

**The Influence of School Building Conditions on Students and Teachers:
A Theory-Based Research Program (1993-2011)**

Abstract

A theory-based research program is a dedicated effort to focus research studies on certain aspects of organizational life so that a coherent knowledge corpus can be developed. Such an effort also can add to and strengthen the theory under consideration. A focused research program is difficult to plan from the beginning. Even after the goal of the plan is agreed upon, developing the theoretical construct of the plan is painstaking work. Considerable input must be given to establishing the bounds of the theory to be explored. Implementation of such a program is equally difficult, again for several reasons. The first reason is the difficulty in enlisting more than one researcher to participate in such an effort. A theory-based research program requires a commitment of several individuals who agree with the basic theoretical constructs under investigation. Second, funding for such a program in the social sciences field is extremely difficult to attain because of the lack of funding sources. In addition, it is difficult to enlist university students to complete studies directly related to the theory under consideration. The theory-based program presented in this paper can be considered a paradigm, a model to investigate how school buildings influence their users. The paradigm consists of a series of relationships that explain how school authorities are responsible for the condition of the school building and how the condition of the school building influences faculty, administrators, parents, and students. Further, it explains how the condition of the building influences the attitudes and achievement of the students who attend school in the building. Theory in the field of educational administration is used to try to explain, in the absence of empirical evidence, how humans and organizations behave. The theoretical model used in this paradigm tries to explain human phenomena related to how the physical environment influences humans. The model explains how school buildings come to be in their current conditions and how the conditions then influence school staff, parents, and students.

For over 18 years research based upon a theoretical model to explain relationships between building condition and the health and productivity of the users has been promoted in the Commonwealth of Virginia. The systematic efforts of professors and students have resulted in a large quantity of valuable research produced from the model and presented here.

The purpose of this manuscript is to describe this cooperative research program that is theory-based and to illustrate the research efforts that have derived from the theoretical model used. The research described here is a result of individuals wanting to examine the possible relationships embodied in the theoretical model and is presented in an evolving chronological order from the first research effort to those 18 years later using the same model. The research resulting from the theoretical model is presented in this order, rather than organized or grouped

into separate themes or components, because the integrity of the theoretical model requires the recognition that there is a continuum of relationships from school leadership and financial ability influence upon building condition to the end result of subsequent influence of building condition on student and teacher health and productivity.

A theory-based research program is a dedicated effort to focus research studies on certain aspects of organizational life so that a coherent knowledge corpus can be developed. Such an effort also can add to and strengthen the theory under consideration. By repeated investigations into the possible relationships between the human effort and the work of the organization, theory can be developed and refined. It is also possible to explore, through a theory-based research program, new relationships that were heretofore unknown or unrecognized by researchers. A theory-based research program requires considerable diligence and effort on the part of the investigators to mount such an effort and to maintain the direction of research efforts once the program is in operation.

A focused research program is difficult to plan from the beginning. If one researcher intends to develop the plan and implement it, considerable thought must be given to developing the theoretical construct to be investigated. If several researchers are intent on working out a program, the task is even more difficult, because consensus must be attained on the goals of the program, area of investigation, and reporting of results. Because several researchers must agree to engage in the original planning effort with only a nebulous goal, similar research interests must be identified for those individuals who might participate in the plan.

Even after the goal of the plan is agreed upon, developing the theoretical construct of the plan requires painstaking attention to detail. Considerable input must be given to establish the bounds of the theory to be explored. Implementation of such a program is equally difficult, again for several reasons. The first reason is the difficulty in enlisting more than one researcher to participate in such an effort. A theory-based research program requires a commitment of several individuals who agree with the basic theoretical constructs under investigation.

The second reason is the extreme difficulty of attaining funding for such a program in the field of the social sciences because of the scarcity of funding sources. In addition, there is always difficulty in enlisting university students to complete studies or work on professor-funded studies that are directly related to the theory under consideration. In many situations, the funding of such a program rests upon the individual efforts of the researchers engaged in the program and the scant resources they may gain from their organization(s). In the vernacular, the research program in this area of study is usually carried out on the backs of individual researchers.

The theory-based program presented in this paper can be considered a paradigm, a model to investigate how school buildings influence their users. The model is also a series of relationships that explain how school authorities are responsible for the condition of the school building and how the condition of the school building influences faculty, administrators, parents, and students. Further, the paradigm explains how the condition of the building influences the attitudes and achievement of the students who attend school in the building.

Initial planning of the paradigm took place at an initial dissertation prospectus examination in which the student and professor proposed a research study dealing with the relationship between the condition of a school building and student achievement and behavior. Questions from the research committee related to how the research study would explain human activity in an organization and at the same time relate to the actual manner in which a school organization functioned. Thus, the goal of trying to explain all of the relationships involved in the research study arose from the questions of the committee. Planning of the theoretical model by the

student and professor followed an intuitive model of development in that questions were raised as to how the school building came to be in its current condition, the relationship between precedents of building condition, and possible influences the school building condition might have upon all users of the facility. From these questions, a theoretical model evolved, which described the relationships among all elements identified as a part of the process.

The use of the word *paradigm* has Kuhnian roots (Kuhn, 1962) in that the word often is used to mean a commonly held belief of people within a given discipline. A paradigm also can be thought of as an example or a model that can or should be followed, or even held up to be emulated. In educational jargon a paradigm is defined as not only a model to be followed but also a way of thinking about certain aspects of the educative process and even the organization itself. Thus, the educative process in the United States is a paradigm that is followed or used to educate children and youth. In more recent decades we have heard increasingly that the paradigm for education should be changed to accommodate new thought and philosophy. Educators oftentimes speak of changing the paradigm, meaning that educators should not think in the usual historical terms about how education takes place and students learn, but they should think in terms of a new definition of how education should take place and students beneficially learn.

Paradigms are useful in directing thought and effort regardless of the setting or environment. Paradigms can be thought of as being very small or rather large in scope, depending upon the subject matter or setting. The model or paradigm of research that is described in this paper is one of small effect, but one that is consistent in noting how researchers can produce knowledge about a very important aspect of how students learn. The model of research as presented is based upon theoretical constructs that may explain how educators, students, parents, administrators, and even buildings interact to influence student achievement. This paradigm of research is very complete in that it begins the explanation of how educators influence the condition of a building and then in turn how the building influences students, teachers, parents, and administrators. In this manner, the paradigm is complete and self-contained and, at the same time, based upon the theory we presently think exists in the public schools.

