There are no findings reported at the middle school level or other under Building Condition and Faculty Attitude.

There are five findings, all significant as reported by the author, placed under the relationship of Building Condition and Faculty Attitude at the elementary level. All five studies reported that Building Condition had an effect on Faculty Attitude. Faculty had higher levels of satisfaction in newer buildings.

Building Condition and Student Achievement had the highest number of findings with 37 related to this particular relationship. Of the 37 reported finding, 30 were considered to be statistically significant, as reported by the author, and seven were considered to be not statistically significant. Of the total findings reported 22 were grouped as high school, two as middle school, five as elementary, and eight as other.

In a review of the 19 significant findings reported under the relationship of Building Conditions and Student Achievement at the high school level, 16 of the 19 findings reported that Building Condition had a positive effect on Student Achievement. One significant finding reported that Building Condition did not have a positive effect on Student Achievement. Two findings reported that building condition did not have a positive or negative effect on Student Achievement. The two findings under the relationship of Building Condition and Student Achievement in middle schools both reported that Building Condition had a positive effect on Student Achievement.

Four findings were reported as statistically significant under the relationship of Building Condition and Student Achievement at the elementary school level. One finding reported that Building Condition had a positive influence on Student Achievement. One finding reported that there was not an influence on Student Achievement. Two findings

reported that Building Condition was a factor in Student Achievement but did not state if it was positive or negative.

Five findings under the in the relationship of Building Condition and Student Achievement reported that Building Condition did have a positive influence on Student Achievement.

Major Research Finding and Conclusions

The synthesis of the findings showed that Building Condition and Faculty Attitude are significant at the elementary level, but not a clear factor at the high school level. High school related findings reported an underlying theme of building security as a factor in the relationship of Building Condition and Faculty Attitude. The theme of security was not present in the reported findings at the elementary or middle school levels.

Building Condition and Student Achievement had 20 of the reported 30 significant findings and had a positive relationship between Building Condition and Student Achievement. The correlation between better building conditions and higher student achievement was supported by 20 findings by 11 different authors or studies. The 20 positive effect findings were found at all educational levels: high school, middle school, elementary school, and other. Seven findings stated that Building Condition had an effect or was a factor in Student Achievement. The five authors stated that Building Condition had an effect on Student Achievement but were not clear if it was a positive or negative effect. Only two of the significant reported findings stated that Building Condition had a negative effect on Student Achievement. This negative effect of Building Condition on Student Achievement was supported by two studies.

Based on the findings extracted in this study Building Condition has an effect on Student Achievement and Faculty Attitude. The findings also support that better Building Conditions will result in a better Faculty Attitude and higher Student Achievement. The conclusion is supported by 30 reported significant findings by 14 different authors or studies.

The conclusion to the major research findings is that one institution produced a large number of research studies that related to the overall relationship between the

school building condition and student achievement and student and faculty attitudes. This body of research provided evidence of a strong association between Building Condition and Student Achievement, students enrolled in school buildings that are assessed as being in poor condition will not perform as well on academic achievement assessment as students in buildings rated as being in good condition. This difference in achievement test scores may vary between three and ten percentile points. These findings are supported by most researchers in the field.

Further, the research findings related to Student and Faculty Attitudes and Building Condition produced weak positive associations. Yet, these associations were positive, suggesting that the condition of the school building and classroom influences how students and faculty feel about their physical environment, and that the physical environment influences their attitudes towards work and wellbeing. These findings are also supported by most researchers in the field.

The theoretical model from which these studies emanated describes relationships between the antecedents of the building condition and the subsequent influences the Building Condition has upon the users of the facility. The preponderance of studies investigated the relationship between school Building Condition and Student Achievement. The relationship between school Building Condition and Student and Faculty Attitudes does not have many studies completed and needs further research.

Based upon the research reviewed, there are several conclusions that can be drawn from this study. The following conclusions are not all of the conclusions that can be synthesized from this study as related to the theoretical model, but are pressing. As areas of future research are determined these conclusions should be factored into future research decisions.

1. School Principals are more knowledgeable about the condition of the school building than anyone else in the educational establishment. (Brannon, 2000)
2. There is a weak association between M&O expenditures and the condition of the school building. (Whitley, 2009)
3. Researchers who employ a research based instrument to evaluate the condition of a school building are able to find significant relationships. (Cash 1993;

Earthman, Cash & Van Berkum, 1996; Hines, 1996; Crook, 2006; Lanham, 1999; Bullock, 2007)

4. There is a strong association between secondary student achievement scores and the condition of the school building. (Cash, 1993; Earthman, Cash & Van Berkum, 1996; Hines, 1996; Crook, 2006; Bullock, 2007)
5. There is a weak association between elementary student achievement scores and the condition of the school building. (Lanham, 1999)
6. There is a weak association between the attitudes students have about their school building and the condition of that building. (Earthman, 2008)
7. There is a strong association between teacher attitudes about the school building and the condition of the school building. (Lemasters & Earthman, 2003)

Chapter 4

Introduction

Chapter 4 contains the critical review of the recommendations for further research of each of the studies. This review includes an introduction, a coded listing of the recommendations for further research from each study reviewed, and a categorization of the recommendations for further research from each study as they are linked to the possible relationships found within Cash's theoretical model. Chapter 4 also includes a synthesis of the recommendations for further research from the studies reviewed, major recommended studies, recommended studies that have been completed, a taxonomy of research needs, and personal reflections

Listing of all Recommendations for Further Research According to Researcher

The listings of the recommendations for further research section of the paper are by the author, in alphabetical order, followed by verbatim listings of their recommendations for further research from each study. Studies that reported recommendations for further research in a paragraph form have been split into individual recommendations for analysis purposes.

Each of the recommendations for further research has been coded, allowing the reader to track each recommendation throughout the study. Recommendations have been labeled by the first letter of the author's last name and a number. For instance, the first researcher is Bailey and his code is B1. Brannon is the second researcher and his code is B2. A complete listing of the researchers and their codes is contained in Appendix E. Studies with multiple authors have the first letter from each author's last name. Recommendations that are reported to be in a particular school level or population have been coded with ES for elementary school, MS for middle school, HS for high school, and OS for other school or no particular level is reported.

Bailey 2009 p. 194 – B1

1. Further research using student attendance rates as a surrogate for student achievement is needed. The measuring of achievement in

many states now takes the form of trying to have every student reach a certain level of performance. As such, students can re-test many times so as to achieve the level performance demanded by the state. This process is very good for the student in that the student is able to succeed. The down side is that for researchers, there is not an extant measurement of the efforts of the student. An initial study might be mounted to determine the degree of correspondence the rate of attendance has upon student performance when accounting for school buildings that are substandard or standard. The results of the study could be a guide to researchers in the effectiveness of the rate of attendance in substituting for academic test scores. B1-OS

2. A review of research of studies devoted to the relationship between school buildings and student achievement should be considered for the next generation of studies. The exact time frame should be dependent upon the quantity of studies completed. A timely review of studies is always appropriate regardless of the time span. As many new accountability measures arise in the future, an update of current research and any new phenomenon involving school building conditions and student achievement, student behavior, and student attitude is a necessity for current educators, administrators, and school building architects and contractors. Meta-analytic studies of common based research efforts to refine the knowledge base upon which these studies are founded allow for fruitful avenues of further research. B1-OS
3. New ideas about student attitude and perceptions of the school environment have surfaced in the current synthesis. The Earthman (2008) study on attitude could be replicated and or manipulated to gain a better understanding of a student's attitude and perceptions of one's school building and how that school building has a larger effect on student morale, perceptions, achievement, and student behavior. B1-HS

4. Lemasters (1997) noted the importance of a national study on the relationship between school building condition and student performance that could encompass different parts of the country. This type of study has yet to be mounted and is being further recommended. A few studies have been completed using data on the national level. Further exploration is needed using such data. B1-OS
5. In the course of designing research studies some new instruments have been developed and used. These instruments measure a number of variables used in the studies involving building condition, student performance, and student and teacher attitudes. All of these instruments would be respectable subjects of validation studies to norm their effectiveness, validity, and reliability. A series of validation studies on the instruments that evaluates the overall condition of the school building such as the CAPE and any other instrument that measures building conditions would be appropriate. B1-HS
6. With the advancement of technology and the use of technology in schools, more research should be conducted on the influence of the incorporated technology use and applications in schools, compared to schools that have limited technology. The examination of technology in school buildings and the relationship on student achievement, behavior, and attitude is needed. B1-OS

The faculty and students at several major universities over the past 20 years have compiled a corpus of research studies dealing with the relationship between school building condition and student achievement, behavior, and attitudes. A study that analyzes the findings of all of the studies completed at these universities from the period of 1993 to 2009 should be mounted to report the results. B1-OS

Brannon 2000 p. 127– B2

1. A more detailed study on how the financial actions of the local governing agency affect the conditions of school facilities could be conducted. This study could possibly determine if school divisions

with a larger pool of financial resources maintain buildings in better condition than those that have less. This type of study would also have to research the budget process for building maintenance and improvements from the initial stages to the approval and allocation of funds. B2-OS

2. A study that closely examines the adequacy of school facilities for the technological advances that each school division will continue to experience in the future could be conducted. B2-OS
3. A comparison of school divisions could be made by first evaluating and determining the condition of school buildings and then assessing the perceptions and financial actions of the leadership of the school divisions that are reported as being in the best and poorest physical condition. B2-OS
4. An investigation could be made regarding the leadership style of superintendents and the possibility of a relationship between the different leadership styles and building condition. B2-OS
5. A study could be performed whereby the financial abilities of school divisions are studied and a comparison made between those divisions with greater financial abilities and those with lesser financial abilities and the condition of school buildings. A more precise analysis might be made using a measure of financial ability and actual building condition from a larger population of school divisions. Comparing a stated index of financial ability and the results of a building appraisal for a large group of school division might lend itself to a better interpretation of this possible relationship. B2-OS
6. An analysis of the number of maintenance and operational employees of a school division and the financial ability of the division could be made. This would include the amount of funds for outside contractors who perform maintenance work. A comparison of this ratio could be made to building condition. B2-OS

7. An investigation could be made into the relationship between the secondary schools in Virginia that have achieved a 70-percent pass rate on Standards of Learning assessments and the condition of those school buildings based on a physical assessment of these facilities. B2-HS
8. An instrument could be developed that could assess school building conditions at each educational level. All relevant categories should be included that affect building conditions and qualities that address the buildings' acceptance to technological change or additions. B2-OS
9. The data used to determine the financial ability of the school division used in this study exhibited a less than strong relationship. The budget requests and fund allocations increased each year over five years, but this does not necessarily indicate a relationship of any sort. A more in-depth analysis of what purpose the budget requests were made might lend some light on this possible relationship. The analysis could use actual item requests with an appraisal of the building. B2-OS