Theory-Based Modeling

Theory Use

Theory in the social sciences field is used to try to explain how humans work and act in organizations. Theory in educational administration, specifically, is used to explain how administrators and school organizations work and act. Theory is considered a system of assumptions about certain phenomena. Theory is based upon repeated observations of human activity. These observations are then translated into a series of statements or abstractions that seek to explain how humans work or organizations function. Hatch and Cunliffe (2006) referred to this phenomenon as an explanation rooted in the specifications of the relationship between a set of concepts. These statements or concepts can then be cast into a system of propositions about human behavior. Theorizing is one of the first steps in developing principles and laws of human nature and activity. The theory developed through observation needs to be tested to find out if predictions can be made about the nature of organizations or how humans within the

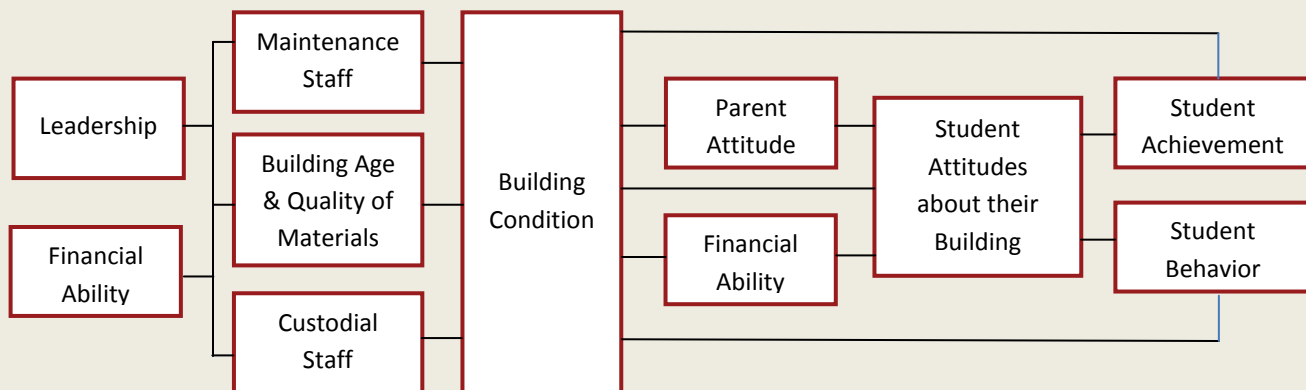
organization act. In other words theory tries to explain or describe a part of reality in our experiences (Hatch & Cunliffe, 2006).

Theoretical statements can be developed into a set of theories or explanations that can be called a theoretical construct. Theoretical constructs are useful in that they explain how a number of assumptions are interrelated. Theoretical models are derived from theoretical constructs and used to provide a comprehensive explanation of a series of assumptions. These are graphic explanations of the theory. From such models a series of explanatory behavior can be used for testing.

The theoretical model presented here can be used to explain human phenomena that are related to how the physical environment can influence humans (Figure 1). This model explains how buildings come to be in their current condition. The model further suggests that student behavior also is related to building condition; further, the building condition influences the attitudes students have about their environment.

Figure 1

Model Showing the Relationship between Student Achievement and Behavior and School Building Condition



Theoretical Model

The model can generate a series of propositions to be tested to determine the validity of the theory. All six of these propositions can be tested individually to determine their validity in describing behavior, which is the essence of theorizing. All of the propositions are part of a theoretical construct that endeavors to explain human behavior in an organization and the possible influence buildings have on individuals.

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 as well as the quality of buildings that are constructed.

The leadership of the school system includes the superintendent, central office administrators, principals, and the school board. These individuals and groups provide the kind of leadership in the school system that will determine eventually the condition of the school buildings. The financial ability of the school system to support education in general is limited by

the resources available, which are the taxes that can be raised locally plus available state assistance. Local school system leadership and financial ability are the two factors that determine how large the maintenance and operations budget and staff are and how much funding is devoted to the care and upkeep of facilities. The demands of the local leadership to keep the facilities clean and in good repair contribute greatly to determining the condition of the school buildings. The interplay between the leadership and financial ability determines how well the maintenance and operations staff functions in keeping the school buildings clean and in a good state of repair. The school board's reduction of the maintenance and operations portion of the operating budget during the annual budget approval process signals to everyone that the school board is more interested in other parts of the organization than in the wellbeing of the school buildings. Conversely, satisfaction of the requests of the maintenance and operations departments conveys a message that the school board believes the school buildings are important (Earthman & Lemasters, 2004).

The condition of the building is also the result of the kind of building material used in the construction of the structure, as well as the age of the facility. School leaders make decisions regarding the amount of funds that will be used in the construction of the school building. Some of these decisions can result in less-than-first-quality materials being used in the building, if the school board is interested in keeping initial construction costs down. Inferior building material does not hold up as well as higher quality material, and as a result the school building deteriorates at a faster rate. In addition, decisions regarding the use of older buildings for housing students can have a negative influence upon student and teacher health and productivity.

The school leadership and the decisions it makes, plus the financial ability of the school system, help to determine the condition of the building used to educate students. These decisions relate to not only how well the building is constructed, but also to how the building is utilized for this purpose and how long the building will be used. Some of the questions these relationships raise are the following:

- What is the relationship between the leadership of the school system and the condition of the school buildings under their charge?
- What factors enter into decisions regarding the amount of funds available for maintenance of school buildings?
- What political factors, if any, enter into maintenance decisions?
- What is the relationship between wealth of the school division and the condition of the school buildings?
- Is there a relationship between the amount of funds expended on upkeep of buildings and the condition of the school buildings?
- Is there a relationship between community support and the condition of school buildings?
- Will school buildings be in better condition if more aggressive leadership on the part of the superintendent is employed in the school system?
- Do the principals have a part in how the buildings are maintained?
- How can leaders project their image of how the schools should look?
- How much of the condition of school buildings can be attributed to effective or ineffective leadership?

Proposition II. The second proposition deals with the relationships among size and effectiveness of the maintenance and operations staff, the age of the building, and the quality of building material used in the school.

All of these factors that have an influence on the condition of the school building can be tested. Obviously, a maintenance and operations department that is fully staffed and budgeted and that understands the desire of the school leadership in having a well-kept building will result in a building that works well. Conversely, a maintenance and operations department working with a reduced budget and staff must sacrifice the completion of some necessary maintenance projects, thereby contributing to the eventual deterioration of the building. The condition of the school building results from not only the efforts of the maintenance and operations staff but also the efforts of the leadership to require school buildings to be in excellent shape. Leaders of the school system must require and demonstrate that they desire the school buildings of the school system to be in the best condition and to have those building components or features that constitute a modern school facility.

The age of the structure is also a contributing factor to the condition of the building. Research studies such as the work of Bowers and Burkett (1987), Chan (1980), Phillips (1997), O'Neill (2000), and others have consistently found that the age of the structure is a negative factor in explaining student achievement. This relationship has been tested repeatedly with positive findings. It is not necessarily the age of the building, however, as much as the lack of components in the building that are essential for good student learning. Buildings that are 50 to 100 years old usually do not have the components necessary for a modern educational program, and as a result the building works against student efforts to learn. Even when such older buildings have some of the necessary components, such as air-conditioning, better lighting, acoustical control, and day-lighting, the installation of such components is not as satisfactory as in newer buildings and often do not help the student in the learning process.

Finally, the quality of the materials used in construction of the building and the quality of workmanship employed help to determine the eventual condition of the school building. Decisions by school authorities to control the initial costs of buildings often determine the quality of building material. Building material that is not of the finest grade can result in rapid deterioration of the building. Poor workmanship in the construction of the building also can be a contributing factor in the eventual condition of the building.

All of these relationships can be tested through research studies that are crafted around sound principles. The age factor has been tested through research previously cited. The researchers of these studies used the age of the building as a surrogate for building condition and in this manner tested the influence of building age on student achievement. In every study, the researchers found that the performance of students in old buildings was below that of students in new buildings. Although such studies did not directly test whether age of building influenced the eventual building condition, the researchers did identify age as a surrogate for condition of the building.

These relationships elicit several questions that could produce data to help explain the importance of these influences:

- Does the size of the maintenance staff have any relationship to the condition of school buildings?
- Does the effectiveness of the operations staff result in school buildings in better shape?

- Does the age of the building directly contribute to the condition of the school building?
- Are buildings rated as in unsatisfactory condition the result of poor building materials?

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

Faculty members are directly affected by their immediate surroundings and working conditions. If they are in a facility that is rundown and lacking in certain features such as thermal control of the environment, adequate lighting and windows, modern science equipment, and controlled acoustical environment, among other features, their attitude will not be as positive as that of faculty members in better kept and modern buildings. In addition, parents will have a feeling about the building in which their child attends school. Through visits, they will conclude that the administration of the school system either cares or does not care about the condition of the buildings in which students are housed. If the building is not in good condition, the parents and community will have a negative feeling about the building. This feeling or attitude will, in turn, be communicated to their children.

The attitudes of the faculty and parents will have a bearing upon the feelings students themselves have about the building. If the students' feelings are negative, the attitudes of the parents and faculty will reinforce that attitude. The students themselves will form an opinion about how the school system feels about them as learners. All of these factors will generate an attitude on the part of the students about their worth and value in society. They will view their surroundings as a judgment the community makes about the value of education.

The following questions relate to stakeholders' attitudes about school conditions:

- Do the attitudes of parents regarding the condition of the building influence the attitudes students hold about the condition of the school?
- Do faculty and administrators influence student attitudes by their behavior and attitudes towards the school building?
- How can the attitudes of students regarding the school building be measured?
- Does the condition of the school building influence the attitudes of students?

Proposition IV. The attitudes students have about their surroundings permeate their feelings about the worth of the building in which they are housed and in turn influence their feelings about their own worth.

The attitudes that are generated by the condition of the building are reflected in how students feel about the building itself. Students take care of buildings and equipment that are in good condition. Students feel good about their school when it looks nice and is well maintained. Conversely, students are not apt to take good care of facilities that are in poor condition.

The following questions are reflective of these issues:

- Do students in poor buildings have lower feelings of self-worth than students in better buildings?
- Is there a relationship between the condition of school buildings and student attitudes?

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

The following questions are of interest in this regard:

- Do students who feel good about themselves and about their surroundings perform better on all measures of performance than students who do not?
- How do students feel about the school building in which they attend school?
- Can these attitudes be compared with building condition?
- How much does attitude influence student performance?
- Does the lack of safety of a school building affect student attitudes, performance, or both?

Proposition VI. In school buildings of good condition, students perform better because of building features and condition that assist in the learning process.

Students perform better when the proper equipment is available to them, the environment is conducive to efficient bodily functioning, and the building is clean and an inviting place to live. Student performance can be enhanced if the building has those components that research has demonstrated to be necessary for efficient and effective learning. These components as identified by Earthman (2004) are good thermal, acoustical, and lighting control. Further, the building should have student-friendly colors in the classrooms as well as functional furniture and equipment in good condition. Finally, there should be sufficient space for the student population, and the building should be clean and well maintained.

Proposition VI elicits the following questions:

- Is there a relationship between building condition and student performance?
- Is there a relationship between building condition and student behavior?
- Is there a relationship between school population density and student performance?
- What is the extent of a possible relationship between building condition and student performance?

The research generated from the various theoretical propositions explicated above serve as a corpus of research on a single topic, but with many possible relationships. The description of the research flowing from the theoretical model is presented more on an evolving chronological basis than on themes or concepts because of the integrity of the model. The presentation also gives the reader an opportunity to see the development of a research program based upon theory.

Theory-Based Research

Initial Research

The first study arising from the aforementioned theoretical model was completed by Cash (1993), who studied high school students in satisfactory and unsatisfactory school buildings in Virginia. Her population consisted of small, rural high schools, each of which had fewer than 100 students graduating as seniors. These schools comprised 190 buildings. Basically, Cash

(1993) was investigating the relationship between the condition of a school building and student achievement and behavior.

An instrument titled the Commonwealth Assessment of Physical Environments (CAPE) was developed to assess the condition of a school building. The items for the CAPE were derived from existing research that examined and found a positive relationship between certain building components and student achievement. The major items of the instrument dealt with thermal environment, lighting, acoustics, color of the walls, condition of the classroom furniture and equipment, condition of the science laboratories, and the presence of graffiti. Other items were added to provide further information about the condition of the building, such as the presence or absence of windows in the classroom and the type of floor covering. All of the items on the CAPE addressed the relationship between building condition and student achievement. Use of this instrument is an important aspect of assessing school building condition, because subsequent researchers have used other types of instruments to assess buildings with results that were neither consistent with nor as robust as the findings of Cash and others. Being able to properly assess the condition of a school building in terms of its relationship to student achievement is very important. Improperly assessing the building condition will skew the results of the comparison with student scores.

Cash (1993) assessed the condition of 143 high school buildings; each building was assigned a score representing its condition. She selected schools scoring in the bottom and top quartiles to define her population of students in poor or good buildings. She then compared the mean scaled scores on the Tests of Achievement and Proficiency (TAP) for the 11th grade students in the two building groups.

Cash (1993) compared the achievement test results of students in buildings rated as being in poor condition to those of students in buildings with good condition ratings. She found a difference between the scores of students in poor buildings and students in good buildings on several subtests of the TAP. Significant differences of four percentile points were found in Reading Comprehension, Math Applications, and the Composite Score between students in poorly rated buildings and those in buildings rated as being in good condition. Differences of five percentile points were found in Science and the Total Composite Score. Differences ranged around two to three percentile points on other subtests. These results compared favorably to previous research on the same subject (Edwards, 1991).