Bullock 2007 p. 92 and 93 – B3

1. Conduct a study at the middle school level of school building conditions and student achievement in schools in urban/suburban areas versus schools in rural areas. It would be beneficial to study the question of school location and students achievement at middle school level. B3-MS
2. A study could be done on student achievement and school building design. When the middle school concept began many elementary and high schools were converted to middle schools. The buildings did not fit the design of an ideal middle school where there would be a separate wing for each grade and there would be very little, if any, interaction between students from different grade levels. Since the middle school concept began there have been many schools built to fit this middle model. A study could be done using school designed as middle schools and those middle schools be housed in converted high

schools and elementary buildings to determine if there is a difference in student achievement. B3-OS

3. A study could be done regionally or nationally at the middle school level comparing the results of studies in other states of the relationship of school building condition and student achievement to see if the results are the similar. B3-MS
4. An in-depth study could be done addressing the relationship of school building condition and its effect on different genders and different nationalities/races. This study showed that males and females were effected differently by the condition of the school building. This should be studied in more detail to see if minority males are affected more or less than non-minority males and the same study for females. B3-OS

Cash 1993 - p. 91-93 – C1

1. Using a revised Commonwealth Assessment of Physical Environment and clarified data gathering instrument, investigate the relationship between school building condition and students achievement and student behavior in urban schools. C1-HS
2. Because of the increased violence in schools, a study of the relationships between building condition and student behavior, using additional data to identify student behavior rating should be conducted. C1-HS
3. Investigate the relationship between student and faculty attitude and building condition more directly in order to determine which factor is dependent on the other. C1-HS
4. Using the Council of Educational Facilities Planners International's (CEFPI'S) Guide for School Facility Appraisal and the Commonwealth Assessment for School Facility Environment (CAPE) on a designated population to determine how effective the CAPE is as an instrument for local building condition. C1-HS

5. Revise the CAPE and apply it to an elementary school population to investigate the relationship between building condition and student achievement and behavior in a younger population. C1-ES
6. Identify a group of students who are moving from an older school to a newer or recently renovated building, and study student achievement scores and behavior before, immediately after, one year after, and three years after to determine if there is a long term effect on student achievement and behavior which occurs because of the changed building condition. C1-OS

Crook 2006 p. 130-132– C2

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. This study could then indicate if building condition is a more important factor in minority achievement than in the general population. C2-OS
2. Researchers could conduct a study that examines a possible relationship between student enrollment, building condition and student achievement. 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. C2-OS
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. This study could be performed at all grade level configurations. C2- OS

4. A study could be conducted that compares student achievement and building conditions on a multi-state level creating regional comparisons. A multi-state examination of building condition and the relationship with student achievement may further validate these studies. C2-OS
5. A study could be conducted that investigates the relationship between student achievement and faculty attitudes and building condition. 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. C2-HS
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. C2-OS
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. C2-OS
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. C2-OS

Earthman 2008 p. 44 – E1

1. With the positive results of the Student School Building Assessment Scale© further study should be encouraged by using this instrument to solidify results of school building influence upon the attitudes of students. E1-OS

Earthman, Cash, and Van Berkum 1996 p. 37 – ECV1

1. A closely designed study of disciplinary incidents and school climate compared to building condition would shed some additional light on that relationship. ECV1-HS

Earthman and Lemasters 2009 – EL1

No recommendations for further research were written in the report by Earthman and Lemasters in 2009.

Hines 1996 p. 108 - 110 – H1

1. Perform a study investigating the staffing levels of school maintenance personnel, their numbers on staff, and how well they handle their work loads. Does the number of workers increase with additional buildings and the aging of buildings? Or is the added work load given to the same number or a lesser number of workers? H1-OS
2. Look at schools that are contracting maintenance and custodial functions to outside firms. Is there any change in building maintenance and cleanliness? Is there any change in student achievement and behavior? H1-OS
3. Do an in-depth comparison of students' attitudes at schools with good building conditions on one hand and students' attitudes at schools with poor building conditions on the other. Are there attitudinal differences? H1-OS
4. Survey school superintendents seeking their attitudes and concerns in regard to operations' functions and budgets. Do they feel that there is a relationship between the facility's status and student achievement and behavior? H1-OS

5. In order to increase reliability perform the same study as done here (building condition and student achievement and behavior), but have all surveys and data gathering performed by one person or group of persons. Will this change the data gathered? H1-HS
6. Survey faculty attitudes in the schools in an effort to determine similarity to student attitudes. H1-OS
7. Survey the communities in an attempt to determine how they feel the condition of their schools affects student achievement and behavior. H1-OS
8. Survey communities to determine if there is any relationship between local composite index, building condition, and student achievement and behavior. H1-OS
9. Investigate further the possibility of a relationship between disciplinary incidents and building condition. What other variables could be involved? H1- OS
10. Survey teachers' and students' perceptions of building condition. Is there consistency with studies of administrative perceptions? H1-OS
11. Perform a study looking at a larger population (building condition and student achievement and student behaviors) H1-HS
12. Perform a study (building condition and student achievement and student behaviors) grouping schools by per pupil cost comparing high expenditure with low expenditure schools. H1-OS
13. Survey teachers for their ideas of discipline in their schools. Is the discipline effective? Does the condition of the building affect disciplinary procedures? H1-OS

Lanham 1999 p. 132-133 – L1

1. This study (relating building and classroom conditions with student achievement in Virginia's elementary schools) could be replicated at the elementary level in several years after the Standards of Learning Assessments are more established and schools have more experience in preparing students for these tests. L1-ES

2. This study (relating building and classroom conditions with student achievement in Virginia's elementary schools) could be repeated on a national level. The survey instrument, though revised, is still very close in content to the instruments used in past Virginia studies. It should now be administered on a national level to determine if similar relationships between these variables and student achievement exist on a national level. This type of study would also be pertinent due to the continued national debate on the role the federal government should play in replacing the aging school infrastructure found across the country. However, certain problems are inherent in a national study. There is no uniform national measure of student achievement that could be used for analysis. L1-ES
3. This study, (relating building and classroom conditions with students achievement in Virginia's elementary schools) with minor modifications in the survey instrument, could be administered to a representative sample of middle schools across Virginia. Middle schools are the only level in Virginia that has not been studied using this type of survey instrument. Middle schools are also participating in the same state assessment program used in this study, so a uniform measure of student achievement is available state-wide. L1-MS
4. Finally, a more detailed study of technology infrastructure, equipment, and utilization of technology could be conducted to gain more insight into the factors influencing the technology assessment score as well as the role technology use plays in achievement in other subject areas. L1-OS

Leigh 2012 p. 82-83 – L2

1. Conduct a state-wide study that would examine the relationship between school facility conditions and teacher attitudes at the elementary level. This study would consist of every elementary school in the Commonwealth of Virginia. The purpose of this study would be to determine if there is a relationship between school facility

conditions and teacher attitudes across the Commonwealth of Virginia.
L2-ES

2. Conduct a study that would incorporate a qualitative element into the research. The study could use a mixed method approach with qualitative inquires such as follow-up interviews with teachers that would strengthen the statistics gathered from the quantitative survey and analysis by providing more detailed information. L2-ES
3. Conduct a state wide study that would compare teacher attitudes in metropolitan school divisions to teacher attitudes in rural school divisions. This would consist of elementary schools across the Commonwealth of Virginia.L2-ES
4. Conduct a study that would explore the relationship between school facility conditions in charter schools and its influence on teacher attitudes. This study would examine buildings that are purchased or leased by charter schools and its influence on teacher attitudes about how it affects student learning. This study would compare teacher attitudes in charter schools rated as unsatisfactory and charter schools rated as satisfactory to see if facility conditions influence teacher attitudes in charter schools.L2-OS
5. Conduct a national study that would explore the influence school facility conditions have on teachers' physical and mental health. This study could be used to help school divisions across the nation look at what measures can be taken to lower health care costs for teachers, whereby taxpayer money could be saved. Healthier teachers would result in teachers who are at work more resulting in higher student achievement scores. L2-OS

Lemasters 1997 p. 202-203 - L3

1. Many of the studies in this synthesis (a synthesis of studies pertaining to facilities, student achievement, and student behavior) were of short duration. Substance would be added to results and conclusions if the

researchers followed student achievement and behavior with longitudinal research. L3-OS

2. Researchers were often negligent in care taken with methodology issues. For example, research of this kind requires the use of non-probability sampling and depends on volunteers responding to questionnaires. Controlling all of the variables in the classroom is nearly impossible. These factors need to be considered when stating findings, and methodology should be incorporated to lessen the influence of all but the designated variables. L3-OS
3. Some of the results of the research were questionable because of flawed methodology. Therefore, studies with improved and concise methodology should be replicated. These include, but are not limited to, those studies by Earthman, Cash, Chan, Hines, Edwards, and Garrett. In addition to replication, there should be efforts to conduct the studies in various climates, in different geographical areas, and at different grade levels. L3-OS
4. Most of the research in this synthesis studied the direct results of the facility on student attitudes and achievement. More inquiries should be made into whether or not the leadership and community's financial support of school buildings send value statements to the students that influence their attitudes toward learning. L3-OS

Lemasters and Earthman 2003 – p. 58-59 - LE1

1. Obviously, the first area of needed research is for similar studies (a study of the relationship of air conditioned classroom and student achievement) to be done with a much larger population. The limited population in this study influenced the findings and probably negated the true effect air-conditioning has upon student achievement. LE1-OS
2. The question of long-term effect of air-conditioning upon student achievement needs to be pursued to a greater extent. LE1-OS

3. Longitudinal studies to determine the influence of the school building upon students are extremely difficult to complete. The thought behind the present study was that with separate measures of achievement on three different grade levels, there would be sufficient evidence of such an impact. The data did show a trend of increase of difference between achievement scores from the 4th grade to the 9th grade, but the difference was not significant. Another study using measures of achievement on the three grade levels with the same students would provide a better base of data. In other words, taking measures of achievement from a class in the 4th grade, another measure when the same class is in the 6th grade and the same when the class is in the 9th grade would provide better data than was available in this study. LE1-OS

Mayo 2012 p.82-83 – M1

1. Conduct a study at the middle school level on two schools, of similar demographic representation that had a complete renovation during the time period of 2004 - 2010. The study would include a mixed method approach where in the researcher would talk to teachers and administrators about the changes in instruction during the stages of the renovation process. Parents and students could be interviewed to discuss perceptions of the renovation process and student achievement. M1-MS
2. Conduct a study at the elementary school level of the renovation process and student achievement. The study could look at the renovation process and student achievement at the fifth grade level in the areas of mathematics and reading, as measured on the Standards of Learning (SOL). The number of elementary schools in the Commonwealth of Virginia meeting the definition of a complete renovation may produce a larger sample size to study. M1-ES
3. Conduct a study looking at a cohort of students and conducting a longitudinal study of the scaled scores of students over a period of

time, such as, sixth grade, seventh grade, and eighth grade during the stages of the renovation process. The study could determine the impact on the renovation process on a select group of students during the stages of the renovation process. M1-OS