In an effort to extend the research, the Cash (1993) study was replicated by Earthman, Cash, and Van Berkum (1996). These researchers studied the high schools in the State of North Dakota. The students in these schools were identified as being good subjects because the state scored highly on the SAT, behind only Japan in scores. The name of the CAPE was changed to State Assessment of Facilities in Education (SAFE), but the content remained the same. Building assessments were completed by the principals of the schools. Data from the North Dakota State Department of Education on the California Test of Basic Skills for 11th grade students were used to compare achievement scores. Again, achievement test scores of students in the two building types were compared. The researchers found significant differences at the .05 level of confidence in scores between students in good buildings and students in buildings rated as being poor; these differences were as high as nine percentile points in Spelling and seven percentile points in Reading Vocabulary and Science (Earthman et al., 1996). The differences were similar to those found by Edwards (1991) and Cash (1993) in previous research. The consistent differences these researchers found were noted in the subtests of Reading, Math Applications, Science, and Total Composite Scores.

Hines (1996) replicated the Cash study using large urban high schools in Virginia. He used the same basic methodology as used in the previous research by comparing achievement test scores of students in buildings rated poor and those rated good by their principals. The Iowa Tests of Basic Skills scores were used in the comparison, and the CAPE was used to assess the buildings. The differences in achievement scores that Hines (1996) found exceeded those found by Edwards (1991), Cash (1993), and Earthman et al. (1996). On some subtests, Hines (1996) found the differences to be as great as 17 percentile points, far exceeding the nine percentile points difference found by previous researchers. The substantial differences included 17 percentile points in Math Applications, 15 percentile points in Reading Comprehension, and 14 percentile points in Total Composite Scores.

Lanham (1999) investigated the possible relationship between student achievement and behavior and condition of the school building attended at the elementary level. For comparison purposes, he used a modification of the CAPE to assess the condition of elementary school buildings and test scores on the Virginia Standards of Learning tests as a measure of student achievement. His participants were a random sample of all elementary school buildings in Virginia. Lanham (1999) used a five-step multiple regression analysis to determine which variable carried the most weight. He found that free and reduced-price lunch participation was the first significant variable. This variable was followed by air conditioning, which was significant in three of the five analyses. He found other building factors to be significant, as well, such as ceiling type, room structure, floor type, and site size. These findings were consistent with the findings of previous researchers, even though Lanham (1999) used different statistical methods in his analysis.

All of the researchers previously cited found significant differences between the performance of students in substandard buildings and those in standard buildings.

Research Compilation

Lemasters (1997) conducted a review of research as a follow-up of previous reviews. Earlier compilations of research findings on school facilities had been completed by Weinstein (1979) and McGuffey (1982). Her review was of research about the relationship of school building condition to student achievement and behavior (Lemasters, 1997).

Her research project included studies of the relationship between 1982 and 1997 (Lemasters, 1997). The researcher reviewed a total of 157 separate potential studies and selected for analysis a total of 57 separate studies, all dealing with the topic of building condition and student achievement. Lemasters' (1997) conclusion was that students in buildings rated as being in satisfactory condition outperformed students in buildings rated as being in unsatisfactory condition. This compilation of research findings served to provide information to other researchers working in the same general area of concern.

As a follow-up of previous research reviews, a compilation of relevant studies was completed by Bailey (2009) to incorporate the results into a comprehensive form. His work was the latest of several reviews of research and covered the decade 1997 to 2007. He identified 127 potential studies for review, but only 57 were directly relevant to the topic of the relationship between school building condition and student and teacher health and productivity. These studies were analyzed according to a set schema and the results reported. He was able to state that the sum of the research indicated the existence of a positive relationship between condition of the school and health and performance of students and teachers. One interesting finding

Bailey (2009) identified that researchers utilizing a building rating instrument designed to properly evaluate those building conditions directly related to student achievement found higher differences in student test scores between the two groups of students than did researchers in studies involving the use of a maintenance-type building evaluation.

Bailey's (2009) research supported the research of Lemasters (1997) and others. The four aforementioned research review studies, Weinstein (1979), McGuffey (1982), Lemasters (1997), and Bailey (2009), are very important works because the relevant research on this topic has been compiled systematically and presented in a utilitarian form for other researchers to use. The findings of the four researchers reflect a trail of evidence that supports the concept that there is a measurable relationship between the condition of a school building and the health and productivity of students and teachers. The evidence of this relationship has accelerated for each research review that has been completed. Some studies have been identified that could not report any relationship between building condition and student achievement. Although not proven, it is surmised that methodological errors in these studies and the use of an improper building evaluative instrument might be the reasons for not finding any relationship.

Extension of Research

Brannon (2000) extended the research to investigate the relationship between the precursors of building condition and building condition itself. The first part of the theoretical model explains the possible relationship between the leadership and the financial ability of the school system in eventually determining the condition of the school buildings for which the school leadership is responsible. Brannon (2000) asked the principals, central office staff, superintendent, and school board members to assess the condition of the school buildings within their school division. Brannon (2000) then assessed the high school buildings using the CAPE instrument. His findings indicated that the principals had a better knowledge of the condition of the school buildings than any of the other groups. This research validated principals' use of the CAPE to properly assess the condition of their buildings, which had occurred in previous research and would occur in subsequent research efforts.

Another extension of research was the study of the relationship between air-conditioned classrooms and student achievement. Lemasters and Earthman (2003) identified 10 school buildings that had either air-conditioned or non air-conditioned classrooms. They compared the academic achievement of students in the two types of classrooms. One of the purposes of the research was to ascertain if the classroom conditions actually influenced their decisions about remaining in the school. Additionally, the researchers investigated teacher attitudes about their own wellbeing and how the classroom influenced student learning. The findings of these researchers indicated that although there was a significant difference in attitudes of teachers in good and poor school buildings, the condition of even the poor classrooms was not enough to cause the teachers to consider moving from the school or leaving the profession. The teachers did, however, indicate they thought the condition of the classroom did influence student learning. Teachers in poor buildings thought the condition of the classroom had a negative influence upon students learning. Teachers in these buildings also thought the classroom condition caused them some health related problems (Lemasters & Earthman, 2003).

Subsequent Research

Crook (2006) used a larger population than had previous researchers to investigate the relationship between building condition and student performance. Both Cash (1993) and Hines (1996) used different segments of the total high school building population of their respective states as their populations. Cash (1993) studied rural high schools and Hines (1996) studied urban high schools. Crook (2006) involved the entire population of 231 high school buildings in Virginia for his study. The percentage of students passing the Standards of Learning tests was used as a measure of student achievement to compare the two student bodies in poor and good buildings, respectively. The correlations he found were significant for the subtests of Math Concepts and Math Application. He reasoned that although his findings were not as extensive as those of previous researchers, they did corroborate the findings of previous research studies because the trends in differences were positive.

Thornton (2006) investigated the relationship between school building condition and the achievement of minority and economically disadvantaged students. He used the same population of high schools identified by Crook (2006) as buildings in poor condition and buildings in good condition. The mean scaled score for students on the Virginia Standards of Learning tests served as his measure of comparison between the two groups of high school students. He found that building condition had minimal (5 of 10 subtests significantly different) influence on the achievement of economically disadvantaged students. This finding does not coincide with standard belief that economic status of the family of the student influences learning. Thornton (2006) did find, however, significant differences in student achievement scores on 7 of 10 subtests between minority students in substandard and minority students in standard buildings. Again, this is unusual because there is no research basis for indicating that racial background has anything to do with student learning. Although he did find significant differences in achievement test scores between students in poor buildings and those in good buildings, which supported previous research, his findings are unusual in that they do not correspond with common knowledge about demographic influences on student learning. His findings might well indicate, however, that buildings in poor condition have a greater influence on minority students than they do on the general population of students.

O'Sullivan (2006) replicated the Cash (1993) study with high schools in Pennsylvania. He used 251 randomly selected high school buildings as his building population. The student achievement results of the Pennsylvania System of School Assessment (PSSA) tests were used to make the comparison between the student population in substandard and students in standard buildings. O'Sullivan (2006) concluded that there was a significant relationship between student academic achievement and schools that had auxiliary buildings adjacent to the school. He further found a significant difference between student academic scores when school buildings had graffiti on exterior walls or had recently painted interior classroom walls. The increase in overall test performance was noted to be 55 points higher for students in schools without graffiti than for students in schools with graffiti. The last conclusion was that there was a significant difference between student academic achievement scores in schools that had undergone renovations or additions and student scores in schools that had not.

Ruszala (2008) at The George Washington University (GW) used the theoretical model to mount a correlation study to investigate the relationship between condition of school facilities and teacher satisfaction in the metropolitan school divisions of Virginia. Two survey instruments were utilized to answer her research questions. The CAPE, referenced earlier, was

used to produce an accurate representation of the physical environment for school buildings. The Teacher Opinionnaire of Physical Environments (TOPE), designed by Ruszala (2006) to measure teacher satisfaction in relationship to specific school building conditions, was the second survey instrument, which was used to measure teacher attitudes. Using the Pearson correlation coefficient, Ruszala (2008) found moderate positive correlations between the CAPE and TOPE survey instruments results for age, paint, and light; a low positive correlation was found for thermal conditions.

Bullock (2007) replicated the Cash (1993) study in Virginia middle schools. This school level had not been explored in systematic fashion in studies dealing with the relationship between school building condition and student achievement prior to Bullock's (2007) study. He included the students in all of the middle schools in Virginia as his subjects. He also used the CAPE to assess the school buildings and the percentage of students passing the Standards of Learning tests as a dependent measure of student achievement. His findings were consistent with previous studies in finding a positive relationship between school building condition and student achievement.

Student attitudes toward their school building condition and their subsequent academic achievement were investigated by Earthman (2008) in an effort to ascertain a possible relationship between these the variables. A significant difference was found in the attitudes of students in satisfactory school buildings compared to the attitudes of students in unsatisfactory buildings. Students in school buildings rated by principals as being in unsatisfactory condition expressed more negative attitudes than did students in satisfactory school buildings. The difference in attitude responses was significant at the .05 level of significance. A comparison of the academic achievement of the two groups of students indicated a significant difference in English scores only. Comparison of student scores in 10 other subject areas were not significant but did show a strong trend toward differences, thereby indicating that, perhaps, with a larger student population, differences might be more pronounced. This research supported the theoretical model, which purported that the condition of the building would influence student attitudes and subsequent academic achievement.

In 2009, Taylor from the George Washington University investigated whether or not a relationship existed between the condition of school facilities in Washington, DC Public Schools and reading proficiency, mathematics proficiency, daily attendance rate, and truancy rate. His findings supported the tenets of the research in this paper. Using Spearman Rho correlation coefficients he found that students in schools with acceptable facility condition ratings achieved higher proficiencies in math, achieved higher proficiencies in reading, exhibited higher rates of attendance, and exhibited lower rates of truancy compared to students in schools with unacceptable ratings (Taylor, 2009).

Whitley (2009) investigated the possible relationship between expenditures of school divisions on maintenance and operations and facilities sections of local budgets. He compared the expenditures in these budget categories for school divisions that had either buildings in satisfactory condition or buildings in unsatisfactory conditions. He found that school divisions with buildings in satisfactory condition spent more totally and more on a per-pupil basis than did school divisions with buildings in unsatisfactory condition. His findings indicate that school divisions with satisfactory buildings spend more for maintenance and operations expenditures than do school divisions with unsatisfactory buildings (Whitley, 2009). Yet, when the expenditures were converted to a per-pupil basis, the school divisions with unsatisfactory buildings had higher per-pupil expenditures. This was the case because the school divisions with

satisfactory buildings had growing student populations and the other school divisions had declining populations. This research explored that portion of the theoretical model dealing with the model's proposed relationship between financial ability of the school division and condition of the school building (Whitley, 2009).

The renovation of a school building inevitably causes problems for both students and teachers while the process is ongoing. This phenomenon was studied by Shifflett (2009) in two high schools that had undergone renovation in the same school division. The researcher found that teachers were indeed inconvenienced while the renovation of the building took place, but after they moved into the renovated building their attitudes were much improved. These findings were similar to those Dawson and Parker (1998) and Maxwell (1999) found in their studies of the renovation process. The findings of Shifflett (2009) must be accepted with some caution because of the large number of teachers who responded in the neutral column for the survey questions. Apparently, a large number of teachers either did not remember or experience the renovation process or they distanced themselves from it in their responses.

Earthman and Lemasters (2009) investigated teacher perceptions of the conditions of their classrooms and how the condition of the building influenced their work. The population for this study consisted of the teachers in schools that were identified in the Crook (2006) study. Crook (2006) identified 11 high schools in which the respective principals stated the buildings were unsatisfactory. These buildings served as the population of their study and were matched with a like number of schools in which the principals rated their respective schools as being in satisfactory condition. The attitudes of the teachers in these two groups of school buildings were compared through the use of an attitudinal scale developed for the project: the My Classroom Appraisal Protocol© (Earthman, 2006) developed by the researchers. There had been other studies concerning teachers' perceptions about their classrooms, but this study was one of the first to compare the perceptions of teachers in satisfactory buildings and those in unsatisfactory school buildings. The findings of these researchers corroborated the findings of previous researchers. Some of the teachers who participated in the study were located in the rural part of the state, a fact that might have influenced some of the findings, because the teachers in this study reported they would not consider moving to another school or quitting the teaching profession (Earthman & Lemasters, 2009). This finding is in contrast with some of the other studies that investigated teacher perceptions of their classrooms. The low response rate to the survey also might have influenced the findings.