4. Conduct a study of all elementary, middle, and high schools of the renovation process and student achievement. The study could look at the renovation process and student achievement of specific tested grades at the elementary, middle and high school levels within the Commonwealth of Virginia, as measured on the SOL. Looking at all three levels may help increase the sample size since there are limited numbers of complete renovations. M1-OS
5. Conduct a study looking at the building level leadership during the stages of the renovation process to determine the impact leadership may pose on student achievement. Doing such a study would require a mixed method approach by interviewing various stakeholders and determining the impact leadership may have on the renovation process with the student achievement results. M1-OS

McLean 2011 p. 77-79 – M2

1. A replication of this study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) should be conducted again at the elementary level with an emphasis on increasing the sample to improve upon the effect size and robustness of the findings, examine the teacher qualifications more in-depth by considering other qualification data collected by the VADOE such as endorsements and if available the type of content specific advanced degrees; such as, reading and math specialist. School attendance rates would remain as the measure for student performance. M2-ES
2. Conduct a replication of this study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) on high school level to determine if

there are differences between the building conditions, teacher qualifications and student attendance rates in high and low performing middle schools. One area of particular interest might be the differences in teacher qualifications in high and low performing schools based upon research that claims a positive relationship between student achievement and content specific advanced degrees; such as mathematics. M2-HS

3. Replicate this study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) again on the elementary level seeking to determine if there are differences between building conditions, teacher qualifications and student attendance rates in high and low performing schools whose performance rating is based upon the school attaining full accreditation and Annual Yearly Progress (AYP) for one to two consecutive years. This comparison should be made on a school by school basis versus a means basis. By making this modification to the school performance rating criteria it should result an increase the number of low performing schools for a more balanced sample population of schools. M2-ES
4. Conduct a similar study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) on the elementary, middle or high school level with the variables building condition, teacher qualifications, and student attendance controlling for technology integration in classroom instruction to determine the difference between the fore mentioned variables in high and low performing schools. Very little if any research has been conducted to measure the impact that this technology integration initiative has impacted student achievement in high and low performing schools. M2-OS
5. Replicate this study again on the elementary level seeking to determine if there are differences between building conditions, teacher

qualifications and student attendance rates in high and low performing schools. The methodology data analysis process would use actual student scores instead of means to compare schools. Conducting the data analysis using actual student scores should help address the impact of the study that is often blunted when using means to make comparisons. M2-ES

6. Replicate this study again on the elementary level seeking to determine if there are differences between building conditions, teacher qualifications and student attendance rates of Title I and non-Title I schools instead of the performance rating of high and low performing. M2-ES

O’Sullivan 2006 p. 120-122 – S1

1. Using the CAPE as the building condition instrument, an investigation of the relationship between school building conditions and student achievement should be initiated at the middle school level. In order to add to this body of knowledge it is imperative that we investigate the relationship between the condition of school facilities and the academic achievement of middle level students. S1-MS
2. Update the high school studies in both urban and rural settings by analyzing the influence building conditions have on student achievement. This study would be advantageous in helping identify what role the local, state or federal government should play in the renovation, repair or construction of school facilities within the Commonwealth. S1-HS
3. A study can be replicated that would investigate the relationship between school building condition and school leadership and teacher effectiveness. This study would analyze teacher’s attitudes towards their school buildings and leadership in order to determine what influence these factors have on their ability to provide effective instruction in the classroom. S1-OS

4. The current study could be replicated by categorizing high schools according to their individual districts and then comparing the building conditions and student academic achievement among these schools. Results of this research could be advantageous to local and state officials in identifying building characteristics and demographics of high performing schools throughout the Commonwealth of Pennsylvania. S1-HS
5. It would be beneficial to identify high performing high schools in low socio-economic areas and survey the building administrators on their schools building conditions to see if there is a correlation with student academic achievement. S1-HS
6. It would be advantageous to replicate this study using a smaller sample size and survey students, parents, building administrators, districts administrators on their perception of school building conditions. This would provide a more thorough investigation on the influence perceptions exert on student academic achievement. S1-HS
7. Future researchers could conduct a more detailed study incorporating the utilization of technology, technology infrastructure and equipment to gain a better understanding of the role technology has in student academic achievement. The increased emphasis on technology in and out of the classroom requires an in-depth study that can provide local, state and federal officials with valuable information concerning the impact technology has on student achievement. S1-OS

Shifflett 2010 p. 96-97 – S2

1. There is a need to evaluate other schools that have been renovated using a qualitative method of analysis on teacher satisfaction and a need to include larger schools as well. Only 74 participants were included in the population for this study and the findings only had three teachers who were coded as dissatisfied. This may not be enough data to make changes based on this study alone. S2-HS

2. A broader study (teacher experiences during a renovation project) including more participants and from other geographical school locations would provide more knowledge towards teacher satisfaction. Different schools with different construction companies need to be evaluated as well. Research could then be conducted to compare the results of these future studies. S2-OS
3. The survey used in this study (teacher experiences during a renovation project) may need to be improved. The open ended questions included in this study listed a few issues that were not covered in the survey. Therefore, additions to this survey or using a more defined survey could add to further research. Another recommendation would include collecting data before, during, and after a renovation project using the same survey with the same population. This would provide baseline data that would be used for a comparison. S2-OS
4. A qualitative study could be conducted on these same two schools to investigate the results of why the teachers had a majority of neutral responses. Open ended questions could cover the decisions made by the school leaders, instructional leaders, construction company leaders, and architectural design leaders, why this phenomenon was perceived as neutral, and why do some of the situations during the renovation project appear to have run smoothly. S2-HS
5. Although the findings in this study can be used by school leaders to increase teacher satisfaction during a renovation project, further study of the demographics and renovation situations are necessary to aid those outside of Augusta County, Virginia. S2-OS

Thornton 2006 p. 100-102 – T1

1. A research study could be conducted that would utilize a qualitative analysis to examine the relationship between building conditions and economically disadvantaged students' and minority students' attitudes toward school. A survey instrument or interview protocol could be constructed to collect responses from students on how they feel about

certain conditions in their school and how certain conditions may affect them physically or mentally. T1-OS

2. A research study could be conducted examining the relationship between the same subgroups utilized in this study and building conditions categorized as structural and cosmetic. This would enable researchers to investigate specific conditions within the buildings. T1-HS
3. A research study could be conducted with more complete breakdown of the minority subgroup. African-American, Hispanic, Asian-Pacific, and Native-American subgroups could be utilized instead of the overall category of minority. This study had African-Americans as the largest subgroup under the heading of minority students. The other subgroups should be broken out to examine the true effect on each minority subgroup. T1-OS
4. A research study could be conducted using the subgroup of minority students in a longitudinal approach. All students are given an identification number in Virginia. This number follows them if they transfer schools or school divisions in the state of Virginia. Therefore, once the researcher has identified the schools in the study, the students in the study can be tracked from year to year. T1-OS
5. The present study (a study examining the school building condition and academic achievement of students identified in low socioeconomic status or minority) should be replicated and the size of high schools could be controlled to eliminate the effect of small school size and large school size that may have existed in this study. T1-HS
6. The present study (a study examining the school building condition and academic achievement of students identified in low socioeconomic status or minority) should be replicated and eliminate the use of the Algebra II test, the World History II test, and the Chemistry test. These classes and tests are traditionally taken by

advanced study diploma students. The rest of the tests are taken by everyone. Therefore, when examining the data, the researcher is examining only the above average students identified in the subgroups of economically disadvantaged and minority. This could attribute to the inconsistencies found in the data in this study. T1-HS

7. A study could be conducted on student attitudes towards the building conditions and student achievement. A study could be completed using the attitudes of students in substandard and standard school buildings and then comparing student achievement between the two groups of students. Then the researcher could conduct an independent samples t-test using the Standards of Learning tests or some other assessment tool. T1-OS
8. A study could be conducted to investigate the relationship of financial ability and school building conditions. A survey can be completed to categorize buildings into two categories such as standard and substandard and then examine the relationship between financial resources, amount of funds spent on facilities, and maintenance and operations by the school divisions. T1-OS

Walton 2011 p. 67-68 – W1

1. A return to the ten research locations in five years to determine if the themes generated as a result of this research study (physical design for safe schools) are still relevant present or whether they appear to have been due to mitigating circumstances. W1-HS
2. Replicate the study (physical design for safe schools) to include teachers and middle and elementary school principals to determine if the themes in the research study are common across the spectrum of public education. W1-OS
3. Increase the number of pre and post high schools in the population to determine if themes are different and to compare the themes to this study (physical design for safe schools). W1-HS

4. Develop research to determine if providing adequate training of principals in the design process of school construction can lead to school designs that better support an optimum safe school environment. W1-OS
5. Apply the research (physical design for safe schools) to a larger sample to include all public high schools in the Commonwealth of Virginia. W1-HS
6. Apply the research (physical design for safe schools) to urban, suburban, and rural schools to see if the issues are different between those units. W1-OS

Whitley 2009 p. 83- 84 – W2

1. Conduct a statewide study that would explore the expenditure of the budget line items of facilities and debt service. This study will consist of every school division in the Commonwealth of Virginia. The purpose of this study would be to determine if there is a relationship between the expenditures of the two budget categories and building conditions statewide. W2-OS
2. Conduct a study that would explore political decisions relative to financial decisions of public school authorities within the Commonwealth of Virginia to gain insight into the reasons behind the funding decisions that result in the condition of the school building. W2-OS
3. A study should be mounted to explore the variables associated with the budget line item of maintenance and operation to determine its impact on building conditions. W2-OS
4. Conduct a study that compares all school divisions that were rated according to building conditions. W2-OS

Categorization of Recommendations According to the Theoretical Model

Each of the relationships found in the theoretical model are listed along with recommendations for further research associated with the specific relationship.

Relationships with no recommendations are listed as a subtitle only.