Bishop (2009) of The George Washington University (GW) utilized independently derived research questions to conduct a qualitative study that suggested achievement, attitude, and behavior are improved when stakeholders are moved into new school facilities. He included in his study three recently opened high schools in Virginia. Although the data were triangulated from various sources, his teacher focus groups supported the previous research in this document. Teachers in the new buildings concurred with the findings of improved student behaviors, improved staff behaviors, and a positive impact on student achievement (Bishop, 2009).

Harrison (2009), also at GW, conducted a study of school building conditions and student achievement in Virginia schools. The relationship was approached through the premise of the growing body of research that connected equal access to clean, safe, and educationally appropriate facilities (Oakes, 2002) to equity for all children, such as that proposed by the Elementary and Secondary Education Act of 1965 and renewed by the No Child Left Behind Act of 2001 (USDE, 2003). The use of adequate building condition as a resource for ensuring optimal student achievement was investigated, particularly in high-poverty, low-achieving

schools in Virginia. The role of the principals of high-poverty, low-performing schools was examined through research concerning the impact of accountability and effectiveness on their perceptions of essential conditions for optimal student achievement. Harrison (2009) found that all principals did not equate the importance of building condition to eight of the nine essential elements of school improvement. Further, principals in above-standard buildings reported that building condition did not affect their ability to engage in any of the seven effective schools practices, whereas principals in below-standard buildings reported that building condition did affect implementation of these practices. The principal's perception of the condition of the building influences how the principal perceives any possible influence the building may have upon school practices.

Research in the Making

Researchers continue to examine and expand the boundaries of the theoretical model. Listed in this document are some of the researchers and their research topics that are progressing in the Commonwealth of Virginia. Researchers in other states and at other universities are conducting studies using the same basic methodology and building assessment instrument that were used in the original Cash (1993) study.

Barry Hollandsworth, a student at Virginia Tech, is currently investigating student attitudes toward buildings in various conditions. There have been a limited number of previous research projects measuring student attitudes in satisfactory and unsatisfactory buildings at the elementary school level, but Hollandsworth's study will investigate the possible relationship between attitudes at the high school level. The instrument Student School Building Attitude Scale© (Earthman, 2007) was developed expressly for high school students with a level of language commensurate to those grades. This instrument will be used to measure attitudes of students in both satisfactory- and unsatisfactory-rated school buildings.

Paul McLean at Virginia Tech is investigating the relationship between condition of the school building and selected student and teacher demographic factors. The researcher will identify high- and low-performing schools as measured by annual yearly progress determined by the Virginia Department of Education. Possible differences in building condition, teacher quality, and student attendance will be measured and compared. This study should shed some light on the differences between these demographic factors of teachers and students in good buildings and those in poor buildings. One of the limitations of the previous research cited in this paper is control of teacher quality. McLean may be able to produce some results that help explain some of the features of this limitation of the quality of the faculty or at least shed some light on the measurement of the quality of faculty.

Several student researchers are currently initiating studies to investigate the knowledge level of principals regarding the relationship between building condition and student achievement. It is reasoned that those principals who are knowledgeable about research findings will then be able to translate that knowledge into action in securing resources to keep their respective buildings in good condition. Another student researcher is organizing a study to determine if there is a difference in perceptions between architects and principals about the importance of selected safety designs in school buildings. This researcher reasons that there may be differences of opinion between the user and the designer of a building regarding design features of schools that promote or hinder student safety. If the principal of a school has concerns about the influence of certain design features upon student safety, the designer of the

building should try to eliminate these features when designing a new building. The study will ascertain if there are differences between principals and architects in perceptions of the importance of design features. Finally, another student at GW is conducting a study of the personal constructs related to how teachers, students, parents, and the community make meaning of a regional alternative day school facility that is 87 years old.

What Is Known About Our Research?

1. To date, the research on the subject of the relationship between building condition and student achievement and behavior that has been cited here has been highly focused upon the various relationships as shown in the theoretical model. The results of these studies have been encouraging and have demonstrated how a concerted effort to investigate identified relationships between the condition of the school building and student and teacher productivity can provide very useful data. The significant differences between the scores of students in unsatisfactory buildings and students in satisfactory buildings have been found to measure from 2 to 17 percentile points. These differences represent findings for one year. Because of changing student populations, it has not been possible to measure the influence of poor school buildings upon students year after year. Nevertheless, such differences in scores are very important and statistically significant.

2. Studies did produce results showing a positive relationship between building condition and student performance. The results in most cases were not large; nevertheless, it is significant that any results were found. These results bode well for further research and the need for extended research efforts.

3. The most positive results have been noted for the subject areas of mathematics and science. Students in poor-condition buildings scored lower in these areas than did students in buildings in good condition.

4. The condition of the school building does influence the attitudes students have about their schooling. Although the evidence is small, a difference in responses to an attitude scale was found between students in poor buildings and those in good buildings.

5. The most productive research studies have used an instrument based upon research findings to evaluate school buildings in contrast to some studies that used maintenance-needs evaluative instruments.

6. The condition of the classroom does influence the attitudes of teachers. Teachers in poor buildings have a more negative attitude than do teachers in good buildings.

7. Researchers who use maintenance-related evaluation instruments to determine the condition of a building in investigating the relationship between school building condition and student performance have not been able to consistently find differences in student scores.

These latter assessment instruments evaluate numerous building components not directly related to student achievement. These components then have equal weight in the overall scoring with the weight of important components such as air conditioning, lighting, acoustics, proper furniture, modern equipment, and safety features. This uneven approach to evaluating the condition of a school building undoubtedly produces results that can be considered skeptical.

Research Limitations

There are limitations to the research that has been completed. The most common limitation is the inability to control all of the variables associated with student and teacher performance. The quality of the teachers, the effectiveness and relevance of the curricular materials, as well as other factors related to the school experience are extremely important to student learning and yet are difficult to control in a research study. These variables are usually under regulation of the school; yet control of these variables is extremely difficult. In the matter of measuring teacher quality, most of the measures researchers have identified are subjective and prone to error. The degree of influence the parents, home, and community have upon students is also difficult to measure and verify. It is well known that these variables control a great deal of the variance associated with student learning, yet researchers have limited means to control for the influence of these variables. The measures available to a researcher to control these variables are at best associational and not precise. The most common measure for controlling for the socioeconomic status of students is the percentage of students participating in the federal government free and reduced-price lunch program. Even though this measure is used extensively by researchers, this measure reflects a great deal of error, especially at the secondary school level. That is because the typical high school student does not participate in the program as fully as possible. There are difficulties in trying to control for all of the confounding variables associated with student and teacher performance.

Research in public schools is becoming much more difficult to conduct each year. The requirement to protect students, teachers, and others associated with the schools is very important and yet that effort, as justified as it might be, is exactly what prevents researchers from completing certain studies. Research using students as subjects must pass many levels of consent and approval within the organization before the research can begin, and even then the safeguards of confidentiality require that the researcher be extremely careful in gathering data. Many school systems simply refuse to entertain research requests because of the possible interruption in class activities or because of the frequency of requests. Even the cooperation of departments of education in various states is not necessarily an assurance that researchers will have access to needed data. Obtaining the cooperation of the local teachers' union, as did Buckley, Schneider, and Shang (2004), has helped, in some cases, to reach individual teachers to gain responses. Nevertheless, researchers will need to work in a sensitive, diligent, and persistent manner with public school authorities to get permission to complete a study.

The March Goes On: Research Needs

There is a great deal of research in the area of the relationship between building condition and student and teacher performance and health. Yet there is a need for further research. The theoretical model that has driven the aforementioned research has not been fully explored. Studies need to be mounted successively with regard to all the relationships identified in the theory model. In addition to those relationships that have been initially investigated, there are some very exciting areas that require attention. Some of the major areas that need new research efforts are noted in the following paragraphs.

The relationship between fiscal capacity of local school systems and the condition of school buildings needs to be further studied. Although studies of production function have not demonstrated overwhelmingly any significant relationship between funds spent and measurable

outcomes, there has been some work in Great Britain suggesting that money spent on building maintenance does have a relationship to student achievement (PricewaterhouseCoopers, 2001). The relationship between the school leadership and financial ability of the school system to maintain good school buildings needs further exploration because it represents the point at which the condition of the school building is normally determined. More research using sophisticated measures of leadership and financial effort is needed in this area. The amount of money a school system spends to keep the building in good shape may have a subsequent relationship to student attitudes and achievement, and this needs more attention.

Further investigations of the possible relationship between school building condition and student attitudes using the Student School Building Attitude Scale© (Earthman, 2007) are needed to expand our knowledge of how the physical environment influences student attitudes. This endeavor should be accompanied by research efforts to investigate the possible relationship between student attitudes and achievement and behavior.

The influence of the physical environment, as represented by the classroom, upon the performance and health of the teacher is still rather virgin territory that needs attention because of the possible stress placed upon teachers. Teachers are being held more accountable for the progress of students, and the influence of the building upon the performance of a teacher, as well as the student, should be further explored. Some enlightening evidence has been shed upon this relationship by Buckley et al. (2004). Their findings indicate that buildings in poor condition can so influence teachers that there is a high rate of absenteeism and a foreboding loss of teachers to the profession. These findings are startling and discouraging at the same time. Additional research regarding the influence of the building upon teacher attitudes and health is required to validate these findings.

There have been sufficient studies not only in Virginia but also in several other states and localities, using the same basic methodology and the same instrument to assess the condition of a school building, that a meta-analysis could be completed. A meta-analysis would provide considerable insight into the possible relationship between building condition and student achievement that individual studies cannot. Such a study should have a high priority for researchers interested in this area of investigation because of the potential for solidifying the findings of previous studies.

Three rather important instruments have been developed and used in the corpus of research discussed in this paper. All of these instruments should be further validated and their reliability further established. The Commonwealth Assessment of Physical Environments© has successfully been used to evaluate the condition of school buildings. The CAPE has been and is currently being used in research studies in various states in this country and in at least two overseas countries. This instrument has been peer validated for content but needs to have reliability established. The two other instruments were designed and used to measure teacher and student attitudes about school building condition. The My Classroom Appraisal Protocol© for teachers and the Student School Building Attitude Scale© have been used successfully in previous studies. Both of these instruments have been validated by a panel of experts but need to be submitted to further evaluation for validity and reliability. Research focused on this area of evaluation is needed.

Case studies of school divisions, examining their operating and capital spending patterns over a decade, would shed some light on the relationship between capital expenditures and school building condition. In addition to such studies, a very important area of research would

involve investigation of the politics of decision making related to the funding of school building maintenance and the condition of school buildings.

It is roughly estimated that during the past year, nine researchers in various states in this country and one or two in England were conducting studies similar to those discussed in this paper regarding the relationship between school building condition and student achievement. In many of these situations, the researcher was using the CAPE and the same basic methodology used in the original Cash (1993) study. Additional statewide studies of the relationship between student performance and school building condition are needed to help build a strong corpus of research findings. At the present time there has been research on the relationship between building condition and student achievement in seven states plus two major cities. At the end of 2010 the number of studies completed in additional states and cities will be evident. This activity speaks to the need for a meta-analysis of the studies that have been completed using similar methodology and comparable data.

All of the aforementioned studies are meaningful examples of research on this subject. The present cadre of studies provides sufficient evidence that a relationship does exist between school building conditions and students and teachers, thereby indicating that educational practitioners should use the results of research to improve school buildings to enhance the educational opportunities of students attending the schools. Yet, in the best tradition of the research profession, there is always a need for additional research to strengthen the body of knowledge regarding these phenomena and to further examine and explain the concepts contained in the theoretical model. The model presents many relationships between the various components that need further fruitful investigation. By using a theory-based plan to investigate sequential elements of a model, researchers are able to focus their efforts and thereby produce better findings. The key to such a fruitful research program is the element of planning successfully to arrive at a goal. This planning goal is to fully explore all relationships of the accepted research model. Systematic planning ensures that such exploration will occur and will, therefore, better explain how humans work in an organization.

The research presented was derived from one theory-based model that was used to explain some relationships about school building condition and user health and productivity. This research was described as an evolving effort of many different researchers from one state. As such, the corpus of resulting research has but one theme, but several different facets of research. The main theme might be: "How do school buildings get in the condition they are in and how does that influence the users of the building?" This might be the most profitable way to view the research as a total effort to investigate relationships.

The work of these multiple researchers demonstrates that a systematic research program based upon theoretical concepts and propositions can be developed and maintained. The researchers in one state were able to produce a research program based upon a single theory to explain how buildings become what they are and how such structures influence the health and productivity of students and teachers, and perhaps other users.