Leadership and maintenance staff

1. Look at schools that are contracting maintenance and custodial functions to outside firms. Is there any change in building maintenance and cleanliness? Is there any change in student achievement and behavior? H1-OS

Leadership and building age and quality of materials

1. An investigation could be made regarding the leadership style of superintendents and the possibility of a relationship between the different leadership styles and building condition. B2-OS

Leadership and custodial staff

Financial ability and maintenance staff

1. An analysis of the number of maintenance and operational employees of a school division and the financial ability of the division could be made. This would include the amount of funds for outside contractors who perform maintenance work. A comparison of this ratio could be made to building condition. B2-OS
2. Perform a study investigating the staffing levels of school maintenance personnel, their numbers on staff, and how well they handle their work loads. Does the number of workers increase with additional buildings and the aging of buildings? Or is the added work load given to the same number or a lesser number of workers. H1-OS
3. A study should be mounted to explore the variables associated with the budget line item of maintenance and operation to determine its impact on building conditions. W2-OS

Financial ability and building age and quality of materials

1. A more detailed study on how the financial actions of the local governing agency affect the conditions of school facilities could be

conducted. This study could possibly determine if school divisions with a larger pool of financial resources maintain buildings in better condition than those that have less. This type of study would also have to research the budget process for building maintenance and improvements from the initial stages to the approval and allocation of funds. B2-OS

2. A comparison of school divisions could be made by first evaluating and determining the condition of school buildings and then assessing the perceptions and financial actions of the leadership of the school divisions that are reported as being in the best and poorest physical condition. B2-OS
3. A study could be performed whereby the financial abilities of school divisions are studied and a comparison made between those divisions with greater financial abilities and those with lesser financial abilities and the condition of school buildings. A more precise analysis might be made using a measure of financial ability and actual building condition from a larger population of school divisions. Comparing a stated index of financial ability and the results of a building appraisal for a large group of school division might lend itself to a better interpretation of this possible relationship. B2-OS
4. A study could be conducted to investigate the relationship of financial ability and school building conditions. A survey can be completed to categorize buildings into two categories such as standard and substandard and then examine the relationship between financial resources, amount of funds spent on facilities, and maintenance and operations by the school divisions. T1-OS
5. Conduct a statewide study that would explore the expenditure of the budget line items of facilities and debt service. This study will consist of every school division in the Commonwealth of Virginia. The purpose of this study would be to determine if there is a relationship

between the expenditures of the three budget categories and building conditions statewide. W2-OS

6. Conduct a study that would explore political decisions relative to financial decisions of public school authorities within the Commonwealth of Virginia to gain insight into the reasons behind the funding decisions that result in the condition of the school building. W2-OS

Financial ability and custodial staff

Maintenance staff and building condition

Building age and quality of materials and building condition

Custodial staff and building condition

Building condition and student achievement

1. A review of research of studies devoted to the relationship between school buildings and student achievement should be considered for the next generation of studies. The exact time frame should be dependent upon the quantity of studies completed. A timely review of studies is always appropriate regardless of the time span. As many new accountability measures arise in the future, an update of current research and any new phenomenon involving school building conditions and student achievement, student behavior, and student attitude is a necessity for current educators, administrators, and school building architects and contractors. Meta-analytic studies of common based research efforts to refine the knowledge base upon which these studies are founded allow for fruitful avenues of further research. B1-OS
2. Lemasters (1997) noted the importance of a national study on the relationship between school building condition and student performance that could encompass different parts of the country. This type of study has yet to be mounted and is being further recommended.

A few studies have been completed using data on the national level. Further exploration is needed using such data. B1-OS

3. An investigation could be made into the relationship between the secondary schools in Virginia that have achieved a 70-percent pass rate on 129 the Standards of Learning assessments and the condition of those school buildings based on a physical assessment of these facilities. B2-HS
4. Conduct a study at the middle school level of school building conditions and student achievement in schools in urban/suburban areas versus schools in rural areas. It would be beneficial to study the question of school location and students achievement at middle school level. B3-MS
5. A study could be done on student achievement and school building design. When the middle school concept began, many elementary and high schools were converted to middle schools. The buildings did not fit the design of an ideal middle school where there would be a separate wing for each grade and there would be very little, if any, interaction between students from different grade levels. Since the middle school concept began there have been many schools built to fit this middle model. A study could be done using school designed as middle schools and those middle schools be housed in converted high schools and elementary buildings to determine if there is a difference in student achievement. B3-OS
6. A study could be done regionally or nationally at the middle school level comparing the results of studies in other states of the relationship of school building condition and student achievement to see if the results are the similar. B3-MS
7. Using a revised Commonwealth Assessment of Physical Environment and clarified data gathering instrument, investigate the relationship between school building condition and students achievement and student behavior in urban schools. C1-HS

8. Revise the CAPE and apply it to an elementary school population to investigate the relationship between building condition and student achievement and behavior in a younger population. C1-ES
9. Identify a group of students who are moving from an older school to a newer or recently renovated building, and study student achievement scores and behavior before, immediately after, one year after, and three years after to determine if there is a long term effect on student achievement and behavior which occurs because of the changed building condition. C1-OS
10. 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. This study could then indicate if building condition is a more important factor in minority achievement than in the general population. C2-OS
11. 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. This study could be performed at all grade level configurations. C2- OS
12. A study could be conducted that compares student achievement and building conditions on a multi-state level creating regional comparisons. A multi-state examination of building condition and the relationship with student achievement may further validate these studies. C2-OS
13. 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. C2-OS

14. 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. C2-OS
15. 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. C2-OS
16. Survey school superintendents seeking their attitudes and concerns in regard to operations' functions and budgets. Do they feel that there is a relationship between the facility's status and student achievement and behavior? H1-OS
17. Perform a study looking at a larger population (building condition and student achievement and student behaviors) H1-HS
18. This study (relating building and classroom conditions with student achievement in Virginia's elementary schools) could be replicated at the elementary level in several years after the Standards of Learning Assessments are more established and schools have more experience in preparing students for these tests. L1-ES
19. This study (relating building and classroom conditions with student achievement in Virginia's elementary schools) could be repeated on a national level. The survey instrument, though revised, is still very close in content to the instruments used in past Virginia studies. It should now be administered on a national level to determine if similar relationships between these variables and student achievement exist on a national level. This type of study would also be pertinent due to the continued national debate on the role the federal government should

play in replacing the aging school infrastructure found across the country. However, certain problems are inherent in a national study. There is no uniform national measure of student achievement that could be used for analysis. L1-ES

20. This study, (relating building and classroom conditions with students achievement in Virginia's elementary schools) with minor modifications in the survey instrument, could be administered to a representative sample of middle schools across Virginia. Middle schools are the only level in Virginia that has not been studied using this type of survey instrument. Middle schools are also participating in the same state assessment program used in this study, so a uniform measure of student achievement is available state-wide. L1-MS
21. Obviously, the first area of needed research is for similar studies (a study of the relationship of air conditioned classroom and student achievement) to be done with a much larger population. The limited population in this study influenced the findings and probably negated the true effect air-conditioning has upon student achievement. LE1-OS
22. The question of long-term effect of air-conditioning upon student achievement needs to be pursued to a greater extent. LE1-OS
23. Longitudinal studies to determine the influence of the school building upon students are extremely difficult to complete. The thought behind the present study was that with separate measures of achievement on three different grade levels, there would be sufficient evidence of such an impact. The data did show a trend of increase of difference between achievement scores from the 4th grade to the 9th grade, but the difference was not significant. Another study using measures of achievement on the three grade levels with the same students would provide a better base of data. In other words, taking measures of achievement from a class in the 4th grade, another measure when the same class is in the 6th grade and the same when the class is in the 9th

grade would provide better data than was available in this study. LE1-OS

24. Conduct a study at the middle school level on two schools, of similar demographic representation, that had a complete renovation during the time period of 2004 - 2010. The study would include a mixed method approach where in the researcher would talk to teachers and administrators about the changes in instruction during the stages of the renovation process. Parents and students could be interviewed to discuss perceptions of the renovation process and student achievement. M1-MS.
25. Conduct a study at the elementary school level of the renovation process and student achievement. The study could look at the renovation process and student achievement at the fifth grade level in the areas of mathematics and reading, as measured on the Standards of Learning (SOL). The number of elementary schools in the Commonwealth of Virginia meeting the definition of a complete renovation may produce a larger sample size to study. M1-ES
26. Conduct a study looking at a cohort of students and conducting a longitudinal study of the scaled scores of students over a period of time, such as, sixth grade, seventh grade, and eighth grade during the stages of the renovation process. The study could determine the impact on the renovation process on a select group of students during the stages of the renovation process. M1-OS
27. Conduct a study of all elementary, middle, and high schools of the renovation process and student achievement. The study could look at the renovation process and student achievement of specific tested grades at the elementary, middle and high school levels within the Commonwealth of Virginia, as measured on the SOL. Looking at all three levels may help increase the sample size since there are limited numbers of complete renovations. M1-OS

28. Using the CAPE as the building condition instrument, an investigation of the relationship between school building conditions and student achievement should be initiated at the middle school level. In order to add to this body of knowledge it is imperative that we investigate the relationship between the condition of school facilities and the academic achievement of middle level students. S1-MS
29. Update the high school studies in both urban and rural settings by analyzing the influence building conditions have on student achievement. This study would be advantageous in helping identify what role the local, state or federal government should play in the renovation, repair or construction of school facilities within the Commonwealth. S1-HS
30. The current study could be replicated by categorizing high schools according to their individual districts and then comparing the building conditions and student academic achievement among these schools. Results of this research could be advantageous to local and state officials in identifying building characteristics and demographics of high performing schools throughout the Commonwealth of Pennsylvania. S1-HS
31. It would be beneficial to identify high performing high schools in low socio-economic areas and survey the building administrators on their schools building conditions to see if there is a correlation with student academic achievement. S1-HS
32. The present study (a study examining the school building condition and academic achievement of students identified in low socioeconomic status or minority) should be replicated and the size of high schools could be controlled to eliminate the effect of small school size and large school size that may have existed in this study. T1-HS
33. The present study (a study examining the school building condition and academic achievement of students identified in low socioeconomic status or minority) should be replicated and eliminate the use of the

Algebra II test, the World History II test, and the Chemistry test. These classes and tests are traditionally taken by advanced study diploma students. The rest of the tests are taken by everyone. Therefore, when examining the data, the researcher is examining only the above average students identified in the subgroups of economically disadvantaged and minority. This could attribute to the inconsistencies found in the data in this study. T1-HS

Building condition and parent attitude

1. Survey the communities in an attempt to determine how they feel the condition of their schools affect student achievement and behavior. H1-OS
2. Survey communities to determine if there is any relationship between local composite index, building condition, and student achievement and behavior. H1-OS

Building condition and student attitudes about their building

1. New ideas about student attitude and perceptions of the school environment have surfaced in the current synthesis. The Earthman (2008) study on attitude could be replicated and or manipulated to gain a better understanding of a student's attitude and perceptions of one's school building and how that school building has a larger effect on student morale, perceptions, achievement, and student behavior. B1-HS
2. With the positive results of the Student School Building Assessment Scale© further study should be encouraged by using this instrument to solidify results of school building influence upon the attitudes of students. E1-OS
3. A closely designed study of disciplinary incidents and school climate compared to building condition would shed some additional light on that relationship. ECV1-HS
4. Do an in-depth comparison of students' attitudes at schools with good building conditions on one hand and students' attitudes at schools with

poor building conditions on the other. Are there attitudinal differences? H1-OS

5. Survey teachers' and students' perceptions of building condition. Is there consistency with studies of administrative perceptions? H1-OS
6. A research study could be conducted that would utilize a qualitative analysis to examine the relationship between building conditions and economically disadvantaged students' and minority students' attitudes toward school. A survey instrument or interview protocol could be constructed to collect responses from students on how they feel about certain conditions in their school and how certain conditions may affect them physically or mentally. T1-OS
7. A research study could be conducted examining the relationship between the same subgroups utilized in this study and building conditions categorized as structural and cosmetic. This would enable researchers to investigate specific conditions within the buildings. T1-HS
8. A research study could be conducted with more complete breakdown of the minority subgroup. African-American, Hispanic, Asian-Pacific, and Native-American subgroups could be utilized instead of the overall category of minority. This study had African-Americans as the largest subgroup under the heading of minority students. The other subgroups should be broken out to examine the true effect on each minority subgroup. T1-OS
9. A research study could be conducted using the subgroup of minority students in a longitudinal approach. All students are given an identification number in Virginia. This number follows them if they transfer schools or school divisions in the state of Virginia. Therefore, once the researcher has identified the schools in the study, the students in the study can be tracked from year to year. T1-OS
10. A study could be conducted on student attitudes towards the building conditions and student achievement. A study could be completed using

the attitudes of students in substandard and standard school buildings and then comparing student achievement between the two groups of students. Then the researcher could conduct an independent samples t-test using the Standards of Learning tests or some other assessment tool. T1-OS

Building condition and faculty attitude

1. Investigate the relationship between student and faculty attitude and building condition more directly in order to determine which factor is dependent on the other. C1-HS
2. A study could be conducted that investigates the relationship between student achievement and faculty attitudes and building condition. 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. C2-HS
3. Survey faculty attitudes in the schools in an effort to determine similarity to student attitudes. H1-OS
4. Conduct a state-wide study that would examine the relationship between school facility conditions and teacher attitudes at the elementary level. This study would consist of every elementary school in the Commonwealth of Virginia. The purpose of this study would be to determine if there is a relationship between school facility conditions and teacher attitudes across the Commonwealth of Virginia. L2-ES
5. Conduct a study that would incorporate a qualitative element into the research. The study could use a mix method approach with qualitative inquires such as follow-up interviews with teachers that would

strengthen the statistics gathered from the quantitative survey and analysis by providing more detailed information. L2-ES

6. Conduct a state wide study that would compare teacher attitudes in metropolitan school divisions to teacher attitudes in rural school divisions. This would consist of elementary schools across the Commonwealth of Virginia. L2-ES
7. Conduct a study that would explore the relationship between school facility conditions in charter schools and its influence on teacher attitudes. This study would examine buildings that are purchased or leased by charter schools and its influence on teacher attitudes about how it affects student learning. This study would compare teacher attitudes in charter schools rated as unsatisfactory and charter schools rated as satisfactory to see if facility conditions influence teacher attitudes in charter schools. L2-OS
8. Conduct a national study that would explore the influence school facility conditions have on teachers' physical and mental health. This study could be used to help school divisions across the nation look at what measures can be taken to lower health care costs for teachers, whereby taxpayer money could be saved. Healthier teachers would result in teachers who are at work more resulting in higher student achievement scores. L2-OS
9. A study can be replicated that would investigate the relationship between school building condition and school leadership and teacher effectiveness. This study would analyze teacher's attitudes towards their school buildings and leadership in order to determine what influence these factors have on their ability to provide effective instruction in the classroom. S1-OS
10. There is a need to evaluate other schools that have been renovated using a qualitative method of analysis on teacher satisfaction and a need to include larger schools as well. Only 74 participants were included in the population for this study and the findings only had

three teachers who were coded as dissatisfied. This may not be enough data to make changes based on this study alone. S2-HS

11. A broader study (teacher experiences during a renovation project) including more participants and from other geographical school locations would provide more knowledge towards teacher satisfaction. Different schools with different construction companies need to be evaluated as well. Research could then be conducted to compare the results of these future studies. S2-OS
12. The survey used in this study (teacher experiences during a renovation project) may need to be improved. The open ended questions included in this study listed a few issues that were not covered in the survey. Therefore, additions to this survey or using a more defined survey could add to further research. Another recommendation would include collecting data before, during, and after a renovation project using the same survey with the same population. This would provide baseline data that would be used for a comparison. S2-OS
13. A qualitative study could be conducted on these same two schools to investigate the results of why the teachers had a majority of neutral responses. Open ended questions could cover the decisions made by the school leaders, instructional leaders, construction company leaders, and architectural design leaders, why this phenomenon was perceived as neutral, and why do some of the situations during the renovation project appear to have run smoothly. S2-HS
14. Although the findings in this study can be used by school leaders to increase teacher satisfaction during a renovation project, further study of the demographics and renovation situations are necessary to aid those outside of Augusta County, Virginia. S2-OS

Building condition and student behavior

1. Because of the increased violence in schools, a study of the relationships between building condition and student behavior, using

additional data to identify student behavior rating should be conducted.
C1-HS

Parent attitude and student attitudes about their building

1. Most of the research in this synthesis studied the direct results of the facility on student attitudes and achievement. More inquiries should be made into whether or not the leadership and community's financial support of school buildings send value statements to the students that influence their attitudes toward learning. L3-OS

Parent attitude and faculty attitude about their building

Faculty attitude and student attitudes about their building

1. Survey teachers for their ideas of discipline in their schools. Is the discipline effective? Does the condition of the building affect disciplinary procedures? H1-OS

Student attitudes and student achievement

1. Many of the studies in this synthesis (a synthesis of studies pertaining to facilities, student achievement, and student behavior) were of short duration. Substance would be added to results and conclusions if the researchers followed student achievement and behavior with longitudinal research. L3-OS

Student attitudes and student behavior

Other – findings that do not fit with a relationship from above

1. Further research using student attendance rates as a surrogate for student achievement is needed. The measuring of achievement in many states now takes the form of trying to have every student reach a certain level of performance. As such, students can re-test many times so as to achieve the level performance demanded by the state. This process is very good for the student in that the student is able to succeed. The down side is that for researchers, there is not an extant measurement of the efforts of the student. An initial study might be mounted to determine the degree of correspondence the rate of

attendance has upon student performance when accounting for school buildings that are substandard or standard. The results of the study could be a guide to researchers in the effectiveness of the rate of attendance in substituting for academic test scores. B1-OS

2. In the course of designing research studies some new instruments have been developed and used. These instruments measure a number of variables used in the studies involving building condition, student performance, and student and teacher attitudes. All of these instruments would be respectable subjects of validation studies to norm their effectiveness, validity, and reliability. A series of validation studies on the instruments that evaluates the overall condition of the school building such as the CAPE and any other instrument that measures building conditions would be appropriate. B1-HS
3. With the advancement of technology and the use of technology in schools, more research should be conducted on the influence of the incorporated technology use and applications in schools, compared to schools that have limited technology. The examination of technology in school buildings and the relationship on student achievement, behavior, and attitude is needed. B1-OS
4. The faculty and students at several major universities over the past 20 years have compiled a corpus of research studies dealing with the relationship between school building condition and student achievement, behavior, and attitudes. A study that analyzes the findings of all of the studies completed at these universities from the period of 1993 to 2009 should be mounted to report the results. B1-OS
5. A study that closely examines the adequacy of school facilities for the technological advances that each school division will continue to experience in the future could be conducted. This study reported that perceptions of school leaders and assessments of facilities suggested that 128 deficiencies were evident within school buildings. The

utilization of technology is a potential source of concern to school divisions who are already experiencing budget restraints. B2-OS

6. An instrument could be developed that could assess school building conditions at each educational level. All relevant categories should be included that affect building conditions and qualities that address the buildings' acceptance to technological change or additions. B2-OS
7. The data used to determine the financial ability of the school division used in this study exhibited a less than strong relationship. The budget requests and fund allocations increased each year over five years, but this does not necessarily indicate a relationship of any sort. A more in-depth analysis of what purpose the budget requests were made might lend some light on this possible relationship. The analysis could use actual item requests with an appraisal of the building. B2-OS
8. An in-depth study could be done addressing the relationship of school building condition and its effect on different genders and different nationalities/races. This study showed that males and females were effected differently by the condition of the school building. This should be studied in more detail to see if minority males are affected more or less than non-minority males and the same study for females. B3-OS
9. Using the Council of Educational Facilities Planners International's (CEFPI'S) Guide for School Facility Appraisal and the Commonwealth Assessment for School Facility Environment (CAPE) on a designated population to determine how effective the CAPE is as an instrument for local building condition. C1-HS
10. Researchers could conduct a study that examines a possible relationship between student enrollment, building condition and student achievement. 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. C2-OS

11. In order to increase reliability perform the same study as done here (building condition and student achievement and behavior), but have all surveys and data gathering performed by one person or group of persons. Will this change the data gathered? H1-HS
12. Investigate further the possibility of a relationship between disciplinary incidents and building condition. What other variables could be involved? H1- OS
13. Perform a study (building condition and student achievement and student behaviors) grouping schools by per pupil cost comparing high expenditure with low expenditure schools. H1-OS
14. Finally, a more detailed study of technology infrastructure, equipment, and utilization of technology could be conducted to gain more insight into the factors influencing the technology assessment score as well as the role technology use plays in achievement in other subject areas.
L1-OS
15. Researchers were often negligent in care taken with methodology issues. For example, research of this kind requires the use of non-probability sampling and depends on volunteers responding to questionnaires. Controlling all of the variables in the classroom is nearly impossible. These factors need to be considered when stating findings, and methodology should be incorporated to lessen the influence of all but the designated variables. L3-OS
16. Some of the results of the research were questionable because of flawed methodology. Therefore, studies with improved and concise methodology should be replicated. These include, but are not limited to, those studies by Earthman, Cash, Chan, Hines, Edwards, and Garrett. In addition to replication, there should be efforts to conduct the studies in various climates, in different geographical areas, and at different grade levels. L3-OS