References

- 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.
- Bishop, M. E. (2009). *A case study on facility design: The impact of new high school facilities in Virginia on student achievement and staff attitudes and behaviors* (Unpublished doctoral dissertation). The George Washington University, Washington, DC.
- Bowers, J. H., & Burkett, C. W. (1987, October). *Relationship of student achievement and characteristics in two selected school facility environmental settings*. Paper presented at the 64th Council of Educational Facility Planners, International Conference in Edmonton, Alberta, Canada.
- Brannon, W. L. (2000). *A study of the relationship between school leadership and the condition of school buildings* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Buckley, J., Schneider, M., & Shang, Y. (2004). *The effects of school facility quality on teacher retention in urban school districts*. Washington, DC: National Clearinghouse for Educational Facilities. Retrieved from <http://www.edfacilities.org>
- Bullock, C. (2007). *The relationship between building condition and student achievement in Virginia middle schools* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Cash, C. S. (1993). *A study of the relationship between school building condition and student achievement and behavior* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Chan, T. C. (1980). The impact of school building age on pupil achievement. *CEFPI Journal*, 18(2), 13-14.
- Crook, J. F. (2006). *A study of school building conditions and student achievement in the high schools of Virginia* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Dawson, C. G., & Parker, D. R. (1998). *A descriptive analysis of the perspectives of Neville High School teachers regarding the school's renovation*. Paper presented at the annual meeting of the Mid-South Educational Research Association, New Orleans, LA. (ED427506) Retrieved from <http://www.eric.ed.gov/PDFS/ED427506.pdf>
- Earthman, G. I. (2004). *Prioritization of 31 criteria for school building adequacy*. Baltimore, MD: American Civil Liberties Union Foundation of Maryland.
- Earthman, G. I. (2006). *My Classroom Appraisal Protocol*©. Survey instrument. Blacksburg, VA: Virginia Polytechnic Institute and State University.
- Earthman, G. I. (2007). *Student School Building Attitude Scale*©. Survey instrument. Blacksburg, VA: Virginia Polytechnic Institute and State University.
- Earthman, G. I. (2008). *The relationship between the attitudes students have about their school building and their achievement*. Scottsdale, AZ: Council of Educational Facility Planners, International.
- Earthman, G. I., Cash, C. S., & Van Berkum, D. (1996, June). Student achievement and behavior and school building condition. *Journal of School Business Management*, 8(3), 26-37.

- Earthman, G. I., & Lemasters, L. K. (2004). *School maintenance & renovation: Administrator policies, practices, & economics*. Lancaster, PA.: Proactive Publications.
- Earthman, G. I., & Lemasters, L. K. (2009). Teacher attitudes about classroom conditions. *Journal of Educational Administration*, 47(3), 323-335.
- Edwards, M. M. (1991, May). *Building conditions, parental involvement and student achievement in the D. C. public school system* (Unpublished master's thesis). Georgetown University, Washington, DC. (ED 264 285)
- Elementary and Secondary Education Act of 1965 20 U.S.C. 6301 et seq. (1965).
- Harrison, E. K. (2009). *Principals' perceptions of the impact of building conditions on student achievement* (Unpublished doctoral dissertation). The George Washington University, Washington, DC.
- Hatch, M. S., & Cunliffe, A. L. (2006). *Organizational theory: Modern, symbolic, and postmodern perspectives*. Oxford, England: Oxford University Press.
- Hines, E. M. (1996). *Building condition and student achievement and behavior* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Kuhn, T. S. (1962). *The structure of scientific revolutions*. Chicago, IL: The University Press of Chicago.
- Lanham, III, J. W. (1999). *Relating building and classroom conditions to student achievement in Virginia's elementary schools* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Lemasters, L. K. (1997). *A synthesis of studies pertaining to facilities, student achievement, and student behavior* (Unpublished doctoral dissertation). Retrieved from *Dissertation Abstracts International*. (UMI No. 9722616)
- Lemasters, L. K., & Earthman, G. I. (2003). *A study of the relationship between air-conditioned classrooms and student achievement*. Scottsdale, AZ: Council of Educational Facility Planners, International.
- McGuffey, C. W. (1982). Facilities, Chapter 10. In W. Herbert (Ed.), *Improving educational standards and productivity* (pp. 237-288). Berkley, CA: McCutchan Publishing.
- Maxwell, L. (1999). *School building renovation and student performance: One district's experience*. Scottsdale, AZ: Council of Educational Facility Planners, International.
- No Child Left Behind Act of 2001. (2001). Pub. L. No. 107-110 § 115, Stat. 1425.
- Oakes, J. (2002). *Education inadequacy, inequity, and failed state policy: A synthesis of expert reports prepared for Williams v. State of California*. Williams Watch Series: Investigating the Claims of Williams v. State of California. (Document wws-rr016-1002) Los Angeles, CA: UCLA Institute for Democracy, Education, & Access. Retrieved from <http://escholarship.org/uc/item/8727d11z>
- O'Neill, D. J. (2000). *The impact of school facilities on student achievement, behavior, attendance, and teacher turnover at selected Texas middle schools in Region XIII ESC* (Unpublished doctoral dissertation). Texas A&M University, College Station, TX.
- O'Sullivan, S. (2006). *A study of the relationship between building condition and student academic achievement in Pennsylvania's high schools* (Unpublished doctoral dissertation). Virginia Polytechnic Institute and State University, Blacksburg, VA.
- Phillips, R. W. (1997). *Educational facility age and the academic achievement and attendance of upper elementary school students* (Unpublished doctoral dissertation). University of Georgia, Athens, GA.

- PricewaterhouseCoopers. (2001, January). *Building Performance: An empirical assessment of the relationship between schools capital investment and pupil performance*. London, England: Department of Education and Employment. (ED 461-980)
- Ruszala, J. A. (2006). *The Teacher Opinionaire of Physical Environment*. Unpublished survey form.
- Ruszala, J. A. (2008). *The conditions of the high school facilities in the Commonwealth of Virginia's metropolitan school divisions and the relationship to teacher satisfaction* (Doctoral dissertation). Retrieved from *Dissertation Abstracts International*. (UMI Document ID 3297152)
- 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.
- Taylor, R. G. (2009). *School facilities in the nation's capital: An analysis of student achievement, attendance, and truancy* (Doctoral dissertation). Retrieved from *Dissertation Abstracts International*. (UMI Document ID 3349627)
- 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.
- US Department of Education. (2003). *No Child Left Behind: Accountability and Adequate Yearly Progress (AYP)*. Retrieved from <http://www.ed.gov>
- Weinstein, C. S. (1979, Fall). The physical environment of the school: A review of the research. *Review of Educational Research*, 49(4), 577-610.
- 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.

Glen I. Earthman is Professor Emeritus at Virginia Polytechnic Institute and State University where he continues to advise doctoral students on research. He has also served as the Director of the US Department of Education sponsored National Clearinghouse for Educational Facilities. His research interests extend to all phases of school facilities, but he has concentrated on exploring the relationship between school building condition and student and teacher health and productivity.

Linda K. Lemasters is an Associate Professor of Educational Leadership and Policy Studies at The George Washington University in Washington, DC. She also serves as Program Coordinator for Educational Administration and Leadership and is president elect of the International Society for Educational Planning. Drs. Lemasters and Earthman have worked together on many research studies about the places where students learn, as well as having authored books and articles on the same.