17. Conduct a study looking at the building level leadership during the stages of the renovation process to determine the impact leadership may pose on student achievement. Doing such a study would require a mix method approach by interviewing various stakeholders and determining the impact leadership may have on the renovation process with the student achievement results. M1-OS
18. A replication of this study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) should be conducted again at the elementary level with an emphasis on increasing the sample to improve upon the effect size and robustness of the findings, examine the teacher qualifications more in-depth by considering other qualification data collected by the VADOE such as endorsements and if available the type of content specific advanced degrees; such as, reading and math specialist. School attendance rates would remain as the measure for student performance. M2-ES
19. Conduct a replication of this study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) on high school level to determine if there are differences between the building conditions, teacher qualifications and student attendance rates in high and low performing middle schools. One area of particular interest might be the differences in teacher qualifications in high and low performing schools based upon research that claims a positive relationship between student achievement and content specific advanced degrees; such as mathematics. M2-HS
20. Replicate this study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) again on the elementary level seeking to determine if there are differences between building conditions, teacher qualifications and student attendance rates in high and low performing

schools whose performance rating is based upon the school attaining full accreditation and Annual Yearly Progress (AYP) for one to two consecutive years. This comparison should be made on a school by school basis versus a means basis. By making this modification to the school performance rating criteria it should result an increase the number of low performing schools for a more balanced sample population of schools. M2-ES

21. Conduct a similar study (a study of the relationship between building condition, selected teacher qualifications, and student attendance in elementary schools) on the elementary, middle or high school level with the variables building condition, teacher qualifications, and student attendance controlling for technology integration in classroom instruction to determine the difference between the fore mentioned variables in high and low performing schools. This research study found a significant difference in the access to a Local Area Network (internet) in high and low performing schools. Very little if any research has been conducted to measure the impact that this technology integration initiative has impacted student achievement in high and low performing schools. M2-OS
22. Replicate this study again on the elementary level seeking to determine if there are differences between building conditions, teacher qualifications and student attendance rates in high and low performing schools. The methodology data analysis process would use actual student scores instead of means to compare schools. Conducting the data analysis using actual student scores should help address the impact of the study that is often blunted when using means to make comparisons. M2-ES
23. Replicate this study again on the elementary level seeking to determine if there are differences between building conditions, teacher qualifications and student attendance rates of Title I and non-Title I

schools instead of the performance rating of high and low performing.
M2-ES

24. It would be advantageous to replicate this study using a smaller sample size and survey students, parents, building administrators, districts administrators on their perception of school building conditions. This would provide a more thorough investigation on the influence perceptions exert on student academic achievement. S1-HS
25. Future researchers could conduct a more detailed study incorporating the utilization of technology, technology infrastructure and equipment to gain a better understanding of the role technology has in student academic achievement. The increased emphasis on technology in and out of the classroom requires an in-depth study that can provide local, state and federal officials with valuable information concerning the impact technology has on student achievement. S1-OS
26. A return to the ten research locations in five years to determine if the themes generated as a result of this research study (physical design for safe schools) are still relevant present or whether they appear to have been due to mitigating circumstances. W1-HS
27. Replicate the study (physical design for safe schools) to include teachers and middle and elementary school principals to determine if the themes in the research study are common across the spectrum of public education. W1-OS
28. Increase the number of pre and post high schools in the population to determine if themes are different and to compare the themes to this study (physical design for safe schools). W1-HS
29. Develop research to determine if providing adequate training of principals in the design process of school construction can lead to school designs that better support an optimum safe school environment. W1-OS

30. Apply the research (physical design for safe schools) to a larger sample to include all public high schools in the Commonwealth of Virginia. W1-HS
31. Apply the research (physical design for safe schools) to urban, suburban, and rural schools to see if the issues are different between those units. W1-OS
32. Conduct a study that compares all school divisions that were rated according to building conditions. W2-OS

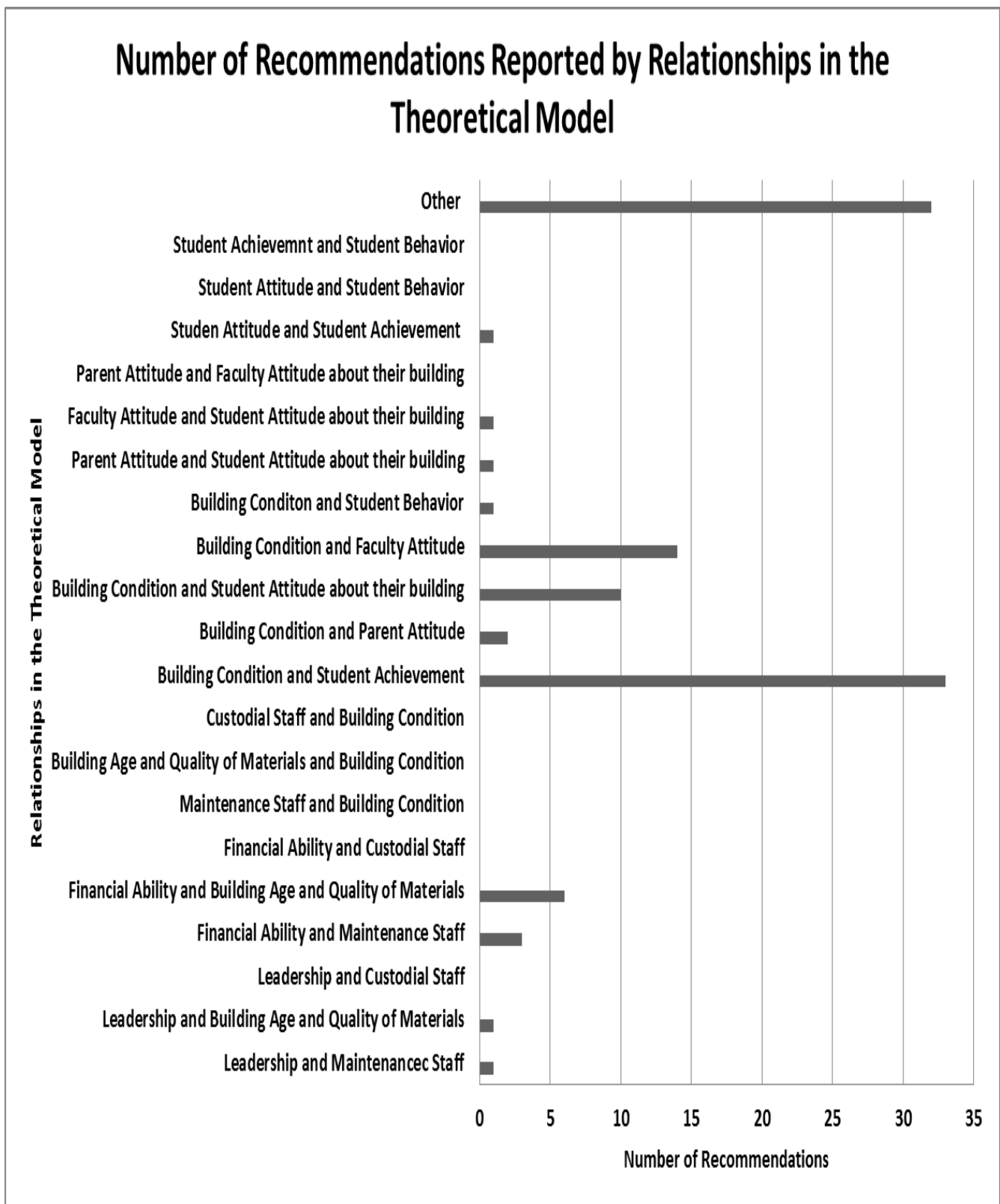


Figure 2. Number of Recommendations Reported by Relationships in the Theoretical Model

Synthesis of Recommended Studies

The study extracted a total of 74 recommendations for further research, related to the theoretical model, from the 20 studies reviewed. A total of 106 recommendations were extracted with 32 categorized under other. The synthesis of the recommended studies focuses on those studies that are related to the relationships found in Cash's theoretical model. A further synthesis of the recommendations for further research, as reported by the author, showed that there were seven recommendations related to elementary school, five related to middle school, 16 recommendations related to high school, and 46 related to other educational facilities.

Each recommendation was placed under one of 20 relationships found in Cash's theoretical model. Each recommendation was only listed once. If a recommendation was not related to a particular relationship it was listed as other. There were 32 recommendations reported under other. Several of the relationships did not have a recommendation placed under them. These relationships were: Leadership and Custodial Staff, Financial Ability and Custodial Staff, Maintenance Staff and Building Condition, Building Age and Quality of Materials, Parent Attitude and Faculty Attitude about their building, Student Attitude and Student Behavior, and Student Achievement and Student Behavior.

Within the theoretical model, 12 of the relationships had recommendations related to and placed under them. These relationships included Financial Ability and Maintenance Staff with three recommendations. Financial Ability and Building Age and Quality of Materials had six recommendations. Building Condition and Parent Attitude had two. Leadership and Maintenance Staff, Leadership and Building Age and Quality of Materials, Building Condition and Student Behavior, Parent Attitude and Student Attitude about their building, Faculty Attitude and Student Attitude about their building, and Student Attitude and Student Achievement each had one recommendation for further research.

The three relationships that had the greatest numbers of related recommendations for further research were Building Condition and Student Achievement, Building Condition and Student Attitudes, and Building Condition and Faculty Attitude. Building Condition and Student Attitude had 10 recommendations placed under a relationship in

the theoretical model. Of the 10 recommendations, three were reported as high school and seven under other. Four of the recommendations, reported by Thornton in 2006, involved a more in depth analysis of subgroups. Recommendations include surveying economically disadvantaged students and or minority subgroups as to their perceptions related to Building Condition. One recommendation included a replication of the Earthman 2008 study on Student Attitude. Another recommendation involves the analysis of Student Attitudes from standard and substandard buildings and then to comparison of those results with Student Achievement on a standardized assessment. Other recommendations for further research included factors such as disciplinary incidents and comparisons with administrative perceptions and Building Conditions.

Building Condition and Faculty Attitude had 14 related recommendations. Of the 14 reported recommendations four were grouped as high school, zero as middle school, three as elementary, and seven as other. Three recommendations, by Leigh in 2012 and Shifflet in 2009, include adding or conducting a qualitative component to the study to strengthen any statistical findings. Two recommendations, by Cash in 1993 and Hines in 1996, combine Teacher/Faculty and Student Attitude as they relate to Building Condition. These recommendations would look to determine what factor, Student Attitude or Faculty Attitudes, would be dependent on the other as it relates to Building Condition. One recommendation included Leadership as it relates to Faculty Attitude and Building Condition. Another recommendation called for an improved survey to be used. Five recommendations for further research, from two authors, included conducting studies on a broader range and with different populations. These included: charter schools compared to public schools, rural versus urban schools, a study of Building Condition and Faculty Attitude in all elementary schools in the Commonwealth of Virginia, and studying different geographical regions. A recommended national study that could possibly identify common themes that may increase teacher health, decrease medical costs, and overall improve Student Achievement was also recommended.

Building Condition and Student Achievement had the highest number of recommendations with 33 related to the particular relationship. Of the 33 reported recommendations, eight were grouped as high school, five as middle school, four as elementary, and 16 as other. The 33 recommendations presented common themes or

frequencies in the study. Three recommendations, from three different authors, included studies at the high school level, more specifically one across Pennsylvania's high schools and studies of urban versus rural high school Student Achievement and Building Conditions. Four recommendations, from three authors, included more detailed studies of minority students, low socioeconomic students, or other subgroups as they related to Building Condition and Student Achievement. Four recommendations for further research, from four authors, suggested studies to be conducted at the national level or regional level to determine if trends exist as they relate to Building Condition and Student Achievement. The final theme from the recommendations for further research included five recommendations for studies to be conducted at the middle school level and other secondary schools, from two authors, as it relates to Building Condition and Student Achievement.

Major Recommended Studies

Based upon the number of recommendations for further research and the number of authors reporting similar recommendations the following studies can be investigated.

School building condition and faculty attitudes

Studies involving Building Condition and Faculty Attitude would include a qualitative component to possibly strengthen any findings. Studies could be approached as a mixed method with a quantitative and qualitative component or as a standalone qualitative study as it relates to Faculty Attitude and Building Condition.

Five different recommendations for further research call for broader studies. Recommended studies could be conducted at all school levels, but include schools from across a state or region. A national study could also be conducted to determine the effect on Building Condition on Faculty Attitude. Other recommendations for further research include studies of charter schools, private schools, or rural versus urban schools. Studies with greater or broader populations would bring more significant findings to the study of Building Condition on Faculty Attitude.

School building condition and student achievement

The relationship with the highest number of recommendations for further research, 33 of the 74 extracted recommendations, was Building Condition and Student

Achievement. Populations with the highest number of recommendations include: high schools, middle schools, sub groups, or studies at the national level. Studies could be conducted at the high school level that focus on Building Condition and Student Achievement in rural and urban school, or include high schools across a state or region. Studies could also be conducted analyzing the performance of subgroups such as low socioeconomic or minorities as it relates to Building Condition and Student Achievement. Other recommendations call for studies to be conducted at the middle school level for effect of Building Condition on Student Achievement. Four authors recommend studies of Building Condition and Student Achievement be conducted on a larger or broader population. The recommended studies include populations across one state, region, or across the nation. The recommended national studies of Building Condition and Student Achievement can now be conducted with the CORE standards being assessed in the majority of states. Studies with greater or broader populations would bring more significant findings to the study of Building Condition on Student Achievement.

Recommended Research That Has Been Completed

Each of the 20 studies reviewed produced several recommendations for further research. The reviewed studies were conducted from 1993 with Cash through 2012 with Leigh and Mayo. Therefore, over the 19 year time span of the research, several of the recommendations for further research have been conducted. The following list displays which studies have been completed, which author recommended the study, the author of the study, and the year it was completed.

- Review the extant research on school building condition and student achievement –B1-OS – Peterson, 2014
- Develop an instrument to assess school building condition on the elementary and middle school level – B2-OS –Lanham, 1999 & Bullock, 2007
- The relationship between ethnic student status and school building condition – B3-OS,C2-OS, - Thornton, 2006
- The relationship between school building condition and teacher attitudes – C10-HS – Earthman & Lemasters, 2009

- Compare school building condition and student attitudes – H1-OS, T1-OS – Earthman, 2008
- The relationship between school building condition and middle school students – B3-MS, L1-MS – Bullock, 2007
- The relationship between school building condition and students in Low income Families – C2-OS – Thornton, 2006

Taxonomy of Research Needs

For the purpose of this study a taxonomy is defined as the study and organized classification of research studies based on the recommendations for further research. Analysis of the recommendations for further research indicates areas and relationships that need more research. Even though the extant research has produced some strong associations, there continues to be a need to produce more research. Most researchable question needs more research until all situations involved are explored. Of course that is almost an impossibility. That said, however, researchers can be confident of the findings that have been produced to date. The relationships that were either not investigated or were investigated by one or two research studies are the areas that need more research to fill the void of research findings. The areas or relationships that need further research are listed below in taxonomy.

The theoretical model used by almost all of the research studies completed at Virginia Tech was initially developed by Cash (1993) and expanded to fit the needs of further research. This model produced several propositions, developed Earthman and Lemasters (2011), which can be used for further research. The propositions follow the logical progression of the model from the decisions of the school authorities and financial ability of the school system in determining the condition of the school building to the eventual effect the school building conditions have upon student and teacher performance and attitudes. The taxonomy of research needs fits into the propositions of the theoretical model. The propositions are not presented in order of priority, but follow the progression of relationships formed in the theoretical model explaining the condition of school buildings and the influence this has upon users of the building.

Proposition I: The leadership and financial ability of the school system determine the efficiency and extent of maintenance and operational services provided in the school system. Decisions by leadership about the cost of a building influence the quality of materials used in the structure.

- *The Relationship between School Leadership and school Building Condition – B2-OS, H1-HS, M1-OS.* The question in this relationship is how much the building condition is affected by the decision of school authorities. Obviously, the decisions made by school authorities does influence the size of the M&O staff who keep the building in good condition as well as well as decisions regarding the total cost of the building. This is reflected in the decisions made such things as the quality of materials in a new building.
- *The relationship between per pupil expenditures and school Building Condition.* This relationship was explored by one research study (Whitley, 2009). The findings of this study were mixed with only the funds spent by a school board on Maintenance having a significant relationship to building condition. Evidence from studies investigating this relationship could help explain why buildings assessed as being in poor condition are in such condition.
- *The relationship between Leadership and Building Age and Quality of Materials.* School authorities and school boards make decisions regarding the cost of any new construction or renovations through the approval process of the capital improvement program. These decisions in turn determine the quality of a school building. Architects are bound to the established budget of a capital project and must make decisions about what kinds of materials that can be used in the building construction. In many instances, less than first class building materials have had to be used in a building because of budget constraints. School buildings constructed with less than first class materials age very quickly over the years and soon are in poor condition.
- *The relationship between Financial Ability and Maintenance Staff.* The maintenance staff of the school system is responsible for the general upkeep of the school building throughout the life of the structure. With sufficient

maintenance staff available, a building should remain in good and usable condition for at least the first fifty years. Only through maintenance work can a building stay in good condition. If decisions to reduce the M&O budget are made, the maintenance staff is directly affected either through a reduced staff or insufficient building material to keep the building functional. Therefore, decisions of the school authorities and school boards regarding the quality of the maintenance staff directly influence the condition of the building

- *The relationship between Financial Ability and Custodial Staff.* Although the custodial staff does not greatly influence the condition of a building, the staff does have responsibility for keeping the building clean. There is some evidence to suggest that the cleanliness of the building does influence the attitudes student and teachers have about their physical environment. Negative attitudes about the school building in turn influence the performance of both students and teachers. This possible relationship needs more attention in the research field.

Proposition II: The condition of the school building results from not only the efforts of the maintenance and operations staff, but also from the efforts of the leadership to require school buildings to be in excellent shape.

- *The Relationship of the Financial Ability of school divisions to school Building Conditions- B2-OS, T1-OS.* One study related to this relationship and produced inconclusive results (Whitley, 2009). The question is about the financial ability of the school division and the condition of school buildings. The relationship between what school boards spend on M&O and the condition of the school buildings seems logical, yet evidence is needed to establish the relationship.
- *The relationship between M&O expenditures and school Building Condition – H1-OS, W2-OS.* This relationship has not been explored as yet and needs to be. Does the size of the M&O staff determine the condition of the school building? This relationship closely corresponds to other possible relationships in school authority decisions.

- *Research political decisions and school Building Condition.* This relationship has not been investigated and needs some attention. In school divisions that have buildings assessed as being in poor condition result from political decisions? Finding out the reasons for buildings being in poor condition is half of the battle to improve poor school buildings. Evidence as to the influence of political decisions in building conditions is needed.
- *Complete validation studies on instruments that are used to assess school Building Condition.* Several instruments to assess the condition of school buildings have been developed over the years. These instruments need to be validated as to their effectiveness. The proper assessment of school buildings is of prime importance to research studies in this area. The findings of some research studies have probably been influenced as a result of how the school building was assessed. There is a large difference in assessing the maintenance needs of a school building and assessing the educational value of a school building based upon research findings. This difference in research findings can be directly related to the instrument used for the assessment of school building assessment. By utilizing a research-based assessment instrument the researcher can obtain a more accurate picture of the condition of the school building for learning purposes.
- *The relationship between Leadership and Maintenance Staff size.* How the school building is maintained over the years is of vital importance in determining the condition of a school building. Does the size of the maintenance staff have any relationship to the building condition? There are recommendations on the size of maintenance staffs depending upon the size of the building promulgated by national organizations. Some schools adhere to these formulae and many school systems do not. Does this make a difference in how buildings are maintained? Research findings on this possible relationship would be helpful to school boards in staffing their maintenance programs.
- *The relationship between Leadership and Custodial Staff.* The assumption on this possible relationship is that if school authorities believe school buildings

should always be clean and in good condition they will demand that custodians make certain the schools are clean and provide due diligence in making sure the building is clean. This also plays out in school authorities making certain the Operations staff always has a full complement of employees and sufficient equipment to keep the building clean and operational.

- *The relationship between Custodial Staff and Building Condition.* The custodial staff does not have responsibility for the actual condition of the building so much as the cleanliness of a building. Yet, cleanliness of buildings does influence how the users of the building feel about their surroundings. What little research that is available does not provide much evidence that a relationship between selected upkeep features of a building and student achievement exists. Basically, researchers could not find a statistically significant relationship between the building condition and custodial staff. This does not negate the further investigation of this area. More research is needed to articulate this possible relationship.

Proposition III: The condition of the school building directly influences the attitudes of faculty, parents, and students.

- *The relationship between School Building Condition and Student Attitudes.* Although there is some research on this relationship, more research is needed to further establish the validity of a significant difference between the achievement scores of students in buildings that are assessed as being in good and poor condition. The basic question here relates to the possible influence the school building has upon student attitude formulation.
- *The relationship between school building and classroom condition and teacher attitudes.* Several studies were completed involving this relationship (Earthman 2008; Leigh, 2012). The results were that school building conditions did affect the attitudes of teachers. Yet this relationship needs further investigation to ascertain if teachers in buildings in poor condition are hindered in any manner in their teaching.

- *The relationship between community attitudes and school Building Condition.* This relationship has not been explored and needs to be. The question is about the influence community groups and individuals have in determining the condition of the school building. In those school divisions that have buildings assessed as being in poor condition, does the community care about the building condition or is the community helpless in decisions? This is a very important proposition.
- *The relationship between Building Condition and Parent Attitude.* Does the condition of a school building result in forming parental attitudes about the learning environment of their children? If a school building is in poor condition, are parents concerned about the effect this could have upon their children. Do parents initiate any action to improve the physical learning environment? If the school building does influence parental attitudes, does a new school building create a more positive attitude towards the school system in parents?
- *The relationship between Parent Attitude and Student Attitude about their building.* This relationship basically asks about the influence parental attitudes about the school building influence student attitudes. A negative parental attitude about the school building could influence the attitude a student forms about the learning environment. Conversely, a positive parental attitude could influence a positive student attitude, which would be beneficial to the student.
- *The relationship between Faculty Attitude and Student Attitude about their building.* Is there a relationship between how a teacher feels about the school building and how students feel about the learning environment? Negative or positive attitudes on the part of the teacher may have an influence upon student attitudes, which might eventually influence student behavior and achievement.

Proposition IV: The attitudes students have about their surroundings permeates their feeling about the worth of the building in which they are housed, the community in which they live, and in turn influence their feelings about their own worth.

- *Research the possible influence school Building Conditions have upon Student Attitudes.* One study was conducted investigating the attitudes students have about their building (Earthman, 2008). Students in schools assessed as being in poor and good condition were asked to respond to a questionnaire. The results did show there was a difference in the attitudes expressed by students in poor and good buildings. The difference in attitudes was not significant and thus more research is needed to further explore this relationship.
- *The relationship between Student Attitude and Student Behavior.* The relationship between the attitudes students may have about their school building may influence their behavior. One would assume that if the building is in good condition the students would have a better attitude about their surroundings and would then respect their surroundings. Nevertheless Cash (1993) found that students in good schools had more discipline incidents than students in poor buildings. More data on this possible relationship are needed.

Proposition V: The resultant attitudes students have about the school building influences to a certain extent their achievement.

- *Research the possible influence student attitudes have about the school building in which they are enrolled and their academic performance.* There is a discernible relationship between the attitudes individuals have and their academic performance. Whether or not there is a relationship between the attitudes students have about their building and their academic performance is yet to be researched. This is indeed a productive area of research.

Proposition VI: As a result of the school building condition, students perform better because of building features and condition that assist in the learning process.

- *Conduct a statistical meta-analysis of extant research on the building condition and student achievement.* Conducting a statistical meta-analysis will provide additional hard data that could provide some insight into the possibilities that poor building conditions have a long term influence on student performance. Is there data that supports a significant statistical

difference between building condition and student achievement over a range of multiple studies?

- *Complete longitudinal studies of school building influence on Student Achievement.* Conducting longitudinal studies in the schools is almost impossible because of the movement of students from one grade to another. Yet studies that utilize the same school buildings that have not been renovated over a span of years might be a fit school building population to ascertain what the successive student bodies have done on achievement tests. A study that would measure academic performance of successive groups of students in the same building could provide some insight into the possibilities that poor building conditions have a long term influence on student performance. Is there a cumulative influence of poor building conditions on student's academic performance?
- *The relationship between Charter School buildings and Student Achievement.* Many charter schools are located in older school buildings that have been abandoned by the public schools as being inadequate to support a modern educational program. Do these building then influence the learning of students enrolled in the building?
- *Research teacher qualifications and School Building Condition.* One study was completed for this relationship (McLean, 2011). The researcher found that the quality of the teaching faculty were basically the same in high and low performing schools. Some researchers have criticized studies for not controlling for teacher quality. This study repudiates this criticism. Subsequent studies should be mounted to find further evidence of this relationship.

The theoretical model produced these propositions for further research. Again, the propositions follow the logical progression of the model from the decisions of the school authorities and financial ability of the school system in determining the condition of the school building to the eventual effect the school building conditions have upon student and teacher performance and attitudes. The presented taxonomy of research needs, through the propositions, serves as a guide in determining the needs for filling the gaps in

the research as it is related to Building Condition and Student and Teacher Performance and Attitude at Virginia Tech and other institutions.

Personal Reflections

The theoretical model, developed by Dr. Cash in 1993, allowed this and several other studies to be conducted at Virginia Tech. The model again theorizes how school buildings came into their current condition and what affect this has on those who occupy the building. The model allowed for several propositions to be developed, by Earthman and Lemasters in 2011, that can serve as a guide to future research endeavors. This study synthesized the works at one university to determine what the research findings have shared and what recommendations for future research have been stated. It is the hope of this author that this study will serve as a guiding document for future research endeavors, allowing the gaps in research to possibly be filled or allow current finding to be further validated. It is also the hope of this author that this study will be used as a succinct resource for the consolidated listings of the findings and recommendations from Virginia Tech as it relates to the theoretical mode.

The theoretical model has served researchers well for over 20 years. But as time passes and society changes new considerations must be made when looking at the relationships within the model. With the advancement of technology and social media, attitudes and performance of students and staff may be affected. Students now have near immediate access to a variety of information and knowledge that was once only found in books and lecture. Teachers have to change their styles as the learner continues to change with this advancement of technology. Therefore, it is necessary to factor technology as it relates to student and teacher performance and attitude.

The advancement of technology is not limited to student and teacher performance and attitude, but in the decisions, designs, and materials used in building educational facilities. Technology has advanced the quality and possible increased the cost of building materials. These advancements in technology will also influence how leadership determines the individual needs and designs for new building construction. In addition to decisions in material, leadership must also factor in building security.

Highlighted in the study by Walton in 2011, building security has become a greater factor when exploring the relationships between building condition and student and teacher performance and attitude. Leadership must factor in security and safety of students and staff when making decisions when it comes to school building construction and design.

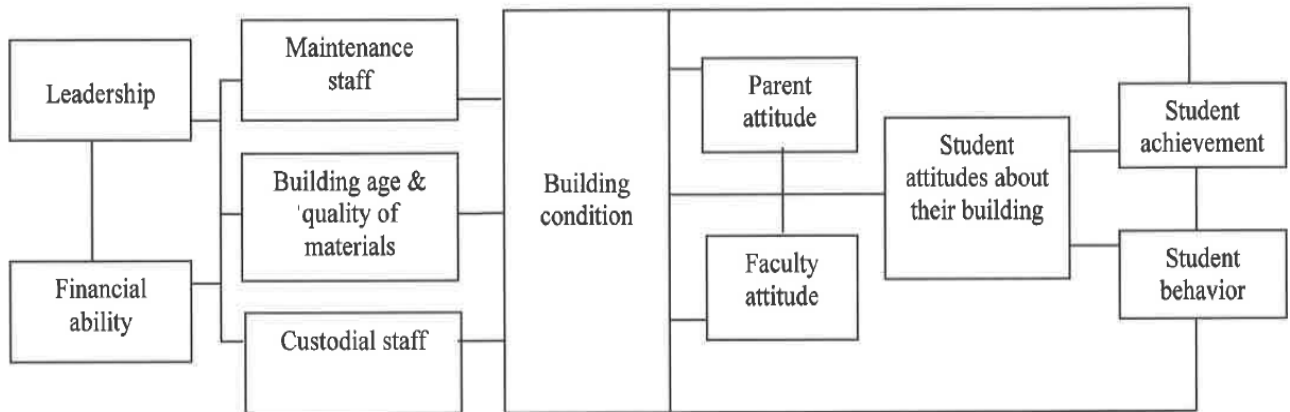
Again, the theoretical model has served researchers well over the past 20 years. None the less, as society changes and evolves we must continue to incorporate new or reoccurring factors as it relates to the relationships of building condition and teacher and student performance and attitudes.

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Appendix A

Dr. Carol Cash's theoretical model showing the relationship between student achievement and behavior and school building condition.



Appendix B

Possible Relationships from the Theoretical Model:

Leadership and Maintenance staff
Leadership and Building age and quality of materials
Leadership and Custodial staff
Financial Ability and Maintenance staff
Financial ability and Building age and quality of materials
Financial ability and Custodial staff
Maintenance staff and Building condition
Building age and quality of materials and Building condition
Custodial staff and Building condition
Building condition and Student achievement
Building condition and Parent attitude
Building condition and Student attitudes about their building
Building condition and Faculty attitude
Building condition and Student behavior
Parent attitude and Student attitudes about their building
Faculty attitude and Student attitudes about their building
Parent attitude and Faculty attitude
Student attitudes and Student achievement
Student attitudes and Student behavior
Student achievement and Student behavior

Appendix C

List of the Studies Reviewed

- Bailey, J. A. (2009). *A synthesis of studies pertaining to school building condition, student achievement, student behavior, and student attitude* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University. Blacksburg, VA.
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- Shifflett, Jr., D. W. (2009). *A study of teacher experience during a renovation project* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University. Blacksburg, VA.
- Thornton, J. C. (2006). *School building condition and student achievement of minority and economic challenged students in Virginia* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University. Blacksburg, VA.
- Walton, Roy (2011). *Physical designs for safe schools*. Unpublished doctoral dissertation. Virginia Polytechnic Institute and State University. Blacksburg, VA

Whitley, T. A. (2009). *The relationship between building expenditures and building conditions among select school divisions in the Commonwealth of Virginia* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.

Appendix D

List of Authors and Coding System

Bailey – B1

Brannon – B2

Bullock – B3

Cash – C1

Crook – C2

Earthman – E1

Earthman, Cash, and Van Berkum – ECV1

Earthman and Lemasters – EL1

Hines – H1

Lanham – L1

Leigh – L2

Lemasters – L3

Lemasters and Earthman – LE1

Mayo – M1

McLean - M2

O’Sullivan –S1

Shifflett –S2

Thornton – T1

Whitley - W1

Walton – W2

Appendix E

IRB Approval Letter



Office of Research Compliance
Institutional Review Board
2000 Kraft Drive, Suite 2000 (0497)
Blacksburg, VA 24060
540/231-4606 Fax 540/231-0959
email irb@vt.edu
website <http://www.irb.vt.edu>

MEMORANDUM

DATE: February 12, 2013
TO: Glen I Earthman, James Scott Peterson
FROM: Virginia Tech Institutional Review Board (FWA00000572, expires May 31, 2014)
PROTOCOL TITLE: Review of Research at Virginia Tech on the Relationship Between School Building Condition and Student and Teacher Performance and Attitudes
IRB NUMBER: 12-1013

Effective February 12, 2013, the Virginia Tech Institutional Review Board (IRB) Chair, David M Moore, approved the New Application request for the above-mentioned research protocol.

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

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

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

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

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

PROTOCOL INFORMATION:

Approved As: **Exempt, under 45 CFR 46.110 category(ies) 4**
Protocol Approval Date: **February 12, 2013**
Protocol Expiration Date: **N/A**
Continuing Review Due Date*: **N/A**

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

FEDERALLY FUNDED RESEARCH REQUIREMENTS:

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

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

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Date*	OSP Number	Sponsor	Grant Comparison Conducted?

* Date this proposal number was compared, assessed as not requiring comparison, or comparison information was revised.

If this IRB protocol is to cover any other grant proposals, please contact the IRB office (irbadmin@vt.edu) immediately.